Handbook of Research on The Applications of International Transportation and Logistics for World Trade

Gökçe Çiçek Ceyhun

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Handbook of Research on the Applications of International Transportation and Logistics for World Trade

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A volume in the Advances in Logistics, Operations, and Management Science (ALOMS) Book Series

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Published in the United States of America by
IGI Global
Business Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Names: Ceyhun, Gökçe Çiçek, 1980- editor.
Title: Handbook of research on the applications of international transportation and logistics for world trade / Gökçe Çiçek Ceyhun, editor.
Description: Hershey, PA : Business Science Reference, [2020] | Includes bibliographical references and index. | Summary: “”This book explores exploring the effective and productive solutions to global transportation and logistics by applying fundamental and in-depth knowledge together with current applications and future aspects”--Provided by publisher”-- Provided by publisher.
Identifiers: LCCN 2019029904 (print) | LCCN 2019029905 (ebook) | ISBN 9781799813972 (hardcover) | ISBN 9781799813989 (ebook)
Subjects: LCSH: Physical distribution of goods. | Business logistics. | Transportation. | International trade.
Classification: LCC HF5415.6 .H368 2020 (print) | LCC HF5415.6 (ebook) | DDC 387.5--dc23
LC record available at https://lccn.loc.gov/2019029904
LC ebook record available at https://lccn.loc.gov/2019029905

This book is published in the IGI Global book series Advances in Logistics, Operations, and Management Science (ALOMS) (ISSN: 2327-350X; eISSN: 2327-3518)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

For electronic access to this publication, please contact: eresources@igi-global.com.

Advances in Logistics, Operations, and Management Science (ALOMS) Book Series

John Wang
Montclair State University, USA

ISSN:2327-350X
EISSN:2327-3518

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Information Science Reference • ©2019 • 497pp • H/C (ISBN: 9781522581604) • US $295.00

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Distribution consists of moving and storing a product from the supplier to customer during the supply chain process. Distribution process is crucial decision of a company due to its effects on supply chain cost and customer satisfaction. In the competitive environment of the business, all companies aim to minimize delivery costs and maximize customer satisfaction by applying optimum distribution network design. The design of effective distribution network requires critical decisions as the location and the capacity of distribution centers together with logistic activities, which consist of transportation and inventory process. The purpose of this research is to define a deep literature review regarding definition of distribution network, distribution channels, selection of distribution, and the factors affecting distribution network design. After reviewing a comprehensive literature on distribution network design, this chapter includes suggestions.

Traditionally, the importance of packaging for international supply chains is most often underestimated. This is surprising for such a complex phenomenon, situated at the interface of different functions (logistics, marketing...), different decision levels (operational, tactical, strategic), and different logistics flows (physical and informational). This chapter questions the traditional design and typology of packaging used within international supply chains in the light of two main drivers: (1) its circular/closed-loop requirements and related performance notion and (2) omnichannel trends, including e-commerce, and new customer delivery services. Mobilizing the spanning concept of "logistics functions of packaging" (LFP), this chapter proposes a conceptual framework enabling to trigger adequate novel packaging solutions matching these new expectations. Recent business cases occurring within international supply chains illustrate and deepen our reflection.

This chapter details the performance evaluation of routing policies and proposes a routing heuristic to determine the minimum traveled distance for different warehouse configurations and pick-list sizes. Numerical experiments are performed considering warehouse configurations used in literature and list sizes are chosen proportional to the number of storage positions of each layout. The proposed heuristic method was shown to reduce the distance traveled by 7% for the evaluated instances. Furthermore, travel distance reductions of up to 30% were found in cases involving large warehouse and pick-list sizes. The proposed heuristic therefore is concluded to provide a more efficient solution than individual routing policies for the picker routing problem.

An increased need for international logistics has emerged with a higher degree of globalization. The quality of logistics services determines the degree of a country's involvement in global trade. In this chapter, the concept of logistics performance in the international trade context is discussed, then the measurement problems of logistics performance are discussed. The links between logistics, trade, and growth are evaluated theoretically. Policymakers and researchers have been widely using Logistics Performance Index (LPI) developed by the World Bank. LPI provides a general information of logistics costs, customs processes, and the quality of the necessary infrastructure for transportation for each country. In this chapter, the definition, the methodology, and the aspects of the indicator LPI, its content and components, and the relations between LPI and some economic factors such as growth and foreign trade, are elaborated. The econometric modelling methods are used to analyze the relations between LPI and economic factors.

This chapter concentrates on the linkage among transportation, energy usage, GDP, and Co2 emissions in EU countries during the period 1970-2014 by analysing the EKC hypothesis. The data is derived from the World Bank's official website to point out environmental consciousness of EU countries by implementing panel data analysis. In this sense, the findings indicate that environmental consciousness is quite low for EU countries from 1970 to 1997. Besides, the environmental issues of EU countries are taken into account from 1997 to 2014. The findings of research demonstrate that their sensitiveness has risen significantly, which is consistent with the inverse-U shape of the EKC hypothesis from 1997 to 2014. Thus, these empirical results support the Kyoto protocol's political aims and goals. Furthermore, Johansen co-integration test is implemented to reveal the long-term linkage among economic growth, air transportation, carbon emissions, and energy usage.

Sea transportation and maritime transport networks have commonly been used with the development of international trade. Maritime transportation is more widely used for the transportation of high-volume cargoes in international trade particularly, since sea transportation is cheaper and safer than road and railway transportation. This chapter investigates the relationship among exports, liner shipping connectivity index, and economic growth in European countries and Turkey. Analysis found that liner shipping connectivity index and economic growth have a positive effect on the exports in European countries and Turkey. It is revealed that 1% increase in liner shipping connectivity index provides the increment 0.21% in the exports. In addition, 1% increment in gross domestic product ensures the increase 1.05% in the exports.

In this research, Drones, which are between incoterms and new forms of transport, are examined. International logistics applications behave in line with the development objectives responsive to changing environmental conditions of business, delivery forms, which are part of the deployment tools and will influence the choice of delivery method with drones were examined. In this context, the purpose of the study is to examine the concepts of logistics and international logistics and the factors that both the buyer and the seller are affected when selecting one of these terms of INCOTERMS. The paper sheds light on the factors when choosing, unmanned vehicles of the future drones and discusses the importance of transportation, delivery market, in terms of the cost of delivery and related rules and regulations drones. Paper concludes with the future trends about the logistics and Incoterms by scanning the available literature.

Logistics service is more complex and knowledge-based in the fourth industrial revolution era. Given this significance, this chapter emphasizes the logistics industry and its specific dynamic capabilities, and measures generating the Industry 4.0 by extending the resource-based logistics (RBL) of Noorliza (2011). The chapter has three parts: Logistics in the fourth industrial revolution, RBL theory, and its impacts and Logistics 4.0 models in the fast-moving environment. This explains how logisticians or logistics firms obtain competitive advantages in the fourth industrial revolution era.

The Resource Based Theory (RBT), where specific sets of resources are bundled into precious, scarce, and hard-to-imitate capabilities, has been demonstrated to be helpful for explaining why some companies have been better than others over time. Accordingly, this chapter, drawing on the related literature, proposes that the RBT has the potential to be applied to important areas of logistics research. Since no clear exposition of the resource-based approach has been provided in the logistics literature, this study helps to understand the critical effects of logistics capabilities in creating competitive advantage. RBT is described with relations and interactions among resource and capability. Authors illustrate how the RBT represents the underlying theoretical support for one of the central propositions of distinctive logistics capability. The chapter examines past researches and illustrates how RBV theory is an appropriate theoretical lens to advance the much-needed understanding of the logistics capabilities.

The concept of sustainability has become increasingly significant and has forced companies to take sustainable measures because of the reduction of energy resources and operational efficiency, the increase in emission release, and environmental pollution. In addition, technological developments and globalization have also affected the maritime industry and coerced shipping companies to struggle to survive in a highly competitive environment. Sustainability is addressed by environmental, social, and economic aspects under the GRI. It should be noticed that many important elements based on economy, environment, social aspects, technology, and information determine sustainability. Sustainability also benefits from KPI indicators that determine ship performance criteria. This chapter examines the concept of sustainability in various dimensions and establishes a general framework by searching the literature of sustainability of liner shipping and also sustainability reports of the international maritime transport companies.

In today's business environment, in which organizations try to outpace their rivals, the power of management and organization come into prominence. Management, as an art and science, constitutes great importance in terms of creating sustainability in the organizations, and sustainability acts as an important agent for being successful in the competition. Especially supply chain management is evaluated to be among the most crucial organizational activities, which needs to be heavily focused on, in order to create customer satisfaction in the process of product and/or service delivery. Furthermore, as it is known, supply chain management is the key element of transportation and logistics. This chapter scrutinizes the importance of management and organization in transportation and logistics. With this purpose, a literature review presents the study both in a historical and contemporary point of view.

Since coal resources are located around the world and often far away from where the coal is consumed, transportation is important. The industries that use coal such as power plants, industrial plants, coke plants, and commercial institutions usually prefer different transportation methods. The demand in these industries and the transportation methods they use differ over time. This chapter analyzes the international coal transportation and demand. An analysis for the US coal market and the transportation to industries along with the methods that are used between 2001-2015 are presented. A trend analysis was performed to show the long-term demand for each transportation method in each industry. Such analysis is also useful as it allows observing the coal demand from each industry. Analysis results reveal the change in coal amounts that are transported to each industry using the railroad, truck, and other methods.

Transportation involves all concepts of distance, speed, and time. Maritime transportation is one of the oldest methods of transportation. Continuous demand for high speed in shipping has led to the emergence

Today's innovative systems and approaches handle the supply chain function in the healthcare institutions in a broader way even though it is generally accepted as the material management. The supply in the hospitals is a comprehensive issue that covers regular material supply, the quality and the speed of services and maintenance process. As in the other sectors, the healthcare sector wants to get the required goods and services in the places where they are needed, when they are needed, with the desired quality and price. Besides, hospitals try to produce low-cost services because of today's competition conditions and increasing number of private hospitals. Today's supply chain management is carried out to decrease the costs, reduce the lean, and increase the quality.

Firms must deal with the factors that increase performance, which support the delivery of the produced goods at minimal cost and time. In this respect, the advantages of digitization have been studied. The path to international trade in its quest to reduce logistics and supply chain costs cross with Blockchain technology. Blockchain technology isn't only an inter-user money transfer technology, but it also includes all the trade supply chain actors. Thus, a visible "supply chain network" that's directed by blockchain, which holds the record in real time and doesn't change pursuant to the sequence occurs. All actors on the network can access and track the flow and distribution of the transaction across borders. How does blockchain technology improve yield and reduce costs? To find the answer, the application areas of digital technology in trade have been investigated. In international trade, a transaction draft was created and the advantages and disadvantages of blockchain were exposed.

Blockchain-based electronic bill of lading will reshape the global logistics industry, replacing old-style paper bill of lading documents. This chapter establishes blockchain-based electronic bill of lading conceptual model, with which stakeholders may be able to state and transfer cargo ownership rights without the hassle of the handling paper, and proposes an implementation of the framework for researchers. This chapter provides a way for stakeholders to exchange these documents digitally, securely, and with no possibility of fraud in a neutral environment – extremely quickly and much more affordably than currently possible. The ecosystem of blockchain-based electronic bill of lading services will transform the global logistics industry. The study findings offer logistics managers and software programmers the ability to develop their documentation strategies and own blockchain-based electronic bill of lading platforms.

This chapter develops a method proposal regarding digitisation of variables in road, maritime, and airline transport, and makes parameters machinable, output-producing algorithms methods. Results regarding which artificial intelligence is proper to be used in storage, distribution, stock, and order tracking, supply chain architecture, and third- and fourth-party logistical practices are sought. For this, artificial neural nets, software techniques, artificial intelligent philosophy, and the reflections on the business world are analysed.

This chapter discusses using blockchain technology in maritime transportation and management. Blockchain technology is less than 10 years old. With a lot of its features, the new technology has the potential to solve many problems in many sectors. Nowadays, this potential attracts many companies and organizations to try the blockchain technology in their sector to find the solution to their problems, to increase their profit, and to decrease the time spent for doing their jobs. Like other sectors, there are many works in maritime transportation and management for using blockchain technology. This chapter introduces blockchain technology and examines current and future uses and applications of it in maritime transportation and management.

Foreword

With the spread of globalization, a rapid growth trend has emerged in the logistics sector. Although the world trade volume contracted or decelerated, the logistics sector continued to grow. The continuous growth of the logistics sector has led to the emergence of many sub-sectors connected to the logistics sector. Today, logistics has reached a vast knowledge from infrastructure to logistics processes, from legal dimension to technology. Development in the sector has also increased the demand for qualified knowledgeable workforce.

Worldwide, tens of thousands of new employees are involved in the logistics industry every year. Therefore, sharing knowledge with scientific and sectoral journals and books is of special importance. However, converting knowledge into a book is time-consuming and laborious. Therefore, the number of sectoral and scientific books is very limited, especially in multidisciplinary fields such as logistics. The books published in the field of logistics have a limited scope and cover a single subject of logistics such as supply chain, warehouse management or logistics processes. However, this book is one of the most comprehensive works on logistics. The purpose of this book is to provide an overview of all activities within the scope of the logistics sector. Therefore, it is an important literature for logistics employees.

This book not only gives fundamental information but also shares the latest developments in the sector with its readers. With this aspect, it appeals to readers of all levels from professionals to students. It is also a handbook for researchers with the contents of the book and the way in which subjects are given. Although the book is composed of many authors, the language is very fluent and the issues in the book are well connected. With this feature, the book will attract wide readers in the sector. Finally, this book is an important scientific study for the development of the logistics sector.

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Ersel Zafer Oral *is General Manager at Margen Marine and Land Research Education Consultancy from 2012. He worked as Assistant Professor Doctor in Dokuz Eylül University School of Maritime Management between 2001 and 2012. He received his Ph.D. from Dokuz Eylül University Graduate School of Natural and Applied Sciences, Marine Geology and Geophysics Doctorate Department in1999. He received his Postgraduate Degree from Dokuz Eylül University Institute of Marine Sciences and Technology, Marine Geology and Geophysics Master Program in1988. He received his Bachelor Degree from Yıldız Technical University Kocaeli Engineering Faculty, Department of Geophysics in 1984.*

Preface

Nowadays, fast growing of international trade together with globalization has shifted traders' attentions to international transportation and logistics. Within this developing economic market, international traders have to enhance new strategies in order to satisfy consumers' rising demands day by day. Hence, the discipline of international transportation and logistics has become more challenging and competitive in today's world. The term of international transportation and logistics, include planning, organizing and application of strategies in order to deliver products or people to international destinations in efficient and productive way. In order to implement effective transportation management, decision-makers have to know the history, the fundamentals, current developments and future applications of international transportation and logistics. This book fulfills the needs for finding effective solutions to international transportation and logistics by providing core and depth knowledge together with current applications and future aspects.

International transportation and logistics have become the driving forces for the globalization of world trade. This discipline is relevant with efficient planning, organizing, applying and controlling of products, people, services and information between the producer/carrier to consumer/receiver. In the current competitive environment of business life, the traders need highly challenging solutions for international transportation and logistics matters. In this manner, this book provides fundamental and depth information together with sectoral applications to the parties related with international transportation and logistics.

In the competitive business area of today, traders want to join international marketplace with highly challenging ways in order to compete with the rivals. Due to international transportation and logistics have become the driving forces for the globalization of world trade, people need deeper knowledge and current applications related with this discipline. This study presents effective and productive solutions to international transportation and logistics area by providing fundamental and depth knowledge together with current applications and future aspects. This theme also effects academic studies by taking attentions of researchers to international transportation and logistics area. Moreover, this discipline tenders opportunities for international advancements and developments of academicians and even students.

The target audience and potential users of this book are trading companies that deals with international transportation and logistics business, national and international transportation and logistics authorities, academicians and students of related area and people who wants to learn basic elements, current applications and developments of international transportation and logistics.

ORGANIZATION OF THE BOOK

The book is organized into four sections and constituted from 26 chapters. A brief description of each of the chapters are listed as follows:

In the first section of the book, fundamentals of international transportation and logistics are evaluated. The section includes two chapters. Chapter 1 identifies Introduction to International Transportation and Logistics. Particularly the chapter identifies the development and scope of logistics, logistics related concepts such as supply chain, value chain and outsourcing. Then it is concluded with literature review of logistics sector's development stages. Chapter 2 reviews International Transportation and Logistics Economics. The author of the paper mentions the place of logistics phenomenon in the economic disciplines and its place in the NACE classification, which expresses the classification of economic activities. Moreover, the study contributes to the book by making an economic evaluation of the logistics sector with its micro and macro aspects and discusses the factors affecting the development of the logistics sector in the world economy.

The second section of the book gives place to the applications of international transportation and logistics by presenting five chapters. Chapter 3 takes an assessment for classification of distribution network design by defining a deep literature review regarding with definition of distribution network, distribution channels, selection of distribution and the factors affecting distribution network design and concluding with future suggestions. Chapter 4 identifies packaging trends in international transportation and logistics. The chapter questions the traditional design and typology of packaging used within international supply chains, developed via two main drivers: its circular/ closed-loop requirements and related performance notion and Omni channel trends, including e-commerce, and new customer delivery services. Mobilizing the spanning concept of "logistics functions of packaging" (LFP), this chapter proposes a conceptual framework enabling to trigger adequate novel packaging solutions matching these new expectations. Lastly, the recent business cases occurring within international supply chains are illustrated. Chapter 5 gives information about order picking optimization based on a picker routing heuristic: minimizing total traveled distance in warehouses. This chapter details the performance evaluation of routing policies and proposes a routing heuristic to determine the minimum traveled distance for different warehouse configurations and pick-list sizes. Numerical experiments are performed considering warehouse configurations used in literature and list sizes are chosen proportional to the number of storage positions of each layout. The proposed heuristic therefore is concluded to provide a more efficient solution than individual routing policies for the picker routing problem. Chapter 6 handles the concept of logistics performance in international trade framework: an empirical evaluation of logistics performance index. In this chapter, the concept of logistics performance in the international trade context is discussed, and then the measurement problems of logistics performance are discussed. The links between logistics, trade, and growth are evaluated theoretically. Policymakers and researchers have been widely using Logistics Performance Index (LPI) developed by the World Bank. LPI provides a general information of logistics costs, customs processes and the quality of the necessary infrastructure for transportation for each country. In this chapter, the definition, the methodology and the aspects of the indicator LPI, its content and components, the relations between LPI and some economic factors such as growth and foreign trade are elaborated. The econometric modelling methods are used to analyze the relations between LPI and economic factors. Chapter 7 approaches analyzing transportation induced economic growth, energy use and co2 emissions - an empirical investigation from EU countries. This paper concentrates on the linkage among transportation, energy usage, GDP and Co 2 emissions in EU countries during the period 1970-2014 by analyzing the EKC hypothesis. The data is derived from the World Bank's official website to point out environmental consciousness of EU countries by implementing panel data analysis. In this sense, the findings indicate that environmental consciousness is quite low for EU countries from 1970 to 1997. Besides, the environmental issues of EU countries are taken into account from 1997 to 2014. The findings of research demonstrate that their sensitiveness has raised significantly, which consistent with the inverse-U shape of the EKC hypothesis from 1997 to 2014. Thus, these empirical results support the Kyoto protocol's political aims and goals as well. Furthermore, Johansen co-integration test is implemented to reveal the long-term linkage among economic growth, air transportation, carbon emissions and energy usage. Chapter 8 sheds light on the impacts of liner shipping connectivity and economic growth on international trade case of European countries and Turkey. In this study, the relationship between exports, liner shipping connectivity index and economic growth has been investigated in European countries and Turkey. As a result of the analysis, it has been found that liner shipping connectivity index and economic growth have a positive effect on the exports in European countries and Turkey. It is revealed that 1% increase in liner shipping connectivity index provides the increment 0.21% in the exports. In addition, it is revealed that 1% increment in gross domestic product ensures the increase 1.05% in the exports. Chapter 9 clarifies Incoterms and the importance of drones as new transport type. In this research, Drones, which are between incoterms and new forms of transport, are examined. International logistics applications behave in line with the development objectives responsive to changing environmental conditions of business, delivery forms, which are part of the deployment tools and will influence the choice of delivery method with drones were examined. In this context, the purpose of the study is to examine the concepts of logistics and international logistics and the factors that both the buyer and the seller are affected when selecting one of these terms of INCOTERMS. The paper sheds light on the factors when choosing, unmanned vehicles of the future drones and discusses the importance of transportation, delivery market, in terms of the cost of delivery and related rules and regulations drones. Paper concludes with the future trends about the logistics and Incoterms by scanning the available literature. Chapter 10 illustrates Resource-based logistics (RBL) and competitive advantage with Logistics 4.0Ps model. Logistics service is more complex and knowledge-based in the fourth industrial revolution era. Given this significant, this chapter emphasizes on the logistics industry, its specific dynamic capabilities and measures in generating the Industry 4.0 by extending the resource-based logistics (RBL) of Noorliza (2011). The chapter has three parts: Logistics in the fourth industrial revolution, RBL theory and its impacts and Logistics 4.0 models in the fast moving environment. This explains how logisticians or logistics firms obtain competitive advantages in the fourth industrial revolution era. Chapter 11 explicates resource-based theory perspective of logistics. The paper, drawing on the related literature, proposes that the RBT has the potential to be applied to important areas of logistics research. Since no clear exposition of the resource-based approach has been provided in the logistics literature, this study helps to understand the critical effects of logistics capabilities in creating competitive advantage. The remainder of this paper is organized as follows: First RBT is described with relations and interactions between resource and capability. Next, how the RBT represents the underlying theoretical support for one of the central propositions of distinctive logistics capability is illustrated. Then, the author examines past researches and illustrates how RBV theory is an appropriate theoretical lens to advance the much-needed understanding of the logistics capabilities. Chapter 12 evaluates Sustainability in Liner Shipping. This paper mentions the concept of sustainability and the importance of this concept for businesses corporate sustainability by using multi-dimensional structure of sustainability. Besides, the authors identify global reporting initiative (GRI), shipping key performance indicators (KPI) and the sustainability reports of liner shipping companies. Chapter 13 illuminates management and organization in transportation and logistics. As the businesses grow, new strategies to regulate logistics planning processes for ameliorating the output are needed. In order to manage logistics more effectively; proper planning, adopting automation and giving value to relations have to be taken into consideration (Kiraga, 2014). In this sense, the purpose of this study is to reveal the importance of management and organization in transportation and logistics. With this purpose, the literature has tried to be scrutinized in a historical approach and it has been revealed that logistics and transportation cannot be performed without effective management and organization. Chapter 14 presents an analysis for coal transportation and demand in US and international markets. This research analyzes the international coal transportation and demand. Then an analysis for the US coal market and the transportation to industries along with the methods that are used between 2001-2015 is presented. A trend analysis was performed to show the long-term demand for each transportation method in each industry. Such analysis is also useful as it allows observing the coal demand from each industry. The analysis results reveal the change in coal amounts that are transported to each industry using the railroad, truck and other methods. Chapter 15 provides information on the place of High Speed Crafts (HSCs) in the maritime transportation. The paper aims to reveal the place and the importance of HSCs in the maritime transportation. For this purpose, the authors will describe maritime transportation, speed, types of HSC, and international regulations about HSC, navigation on HSC and HSC accidents. Chapter 16 takes attention to transportation of chemical cargoes by tanker ships. The study discusses types of chemical tanker, types of loads, chemical tankers operations in terms of commercial and safety have unique risks, hazards and dangers. The paper concludes with dangers of chemical loads in general and how the operations are performed to guide seafarers. Chapter 17 presents perspective about operational process in gas tankers in marine transportation logistics by providing information about the difference in the operations of LPG (Liquid Petroluem Gas) tankers and operational processes in gas tankers together with the largest and most time-consuming load exchange operations on gas tankers. The study ensures a practical guide for LPG vessels workers and students in the education process.

Section 3 of the book renders current developments of international transportation and logistics. Chapter 18 gives information about secure bet in the maritime supply chain: current situation and opportunities for ports' attractiveness. The focus of this chapter is to identify main drivers with respect to their relevance for managerial practices and propose an agenda that permits to tackle the obstacles that ports may find when aiming at enhancing their attractiveness. The study reviews the relevant literature, reports and media to provide a comprehensive and up-to-date picture. It further opens the discussion related to exogenous, endogenous and subjective factor of port attractiveness and their influence on stakeholders' decisions. The study concludes with proposals for further research. Chapter 19 is dealing with green logistics practices and sustainable business model: the factors, roles and impacts. The aim of this chapter is to present a broad introduction to the knowledge of green logistics in a practical manner; definition and dimensions of green logistics practices; factors of green practices and their roles and impacts. Given the importance of logistics in global economic and increasing concern in environmental sustainability, this chapter attempts to look at the work model in green leadership for fostering competitiveness and sustainability development in today's world. It will look at how green attributes can be transformed into the practical lives of today's leaders, and take away the essence, insights and tools of green leadership and step up to the next level as a true firm, definitely from a logistics service provider perspective. Chapter 20 provides an insight for the green logistics vision, the zero waste goal with recycling logistics. In this research, the studies made on international level in line with the zero waste goal with recycling logistics in green logistics vision are examined. Businesses acting sensitive to the changing environmental conditions, adopting the zero waste with recycling logistics in green logistics vision in line with their development goals are within the contemporary production targets. In a global view, the goal is both creating a livable world and to reduce the life cycle costs. In this regard, the aim of the study is to research the status of the recycling logistics, to create awareness on the role and importance of the logistics services and operators in the waste industry. Besides the goal of the paper is to scan the available literature with the reported applications in the less developed countries in line with the zero waste goal with green logistics vision and to emphasize the importance of these applications. Chapter 21 illuminates the effect of reverse logistics activities on brand value and customer satisfaction and a case study in Turkey. The aim of this study is to examine the effect of reverse logistics activities in Turkish firms, which are required to act responsibly towards the environment and to explain the relationship between reverse logistics processes and customer satisfaction and brand equity. The findings of this study contribute to understanding that an increasing number of them have integrated reverse logistics practices into their operations to develop a sustainable competitive advantage. The findings also indicate that reverse logistics play an active role in Turkish enterprises improving brand equity and customer satisfaction while preserving the environment in the local and the global communities. Chapter 22 gives information about supply chain management in health institutions. The aim of this study is to analyze the effects of supply chain factors, the integration of supply chain, demand forecasting and the effects of supplier performance on the elasticity of supply chain and all of these factors on the ability of official health institutions and the supplier of medical equipment to meet the customers' needs. Within this scope, supply chain risk factors, the integration of supply chain, supplier performance, demand forecasting, supply chain elasticity and the ability to meet the needs of customers are studied.

Section 4 reviews emerging trends and future vision of international transportation and logistics. Chapter 23 presents information about the digital transformation in international transport and logistics, blockchain. Firms must deal with the factors that increase performance, which support the delivery of the produced goods at min. cost and time. In this respect, the advantages of digitization have been studied. The path to international trade in its quest to reduce logistics and supply chain costs cross with Blockchain technology. Blockchain technology is not only an inter-user money transfer technology, also includes all the actors of trade supply chain. Thus, a visible "supply chain network" that is directed by blockchain, which holds the record in real time and does not change pursuant to the sequence occurs. All actors on the network can access and track the flow and distribution of the transaction across borders. How blockchain technology improves yield and reduces costs? To find the answer, the application areas of digital technology in trade have been investigated. In international trade, a transaction draft was created and the advantages and disadvantages of blockchain were exposed. Chapter 24 provides a conceptual system of blockchain based electronic bill of lading. This study aims to establish blockchain based electronic bill of lading conceptual model, which stakeholders may be able to state and ownership rights of transfer cargo without the hassle of the handling paper, and propose an implementation of the framework for researchers. This study will provide a way for stakeholders to exchange these documents digitally, securely, and with no possibility of fraud in a neutral environment – extremely quickly and much more affordably than currently. The ecosystem of blockchain based electronic bill of lading services will transform the global logistics industry. The study findings offer logistics managers and software programmers to develop their documentation strategies and own blockchain based electronic bill of lading platforms. Chapter 25 explicates artificial intelligence in supply chain management. This study aims to develop a method proposal regarding digitization of variables in road, maritime and airline transport and making parameters machinable, output producing algorithms methods. Results regarding which artificial intelligent is proper to be used in storage, distribution, stock and order tracking, supply chain architecture, third- and fourth-party logistical practices are sought. For this, today artificial neural nets, software techniques, artificial intelligent philosophy and the reflections on the business world are analyzed. Finally, Chapter 26 explains blockchain technology in maritime transportation and management. This chapter discusses the use of blockchain technology in maritime transportation and management. Blockchain technology is a new technology that is only known for almost ten years. With the lots of its features, this new technology has potential to solve many problems in many sectors. Nowadays, this potential attracts many companies and organizations to try the blockchain technology in their sector to find the solution to their problems, to increase their profit and to decrease the time spent for doing their jobs. Like other sectors, there are many works in maritime transportation and management for using blockchain technology. In this chapter, an introduction of blockchain technology has been made and the current and future uses and applications of blockchain technology in maritime transportation and management are examined.

Acknowledgment

As the editor of *Handbook of Research on the Applications of International Transportation and Logistics for World Trade*, firstly I would like to thank each one of the authors, who contributed their time and expertise to this book. This book would not have become a reality without their support.

Secondly, I would like to thank valuable contributions of the reviewers regarding the improvement of quality, coherence, and content presentation of chapters. Most of the authors also served as referees; I highly appreciate their double task.

Lastly, I would like to thank to my family; my husband Tayfun Ceyhun for supporting all my efforts and my children Zehra Ceyhun, Karmen Ela Ceyhun and Aren Alp Ceyhun for my motivation during this project.

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Chapter 1
Introduction to International Transportation and Logistics

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ABSTRACT

Logistics is the management of the flow of goods, information, and resources between the point of origin and the point of consumption. It is a business concept that evolved during the 1950s due to the increasing complexity of supplying businesses with materials and transporting products in an increasingly globalized supply chain. The complexity led to a call for experts in the process called logisticians. Work in logistics involves the integration of information, transportation, inventory, warehousing, material handling, packaging, human resources, and sometimes security. The goal is to manage the life cycle of a project from birth to completion. The main functions of a qualified logistician include inventory management, purchasing, transportation, warehousing, consultation, and organizing and planning of these activities. Logisticians combine a professional knowledge of each of these functions to coordinate resources in an organization.

INTRODUCTION

Today, the concept of logistics plays an important role in reaching all consumers of all products and services. In production activities, it is important to supply raw materials, semi-finished products and other necessary equipment before production, and to carry out transportation and distribution activities after production. Services such as customs clearance, warehousing, insurance, packaging and stock control processes play supporting role in these processes. The importance of logistics becomes even more important when it comes to the inclusion of inputs from different countries in the production process or the delivery of the final product to the final consumer in different countries. In today's competitive

DOI: 10.4018/978-1-7998-1397-2.ch001

conditions, the fastest way to produce the most cost effective and high-quality products to the final consumer depends on the efficiency of the services provided within the scope of logistics.

With logistic activities, companies increase their efficiency in cost and time management and the firms minimize the obstacles in reaching the final point of the product at the desired standards and quality. Moreover, the companies support their performance with positive results such as increasing alternative solutions suitable for developing and changing conditions. The fact that companies increasingly demand logistics services has been effective in reshaping the concept of logistics and the development of the logistics service sector. Therefore, the logistics sector has started to play an important role in the economies of countries.

Many macroeconomic factors have been influencing the recent relocation of logistics in the world. One of these factors is production changes driven by rapidly developing economies such as China, India, Brazil and Russia. Other factors include the shift of relevant centers to Asian continent in economic activities, increased wages, prices of petroleum and products, and reduction of Common Market barriers due to harmonization in policies and legislation (Gröhn, 2006).

In this study, the development and scope of logistics have been clarified and logistics related concepts such as supply chain, value chain and outsourcing were explained. Then, the paper was concluded after literature review of logistics sector's development stages.

BACKGROUND

The term of logistics which has gained importance in recent years, it is a very old concept. The word is derived from the Greek word "**logisticos**" and it means "science of calculating" or "skill in calculating" (Voortman, 2004).

When looking at the development of the logistics concept, it is seen that the first use dates back to the 1700s. Initially, it was included in the literature as a military origin concept. In this context, logistics has been used to express the design and implementation of all elements that will support the operational capability of a military unit, the provision of the relevant equipment and materials, and all necessary planning (Gourdin, 2006). In other words, logistics in the military field is defined as the activities carried out in order to provide the necessary support items and service support to the fighters in accordance with their strategy and tactics (Bulut, 2007). The first use of logistics in the military field also shed light on the scope of logistic activities that gained importance in the field of trade in the subsequent process. Logistics, which has been examined in a multi-faceted way with the science of economics, has become a field of expertise and work today (Long, 2003).

In the early 1900s, logistics, which was considered as a part of the management strategy, was used especially in the distribution of agricultural products as a method of providing time and space benefits. The 1960s were the first references to logistics in academic studies. In the 1960s, many types of services included in the concept of logistics began to gain importance in the manufacturing industry, with particular emphasis on distribution activities. However, the integration of services within the scope of logistics took place in the 1990s. In spite of the fact that the 1990s was a period of technological and political changes that revolutionized the introduction of computer technology and communication, regulations in transport activities and policies gained great importance in the development of the logistics concept (Rushton et.al, 2000). In the 2000s, the concept of logistics has been referred to as a more comprehensive concept -supply chain management-, which is an important strategy for companies to gain competitiveness (Gröhn, 2006).

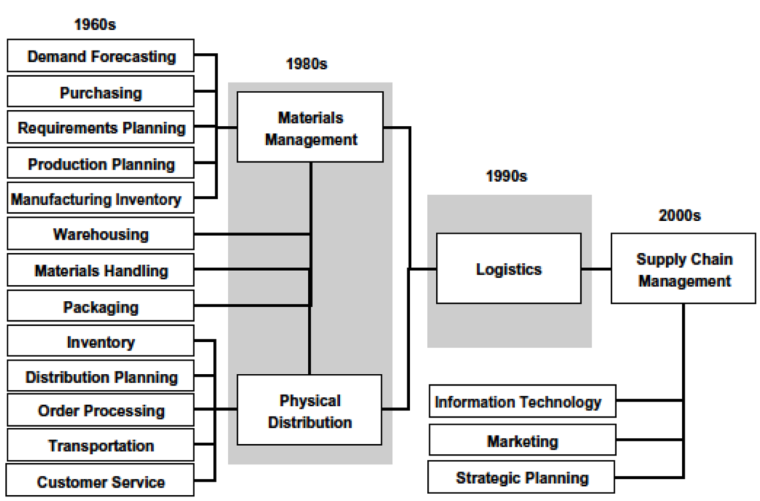
The development of the logistics concept between the years 1960-2000 is shown in Figure 1. In the 1960s, the services within the scope of logistics were handled separately. Demand management, procurement, needs planning, production planning and production inventory of these services were gathered under the name of "Material Management" in 1980s. On the other hand, stock management, distribution planning, order process, transportation and customs operations are combined under the name of "Physical Distribution". Besides, storage, handling, packaging and packaging services were included in the process as intermediate services. In the 1990s, it was seen that all services were combined under the name of logistics. Therefore, all services mentioned in the literature began to be expressed under the concept of "logistics". Afterwards, the activities related to information technologies and marketing and strategic planning activities carried out in conjunction with logistics revealed the concept of supply chain management which is a more comprehensive concept than logistics (Hesse and Rodrigue, 2004).

Logistics is seen as the most important and necessary factor in the realization of all economic activities (Voortman, 2004). Without logistic activities, there is no movement of goods and operations such as storage, insurance, packaging cannot be realized, products cannot be delivered and services cannot be provided to consumers. With this aspect, logistics has great importance in the economic activities of all organizations (Waters, 2003).

Today, logistics has been accepted as an optimization of the flow of goods, persons and information. The concept of logistics leads to discussion of concepts such as outsourcing, value chain, transportation economics, distribution planning (Orhan, 2003). In a broad sense, the concept of logistics is defined as the process of allocation and control of resources for supply, production and distribution activities (Canıtez, Tümer, 2005).

According to Council of Supply Chain Management Professionals, Logistics means providing, controlling and planning the flow of all kinds of products, services and information, from the starting point of the raw material to the end point where the product is consumed, the flow and storage of the inven-

Figure 1. Evolution of logistics integration, 1960-2000
Source: Hesse, Rodrigue, 2004, 175



tory in an efficient and cost effective manner (CSCMP, www.cscmp.org). Apart from this, UK Institute of Logistics and Transport has defined logistics as positioning resources at the right time, in the right place, at the right price and at the right quality (Rushton et.al, 2000).

Definitions regarding the logistics show that the concept of logistics is an important part of economic activities both in national and international area. Logistics is of particular importance when it comes to international trade, which is the most important activity for countries to gain competitiveness. The efficiency of logistics services affects the volume of international trade.

According to the changing demand structure such as “Foreign Trade Logistics”, “International Trade Logistics” or “International Logistics” logistic services for international trade activities such as transportation, storage, customs clearance, insurance, packaging, demand planning, stock management change and development services. International trade activities are discussed in the literature under the headings of “Foreign Trade Logistics”, “International Trade Logistics” or “International Logistics”. International trade activities cover logistics services, transportation, storage, customs clearance, insurance, packaging, demand planning and stock management (Waters, 2007).

BASIC LOGISTICS SERVICES

Logistics activities are multifaceted. These activities are of a variety that can be directly determinant on the level of efficiency of enterprises and in demonstrating their competitiveness. Effective logistics services have become a key factor in the success of competitive markets shaped by globalization in the world.

Logistics services are strategic activities for the management of the flow of goods, services, information and for establishing the connection between the consumer and the supplier. The most widely known logistics services are primarily transportation and then storage activities. However, the logistics sector offers a wide range of services. In addition to transportation and warehousing activities, the management of orders, demand planning, packaging, handling, insurance, customs clearance, inventory management, customer service and new developing services according to the increasing demands are included in logistics services (Mena et al., 2007).

Transportation Services

Transportation services are among the most important logistics activities. The transportation activity is the transportation of goods, products or goods from one place to another in a narrow sense, and in a broad sense, the timely delivery of the goods produced to the needed regions and centers in order to meet the consumer needs. The aim of transportation within the scope of logistics activities is not only to transfer the goods from one point to another, but to realize this process in the most accurate way, with the fastest, safest and most economical method. Therefore, especially in the case of international transportation activities, transportation can be defined as the comprehensive activities including different services from the preparation of the documents required for the transportation of the goods to the delivery of the warehouse of the receiving company (Waters, 2003, Çancı, Erdal, 2003).

Transportation services, which have gained importance within the last thirty years in logistics activities, consist of different sub-transportation services including highway, maritime, airway, railway, pipeline transportation and multi-transportation within the scope of logistics activities related to products or raw materials (Bowersox et.al, 2002). Which type of sub-transportation is preferred may vary depending on factors such as property of transported goods, transport time, cost of transport service, infrastructure adequacy of transport type, political structures and policies of countries (Delfman, 2006). For example, maritime transport is the only alternative if large volumes of cargo are sent to the United States. On the routes that allow the use of other types of transport in addition to maritime transport, airway or road transport may be preferred due to the long transport time on the maritime as far as the situation allows.

Warehousing, Bonded Warehousing and Handling Activities

Another important service group in logistics services is storage, warehousing and handling services, which also play a major role in the realization of physical distribution.

While international logistics activities are carried out, in the shipment of goods from the sender to the customer the location of warehouses and enreports is playing important role during all the activities (Çancı, Erdal, 2003).

Warehouses can be defined as facilities where raw materials, semi-finished and finished goods are separated from the supply sources after the separation is made, records are kept and maintained and distributed to the domestic or foreign companies or final consumers (Acar, 2010). Warehouses are commonly used as “distribution centers” or “logistics centers. In this context, warehousing services facilitate the movement of all the input sources required for production to the production sites and on the other hand, the movement of the final products arranged in large quantities and according to customer orders (Waters, 2003).

In the meantime, bonded warehouses are the places where the quantity, quality and properties of the goods are examined, valuation is made and protected under appropriate conditions, which are established in the customs areas and have the characteristics specified in the relevant articles of the Customs Law and Customs Regulations (Çancı, Erdal, 2003).

One of the most important services realized in the bonded warehouse transaction process is the handling activities. Provided that the appearance and technical characteristics of the temporarily stored goods are not changed, they may be subjected to certain procedures under the permission and supervision of the customs administration to ensure their preservation in the same case. These operations are called “handling”. Handling means stacking, relocating, transferring from large containers to small containers, renewing or repairing, ventilating, sifting, mixing and similar operations of the goods under customs supervision without changing the essential qualities (Customs Law, 4458 no). Handling is carried out during the transportation, storage and loading of the products and this process directly affects the efficiency of the processes. It can be defined as a process that does not change the value of the product, does not provide benefit, but can cause loss of the value of the product if it is not done correctly (Dölek, 2004).

Customs Clearance Services

Customs clearance services are one of the complementary services that play an important role in logistics activities. Outflow of goods or services outside the borders of the country or the entry of goods or services within the borders of the country takes place through customs clearance procedures shaped by customs legislation. Most of the time, there are legal regulations that vary according to the product or country that are imported and exported, and it is important to follow the processes and not to make mistakes in the documents that need to be prepared. Minor mistakes made may leave exporters and importers in a difficult position. For this reason, it is important that the transactions are carried out by companies specialized in their fields.

Within the scope of customs clearance services, entry and exit operations of the vehicle carrying the goods from the country border, preparation of summary declaration and customs declaration, preparation or follow-up of other documents that need to be prepared in the annex of the declaration and which differ according to the import and export, obtaining the necessary permissions from the relevant institutions according to the characteristics of the product, calculation of customs duties, import or export of goods are carried out.

Insurance Services

Since risk factors are important when it comes to international trade activities, goods subject to international trade must be insured in accordance with the provisions of the agreement between the parties. Insurance services are an assurance against these risks, especially since there may be more risks during transportation activities, which is one of the most important of logistics activities.

The insurance of internationally traded goods and their protection against certain risk factors provides legal protection in one aspect, while the trust environment between the parties arises and the protection of the values of the goods carried against the risk factors that may arise (Dölek, 1999).

The logistics service provider companies, which the contracting party has agreed for other logistics activities, are able to provide insurance services as an extension of the service concept of the logistics companies.

Stock and Inventory Management

Stock and inventory management are two complementary concepts and have an important place in logistics activities. Inventory means the availability of supplied materials, materials, semi-finished and finished products in order to keep production at the desired level and to deliver and sell according to the desired specifications. Inventory is the list of the stocks that held (Waters, 2003).

Inventory management determines at which points and quantity of products to be kept in order to achieve the correct flow of goods. One of the most important problems of companies is that inventory cannot be kept at the desired level. Excess inventory, low inventory or lack of storage of existing goods under the necessary conditions imposes additional costs. Operating costs may rise due to incorrect inventory management policies (Keskin, 2006).

Due to very small materials and parts that are not available on time, the entire production system can be clogged and the existing customer potential can be lost. On the other hand, the inputs in the inventory which are kept with surplus but which cannot be included in the production line due to the improper planning of the demand increase the operating costs. Within the scope of logistics activities, operating costs arising from inventory can be significantly reduced and production efficiency level can be increased. In this respect, inventory management is of great importance in logistics processes (ITO, 2006).

Handling and Packaging Services

Handling and packaging services have recently become an important service undertaken by logistics companies with international standards gaining importance in this regard.

Packaging can be defined as all protective devices used in the distribution chain from the manufacturer to the consumer for safe and undamaged transportation of products (IGEME, 2006). Packaging provides the protection, control, shelter, presentation, promotion and transportation of the product in an economic and environmentally sensitive manner throughout the whole life.

Packaging is a process that has a direct impact on the success of the workflow in foreign trade and logistics services. Especially during handling activities, packaging becomes crucial. Controls of imported or exported goods are to be carried out quickly and efficiently, however, it is necessary to be careful about packaging in terms of physical quality as well as protection of production and consumption conditions (Bowersox et.al, 2002).

A package is defined as the final container which allows the packaged products to be brought together and loaded onto the transported vehicle subject to customs clearance. Different types of packages have been defined for packaging services in international transport activities. These can be specified in boxes (boxes), crates, bags and sacks, bales and pallets. Markings and labels must be made on the packages in accordance with international standards (Canıtez, 2009).

CONCEPTS RELATED TO LOGISTICS

The concept of logistics is commonly perceived as transportation or shipping. The main reason for this is due to the predominant position of transport activities in logistics services. However, transportation services are not sufficient, especially in the case of international trade, and other services, which can also be considered as complementary, are needed. Therefore, transportation constitutes only a part of the logistics service range.

Other misperceptions about the concept of logistics are supply chain and value chain concepts. Supply chain is defined as a concept related to information systems of logistics services, while value chain is evaluated in relation to management systems. Logistics, on the other hand, has begun to take its place among the economic disciplines that affect these systems and is seen as a concept which has an important place in the economies of the country with its size.

Supply Chain Concept

The supply chain can be defined as information systems that include the procurement, storage, stock control, order management, distribution, delivery of the product to the customer and necessary for the monitoring of all these activities (http://www.cscmp.org).

The supply chain covers not only the flow of products, but also the flow of money, paper and information. In this context, the four main components of the supply chain, procurement, internal activities, distribution and process integration, gain importance. In the procurement process, the presence of supplier companies, demand management, inventory management, and corporate resource planning (ERP) systems become more important. Within the scope of distribution, logistics management, customer relationship management (CRM) and green logistics issues come to the fore. Process integration refers to the coordination of all companies in the supply chain (suppliers, transporters, internal departments and other companies) and all activities carried out, risk management and performance measurement in this process (Wisner et.al., 2009).

There is a significant difference between the concept of logistics and supply chain management, which is often thought to have the same meaning. Logistics includes activities such as transportation, storage, customs clearance, handling to transport products to where they should be. In this context, Logistics Management is defined as the management of the activities taking place along the two-way flow of materials between the shipping points and the delivery points in line with customer requirements (Tanyaş, 2005). Hence, supply chain management is a more comprehensive concept than logistics management and covers topics not included in the logistics concept such as integration of information systems, planning and control activities (Bowersox et.al, 2002, Yüksel, 2002).

Globalization directly affects production processes. The production process of a good takes place in different countries. This has further increased the importance of supply chain management. Today, the raw materials or semi-products required for the production of a product are procured from different countries, the stages of production take place in different countries and then the product is exported to many countries. Supply chain management aims to identify the suppliers, make the production planning, deliver the products to the final consumers and integrate all these processes, increase the productivity of the companies, increase the amount of the products produced, reduce the time losses and costs (Su, 2002). Logistics service providers play an important role in the efficiency of the supply chain. The coordination of the companies in the chain, the transportation of raw materials and products, the transactions during the transportation activities and the risk management are carried out within the scope of logistics services (Delfman, 2000).

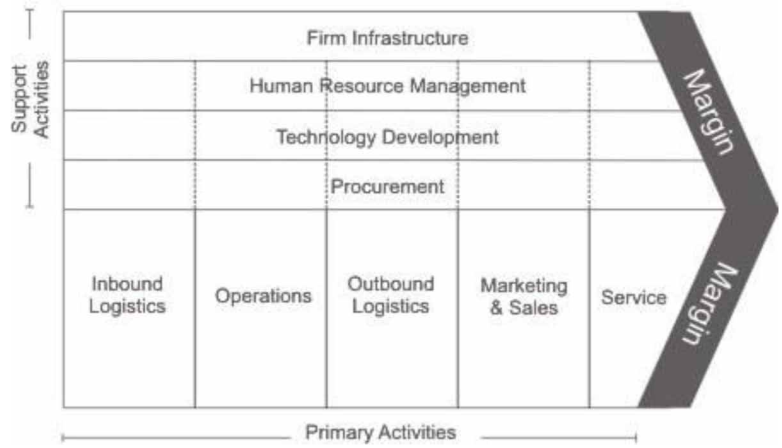
The Concept of Value Chain

The value chain is defined as the interconnected set of activities that create value at all stages of the production until the basic raw material resources in the production stage become consumer goods reaching the final consumer (Porter, 1998). Firstly, the concept introduced by M. Porter in the literature is expressed as a method that gives different perspectives to the competitive situations of enterprises (Türk, 2004).

Within the scope of the value chain approach, there are two groups that create value: primary (basic) activities and secondary (supporting) activities. Primary (core) activities, pre-production logistics, production-related operations, post-production logistics, marketing and sales, after-sales services, five value-creating activities, secondary (supporting) activities, firm infrastructure, human resources management, technological development and procurement structure. According to Porter, when the core activities and supporting activities are integrated, the company's productivity and thus its profitability increase. Figure 2 shows the value chain model developed by Porter and its activities.

There is a significant difference between value chain and supply chain concepts. The value chain is expressed as a management approach in which all the rings in the chain have to add value to the product and the non-value adding ring is eliminated. Supply chain is a kind of value chain and a management approach that arises from the fact that the chains of the chain are independent firms (Tanyaş, 2004).

Figure 2. Porter's generic value chain
Source: Porter, 1985: 37



Outsourcing

Outsourcing can generally be defined as the supply of input products or services from other companies in the course of a company's activities. Outsourcing, which became an important strategy for companies after 1980s, focuses on self-efficacy of companies and enables them to procure other necessary products and services faster and more cost-effectively than other companies with self-efficacy (Waters, 2003). In this way, companies can convert fixed costs into variable costs, benefit from the investment and creativity of other specialized firms, thereby increasing their efficiency and competitiveness, and thus making more effective use of foreign market opportunities (Tanyaş, 2009).

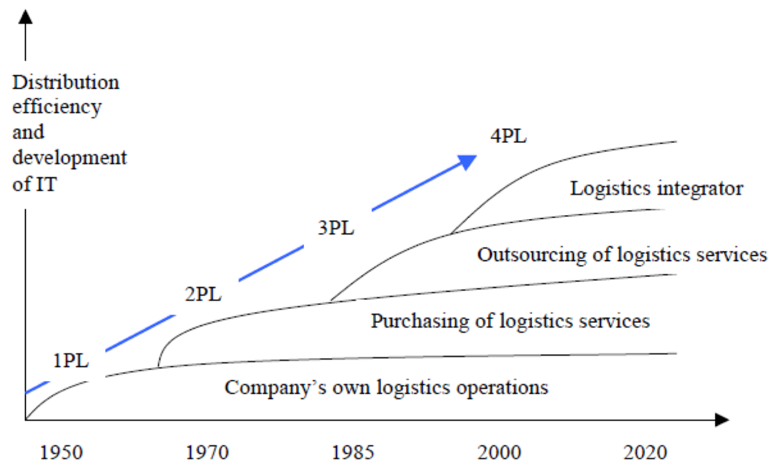
Outsourcing becomes more important when it comes to logistics services. In particular, small and medium-sized companies to establish the infrastructure to carry out logistics operations within their own structure creates difficulties in terms of planning and increases production costs. Therefore, outsourcing of logistics services has become widespread in many trade and production regions around the world.

The provision of logistics services through internal and external procurement takes place at different stages. These stages are commonly found between 1P (First Party Logistics) "and" 4PL (Fourth Party Logistics) (.Kivinen, 2002). These steps can be seen in Figure 3.

Small-scale companies provide basic logistics services with their own competencies with 1PL. In the case of 2PL (Second Party Logistics), companies supply various services such as transportation, storage, customs clearance and insurance from different service providers depending on the increase in business volume.

Companies providing services within the framework of 3PL (Third Party Logistics) and 4PL (Fourth Party Logistics) are involved in all or most of their customers' supply chain activities. In this process, companies add information-based value to the businesses they serve (Lagneaux, 2008). 3PL gained importance with the introduction of outsourcing in logistics activities. Often with third-party logistics, defined as "the provision of multiple logistics services under a contract by a single service provider" or the avoidance of basic logistics activities within the supply chain by specialized logistics companies (at least three consecutive activities) (Tanyaş, 2005).

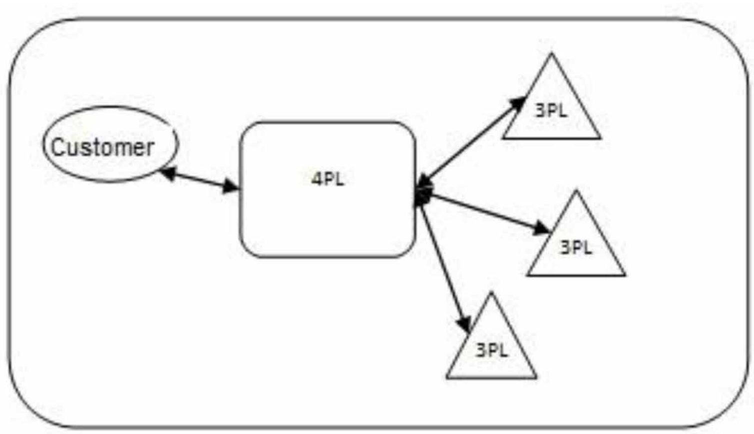
Figure 3. Develpoment of outsourcing
Source: Kivinen – Lukka, 2002: 22



Logistics activities are usually provided by manufacturers through outsourcing from 3PL service provider logistics companies. As a result of their expertise, 3PL companies have great flexibility in a wide geographical area in the process of delivering the raw material from the source to the end product and delivering the final product to the end user with lower processing cost and better service quality (www.cemt.org.).

4PL stands for the integrated presentation of all logistics activities. Therefore, fourth-party logistics companies are the only point of contact for manufacturers who want to receive integrated logistics services (Lu, Su, 2002). In the 4PL applications, as shown in Figure 4, the company receiving service establishes a connection with a single service provider, while the fourth party logistics company providing services can receive services from different third party logistics companies while providing integrated services. However, he undertakes all responsibility for his own customers (Delfman, 2006).

Figure 4. 4 PL logistics
Source: Delfmann, 2006



In recent years, innovations in production processes, increasing developments in information and communication technologies and changing structure of competition lead to outsourcing to 5PL (Fifth Party Logistics). 5PL stands for supply chain management. In this type of outsourcing, all services from the starting point of the raw material to the final destination of the final product and the coordination of the supply-demand relationship are under the responsibility of the 5PL service provider. It is expressed as the trend of the future (Lu, Su, 2002).

Development Stages of Logistics Sector

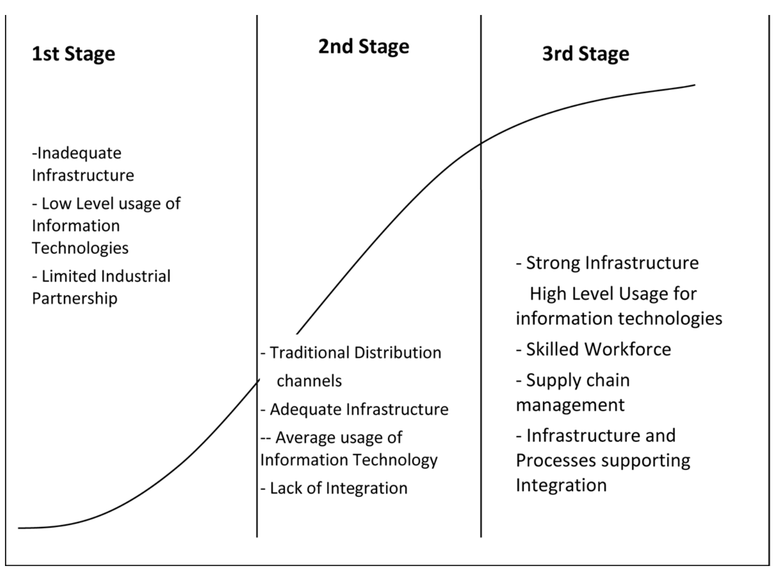
The economic developments are increasing the importance of the logistics sector day by day. When an evaluation is made for the development level of the logistics sector, it is seen that the countries differ according to their income levels. Generally, it is considered that the development of logistics sector is higher in high income countries. In low-income countries, the development of the sector remains low.

The most important reason why the logistics sector is more developed in high-income countries can be explained by the fact that they can allocate more resources to infrastructure investments. The development of the sector is highly dependent on the infrastructure investments to be made by both public and private sectors. Examples of these are highways, sea and airports, railways, warehouses and bonded warehouses. These investments can only be made in sufficient amounts in high income countries (Arvis et al, 2007).

In general, the development of the sector among the world countries can be explained in three stages as illustrated in Figure 5 (www.mapletreelogisticstrust.com):

- First Phase: In this phase, which can be called as low development level, the infrastructure related to logistics services is very weak. The level of usage in information technologies is very low. Accordingly, there are limited opportunities for the provision of logistics services. There are few logistics companies in the sector. Generally, in low-income countries, the level of development

Figure 5. Development of logistics industry
Source: MapletreeLog, 2010, slide.18



of the logistics sector is at an early stage. Vietnam, Senagal, Uganda, Bangladesh, Uzbekistan, Kyrgyzstan are examples of these countries. At this stage of development, goods are shipped directly from the country of origin to different countries by single mode transport. Distribution centers operate on a national basis.

- Second Phase: Logistics is a process in which the development of the sector accelerates. At this stage, there are efforts to increase the logistics services provided due to the improvement of the logistics infrastructure. Information technologies are increasingly used in the supply of basic logistics services. Middle-income developing countries are usually in the second stage of the logistics sector. At this stage, although traditional distribution channels are actively used, central distribution activities and central warehouses come to the fore. Central warehouses enable the goods to be sent through activities that create added value to different countries from a certain point. For example, goods can be prepared in a central warehouse according to the demands of different consumers in different countries.

- Third Phase: This is the stage where the level of development is highest in the logistics sector. At this stage, there is a strong infrastructure that supports the logistics service supply. As the infrastructure for corporate, physical, technological and labor force is completed, there is a strong supply chain management. Central coordination of supply chain management activities is ensured with strong logistics platforms. At this stage, the link between manufacturers, suppliers and logistics companies has gained importance. Qualified workforce is employed in the sector and specialization is given importance. At this level of development of the logistics sector, there are generally developed countries with high income levels. Singapore, Japan, Germany, Netherlands, England, Sweden, Switzerland, Norway, Belgium are examples of countries where the logistics sector is highly developed.

SOLUTIONS AND RECOMMENDATIONS

In a globalized world, logistics is gaining importance in sustainability of economic activities. Logistics has a wide range of services. In addition to transportation and warehousing activities, the management of orders, demand planning, packaging, handling, insurance, customs clearance, inventory management, customer service and new developing services according to the increasing demands are included in logistics services. These services cover all national and international processes during the procurement, inclusion and post-production distribution of raw materials or intermediate goods during the production of a good.

With the efficiency and efficiency of logistic services in all sectors of production, companies can increase their efficiency in cost and time management and increase their competitiveness by producing alternative solutions suitable for developing and changing conditions. This situation positively affects the competitiveness of the sector in which the firm is located and the national economy.

Although the logistics sector is a competitive sector, it is also the determinant of the competitiveness for other sectors. Especially in the industrial sectors, competitiveness is associated with the increase in export volume. Exports are weak without logistic activities. In addition, raw materials and semi-finished products supplied by companies operating in industrial sectors from different countries can also be realized through logistics activities. The efficiency of logistics services means that the industrial firms and industrial sectors and the country gain competitiveness. Therefore, the logistics sector is a key sector in achieving competitiveness both at the firm, sector and country level. The logistic sector, which has a mutual relationship with all industrial sectors, creates a competitive power both within itself and in the industrial sectors and increases the competitiveness of the country.

FUTURE RESEARCH DIRECTIONS

The logistics sector, which has an important share in the service sector and has an increasing share, is one of the critical factors in competitiveness. When the logistics sector is evaluated in terms of competitiveness, three different perspectives emerge. These are; competitiveness of logistics sector, competitiveness of logistics sector in other sectors, competitive power created by the logistics sector in the national economies.

Relevant and supportive sectors institutions and organizations that are of great importance in ensuring development with the sectors directly linked to the logistics sector. The competitiveness of the logistics sector is based on being the key sector for all industries, services and trade sectors. Although all of the industrial sectors vary in intensity, they need logistics services. This situation is important for the sector to continue its development.

In this study, a comprehensive literature review is given. Future studies may examine the direct impact of the logistics sector on the national economy or the impact and determinants of the logistics sector on economic indicators. For this purpose, it is necessary to access data representing the logistics sector such as transportation, storage and communication data on country basis. Although it is not easy to access these data, especially in developing countries, these issues may serve as the basis for further research as the sector is still in the process of new development.

CONCLUSION

Logistics, despite its importance for many years, has become a concept that has increased its awareness in recent years. Logistics, which was first used in the military field, started to be considered as a part of the management strategy in the early 1900s, and today it has become an important concept in the realization of economic activities with the development of information and communication technologies.

There are various concepts associated with the concept of logistics. The leading ones are supply chain, value chain and outsourcing. Supply chain refers to the information systems required to monitor all these activities, including the procurement, storage, inventory control, order management, distribution and delivery of the products to the customer. Logistics service providers play an important role in the efficiency of the supply chain, which is a more comprehensive concept than logistics. The coordination between the companies in the chain, the transportation of raw materials and products and the transactions during the transportation activities and the risk management are realized within the scope of logistic services. The value chain, which is another logistics-related concept, is defined as the interconnected set of activities that create value at all stages until the basic raw material resources in the production stage become consumer goods reaching the final consumer. In the effectiveness of the value chain, there are five core value-creating activities: pre-production logistics, production-related operations, post-production logistics, marketing and sales, and after-sales services. At this point, logistics services have an important place in the activities that create value in the efficiency of a company. One of the other concepts, outsorcing, is generally defined as the supply of products or services from other companies in the process of carrying out its activities. In recent years, logistics activities have been the most outsourced service provided by enterprises operating in all sectors. While the companies concentrate on production, which is their specialty, they provide logistics services such as transportation, storage, customs clearance, packaging, handling through outsourcing from various logistics service provider companies.

The development of the logistics sector and the logistics services provided varies according to the income levels of the countries. In general, it is seen that the development of logistics sector is higher in high income countries and in low income countries, the development of the sector is low. The presence of a strong logistics infrastructure in a country, the use of information and communication technologies at a high level, the availability of qualified labor force in logistics and the overall management of the supply chain process in enterprises accelerate the development of the logistics sector and this situation plays an important role in the economic development of the countries with the external effects created in other sectors.

REFERENCES

Acar, Z. (2010). *Depolama ve Depo Yönetimi, 1.b*. Ankara, Turkey: Nobel Yayın Dağıtım.

Arvis, J. F., Saslavsky, D., Ojala, L., Shepherd, B., Busch, C., Raj, A., & Naula, T. (2007). Connecting to compete: Trade logistics in the global economy. The Logistics Performance Index and Its Indicators. Worldbank Press, Washington, DC. Retrieved from http://siteresources.worldbank.org/INTTLF/Resources/lpireport.pdf

Bentzen-Laugesen-Cerneckyte, e. p. 21; MappletreeLog, Overview of Mapletree Logistics Trust, Mapletree Logistics Trust Management Ltd Presentation April 2010. Retrieved from http://www.mapletreelogisticstrust.com/data/resources/docs/newsfiles/ PR/Intro%20slides%20on%20MLOG_Apr%202010.pdf

Bowersox, D., Closs, D., & Cooper, M. B. (2002). Supply chain logistics management, McGraw-Hill Companies Inc. Series, New York.

Bulut, Ö. (2007). Türkiye'de Taşımacılık Sektörünün Lojistik Olgusu İçerisinde İncelenmesi, Kadir Has Üniversitesi SBE, (Yayınlanmamış Yüksek Lisans Tezi), İstanbul, Turkey. 4458 s. Gümrük Kanunu, md.3 (5911. S.K. ile Değişiklik Yapılmış Hali)

Çancı, M. (2003). *Murat Erdal, Uluslararası Taşımacılık Yönetimi* (p. 24). İstanbul, Turkey: UTİKAD Yayını.

Canıtez, M. (2009). *Uluslararası Pazarlamada Lojistik ve Uygulamalar*. Ankara, Turkey: Gazi Yayınevi.

Canıtez, M., & Tümer, G. (2005). *İhracat ve İthalatta Lojistik. Uygulamalı İhracat-İthalat İşlemleri ve Dokümantasyon (Editörler: KARAHAN Kasım, CANITEZ Murat)*. Ankara, Turkey: Gazi Kitabevi.

Craig, V. (2004). *Global logistics management* (1st ed.). Lansdowne, South Africa: Juta and Company.

CSCMP. (n.d.). Council of Supply Chain Management Professionals. Retrieved from http://www.cscmp.org

Delfman, W. (2004). Logistics service providers market view, University of Cologne. Retrieved from http://www.spl.uni. koeln.de

Delfman, W., & Albers, S. (2000). Supply chain management in the global context, Universitat zu Köln Working Paper, WP-No.102, Köln, Germany.

Dölek, A. (1999). *Mevzuat Işığında Dış Ticaret İşlemleri ve Piyasa Uygulamaları*. İstanbul, Turkey: Beta Basım Yayım Dağıtım.

Gourdin, K. (2006). *Global logistics management: a competitive advantage for the 21st century* (2nd ed.). New York: Wiley-Blackwell Publishing.

Hai Lu - Yirong Su. (2002). An approach towards overall supply chain efficiency. (Master Thesis), Göteburg University, Sweden. pp. 26-27.

Hesse, M., & Rodrigue, J. P. (2004). The transport geography of logistics and freight distribution, *Journal of Transport Geography, 12*(3).

İGEME. (2006). *100 Soruda Dış Ticaret* (p. 166). Ankara, Turkey: DTM Yayınları.

İTO (İstanbul Ticaret Odası). (2006). Türkiye Lojistik Sektörü Altyapı Analizi, Yayın No: 2006-14, İstanbul, Turkey, s. 15.

Jari, G. (n.d.). Formulation of Logistics Policies, Transforum: 3rd Forum Meeting. Amsterdam, The Netherlands. Retrieved from http://www.transforum-eu.net/IMG/pdf/Logistixs.pdf

Joel, D. (2009). *Wisner - Keah-Choon Tan – G. Keong Leong, Principles of supply chain management* (2nd ed., p. 16). Mason, OH: South Western Cengage Learning.

Keskin, M. H. (2006). *Lojistik*. Ankara, Turkey: Tedarik Zinciri Yönetimi, Nobel Yayın Dağıtım.

Long, D. (2003). *International logistics: Global supply chain management* (1st ed.). New York: Springer.

Mena, C., Christopher, M., Johnson, M., & Jia, F. (2007). Innovation in Logistics Services, NESTA (National Endowment for Science, Technology and the Arts), Cranfield. p. 3.

OECD. (2002). *Transport logistics, shared solutions to common challenges.* OECD Publication, Paris, France. Retrieved from http://www.cemt.org/pub/pubpdf/JTRC/02LogisticsE.pdf

Osman Z. Orhan, Dünyada ve Türkiye'de Lojistik Sektörünün Gelişimi, İ.T.O (İstanbul Ticaret Odası) Yayınları, Yayın No: 2003-39. İstanbul, 2003, s.10

Porter, M. (1998). *Competitive advantage - creating and sustaining superior performance*. New York: The Free Press.

Rushton, A., Oxley, J., & Croucher, P. (2000). *The handbook of logistics and distribution management* (2nd ed., p. 18). London, UK: Kogan Page Publishers.

Mehmet Tanyaş, "Tedarik Zinciri-Değer Zinciri Farkı", Lojistik Dergisi (LODER-Lojistik Derneği Süreli Yayını), Kasım 2004, Sayı: 3, s. 13.

Mehmet Tanyaş, "Tedarik Zinciri Yönetimi ve KALDER Kıyaslama Grup Projesi", 14. Kalite Kongresi, KALDER, İstanbul, Turkey, 16.11.2005, s.4

Tanyaş, M. (2009). *Akademi Lojistik: Lojistik Kavram ve Terimleri Rehber Kitabı* (p. 8). Mersin Ticaret ve Sanayi Odası Yayını.

Türk, Z. (2004). "Stratejik Yönetim Muhasebesi Yaklaşımı: Değer Zinciri Maliyet Analizi", AÜ SBF Dergisi, Cilt 59. *Sayı*, *3*, 2.

Voortman, C. (2004). *Global Logistics Management* (1st ed.). Lansdowne, South, Africa: Juta and Company Limited.

Waters, D. (2003). In D. Waters (Ed.), Logistics, an introduction to supply chain management (p. 23). New York: Palgrave Macmillan.

Waters, D. (2007). Global logistics: new direction. In *Supply chain management* (5th ed., p. 18). London, UK: Kogan Page Publishers.

Hilmi Yüksel, "Tedarik Zinciri Yönetiminde Bilgi Sistemlerinin Önemi", Dokuz Eylül Üniversitesi, Sosyal Bilimler Enstitüsü Dergisi, Cilt 4 Sayı 3, 2002, s. 262.

ADDITIONAL READING

Cooper James, C. (1994). *Logistics Futures in Europe: A Delphi Study*. Cranfield: Centre for Logistics and Transport, Cranfield University.

Dawson, P. J.-A., & Sanjuan, A. I. (2005). I SANJUAN, Structural Breaks, The Export Enhancement Program And The Relationship Between Canadian And US Hard Wheat Prices. *Journal of Agricultural Economics*, *57*(1), 101–116. doi:10.1111/j.1477-9552.2006.00034.x

Elia Stefano – Elena MAGGİ – Ilaria MARİOTTİ, Does The Logistics Sector Gain From Manufacturing Internalisation?An Empirical Investigation On The Italian Case, *Economic and Statistics Discussion Papers* No.52/09, Universita Studiorum Molise, Italy, 2009, http://web.unimol.it/progetti/repec/mol/ecsdps/ ESDP09052.pdf (14.02.2010).

Harris Richard – Robert SOLLIS. (2003). *Applied Time Series Modeling and Forecasting*. Chichester, W. Sussex: John Wiley and Sons.

Hendry, D. F.-G. E. (1993). *MİZON, "Evaluating Dynamic Econometric Models by Encompassing the VAR"', Phillips, P. C. P., Models, Methods and Applications of Econometrics*. Oxford: Basil Blackwell.

Jarzabkowski Paula – Julia BALOGUN – David SEIDL, Strategizing: The Challenges of a Practice Perspective, *Human Relations,* Volume 60(1):5-27, DOI: , SAGE Publications, 2007, http://hum.sagepub.com/cgi/content/abstract/60/1/5, (05.10.2011) doi:10.1177/0018726707075703

Jean-François Arvis - Raballand GAEL - Marteau JEAN-FRANÇOIS. "The Cost of Being Landlocked: Logistics Costs and Supply Chain Reliability", *Worldbank Policy Research,* Working Paper 4258, June, 2007 http://siteresources.worldbank.org/EXTTLF/Resources/515433-1274994820828/Cost_of_Being_Landlocked.pdf (10.12.2007).

Johansen, S. (1988). Statistical Analysis of Co Integration Vectors. *Journal of Economic Dynamics & Control*, *12*(2-3), 231–254. doi:10.1016/0165-1889(88)90041-3

Johansen, S. (2005). The Interpretation of Cointegrating Coefficients in the Cointegrated Vector Autoregressive Model. *Oxford Bulletin of Economics and Statistics*, *67*(1), 93–104. doi:10.1111/j.1468-0084.2005.00111.x

Kent, G. (2006). *Global Logistics Management: A Competitive Advantage For The 21st Century* (2nd ed.). New York: Wiley-Blackwell Publishing.

Vahrenkamp Richard – Christoph SIEPERMANN. (2005). *Logistik Management und Strategien, 5*. Auflage, Oldenbourg Verlag München.

Zafer, A. (2010). *Depolama ve Depo Yönetimi, 1.b*. Ankara: Nobel Yayın Dağıtım.

KEY TERMS AND DEFINITIONS

Customs Clearance: The permission that is presented to a national customs authority grants to imported goods can enter to the country or to exported goods can leave the country.

Handling: Integration or coordination of packaging and operations for movement of goods and materials.

Insurance: contractual arrangement that guarantees to compensate the loss or damage sustained to another party.

Inventory: Inventory refers to the goods available for sale and raw materials that are used for producing goods.

Outsourcing: outsourcing is the action of getting services or goods from a foreign supplier.

Storage: leaving, holding, or placement of materials or goods with the intention of retrieving them at a later time.

Supply Chain: Supply chain is the network of all the organizations, individuals, activities, resources, and technology from the supplier to the manufacturer or to the end user.

Chapter 2
International Transportation and Logistics Economics

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ABSTRACT

Logistics is important in the service sector, even more so in international trade, a vital part of the economy. The delivery of raw materials and intermediate goods to manufacturers, and final goods to consumers, requires effective transport and management of the process. From this point of view, it is important to examine the economic dimension of logistics and transportation activities. This chapter clarifies logistics activities and mentions their place in economic disciplines. The economic analysis of the logistics sector is discussed in two dimensions as micro and macro scales. Effective factors in the development of an international logistics sector are explained.

INTRODUCTION

The logistics sector, which has developed greatly in recent years, is the lifeblood of economies. The logistics activities become much more important, especially in the case of production and trade. The procurement of raw materials by the manufacturing companies, including them in the production process and having the products reach the hands of the final consumer after production are realized through logistics activities.

Logistics activities are versatile. These activities are of a variety which can be directly determinant on the level of effectiveness and efficiency of the enterprises and in the exhibition of their competitiveness. The effective logistics services have been the key factor for the success of the competitive markets shaped by the globalization in the world.

The transportation services are among the most important logistics activities. The transportation activity is, in its narrow meaning, the transfer of a commodity, product or goods from one place to another, and in the broad sense, the delivery of goods produced in order to meet the consumer needs to the regions and centers where they are needed. The aim of transportation within the scope of logistics activities is not only to transfer1 the goods from one point to another, but also to realize this process in the

DOI: 10.4018/978-1-7998-1397-2.ch002

most accurate, fastest, safest and most economical way. Therefore, especially in the case of international transportation activities, transportation can be defined as the whole of comprehensive activities including different services ranging from the preparation of the documents required for the transportation of the goods to the delivery up to the warehouse of the purchasing company (Çancı and Erdal, 2003). The transportation services, which have gained importance in the logistics activities the past thirty years, consist of different sub-transportation services including highway, maritime, airway, railway, pipeline transportation and multi-transportation within the scope of logistics activities related to the products or raw materials (Bowersox et.al., 2002). Which sub-transportation type will be preferred may vary depending on the factors such as the feature of transported goods, the transport time, the cost of the transport service, the infrastructure adequacy of the transport type, the political structures and policies of the countries (Delfman, 2004).

There are many services besides the transportation activities within the scope of logistics. Logistics services are strategic activities for the management of the flow of goods, services and information and for establishing the connection between the consumer and the supplier. In addition to transportation services, warehousing activities, demand planning, packaging, handling, insurance, customs clearance, inventory management, customer services and newly developed services according to the day-by-day increasing demands are included in the logistics services (Mena et.al., 2007).

The wide range of services offered in the logistics sector and the added value created by these services make it necessary to handle the logistics with its economic dimension. From this point of view, firstly, the place of logistics phenomenon in the economic disciplines has been mentioned and its place in the NACE classification, which expresses the classification of economic activities, has been specified in the chapter. Then, by making an economic evaluation of the logistics sector with its micro and macro aspects, finally the factors affecting the development of the logistics sector in the world economy have been included.

BACKGROUND

Logistics, which firstly expressed the activities in the military field and later gained importance with the adaptation of the military applications to the field of management and production, has now become an interdisciplinary science which has a link with many branches of science such as primarily economics, management, marketing, political sciences, sociology, mathematics and engineering sciences (Stock, 1997). The relation of logistics discipline with economics is expressed by Stock (1997) within the scope of different theories.

The Benefit-Cost analysis which is of importance at the point of evaluating the investment projects in terms of efficiency, the selecting the projects that will provide the highest benefit to the society or determining the order of priority, plays an important role in budgeting and especially in balance analysis in logistics applications.

On the other hand, the Input-Output analysis has a guiding role in the efficient operation of the logistics decision mechanism and the planning of the logistics applications. The Input-Output analysis is a method of determining the relations of the industries with each other in an economy through input-output tables and shows the inter-industry goods and services flows.

The pareto efficiency and product life cycle theory has also an influence on the effectiveness of the logistic decision mechanism. Pareto Efficiency is a general state of equilibrium, which means that the changes in the production or consumption bring at least one person to a better position without putting anyone else in a worse position. In the Pareto Efficiency, the simultaneous equilibrium situations of the consumers, producers and the owners of the production factors are involved. In this respect, it has been directive within the scope of logistics applications in the inventory, in other words, in the stock management.

On the other hand, the Product Life Cycle theory states that the comparative advantages of various inputs used in the production of a product is different between countries, therefore the comparative advantage of the product may change in parallel with the change in the inputs during the life cycle. In this context, it is seen as an effective theory in determining logistics strategies as well as the efficiency of the logistics decisions.

One of the economic theories related to logistics discipline is The Benefit Theory. Benefit is defined as the ability of goods and services to meet human needs in economics and is important in consumer balance analysis. In this context, the Benefit Theory gains importance especially in the determination of suppliers in the logistics processes of the goods or services consumed, in the issue of the supply of logistics services and the creation of added value for the goods or services in the consumer.

Weber's Establishment Location Theory is the economic theory that encompasses how the location where the company will be established or production will be done, under which conditions the production will be made, the location where the raw material procurement costs of the firm, the cost of production and the marketing expenses can optimally affect the production will be selected. In this context, the establishment location theory is effective in logistics, especially in the selection of warehouse location.

The Absolute Advantages Theory, the Comparative Advantages Theory, one of the classical international trade theories, explains the basics of the logistics and competitiveness relationship. According to the Absolute Advantages, the basis of international trade is free movement of goods. Since the countries are more profitable than closed economy situation, they turn to international trade, in case that a country has absolute advantage in the production of certain goods, it exports this product. The Theory of Comparative Advantages, which was developed by D. Ricardo, has been put forward in the continuation of the Absolute Advantages Theory which has deficiencies in many aspects. The Theory of Comparative Advantages, defending the international trade, expresses that the comparative advantage is necessary and sufficient for the international trade, not the absolute advantage. These classical theories of international trade have become the basis of the international trade activities, which are of great importance for countries to gain competitiveness today.

The Competitive Advantages can be expressed as version of the classical international trade theories adapted to the present day. With the competitive advantages, Porter refers to the importance of the companies and the industries in which they are in achieving competitive power of the countries. He argues that firms can have competitive advantage and increase international trade volume only by creating value. The competitive advantage that the companies will have may be through price competition or non-price competition. Logistics is important in either way. In this respect, innovation gains importance in value creation issues with logistics. On the other hand, the competitive advantages approach, which emphasizes the importance of clustering for the sectors to gain competitive advantage, constitutes a basis for the formation of logistic clusters.

Krugman's New Trade Theory points out that economic actors such as companies, buyers, sellers, sector-related organizations in a region attract the other companies to the same region and that this attraction area is formed by way of the common information sources and the externalities formed by the synergy created. Therefore, the synergy within the logistic clusters and their effects on the industrial sectors are important in this context.

On the other hand, Nash Equilibrium is defined as the best strategy that a company can choose according to the strategy applied by the other companies. With this aspect, logistics becomes effective in decision mechanisms and supplier relations.

The Company Theory covers the strategies with the aim of profit maximization according to the market type in which the company exists. Therefore, it represents an important relationship with the determination of logistics strategies. These relationships between the economic theories and the logistics discipline are summarized in Table 1.

GENERAL STRUCTURE AND ECONOMIC ANALYSIS OF THE LOGISTICS SECTOR

Logistics sector is a service sector in terms of structure. When it is considered in all service sectors, it is seen that it has a significant weightiness. The reason of this originates from the fact that it is a complementary sector for both industry and service sectors.

The fact that the manufacturing industry has a significant share in the world trade as a result of the developments in the world economy in recent years has ensured welfare increase and high-income level and this has greatly increased the importance of the service sector. The share of service sectors in the

Table 1. The economic theories and the logistics applications

Theory	Logistics Applications
Benefit-Cost Analysis	Budgeting; Balance Analysis
Input-Output Analysis	Logistics Decision Mechanism and Planning
Pareto Effectiveness	Inventory Management; Logistics Decision Mechanism
Product Life Cycle Theory	Logistics Decision Mechanism, Strategy Formulation
Benefit Theory	Supplier Selection, Creating Value Added with Logistics
Weber's Establishment Location Theory	Storage Location Selection
Theory of Absolute Advantages	Competitiveness, International Trade
Comparative Advantages	Competitiveness, International Trade
Competitive Advantages	Competitiveness, International Trade, Innovation, Creating Value Added with Logistics, Logistics Clusters
New Trade Theory	Logistics, Clusterings, Competitiveness
Nash Dengesi	Logistics Decision Mechanism, Supplier Relations
Company Theory	Logistics Strategy

Source: Stock, 1997:521-525.

world GDP has doubled the industrial sector. While the share of the industrial sector decreased from 38% in 1971 to 28% in 2005, the share of the services sector in GDP increased from 54% to 69% in the range of the same years. In 2009, the share of the industrial sector was 30.8% and the share of the service sector was 63.4% (World Bank, 2010).

With the increase in the weightiness of the service sectors, the effects of the activities in the transportation, banking, tourism, marketing, distribution and communication sectors, which are important sub-sectors, on the economy have significantly become evident. Today, the services within the scope of service sector are produced by many companies in the world and these companies contribute positively to the economies and competitiveness of the countries in which they are located with the services they produce. Besides, the services are of great importance in establishing the infrastructure of both the domestic and foreign markets. Therefore, it is also important for national and international trade. The economic performance of a country depends on the efficiency of the service sector. It also creates opportunities for employment, entrepreneurship and investment and plays a decisive role in raising the life standard in the country. Accordingly, in recent years, the service sector has increased its importance in world trade and investments, gradually increased its share in the Gross National Product in many countries, and has also been in the first place in terms of providing employment (Onur and Bektaş, 2008).

Today, as a result of increasing competition, the manufacturing industry has become increasingly dependent on the service sector. The competitive advantage of the companies operating in the manufacturing industry now depends on the success of the services related to the produced product rather than the produced product. The services such as delivery to the consumer on time, distribution, after-sales services, etc. can be specified as examples of these services related to the product. In addition, the factors that play a role in creating added value for many companies operating in the manufacturing industry can be expressed as planning the production and process, control, procurement and purchasing that are not seen. Achieving success in these factors requires the effectiveness of the service sector (Porter, 1990). Logistics services gain importance at this point and ensure increasing the productivity of the companies, decreasing the production cost and having more competitiveness in the international markets.

With the procurement of logistics services from the specialist companies within the scope of outsource utilization, the position and importance of logistics sector in economic sectors have been increasing day by day.

THE PLACE OF THE SERVICES PROVIDED IN THE LOGISTICS SECTOR IN THE ECONOMIC ACTIVITIES CLASSIFICATION

Economic activities in the world, practices and definitions related to the service sector have been defined in accordance with the General Agreement for Trade in Services-GATS (İGEME, 2006).

In this context, ISIC - International Standard Industrial Classification of all Economic Activities has been made by the United Nations and economic activities have been categorized. The European Union, based on ISIC, has developed the system of Statistical Classification of Economic Activities (NACE-Nomenclature générale des Activités économiques dans les Communautés Européennes)) used in the European Union. The coding systems used in ISIC and NACE are basically the same, and a “dot” sign is placed between the first two digits (division level) and the last two digits (groups and classes) in NACE in order to distinguish two classifications easily (TUIK, 2010).

The services provided in the wide spectrum of the logistics sector have been included in the classifications updated as ISIC. Rev.4 and NACE Rev.2. in the code numbers of 49, 50, 51, 52, 53, 60, 61, 62, 63 and 64 in the total of 99 code numbers (Ehmer and Heymann, 2010). Table 2 shows the NACE Rev.2 classification of logistics services.

ECONOMIC ANALYSIS OF THE LOGISTICS SECTOR

In recent years, the structures of products and services have diversified depending on the consumer demands and have become more complex. In addition, the logistics services have also developed and become important with the expansion of the range of products and services in national and international markets. Thousands of new products and services have been introduced, sold and distributed to the final consumers all over the world. As a result, the markets have gained increased competitiveness in this way, on the other hand, the companies have faced increasing difficulties in maintaining their traditional profitability and growth rates. In the face of this situation, the companies are required to continuously develop new strategies in order to increase their competitive advantage and profit rates. The increase in the rate of profit is achieved by increasing the revenue or decreasing the production costs.

Today, with the impact caused by globalization, companies around the world have to create added value by decreasing their costs and improving and differentiating the services they offer. In this context, the logistics sector is important in terms of the impact it has on reducing costs, the effectiveness of the services provided and the value it creates, and has a noticeable role in economic development. Besides, it is considered as one of the main factors in the realization of economic growth (Webb, 2006).

The logistics sector is of great importance both in micro and macro aspects in the national economy. The fact that the service providers operating in the logistics sector fulfill all of the activities in the service receiving companies such as taking the order of a product in the pre-production process, stock control, supply of raw materials, including them in the production process, post-production storage, distribution, customs clearance, insurance, packaging gives cost advantage, competitive advantage to these companies depending on speed and flexibility. Therefore, the logistics sector is of great importance for companies operating in all industrial sectors. On the other hand, from a macroeconomic perspective in general, the logistics sector is one of the sectors that makes the highest foreign exchange income in the economies of the countries.

The logistics sector, which is the lifeblood of the international trade, in addition to being an important employment field, creates added value in many sectors through the activities it has. Today, the logistics sector has become one of the main factors for a country to obtain competitive advantage.

Microeconomic Analysis of the Logistics Sector

Micro-economic analysis of logistics sector can be considered under the headings of the company and market structure and the supply and demand balance. The company and market structure expresses the characteristics of the companies operating in the sector according to their service types and the structural characteristics of the logistics sector. On the other hand, the supply and demand balance indicates the supply and demand structure in the logistics sector and the situation related to balance formation.

Table 2. NACE Rev.2 classification of logistics services

H	TRANSPORTATION AND STORAGE SERVICES
49	**Road transport and pipeline transport services**
49.1	Railway passenger transport services, intercity
49.2	Freight transport services by railway
49.3	Other passenger transport by road transport
49.4	Freight transport by road and transport services to homes and businesses
49.5	Pipeline transportation services
50	**Waterway transport services**
50.1	Sea and coastal water passenger transport services
50.2	Freight transport services in sea and coastal waters
50.3	Passenger transport services in inland waters
50.4	Freight transport services in inland waters
51	**Airway transport services**
51.1	Airway passenger transport services
51.2	Freight transport services by airway and space vehicles
52	**Storage and support services, for transportation**
52.1	Warehousing and storage services
52.2	Support services for transportation
53	**Postal and courier services**
53.1	Postal services, under the universal service obligation
53.2	Other postal and courier services
60	**Programming and publishing services**
60.1	Radio broadcasting services
60.2	Television programming and broadcasting services; publication of the originals
61	**Telecommunications services**
61.1	Wired telecommunication services
61.2	Wireless telecommunication services
61.3	Satellite Telecommunication services
61.9	Other telecommunication services
62	**Computer programming, consultancy and related services**
63	**Information services**
63.1	Data processing, hosting and related services
K	**FINANCE AND INSURANCE SERVICES**
64	**Financial services (except insurance and individual pension)**
64.1	Services of the financial intermediary institutions
64.2	Services of holding companies
64.3	Services of tourists, funds and similar financial entities
64.9	Other financial services (except insurance and pension funds)

Source: TÜİK, http://tuik.gov.tr

Company and Market Structure in Logistics Sector

The companies operating in the logistics sector are the companies that provide services creating added value such as transportation of the raw materials, semi-finished products and final products from the starting point of production to the final destination, customs clearance, insurance, packaging and handling.

The company structure in the logistics sector differs according to the service supply structure of the operating companies. Logistic services are requested by manufacturers or manufacturers / exporters through outsource utilization. As mentioned earlier, the development of the demand for logistics services has revealed the concepts of 2PL, 3PL, 4PL and finally 5PL. Through an overall consideration, it is seen that the company structure providing 4PL services is encountered in the developed countries and it is difficult to encounter companies that provide 5PL services. In the developing countries, the companies offering 3PL services are more intensive and the companies offering 4PL services are in the development process.

As general structure, the logistics sector can be defined as oligopoly from the incomplete competition markets. However, its complex structure may deviate from the oligopoly structure when the subsectors are involved For example, when the railway transport is considered, it is seen that there is a complete monopoly structure in many countries (Laisi, 2010).

Oligopoly market is a type of market where a small number of sellers that will influence each other confront infinite number of buyers. The reason for the fact that small number of companies exist in the market is due to the entrance barriers such as the scale economies, issue of capital and the limit price policies (Dinler, 2002).

Entrance barriers for the logistics sector become less or higher depending on the structure of the firms that will enter the sector. The companies providing logistics services are generally structured as the companies providing 2PL, 3PL, 4PL and 5PL services. Entrance barriers to the market increase as the structure reaches the 5PL service. As mentioned before, 5PL signifies a structure in which all logistics services are provided within an integrated the procurement chain. For this reason, barriers such as capital problems and scale economy are seen more in entering the market. In the companies providing 2PL and 3PL logistics services, the entry barriers become relatively less as the presentation of the basic logistics services is the subject matter (Deloitte, 2010).

Entrance barriers in the logistics sector can be basically expressed as absolute cost advantage, scale advantage, transportation and service networks and legal regulations (Friederiszick et al., 2009).

The absolute cost advantage is that the companies operating in the sector provide services at a lower cost than those that will potentially enter (Dinler, 2002). The absolute cost advantage in the logistics sector come out mainly related to the technological information advantage and the capital advantage. The services provided in the logistics sector require technological equipment to a large extent. That the companies that will newly enter the market obtain the sufficient technological equipment limits the entrance to the market due to its cost. On the other hand, the fact that the settled companies have capital advantage is a factor preventing potential companies from entering the market. Vehicle fleets and warehouses to be established for efficient service presentation in the logistics sector can be made possible with a strong capital structure.

The scale advantage is also important in the logistics sector which is a service sector. As the scale of the company grows, the services offered increase and gain quality. For example, a large-scale logistics company has its own vehicle fleets and can offer more flexible services. In this context, the large scale for potential companies that will enter the market creates financing problems and limits the entrance to the market to a certain extent.

Transport and service networks are important entrance barriers for companies entering the market. Since the logistics services are internationally offered services, the wide range of connections and transportation networks with other countries increases the competitiveness of the company. That the transportation and service networks of the settled companies in the market is wider, in other words, providing service on longer routes creates entrance barriers for the potential companies that will newly enter the market.

Legal regulations can be mentioned as another entrance barrier in the logistics sector. The companies operating in the logistics sector, especially in the case of international trade-related services, must comply with international conventions, meet various standards within the scope of legal regulations and have the necessary documents. Obtaining authorization certificates for road vehicles and the necessity of having trained vehicle drivers can be given as examples. Since this situation is perceived as a bureaucratic obstacle, it limits the companies that will newly enter the market.

The entrance barriers concerning the transport sector which is an important sub-sector in the logistics sector vary depending on the type of transport. There are high entrance barriers in the maritime transport which is the most preferred type of transportation in the world. High capital requirements, compliance with international technical standards, assurance of experience and service quality can be cited as main entrance barrier. The entrance barriers are lower in the road transportation which the most preferred another mode of transport. Equipment costs, capital requirements especially for the developing countries, bureaucratic barriers and legal regulations and compliance with the international standards can be cited among the entrance barriers (The Asia Foundation, 2008). On the other hand, high entrance barriers are encountered in the railway and air transport. The cost of railway vehicles and equipments in the railway transport, sunk costs related to the infrastructure, deficiency of the second-hand railway vehicle market, intermodal transport ability (For example Ro-La or Ro-Ro Transport), storage facilities are among the main entrance barriers (Laisi, 2010). The main entrance barriers in the air transport can be specified as the scale economies, the absolute cost advantage, sunk costs, the idle capacity, the limit pricing, the destructive pricing, the monopoly rights, the bilateral agreements (Müller-Rostin et.al., 2008).

Supply and Demand Balance in the Logistics Sector

The logistics services are products that are immediately used and cannot be stored due to the structure. The logistics sector is a sector where logistics services are produced. The importance of logistics services and the sector increases when economic activities carried out between different locations are concerned. When the logistics services are not realized, efficiency and cost effectiveness cannot be achieved (Rodrigue et.al., 2009).

The logistics sector is subject to supply and demand changes in the market and the market balance is ensured by supply and demand of logistics services. The demand curve in the logistics sector is a downward sloping curve as shown in Graphic.2. Accordingly, when the price rises, the demanded amount of logistics service decreases. As a matter of fact, as a result of the increased fuel costs after the economic crisis in 2008 and beyond, the increase in transportation costs and the increase in the prices of the logistics services provided caused the demand to decrease and this situation has been reflected in the international trade.

When the demand structure for logistics services is evaluated, it is seen that it is a derivative demand. Derivative demand can be defined as the demand that arises as a result of the demand for a product and which is not directly related to the consumption need, and which increases or decreases due to the increase or decrease in the demand for that product. Since the logistics services arise when there is a demand for a product, the demand structure is considered as derivative demand (Rodrigue, 2006).

The supply curve for logistics services is an upward slope curve as shown in Graphic.3. The price also increases as the amount of logistics services supplied increases (Yanjuan and Minghua, 2006).

Market equilibrium occurs at the intersection of supply and demand curves. Graphic.4 shows the state of equilibrium. The quantity supplied at the point of equilibrium and the quantity demanded are equal at the Po price level only at the Qo point.

When there is an increase in the supply and demand of logistics services, the supply and demand curves shift to the right and new equilibrium point is formed. As can be seen in Figure 3, the demand curve shifted from D1 to D1 and the supply curve shifted from So to S1, and the new equilibrium point has been formed at the price level P1 and at the amount of Q1.

In the logistics sector, the foreign trade companies and the companies that carry out production and trade in the country constitute the main demand source and the logistics service provider companies constitute the main supply source. Efficiency of supply and demand in the market ensures a solid ground for the logistics sector. Logistics services are affected by some factors such as price and cost, just like goods. Therefore, reducing the logistics costs, improving the service quality, promoting the development of logistics services are important for the government in terms of ensuring the efficiency of supply and demand (Yanjuan and Minghua, 2006).

As already mentioned, the logistics sector covers a large number of services. In the transport services which is the most important of these, it can be specified as supply variables, frequency of transport ser-

Figure 1. Graph 2: international logistics demand curve and graph 3. international logistics supply curve

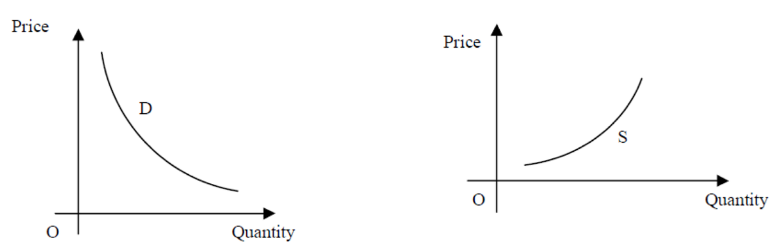
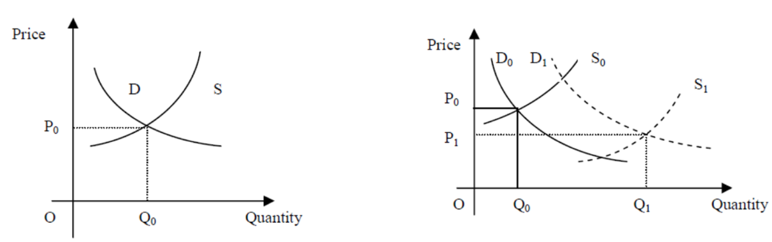


Figure 2. Graph 4. ınternational logistics supply-demand balance graph 5. ınternational logistics supply-demand changes



vice and network. These are determined by the volume or amount of load per time or distance. When the supply variables are evaluated according to transport modes, the road condition, the traffic density and control level (eg speed limits), road widths, vehicle capacities, speed, frequency of the provided service are the leading variables in road transport. The number of rails, the capacity of stations and maneuvering stations, vehicle capacities and speed in the railway transport; the capacity of the airport, the capacity of aircraft, the frequency of the service and speed of the vehicles in the airline transportation; the capacity of the ports, the capacity of ships, the frequency of service and the speed of the ship in the maritime transport can be specified as supply variables. Demand for transportation is generated by individuals, institutions, industries and companies. Since logistics refers to all services related to the movement of goods between two points, the demand varies according to the amount of the freight and the distance of transport. In this context, demand in freight transport can be stated as a function of economic activities (Rodrigue et al., 2009).

Macro-Economic Analysis of Logistics Sector

When the basic production factors which are land, labor and capital utilization are taken into consideration, it is seen that logistics services have a relationship with factors such as inflation, interest rates, productivity, energy costs. Delivery of the products from the point of production to the point of consumption is of great importance in terms of GNP in the countries which have completed the industrialization process and in the developed countries. These countries spend billions of dollars on transport, storage and warehousing and stocking services. Therefore, the improvement of the logistics function of a company increases productivity in the country and has a positive effect on the cost decrease of the products and services that are important for the high employment level and the increasing standard of life, the depths of country, the value of the currency, international competitiveness, investment capital and economic growth. As a result, effective and efficient implementation of logistics activities creates a macro-economic impact and the strategies aiming to increase logistics performance are of great importance not only for companies but also for the country and the socio-economic welfare of the country (Kujawa, 2003).

The macro-economic analysis of the logistics sector can be carried out under five main headings as economic growth, international trade, foreign investments, employment and competitiveness.

Economic Growth

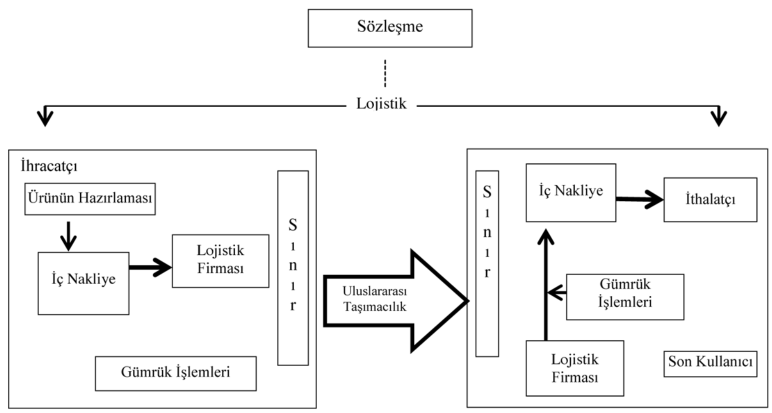
The logistics sector has a driving force for economic growth. The strong relationship between logistics and industrial sectors reveals the role and importance of logistics in economic growth. Today, it is not possible to realize the production activities without logistics activities (Liu, 2009).

Lean and Jinghi (2010) explain the close relationship of the logistics sector with economic growth and the living standards of individuals in different ways. Firstly, when the transportation costs decrease, the productivity of the companies increases and they obtain cost advantage. Secondly, the end-users benefit from the development of the sector and obtain consumer goods faster and at lower cost. Thirdly, the logistics sector creates an important employment area with many sub-sectors and solves a certain part of the unemployment problem. Finally, the logistics sector also creates an external impact for related sectors such as the transport vehicles and equipments industry (Lean and Jinghi, 2010).

Majdalana et al. (2007) consider the efficiency of the logistics sector as a strategic necessity for achieving economic growth. They base this on the four basic economic factors. These factors include increasing economic activities, increasing the competitiveness of the industry, growth in the industrial sector, and the emergence of the sustainable business opportunities (Majdalana et al., 2007).

i. Increasing the economic activities: Accessibility to markets forms the basis for increasing the economic activities. Efficient flow of goods and easy access to these markets are required in all local, national, regional or global markets. If this is not the case, sectors cannot create value. Therefore, the provision of strong and efficient transport and logistics services is considered to be important in increasing economic activities as well as providing fast and efficient cost-effective access to markets for national trade and production. Logistics services play an active role in increasing the production activities. Inclusion of semi-finished products in the production process, planning of the production process, inventory management are included within the scope of logistics services. In this respect, the effectiveness and the efficiency of the logistics services lead to an increase in the production activities.
ii. Increasing the competitiveness of the industry: All manufacturing companies compete about the issues of quality and price. Today, cost-effective access to high-quality services has a major impact on the competitiveness of the companies. The effectiveness of the logistics sector provides the manufacturing companies with competitiveness to compete in both issues, thus the logistics effectiveness increases the competitiveness in the field of industry.
   As mentioned before, the logistics sector provides services to companies regarding the issues such as raw material supply, transportation, storage, customs clearance, insurance, inventory management, order tracking, besides production activities. Providing these services in an integrated way from the companies providing services in the logistics sector ensures cost advantage to the companies. At the same time, companies have an advantage in the issue of quality as they are completely focused on their own production issues. This situation provides competitive power for all companies following the same strategy, and the competitiveness of the companies increases the competitiveness of the industry.
iii. Growth in the sector: The transportation and logistics sector creates opportunities for increasing the economic activities. In the developed industries in North America and Europe, the transport and logistics sector has displayed a better performance than the growth of GDP over the last decade and has had an important place in the economy. The essential requirement for strong growth (development) potential is expressed as the continuous disintegration of the value chain at national, regional and international levels. Although this growth potential is a reality for many markets, the opportunities of the Middle East reveal the strong transport and logistics sector, which is crucial for the Middle East, as noted earlier, globally and in its own wider geographic regions.
iv. The emergence of sustainable business opportunities: Logistics constitute an important potential for development of employment, besides increasing the economic activities in the industrial and other sectors. Compared to other industries, the transport and logistics sector create employment at many different levels of qualification besides being a labor-intensive economic sector. It is seen that it has a rapidly developing portrait in the issue of employment especially in the developed economies.

Figure 3. The relationship between ınternational trade and logistics
Source: Yanjuan-Minghua, 2006: 1085



International Trade

The logistics sector, which has become one of the three most important sectors of the 21st century, has a direct connection with the international trade activities. As the logistics sector develops, with the efficiency of the activities such as facilitating transportation activities, storage, customs clearance, packaging both the efficiency and volume of international trade activities increase, thus logistics and international trade affect each other mutually (Behar and Manners, 2008).

In recent years, some key factors have accelerated the growth of international trade. These factors can be specified as the increasing demand in new markets, the demand for foreign products, the elimination of trade barriers, the aim of scale economies by manufacturering companies, the increase in the activities of specialized service companies, developments in the logistics applications and developments in the information and communication technologies.

Among the factors that accelerate the development of international trade, the developments in logistics applications play an important role. That the companies carry out storage, distribution and transportation activities in the global area With logistics leads to an increase in the international trade and thus in the competitive power. The effective logistics activities make all markets in world easily accessible and affect production activities at the same time. In case of the manufacturing companies targeting scale economies, the pre-production and post-production logistics activities reduce the production costs. This creates an effect increasing the international trade (Waters, 2003).

The logistics activities exist in every process of the international trade. As seen in Figure 5, following the agreement between the exporter and the importer, the delivery of the ordered goods to the carrier, the internal transportation during this period, the realization of the customs procedures, the crossing of the customs border and the shipment to the importing country, the insurance transactions for the possible risks faced during the transportation are carried out within the scope of the logistics services. Additionally, at the arrival to the importer country, the customs entry procedures, conducting the storage operations if necessary, the internal transportation of goods to the company are also realized within the scope of logistic services (Yanjuan and Minghua, 2006).

Foreign Investments

Another macroeconomic impact creat4ed by the logistics sector is related to the foreign investments. Capital transfer enables the developed countries to gain competitiveness by reaching cheaper raw materials and labor. There is a capital deficiency in the developed countries. Low purchasing power and foreign exchange bottleneck prevent the development of domestic industry and gaining the increased competitiveness in the developing countries. Therefore, in developing countries, proper environment is prepared for the foreign capital with more flexible legislation, cheap labor and other favorable conditions in the developing countries compared to the developed countries (Oksay, 1998).

Developments in the production processes has affected the foreign investments made in the logistics sector. The fact that the production processes take place in different countries has led the logistics companies which have to dominate the production processes to turn to the foreign investments (Elia et.al., 2009). The advantage of cheap labor, flexible legislation and geographical location of some regions that especially the developing countries have causes the foreign capital flow from the developed countries (UNCTAD, 2006).

It is seen that foreign investments have an increasing share in the logistics sector in recent years. Expectations from the foreign investments can generally be specified as creating a healthy competitive environment within the country, introducing new technologies to the country, bringing know-how, obtaining the political and economic support of the developed and capital exporting countries, opening up to the outside, developing the human resources and increasing the employment (Oksay, 1998).

Employment

Logistics sector has become one of the most important employment creating sectors in recent years. The sector which has a comprehensive and complex structure is increasingly in need of labor force (OECD, 2002).

The logistics sector is both technology-intensive and labor-intensive sector. The fact that the number of companies operating in the sector has increased and the existing companies have expanded their service fields create requirements for labor force (Oda, 2008). The sector offers significant opportunities especially for the people living in the urban areas (Lean and Jinghi, 2010).

In Germany, where the logistics sector has the highest level of development, 2,5 million people have been employed in the logistics sector together with the sub-sectors. DHL-Deutsche Post, which ranks the first among the leading logistics sector companies in the world is in Germany and has a significant share in the employment rate (Ganguli, 2008). The investment made by the company for the logistics center in Leipzig alone has created employment for 10,000 people in total, including the employees working directly and indirectly with the logistics center (DHL, 2008).

The logistics companies turn to foreign investments since they provide services between different regions and countries and the foreign investments create new employment opportunities (Deutche Post and DHL, 2011). Germany where the maximal number of people are employed in the logistics sector is followed by the UK with 2,3 million people and by Italy with 1,1 million people. In France, 8 hundred thousand people are employed in the sector. In this context, it can be stated that logistics sector constitutes an important employment field.

THE EFFECTIVE FACTORS IN THE DEVELOPMENT OF LOGISTICS SECTOR IN THE WORLD

The logistics sector stands at the top of the fastest developing sectors in the world. Several factors accelerating this development can be mentioned. Globalization, liberalization of trade, differentiated competition structure and technological developments are the leading ones (Waters, 2003).

Globalization has been the most important factor in the development of the logistics sector (UNCTAD, 2006). Globalization can be evaluated as the point attained as the result of the fact that the international trade has grown up, The labor and capital movements have inreased, the ideological polarization between states has come to an end, the countries have come closer to each other in many ways depending on the rapid change in technology. For this reason, besides its economic aspect, the phenomenon of globalization has also political and socio-cultural aspects (Aktan, 1999). From an economic perspective, globalization can be defined as “the multifaceted interaction of the national economies with the world economy or the integration of the world into a single market” (İyibozkurt, 1994).

Liberalization of the international trade has been an important factor in the development of the sector. The efforts of the World Trade Organization (WTO) to remove the barriers and diverse applications in the international trade have accelerated liberalization of trade. In addition, the economic integrations such as European Union (EU), North American Free Trade Agreement (NAFTA), Association of South-East Asian Nations (ASEAN), European Free Trade Agreement (EFTA), Latin American Free Trade Agreement (LAFTA) facilitated the trade between the countries and reduced the customs barriers. This situation has generated a necessity for an efficient logistics system (Zeybek, 2007).

Globalization and trade are two concepts that can be considered as parts of a whole without being separated. With the recent economic and technological developments, the effectiveness in the increasingly growing trade volume and production activities have gained great importance (World Bank, 1999). Nowadays, it is seen that the companies in many countries now have an increasingly growing structure in the markets outside their own countries. Depending on this, the international trade volume is in a significant increase (Rodrigues et.al., 2005).

The importance of production costs and product and service quality has increased for the companies that have to struggle with their competitors on a global scale today when the conditions of the competition have differed (Waters, 2003). With the globalization, the companies, while operating in different countries and regions, have to procure raw materials, semi-finished products from different countries, to assemble them in production centers under the most favorable conditions and then to present the final products for sales in the markets of many countries with the most appropriate distribution channels and to plan this process accurately (Erdal, 2005). Today, the production activities move from the west to the Eastern Europe and Asia, and the goods after the production activity are transported from this region to the western countries. For example, more than 46% of the containers transacted in the port of Rotterdam are the containers imported from the Asian countries (Bentzen et al., 2007). In present time when the production and distribution processes have become global, the importance of logistics services have increased with the outsource utilization and the change in the logistics service concept has been remarkable.

Many services included in the logistics services such as transportation, customs clearance, warehouse management, packaging, handling, labeling, foreign trade and insurance consultancy are considered as the most complex and most important cost items in the international trade (Rodrigues et al., 2005). The fact that the industrial products constitute approximately 30% of the world trade and that the production activities in many countries are realized with raw materials and auxiliary materials procured from other countries requires the logistics work processes carried out through the flow of goods and services from the producer to the consumer to be planned the most accurately, with the highest quality and in such a way that will be reflected minimally on the production costs. The logistics services, with outsource utilization, enable manufacturing companies to focus more in their own fields of expertise, in other words, in their production activities, enable them to benefit from the scale economies and create added value for many sectors (UNCTAD, 2006).

Another factor that puts the logistics sector forward is the structure of competition that has become different due to the effect of globalization. Today, companies can survive depending on their competitiveness. For this, they are supposed to increase their market share by producing products which are both higher quality and more cost-effective and that create value for the end consumer. In this context, companies need to be in a structure that is open to innovations and being in constant change, taking the consumer demands into account and meeting them just before their competitors. It is important for the companies to have a strong supply chain structure in order to provide these competencies and to show the ability to put the products to the market just in time and at the desired place with competitive prices by supplying inputs at low costs. The effectiveness of the logistics activities offered within the logistics sector has been an important strategic tool for companies to increase their competitiveness.

That the companies primarily taking the cost factor into account supply every process of the production from different countries and determine the production sites as the places where the combination of production factors occur at the lowest cost in the world is one of the frequently preferred ways. These developments have generated new opportunities for many new sectors among which logistics is included. Furthermore, the extension of the accelerated mobility of capital, technology and end products has been in the development and innovation in the logistics sub-processes (Zhou, 2002).

The costs related to transportation activities which is an important logistics sub-process, has a significant share in production costs and can also be a determining factor of competition in some sectors such as mining, basic chemistry, iron and steel and cement. In transporting raw materials and semi-finished goods and the delivery of the finished goods to the market, the quality of the service provided is also as important as the transportation costs (Uzunoğlu et al., 2001).

SOLUTIONS AND RECOMMENDATIONS

The globalization of production and retail has differentiated the direction, quality and scope of logistics activities. With the necessity of developing business models for effective and efficient use of the limited and valuable resources that are gradually decreasing worldwide, studies on "logistics and its sub-components" have become much more important in the competitive environment. Among the cost-reducing strategies they have identified, the companies have emphasized their works on the logistics components involved in every stage of the process from the pre-production of the product to the delivery at the final point.

The fact that customer services is also included among the logistic functions in addition to the physical distribution activities and warehousing has made it compulsory to use the automation systems effectively in order to create more value for the customer. Functions such as transportation, stock tracking, order processing, material supply, packaging, storage, material transportation, obtaining and sharing information are multi-dimensional and control and their control and planning are important. At this point, the role of the strong technological infrastructure is great.

FUTURE RESEARCH DIRECTIONS

The rapid change in technology is rapidly reflected on the information, communication and transport sectors. These are innovations towards reducing the space and time (Mena et al., 2007). In the global market where the quality of products become close to each other, the selection criteria concentrates on accessibility and price. The final consumer wishes to use the right of purchase of any goods he desires up to the end at any time he desires, at any place he desires, under any conditions he desires and at any price he accepts. In this context, the role of the delivery of the products to the final consumer under the most favorable conditions, that is, the execution of the logistics operations with strong technological infrastructure and equipment is great.

One of the most important reasons why the logistics sector has become so important in the world economy is that it has a structure that provides services to most of the sectors other than itself as mentioned before. The logistics sector, which primarily provides services to the manufacturing industry, also provides services to healthcare, retail and tourism sectors. However, when it is evaluated from the aspect of international trade, the main reason for the development of the logistics sector today can be stated as the fact that different sectors in the manufacturing industry wish to present the goods they produce to the international markets. Many basic sector such as automotive, textile, electronics, glass, ceramics, chemistry, pharmaceutical etc. gain competitiveness with the services provided in the logistics sector. Therefore, the logistics sector has reached the position of having the function that leads the other sectors to achieve success in the international arena and gain international competitiveness.

CONCLUSION

The logistics sector, which has a wide range of services, has started to become one of the sectors that is becoming increasingly important in the economies of the countries. Especially when it is considered with its international trade dimension, international transportation and logistic activities supporting it gain importance and even the effectively provided services become the source of competitiveness in the economies of the countries. It is possible to see the wide range of services that logistics has within the context of ISIC. Rev.4 ve NACE Rev.2 which express the classification of the international economic activities. In these classifications, the logistics services take place in the code numbers of 49, 50, 51, 52, 53, 60, 61, 62, 63 and 64 in the 99 code numbers

Logistics is a multidisciplinary field and has links with many branches of science such as economics, management, marketing, political sciences, sociology, mathematics and engineering sciences. When it is considered in terms of economics, logistics takes place in many economic theories. Absolute Advantages Theory, Comparative Advantages Theory, Competitive Advantages, New Trade Theory, Product Life Cycle Theory, Pareto Efficiency, Company Theory and Weber's Place of Establishment Theory are some of the economic theories that include logistics.

The economic importance of logistics sector can be discussed in micro and macro dimensions. The fact that the service providers operating in the logistics sector fulfill all of the activities at the companies receiving the services such as taking the order of a product in the pre-production process, stock control, supply of raw materials, including them the production process, post-production storage, distribution, customs clearance, insurance, packaging leads those companies to gain cost advantage and competitive advantage depending on the speed and flexibility. Therefore, the logistics sector is of great importance for companies operating in all industrial sectors. On the other hand, when it is considered from a macroeconomic perspective in general, the logistics sector has an impact on the economic growth as it is one of the sectors making the highest foreign exchange income in the national economies. Besides being an important area of employment, the logistics sector which is the lifeblood of the international trade creates added value in many sectors through the activities it holds.

Many factors have been effective in making the logistics sector important in the world economy. On top of these factors, it can be specified as globalization, liberalization of the international trade, developments in the information and communication technologies and the changing structure of competition. Today, the logistics sector has become one of the main factors for the companies and the economies of the countries to gain competitive advantage.

REFERENCES

Bentzen, K., Laugesen, M., & Cerneckyte, V. (2007). Transport and Logistics Centres, FDT. (Association of Danish Transport Centres) - The consolidated WP 3 Final Report, Aalborg, Denmark. Retrieved from http://www.porteconomics.nl/docs/Interreg%20report.pdf

Aktan, C. C. (1999). *Globalleşme, Ekonomik Kriz ve Türkiye, TOSYÖV Yayını Ekonomik, Sosyal ve Siyasal Araştırmalar Serisi*. Ankara, Turkey: Kasım.

Behar, A., & Manners, P. (2008). Logistics and exports. CSAE (Centre for The Study of African Economies) Working Paper Series, CSAE-WPS/2008-13. Retrieved from http://www.csae.ox.ac.uk/workingpapers/pdfs/2008-13text.pdf

Bowersox, D. J., Closs, D. J., & Cooper, M. B. (2002). Supply chain logistics management, McGraw-Hill Companies Inc. Series, New York.

Muller-Rostin, C. (2008). Airport entry and exit: A European analysis, GAP (German Airport Performance) Research Project. Retrieved from http://userpage.fu-berlin.de/~jmueller/gapprojekt/downloads/gap_papers/Muel_Rost_Nie_Ivan_Han_Ehm_Airport%20Entry%20and%20Exit_jul_08.pdf

Debjani, G. (2008). Logistics services under Indo-EU TIA, ICRIER (Indian Council For Research on International Ecoomic Relations, 2008. Retrieved from http://wtocentre.iift.ac.in/EU%20BTIA/EU%20BTIA/Report%20on%20Logistic%20Services%20-%20India-EU%20BTIA.pdf

Delfman, W., & Albers, S. (2000). Supply chain management in the Global Context, Universitat zu Köln Working Paper, WP-No.102, Köln, Germany.

Deloitte. Türkiye Gayrimenkul Sektörü Raporu, TC Başbakanlık Yatırım Destek ve Tanıtım Ajansı Yayını, Ocak 2010. Retrieved from http://www.invest.gov.tr/tr-TR/infocenter/publications/Documents/GAYRIMENKUL.SEKTORU.pdf

Deutsche Post – DHL. Retrieved from http://www.dp-dhl.com/reports/2009/gb/en/group-management-report/ employees.html

DHL. (2008). DHL Hub Leipzig/Halle, Deutsche Post World Net Corporate Communications/Public Relations Publications, Germany. Retrieved from http://www.dp-dhl.com/content/dam/logistik_populaer/leipzig_hub/hub-leipzig_en.pdf

Waters, Donald, W. (2003). Logistics, an introduction to supply chain management (D. Waters, Ed.). Palgrave Macmillan, New York.

IyibozkurtE. (1994). *Türkiye-Avrupa Topluluğu Gümrük Birliği*. Bursa, Turkey: Ezgi Kitabevi.

Ehmer, P., & Heymann, E. (2010, Dec. 9). German logistics sector back on growth track, Deutsche Bank Research, Research Briefing, Frankfurt, Germany.

Elia, S., Maggi, E., & Mariotti, I. (2009). Does the logistics sector gain from manufacturing internalisation? An empirical investigation on the Italian case, Economic and Statistics Discussion Papers No.52/09, Universita Studiorum Molise, Italy. Retrieved from http://web.unimol.it/progetti/repec/mol/ecsdps/ ESDP09052.pdf

Friederiszick, H., Gantumur, T., Jayaraman, R., Röller, L. H., & Weinmann, J. (2009). Railway alliances in EC long-distance passenger transport: A competitive assessment post-liberalization 2010. ESMT White Paper No. Wp-109-01, ESMT European School of Management and Technology. Retrieved from http://www.esmt.org/fm/292/WP-109-01.pdf

Hülya, Z. (2007). *Ulaşım Sektöründe İntermodalite ve Lojistik Alanındaki Gelişmeler ve Türkiye'ye Yansımaları*. Ankara, Turkey: Gazi Üniversitesi SBE, Yayınlanmamış Doktora Tezi.

İGEME (İhracatı Geliştirme ve Etüd Merkezi), Türkiye'nin Hizmet Sektörü İhracatı ve Geliştirilmesine Yönelik Öneriler. İGEME Yayınları, Ankara, Turkey. Retrieved from http://www.igeme.org.tr/KKS/Arastirmalar

Kujawa, B. J. (2003). An investigation into logistics outsourcing practices, trends and issues within the manufacturing sector in South Africa. (Doctorate Thesis), Rand Afrikaans University, South Africa. Retrieved from http://ujdigispace.uj.ac.za:8080/dspace/ bitstream/10210/2430/1/TITLE%20PAGE.pdf

Lean, H. H., & Jinghi, S. (2010). Logistics development and economic growth in China, Institute of China Studies. (University of Malaya), ICS Working Paper Series, WP No: 2010-5, Malaysia. Retrieved from http://www.iadb.org/intal/intalcdi/ PE/2010/05814.pdf

Liu, S. (2009, July). A research on the relationship of logistics industry development and economic growth of China. *International Business Research, 2*(3), pp. 197-200.

Webb, M. (2006). Supply chain and logistics the key to economic growth, Engineering News, February 2006, Volume 26, No.3. Retrieved from http://www.engineeringnews.co.za/article/supply-chain-and-logistics-the-key-to-economic-growth-2006-02-03

Majdalani, F., Koegler, U., & Kuge, S. (2007). Middle East transport and logistics at a crossroads. World Economic Forum's Arab World Competitiveness Report 2006-2007. New York: Oxford Press. Retrieved from http://www.boozallen.com/media/file/ME_Transport_Logistics_Crossroads.pdf

Metin, C., & Erdal, M. (2003). *Uluslararasi taşimacilik yönetimi*. Istanbul, Turkey: Utikad Yayını.

Milla, L. (2010). Railway freight markets' mergers and acquisitions–comparing European Union and Russia. In *Proceedings International Manufacturing Symposium,* Cambridge, UK. Retrieved from http://www.ifm.eng.cam.ac.uk/cim/symposium2010/ proceedings/13_laisi.pdf

Murat, E., & Küresel Lojistik, U. (2005). *Uluslararası Taşımacılık ve Lojistik Hizmet Üretenler Derneği*. İstanbul, Turkey: Yayınları.

Mena, C., Christopher, M., Johnson, M., & Jia, F. (2007). Innovation in logistics services, NESTA. Cranfield, UK: National Endowment for Science, Technology and the Arts.

OECD. (2002). Transport logistics, shared solutions to common challenges. OECD Publication, Paris, France. Retrieved from http://www.cemt.org/pub/pubpdf/JTRC/ 02LogisticsE.pdf

Oksay, S. (1998). Çokuluslu Şirketler Teorileri Çerçevesinde, Yabancı Sermaye Yatırımlarının İncelenerek, Değerlendirilmesi, Dış Ticaret Müsteşarlığı Dergisi, Sayı 8, Ocak 1998. Retrieved from http://www.econturk.org/ Turkiyeekonomisi/oksay3.pdf

Onur, G., & Bektas, B. (n.d.). Dünya Hizmet Ticaretinde Gelişmeler ve Türkiye Açısından Yarattığı Fırsatlar, Güneydoğu ve Doğu Kalkınma Projesi. Retrieved from http://www.gapdogukalkinma.org

Orhan, O. Z. (2003). Dünyada ve Türkiye'de Lojistik Sektörünün Gelişimi, İ.T.O. (İstanbul Ticaret Odası) Yayınları, Yayın No: 2003-39. İstanbul, Turkey.

Porter, M. E. (1990). *Competitive advantage of nation*. New York: The Free Press.

Rodrigue, J. P. (2006). Challenging the derived transport-demand thesis: geographical issues in freight distribution. *Environment and Planning A, 38*(8), pp. 1449-1462. Retrieved from http://people.hofstra.edu/jean-paul_rodrigue/downloads/Derived%20Demand.pdf

Rodrigue, J. P., Comtois, C., & Slack, B. (2009). *The geography of transport system* (2nd Ed.). New York: Routledge. Retrieved from http://www.people.hofstra.edu/geotrans/eng/ch5en/conc5en/ worldlogisticscosts.html

Rodrigues, A. M., Bowersox, D. J., & Calantone, R. J. (2005). Estimation of global and national logistics expenditures: 2002 data update. *Journal of Business Logistics, 26*(2). Retrieved from https://www.msu.edu/~rodri205/CV/Documents/ISL2005%20Article.pdf

OdaS, . (2008). *Türkiye'de Lojistik Sektörü ve Dış Ticaret Üzerine Etkileri*. Trakya Üniversitesi SBE, Yayınlanmamış Yüksek Lisans Tezi.

Stock, J. R. (1997). Applying theories from other disciplines to logistics. *International Journal of Physical Distribution & Logistics Management*, *27*(9/10), 515–539. doi:10.1108/09600039710188576

The Asia Foundation. (2008). The cost of moving goods, road transportation, regulations, and charges in Indonesia. The Asia Foundation Publication, Indonesia. Retrieved from http://asiafoundation.org/resources/pdfs/movinggoodslightenglish.pdf

TÜİK (TC Başbakanlık Türkiye İstatistik Kurumu). (2010). *CPA 2008, Avrupa Ekonomik Topluluğunda Faaliyete Göre Ürünlerin İstatistikî Sınıflandırılması*. Ankara, Turkey: TÜİK Yayını.

UNCTAD (United Nations Conference on Trade and Development). (2006). Report of the ad hoc expert meeting on logistics services. Intergovernmental Meetings, Geneva, 13 July, 2006. Retrieved from http://www.unctad.org/en/docs /c1ahm1d3_en.pdf

UNCTAD. (United Nations Conference on Trade and Development). Trade and development aspects of logistics services, Intergovernmental Meetings, Geneva, 7 July, 2006. Retrieved from http://www.unctad.org/en/docs/ c1ahm1d2_en.pdf

UNCTAD. Negotiations on transport and logistics services: Issues to consider, Issue Nr. SDTE/TLB/2005/3, Geneva, 2006. Retrieved from http://www.unctad.org/en/docs/ sdtetlb20053_en.pdf

UZUNOĞLU Sadi ve diğerleri, Dış Rekabet Baskısındaki Sektörlerde Maliyet Profili, İTO (İstanbul Ticaret Odası) Yayını, Yayın No: 2001-43.

Wenjuan, Z. (2002). Different Scenarios for Boras as a Regional Logistics Center, Göteborg University School of Economics and Commercial Law, Master Thesis N: 2002.36, ISSN 1403-851X, Goteborg. Retrieved from http://gupea.ub.gu.se/bitstream/ 2077/2364/1/gbs_thesis_2002_36.pdf

WORLD BANK. (2010). *Doing business report 2011*. Washington: World Bank Press.

WORLDBANK. (1999). *Entering the 21st century: World Development Report 1999/2000*. New York: Oxford University Press.

Yanjuan, C., & Minghua, D. (2006). Research on the development and strategy of the international logistics of China, International Conference on Management Science and Engineering, 6-7 October 2006, pp. 1084-1088. Retrieved from http://www.seiofbluemountain.com/upload/product/201001/12640404311mlqdr2m.pdf

Zeynel, D. (2002). *Mikro Ekonomi, 14.b*. Bursa, Turkey: Ekin Kitabevi.

KEY TERMS AND DEFINITIONS

Economic Value Added (EVA): A measurement of shareholder value as a company's operating profits after tax, less an appropriate charge for the capital used in creating the profits.

Economy of Scale: A phenomenon whereby larger volumes of production reduce unit cost by distributing fixed costs over a larger quantity.

Export: To send goods and services to another country.

Fulfillment: The act of fulfilling a customer order. Fulfillment includes order management, picking, packaging, and shipping.

Globalization: The process of making something worldwide in scope or application.

Gross National Product (GNP): A measure of a nation's output; the total value of all final goods and services a nation produces during a time period.

Import: Movement of products from one country into another. The import of automobiles from Germany into the US is an example.

Inbound Logistics: The management of materials from suppliers and vendors into production processes or storage facilities.

Logistics Costs: The factors associated with the acquisition, storage, movement, and disposition of goods.

Outbound Logistics: The process related to the movement and storage of products from the end of the production line to the end user.

Chapter 3
An Assessment for Classification of Distribution Network Design

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ABSTRACT

Distribution consists of moving and storing a product from the supplier to customer during the supply chain process. Distribution process is crucial decision of a company due to its effects on supply chain cost and customer satisfaction. In the competitive environment of the business, all companies aim to minimize delivery costs and maximize customer satisfaction by applying optimum distribution network design. The design of effective distribution network requires critical decisions as the location and the capacity of distribution centers together with logistic activities, which consist of transportation and inventory process. The purpose of this research is to define a deep literature review regarding definition of distribution network, distribution channels, selection of distribution, and the factors affecting distribution network design. After reviewing a comprehensive literature on distribution network design, this chapter includes suggestions.

INTRODUCTION

In today's competitive trade environment, main target of the companies is to achieve maximum profit with minimum cost while considering customer satisfaction. For this purpose, firms develop distinctive strategies by applying convenient distribution network design as a part of logistic supply chain. Hence, the companies' ultimate aim is distribution to final customer in most effective way; they have to keep abreast of distribution network design process.

The performance of logistic supply chain is considered crucial weapon to keep competitive strength in global markets of world. Distribution network design requires making various decisions as size and location of distribution centers, allocation of product groups, logistic activities that constitutes from transportation and maintenance of inventory and products and their governance (Mourits and Evers,

DOI: 10.4018/978-1-7998-1397-2.ch003

1995). In terms of the whole economic system, the definition of distribution can be identified as the allocation of assets and income. Moreover, distribution is relating with goods' allocation to the receivers in the business economics and all activities during this process cover tangible and intangible goods from manufacturers to customers. That's why distribution process requires preparation of goods according to their volume or type in order to satisfy customer's demand efficiently (Segetlija, et.al., 2012).

According to Castro and Matarrollo (2009), logistics cost is derived from 10% to 35% of gross sales depending on value, geography and business. Due to the fact that distribution is mandatory activity of logistics, the companies try to deliver products in the right place and time by having efficient distribution network. Moreover, one of the main goals of logistics is to reduce inventories and cut down fixed capital (Castro and Matarrollo, 2009). The main objective of this paper is to provide a deep literature review regarding with distribution network design by explaining the factors which effects distribution network decisions and propose the appropriate distribution network configuration for distribution problems.

BACKGROUND

Supply chain management, which has been attractive for both practitioners and academicians in the recent years, is the key driver of logistics. It can be defined as the management of relations between firms and interdependent organizations or business units. These business units can be summarized as purchasing, logistics, material suppliers, marketing and production facilities (Yatsyshina, 2016). One of the vital parts of supply chain is distribution. Distribution is related with moving and storing a product in the supply chain from supplier to customer. It can be realized in every stages of the supply chain and it is crucial for influencing customer value and supply chain cost (Chopra, Meindl, 2006).

On the other hand, network of storage facilities, arrangement of people and transportation system is related with distribution network and main goal of this process is delivering final products to the customers. Distribution network design determines structure of distribution network as location, type, size and number of echelons in supply chain. The primary objective of this activity is to optimize flow of products from production points to the demand points. In this way, distribution network design has significant influence on performance of supply chain by affecting consumers' service levels and costs. Because of this, a successful distribution network design contributes high service levels together with decreasing logistics costs. To this respect, distribution network design includes optimization of goods' flow and improvement of existing network (Yatsyshina, 2016).

According to Tuzkaya and Önüt (2006) distribution network systems require various decision policies in different levels as strategic, tactical and operational grades. Strategic decisions include physical network design, providing of resources. Besides, tactical decisions are related with design of network service, while operational decisions include application of schedules. Apart from this, Boujelben (2013) claims that distribution network design is relating with strategic and tactical planning levels and requires mid-terms and long-term decisions. On the other hand, Perl and Sirisoponsilp (1988) classify distribution network in three components as facility location, transportation and inventory decisions. These components constitute three hierarchical levels of logistics decisions. These three decisions result in exchange between relevant cost components.

From theoretical aspect, a large number of models have been conducted related with distribution network design. Some of them have been focused on multi-echelon networks, integration of warehouses and transportation modes. Some studies are related with inventory analysis, integration of location models and impacts of distribution centers. In addition, some scholars are interested with mathematical programming approach, supply network problems, heuristic solution methods and hybrid heuristic algorithms. All of these paradigms have presented different explanations for optimal distribution network design (Tuzkaya, Önüt, 2006). This paper will present a deep literature review related with most prominent approaches regarding with distribution network design.

Classification of Distribution Network Design

The process of distribution network design has two stages. The first one is supply chain network's broad structure that is relating with the number of phases in the supply chain and their roles. The second stage is dealing with converting the broad structure into the certain locations and their capacity, capability and demand allocation. The optimal distribution network aims to carry out variety of supply chain targets from minimum costs to maximum responsiveness (Chopra, Meindl, 2016).

Primary goal of distribution network design is to determine optimum network structure in order to minimize costs and fulfil the expectation of service level. Another target of this process is to guarantee profit maximization by increasing service level with cost minimization and revenue maximization. In order to acquire profit maximization, it is required to forecast latent revenue derived from development of the service level (Castro and Matarrollo, 2009). Besides, Perl and Sirisoponsilp (1988) have defined the target of distribution network design as to balance the relationship between inventory cost, transportation and facility. All of these processes is relating with the decisions of logistics management and design of distribution network requires supporting decisions together with mathematical models.

According to Jayaraman (1998), designing of distribution network system requires to forecast several costs and benefit measures as the effect of inventory amount in the distribution network process. However, there is significant relationship between transportation, location and the decision of inventory. Therefore, the decisions related with strategic distribution center location may require identifying numbers and locations of warehouses and plants. Other decisions covers assignment of loads and size of shipments.

Perl and Sirisoponsilp (1988) have defined the elements of distribution network design process as follows; location and number of distribution centers, customers' allocation to distribution centers, design of flow from supply centers to distribution centers, service of transportation between plants and distribution centers, inventory level at the distribution center.

On the other hand, distribution network design is required to define the important costs which are constitutes from network configuration as order management costs, inventory costs, transportation costs and handling costs. Order management costs include the costs related with process of orders as personnel and information systems. Inventory costs are dealing with logistics stocks types as work in progress-stock, safety stocks, cycle stock, and in-transit stocks. This cost can be evaluated in two categories as maintenance costs and order costs. Transportation cost can be classified in two categories as primary transportation costs (transportation between suppliers, central warehouses and the regional warehouses or transport points) and secondary transportation costs (transportation between distribution network nodes and final customer). Handling costs are related with handling activities arising from warehouses and transit points as picking, order consolidation and loading or unloading activities (Castro and Matarrollo, 2009).

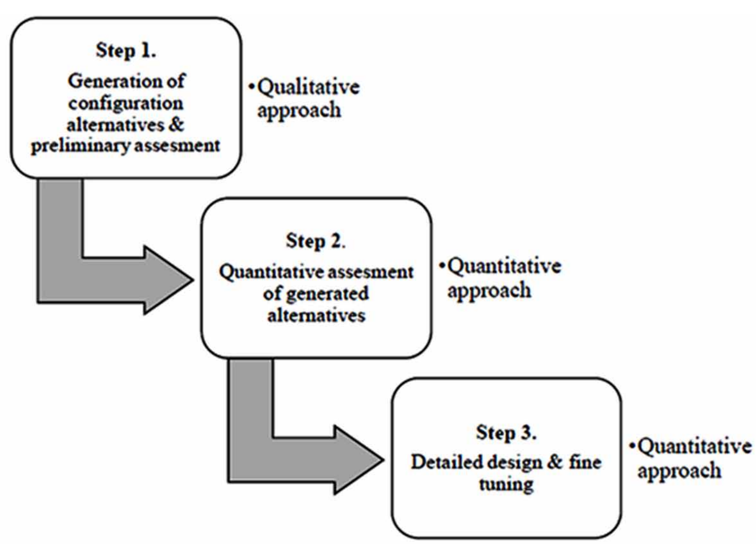
Distribution Network Choices

Due to the crumbling financial performance competition between companies, force them to pay more attention to distribution network design and their effects. In this manner, there are some drivers should be considered in terms of distribution network design. These factors can be classified as service, product, supply, and demand macro drivers. Service macro driver includes completeness and cycle time. Product macro driver consists of density, contribution margin, value, obsolescence risk and variety. Supply macro driver is comprised from customers' number, seasonality, orders' dimension and delivery frequency. Demand macro drivers include number of plants, specialization level, and distance between plant and client (Castro and Matarrollo, 2009).

A well-organized distribution network design requires having three significant steps. The first step is configuration alternatives' generation and pre-assessment. The second step is existing alternatives' quantitative assessment. The last step is design in a detailed way and fine-tuning of the process (See, Figure 1). The configuration alternatives' generation process is related with defining of possible configurations for distribution network and choosing the alternatives. Generally, qualitative approach is used in this step. On the other hand, other steps require quantitative analysis in order to select the best of distribution network design (Yatsyshina, 2016).

Another study that was conducted by Mourits and Evers (1995) offers four steps regarding with distribution network design. The first one is Arrangement stage, which is used for defining location and numbers of facilities. The second one is Deployment stage that requires identifying optimum inventory distribution. The third one is flow stage that incudes defining of safety stock, order frequencies and batch sized levels. The last stage is Operations stage, which includes developments of operational procedure as algorithms of delivery and order placement (Mourits and Evers (1995).

Figure 1. Three steps of decision making in distribution network design
Source: Yatsyshina, 2016



Options for Distribution Network Design

The options for distribution network design has influenced from different factors. In order to develop well-organized distribution network design a company should decide if a product would be transferred to customer location or will be taken from a prearranged site. Moreover, it is crucial to define if a product will be flown through an intermediate location. The companies may decide distribution network design options as follows, after clarifying above matters (Chopra, Meindl, 2016).

Manufacturer Storage with Direct Shipping

In this type of choice, products are directly transferred from manufacturer to the end customer. This means also drop shipping. There will be no inventory in this option (See, Figure 2). Retailer provides the communication between customer and manufacturer (Chopra, Meindl, 2016).

Manufacturer Storage with Direct Shipping and In-Transit Merge

In this design, the manufacturer sends each product to the end customer. If there are different pieces from different locations, they are combined in-transit merge for sending single delivery to the customer. The flow of this process is shown in Figure 3.

Distributor Storage with Carrier Delivery

In this style, inventory is held by distributors/retailers in intermediate warehouses. Besides, package carriers between intermediate locations and the end customer are transporting the products. The flow of this process is shown in Figure 4.

Figure 2. Manufacturer storage with direct shipping
Source. Chopra, Meindl, 2016

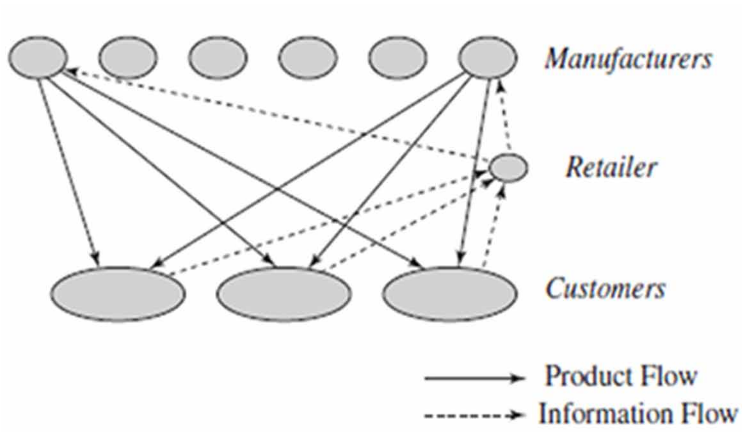


Figure 3. Manufacturer storage with direct shipping and in-transit merge
Source. Chopra, Meindl, 2016

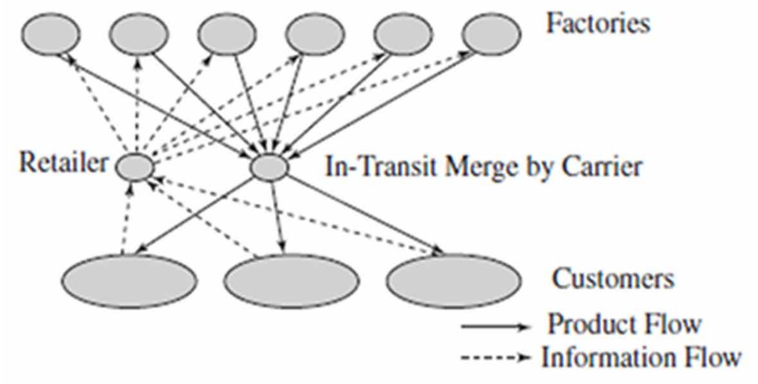
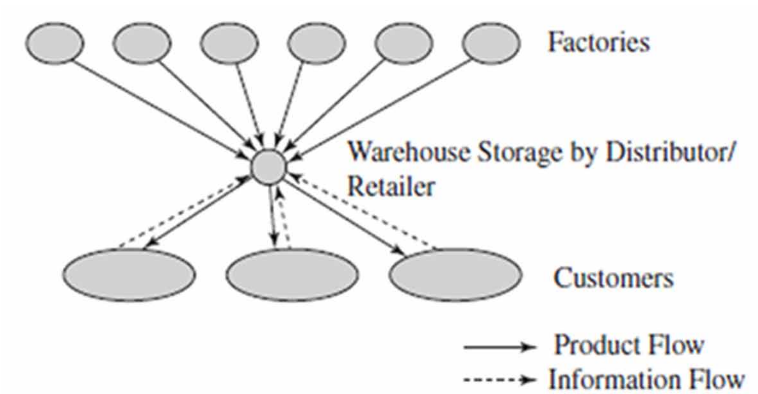


Figure 4. Distributor storage with carrier delivery
Source. Chopra, Meindl, 2016



Distributor Storage with Last-Mile Delivery

In this type of option, the package carrier is passed over and the product is delivered to the customer's home by distributor/retailer. The required parts are sent from local distribution center and there may be multiple deliveries per day. In this kind of design, the distributor warehouse is closer to the end customer.

Manufacturer or Distributor Storage with Customer Pickup

Under this option, distributor warehouse or manufacturer keep the inventory and the orders are made by customer via online or on phone call. Afterwards customers get their products from the designated pickup points. When required the products are sent to the pickup points from the storage.

Figure 5. Distributor storage with last-mile delivery
Source. Chopra, Meindl, 2016

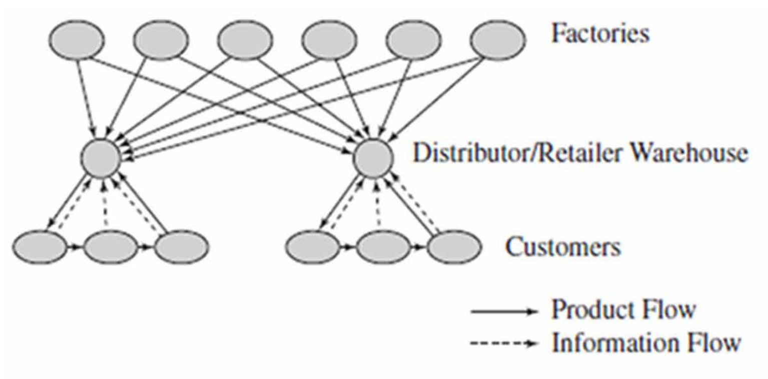
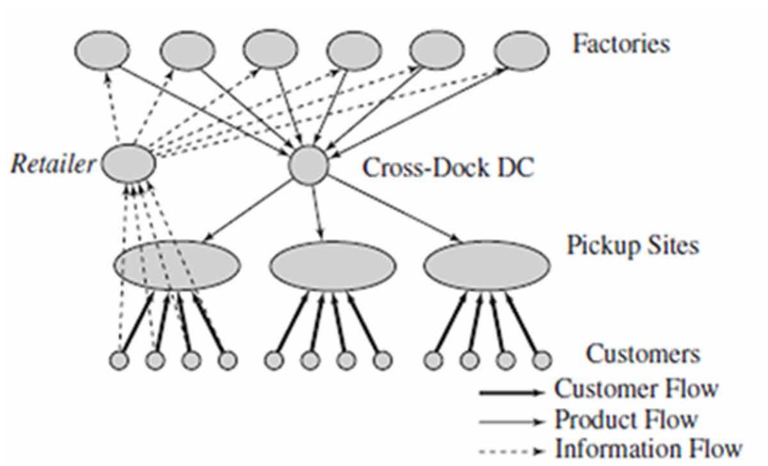


Figure 6. Manufacturer or distributor storage with customer pickup
Source. Chopra, Meindl, 2016



Retail Storage with Customer Pickup

In this type of style, local retails stores keep the inventory and customers get the products by walking into the retail store or can order online/by phone then take it from the retail store. Under this option, the lack of aggregation enhances the inventory costs.

Moreover, there can be different approaches to the options for distribution network design. One another different classification is listed as below.

Types of Facilities

Distribution networks design is effected by different types of facilities in distribution network. According to role in the supply chain, there are two main distribution facilities can be categorized as transshipment facilities and warehouses. While transshipment facilities are acting as holding yards, the warehouses old

Figure 7. Three echelon distribution network, type 1
Source: Ambrosino, Scutella, 2005

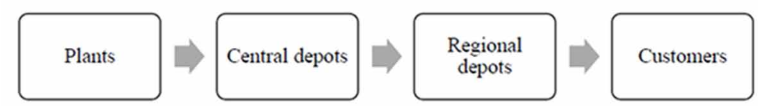


Figure 8. Three echelon distribution network, type 2
Source: Ambrosino, Scutella, 2005

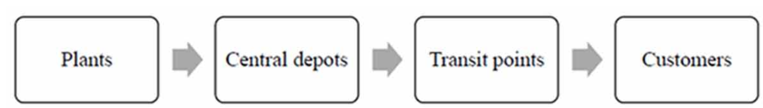
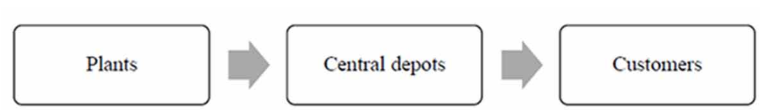


Figure 9. Three echelon distribution network, type 3
Source: Ambrosino, Scutella, 2005



inventory and balance uncertainty of demand (Yatsyshina, 2016). The functions of warehouses can be summarized as follows (Frazelle, 2002):

- Work-in-process warehouses: This kind of warehouses keep partially completed products.
- Raw material and component warehouses: This style of warehouses keep raw materials at induction point for assembly process.
- Distribution warehouses and distribution centers: Under this type of warehouses, the products are accumulated from other manufacture points within a single company or from different companies.
- Local warehouses: In this option, the transportation distances are shortened in order to response customer demand.
- Fulfillment warehouses and fulfillment centers: Under this type of warehouses for individual consumers, small orders are received, picked and shipped.
- Finished goods warehouses: This style of warehouses keep inventory in order to provide a balance between production and demand.

Transshipment is also new and efficient distribution technique, which is known as just-in time or cross-docking distribution. The types of transshipment facilities can be classified as follows:

- In the type of cross-dock transshipment facility, the incoming sorted products do not require order picking or intermediate storage and they are shipped to further customers in few hours.
- The Product-fulfillment centers is usually used by online retailers and it responds end customers' orders directly.
- Other facilities can be classified as repair depots, installation and depots.

Number of Echelons

The prominent specification of distribution network design is number of echelons and it is widely decided in qualitative context and perceived as quantitative papers

Ambrosino and Scutella (2005) have defined three types of distribution networks according to types of nodes as customers, central depots, regional depots, transit points and plants.

The first type of network design includes routes start from plants to central depots then regional depots and to the customers finally.

In the second distribution network type, the system is similar to first one, but regional depots are used instead of transit points. In thıs design, transit points do not store inventories and they resend goods immediately after receiving them. Hereby in this type, service level is lower than first design.

The third distribution network design is constitutes from three nodes as plants, central depos and customers. In order to use this type of configuration the clients must guarantee full load of transportation.

Major Elements Affecting Distribution Network Design

Distribution network performance can be appraised by two factors. These are cost of customer satisfaction and value that presented to the customer (Chopra, Meindl, 2016).

Distribution network design is being influenced from a wide range of factors. Regarding with the factors influencing distribution network design, scientific ideas show difference from each other. Some authors focus warehouses while defining the effect of factors about distribution network. However, some of the authors deal with if the inventory is needed or not (Yatsyshina, 2016). Some authors focus on class of products when deciding distribution network design. According to Kotler (1997), convenience goods are dealing with intensive distribution, specialty goods are associated with exclusive distribution and shopping goods need selective distribution. Convenience goods require minimum of comparison effort and they are bought by consumers immediately. Whereas Specialty products have brand identification and significant groups of buyers are ready to pay special fees. Lastly, shopping products need to be spent considerable effort and time because of being purchased less frequently.

There can be different classifications related with this process. One approach classifies the factors that influencing distribution network design in four categories as follows (Yatsyshina, 2016):

- Product characteristics: All products can be classified in two categories as innovative products and functional products. However, these two types require different distribution strategies and supply chain. While functional products require efficient supply chain, innovative products require responsive supply chain. Moreover, the products' physical properties affect distribution network design in terms of transport modes and inventory level. Product value and purchase size can be defined as other factors affecting distribution network design.
- Cost related factors: The major factor of distribution network design is inventory-carrying costs. The charges of storage area, damage related losses, handling, insurance and administrative costs can be defined as the drivers of inventory carrying costs. According to a different classification, inventory-carrying costs are constituted from capital costs, capital investments, variable costs, tracking costs and labor costs. Moreover, the meaning of these costs is originated from the cost of money comes from inventory.

- Market uncertainties & customer needs: Market uncertainties influence the performance of supply chain in negative way and the market possibilities and constraints should be known clearly for efficient supply chain. The components of customer needs can be identified as response time, product availability, customer experience, order visibility and returnability.
- Other factors: These factors can be evaluated as *distance between nodes, which have an impact on* optimal number of facilities, special warehousing needs, production characteristics, geographic environment and commercial environment.

SOLUTIONS AND RECOMMENDATIONS

Distribution network decisions can be evaluated as the most critical purpose of logistic management decisions, because of influencing customer service quality and distribution cost. There are different models for distribution network design that present different assumptions. (Perl, Sirisoponsilp, 1988). This paper has focused the specific literature review and presented a classification for distribution network design and the basic factors that influence distribution network design.

The decision regarding with distribution network design is not easy, because this decision is connected with tactical, strategic and operational level decisions. Moreover, network-planning decisions are also integrated with inventory positioning, network design and allocation of resources. In practice, this process can be realized by accounting for transportation, warehousing and inventory costs along with all supply network (Tsao et.al, 2016).

When designing convenient delivery network, product characteristics and network requirements should be considered. Different network designs have different strengths and weaknesses. To this respect companies usually benefit from different combination of delivery networks. Decisions on this matter are related with companies' strategic position and characteristics of products. As a result, when designing distribution network, the key factors must be considered as customer needs which are constitutes from product availability, response time, returnability, convenience and order visibility. Besides, major costs must be evaluated as inventories, handling, transportation and information. Moreover, the strengths and weaknesses of different distribution options must be evaluated. Different distribution options affect response time, transportation cost and inventory cost. Lastly, the effects of online sales in different industries must be considered when deciding on distribution network design. Online sales has become widespread because of reducing costs in supply chain and increasing customer satisfaction products (Chopra, Meindl, 2016).

FUTURE RESEARCH DIRECTIONS

Distribution process, which means storing and moving products from supplier to the customer, is one of the significant decisions for a company because of influencing costs and customer satisfaction during supply chain. Consequently, the design of distribution network includes distribution center capacity, location and logistic activities. This paper presents a literature review on definition of distribution network, distribution channels, selection of distribution and the factors affecting distribution network design.

However, this study does not provide any implementation and practical examples regarding with distribution network design for decision makers. The future studies may consider practical scenarios for deciding distribution channels, selection of distribution network and the design of distribution network. Further researches must be conducted to determine the appropriate distribution network design for companies in different industries.

CONCLUSION

Distribution network design is one of the most critical decisions of a company in terms of operational and logistical aspects. Due to fact that this process has great impact on customer satisfaction, time and costs, it should be evaluated diligently. Moreover, it is a key driver success of a company to find out exact relationships between inventory, facility location and transportation (Jayaraman, 1998).

Different studies have various classifications regarding with options for distribution network design. The two different aspects were handled in this paper. The first of the classifications includes, "Manufacturer Storage with Direct Shipping", "Manufacturer Storage with Direct Shipping and In-Transit Merge", "Distributor Storage with Carrier Delivery", "Distributor Storage with Last-Mile Delivery", "Manufacturer or Distributor Storage with Customer Pickup", "Retail Storage with Customer Pickup" as options for distribution network design (Chopra, Meindl, 2016). The second classification of this paper on distribution network design covers "Types of facilities" and "Number of echelons".

As a conclusion, the aim of this paper is to provide a literature review regarding with distribution network design and the elements affecting distribution network design. In this manner, the chapter evaluated the classification of distribution network design, distribution network choices, options for distribution network design and major elements affecting distribution network design. Finally, paper was concluded with future suggestions and research directions.

ACKNOWLEDGMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

Ambrosino, D., & Scutella, M. G. (2005). Distribution network design: new problems and related models. *European Journal of Operational Research*, *165*(3), 610–624. doi:10.1016/j.ejor.2003.04.009

Boujelben M.(2013). Modeling and solving a distribution network design problem with multiple operational constraints. Application to a case-study in the automotive industry. Operations Research. Ecole Centrale Paris, 2013.

Castro, A., & Matarrollo, Y. (2009). *Strategic distribution network design (DND)*. Politecnico Di Milano, Italy: Model and Case Studies in the Consumer Electronics Industry.

Chopra, S., & Meindl, K. (2016). *Supply chain management, strategy, planning, and operation* (6th ed.). USA: Pearson Education

Frazelle, E. (2002). Supply chain strategy: the logistics of supply chain management. McGraw Hill, 258-261.

Jayaraman, V. (1998). Transportation, facility location and inventory issues in distribution network design: An investigation. *International Journal of Operations & Production Management*, *18*(5), 471–494. doi:10.1108/01443579810206299

Kock, C. (2008). *Malt distribution network design for the South African Breweries. Submitted Bachelors of industrial engineering Faculty of Engineering*. University of Pretoria.

Kotler, P. (1997). *Marketing management: Analysis, planning, implementation, and control*. Upper Saddle River, NJ: Prentice-Hall.

Mangiaracina, R., Song, G., & Perego, A. (2015). Distribution network design: a literature review and a research agenda. *International Journal of Physical Distribution & Logistics Management*, *45*(5), 506–531. doi:10.1108/IJPDLM-02-2014-0035

Mourits, J., & Evers, M. (1995). Distribution network design: an integrated planning support framework. *International Journal of Physical Distribution & Logistics Management*, *25*(5), 43–57. doi:10.1108/09600039510089703

Perl, J., & Sirisoponsilp, S. (1988). Distribution networks: facility location, transportation and inventory. International Journal of Physical Distribution & Materials Management, 18(6), pp. 18-26.

Segetlija, Z., Mesarić, J., & Dujak, D. (2012). Importance of distribution channels-marketing channels-for national economy. In Pavlović, D. K., & Benazić, D. (Eds.), Marketing Challenges in New Economy (pp. 785-810). Juraj Dobrila University of Pula.

Tsao, Y., Zhang, O., & Chen, T. (2016). Multi-item distribution network design problems under volume discount on transportation cost. *International Journal of Production Research*, *54*(2), 426–443. doi:10 .1080/00207543.2015.1018453

Tuzkaya, Ü., & Önüt, Z. (2006). Multiechelon and multitransport mode product distribution network design: an application, *4th International Logistics and Supply Chain Congress*, İzmir, Turkey.

Yatsyshina, P. (2016). Factors of distribution network design: Evidence from Russian market. (Master's Thesis), St. Petersburg University, Graduate School of Management.

ADDITIONAL READING

Boujelben, M. K., Gicquel, C., & Minoux, M. (2014). A Distribution Network Design Problem in the Automotive Industry: MIP Formulation and Heuristics. *Computers & Operations Research*, *52*, 16–28. doi:10.1016/j.cor.2014.07.007

Butcher, G. (1974). Planning the Ideal Distribution Network. *Retail and Distribution Management*, *2*(Issue: 1), 47–49. doi:10.1108/eb017773

Escalona, P., Marianov, V., Ordóñez, F., & Stegmaier, R. (2018). On the Effect of Inventory Policies on Distribution Network Design with Several Demand Classes. *Transportation Research Part E, Logistics and Transportation Review*, *111*, 229–240. doi:10.1016/j.tre.2017.10.019

Javid, A. A., & Hoseinpour, P. (2015). Incorporating Location, Inventory and Price Decisions into a Supply Chain Distribution Network Design Problem. *Computers & Operations Research*, *56*, 110–119. doi:10.1016/j.cor.2014.07.014

Lalwani, C., Disney, S. M., & Naim, M. M. (2006). On Assessing The Sensitivity to Uncertainty in Distribution Network Design. *International Journal of Physical Distribution & Logistics Management*, *36*(Issue: 1), 5–21. doi:10.1108/09600030610642904

Mann, A. F. (1974). Planning a Distribution Network. *Retail and Distribution Management*, *2*(Issue: 5), 45–48. doi:10.1108/eb017810

Miranda, P., & Garrido, R. (2004). Incorporating Inventory Control Decisions into a Strategic Distribution Network Design Model with Stochastic Demand. *Transportation Research Part E, Logistics and Transportation Review*, *40*(3), 183–207. doi:10.1016/j.tre.2003.08.006

Miranda, P., & Garrido, R. (2009). Inventory Service-Level Optimization within Distribution Network Design Problem. *International Journal of Production Economics*, *122*(1), 276–285. doi:10.1016/j.ijpe.2009.06.010

Sari, L. T., & Henneta, J. C. (2016). Cooperative inventory planning in a distribution network. *International Journal of Production Research*, *54*(19), 5916–5931. doi:10.1080/00207543.2016.1189103

Straka M., Malındzak D. (2010). Classifıcation Of Distribution Networks. Total Logistic Management. No. 3, pp. 79–86.

Wang G., Gunasekaran A., Ngai E. (2016). Distribution Network Design with Big Data: Model and Analysis. Ann Oper Res (2018) 270:539–551.

Yang, J., Guo, J., & Ma, S. (2016). Low-Carbon City Logistics Distribution Network Design with Resource Deployment. *Journal of Cleaner Production*, *119*, 223–228. doi:10.1016/j.jclepro.2013.11.011

KEY TERMS AND DEFINITIONS

Cycle Time: The total process time from beginning to the end in order to complete a cycle of the operation.

Deployment: The process of allocating resources for effective action.

Distributor: An independent person or a company that provides products to the consumers, shops or companies.

Echelon: A level that someone or something has attained in a society, a profession or an organization.

Handling: The process of packaging, and movement of materials or goods to the customers.

Heuristic: The mental process that enables people to solve problems by experimental methods.

Inventory: A detailed catalog or list of goods, properties or qualities.

Node: A central or connection point in a network system.

Retail: The activity of selling products usually in small quantities.

Supply chain: The channel of distribution that enables products to be delivered from the supplier to the final buyer.

Transshipment: The transfer of products from one carrier to another.

Warehouse: A planned space, structure, building or room used for storing manufactured goods.

Chapter 4
Packaging Trends in International Transportation and Logistics

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ABSTRACT

Traditionally, the importance of packaging for international supply chains is most often underestimated. This is surprising for such a complex phenomenon, situated at the interface of different functions (logistics, marketing...), different decision levels (operational, tactical, strategic), and different logistics flows (physical and informational). This chapter questions the traditional design and typology of packaging used within international supply chains in the light of two main drivers: (1) its circular/closed-loop requirements and related performance notion and (2) omnichannel trends, including e-commerce, and new customer delivery services. Mobilizing the spanning concept of "logistics functions of packaging" (LFP), this chapter proposes a conceptual framework enabling to trigger adequate novel packaging solutions matching these new expectations. Recent business cases occurring within international supply chains illustrate and deepen our reflection.

DOI: 10.4018/978-1-7998-1397-2.ch004

INTRODUCTION: MOBILIZING THEORY TO UNDERSTAND AND MEET PACKAGING TRENDS IN INTERNATIONAL TRANSPORTATION AND LOGISTICS

Packaging is omnipresent in today's international supply chains. Worldwide use of maritime vessel containers, for instance, has been multiplied by more than 16 between 1980 and 2016, representing a cargo increase from 102 million tons to 1687 million tons (CNUCED, 2016). In this chapter, the authors make an inventory of theoretical frameworks in order to understand and meet principal packaging trends in contemporary international supply chains. Research-side, packaging logistics, and its constitutive concept of logistics functions of packaging (or LFP) turn out to be particularly suitable for analysing and meeting two main change drivers that characterize contemporary supply chains: first, circular economy and closed-loop logistics requirements, and second, omnichannel trends, including e-commerce. Most managers and researchers dealing with international supply chains are familiar with these trends, but only some of them fully consider the related impacts on packaging. More precisely, this chapter analyses how relevant and adequate traditional packaging designs and typologies still are with regards to these new market evolutions and proposes a new theory-based solution for matching the new challenges.

But what is packaging? Packaging can be defined as "a means of ensuring safe and efficient delivery of the goods to the ultimate consumer followed by an efficient reuse of the packaging or recovery and/ or disposal of packaging material at minimum cost" (Bjärnemo et al., 2000). For a long time, the role of packaging within the supply chain has been overlooked by both academia and practitioners (Azzi et al., 2012), in spite of its strategic and operational importance (Pålsson & Hellström, 2016). If this observation is already true for national or domestic supply chains, the lack of scientific and professional contributions in this domain is even more surprising for international supply chains characterized by long circuits, numerous chain members, "touches" and other links, more frequent process operations in heterogeneous contexts (climate, temperature, sun rays, corrosion, technologies, infrastructure/ mechanization/automatization levels, and cultures), a high number of in-transit changes that have to be made between transportation modes and warehouse locations, and the long duration of customer claims in case of damaged product arrivals due to inadequate packaging (Chan et al., 2006). Fortunately, perceptions are starting to change. Not only does globalization of supply chains contribute to the continuous rise of the packaging industry (Azzi et al., 2012), the latter also improves, through steady container innovations, the overall strategic viability and operational fluidity of international supply chains. In other words, we cannot ignore the numerous interactions between, on the one hand, increasing globalization and, on the other, the importance of the packaging industry and its heterogeneous "products" deployed within global supply chains. Meanwhile, the role of packaging within international supply chains is rightly-perceived "as a 'unitization' system, which begins with the shipper and ends with the customer" (Chan et al., 2006).

In line with the international nature and scope of this book, this chapter cites concrete packaging examples from global supply chains covering various regions of the planet to support and illustrate the authors' flow of reasoning. Adopting a dedicated international perspective seems not indispensable, as most contemporary supply chains are *per se* international or global (Hult et al., 2014; Meixell & Gargeya, 2005), as developed in Box 1.

Indeed, the packaging examples and business cases in this chapter will not only meet the—somehow formal—requirement of stemming from international supply chains, but have been chosen so that they also illustrate their noticeable impact on global world trade, such as the European pallet crisis in the event of a no-deal Brexit and the loss of an estimated 354 containers from the mega containership MSC Zoe in the German North Sea.

Box 1. The international nature of supply chains

"By some estimates, 90 percent of today's global demand is not fully met and satisfied by local supply. Or, stated differently, nine of ten products you buy in your local metropolitan area come from somewhere outside the general reach of that area. This incredible supply chain storyline is backed up by today's global trade numbers. International trade across countries' borders has increased dramatically in the last few decades. This means that the global marketplace is highly dependent on global supply chains to provide the buying and supplying infrastructure that the world has come to depend on these past several years. In essence, the incredible growth in world trade observed over the past decade is driven largely by the effective development and implementation of global supply chains. No wonder companies today are expecting their supply chains to have to be 43 percent more global in a decade to satisfy the forecasted curve on the international trade graph."

Source: Hult et al. (2014).

In order to address the issue of the book chapter, it seems indispensable to mobilize some related concepts first, due to the complex nature of the packaging notion. Indeed, packaging involves various academic disciplines or professional fields (management, IT, manufacturing, etc.). Its complexity is still high within its management domain, as it is situated at the interface of different functions (logistics, marketing, environment, etc.), different decision levels (operational, tactical and strategic), and different logistical flows (physical and informational). In order to grasp it meaningfully and to articulate the two identified change drivers, the authors mobilize the spanning concept of "logistics functions of packaging" (LFP) that belongs to the relatively young literature stream of packaging logistics. According to Saghir (2004, p. 28), "packaging logistics is a new concept that needs to build up knowledge and theories that can cast light on its influence on the performance of logistics and packaging systems, knowledge and theories that are not available yet".

Adopting this dedicated perspective enables the consideration of multiple interactions along the supply chain and between the involved systems and processes, resulting in a view and scientific reasoning that researchers appreciate as being global, holistic, systemic, systematic, integrated, integral, integrative, or comprehensive (Azzi et al. 2012; Chan et al., 2006; Hellström & Saghir, 2007). More importantly, adopting the angle of packaging logistics allows for the measurement of the influence of packaging logistics on the performance of a company or a supply chain. Packaging logistics still has a "manageable" number of researchers and related works (Azzi et al.'s 2012 comprehensive literature review, but also: Chan et al., 2006; Fulconis & Philipp, 2016, 2018a, 2018b, 2019; García-Arca & Prado Prado, 2008; García-Arca, Prado-Prado, & Gonzalez-Portela Garrido, 2014; Hellström & Saghir, 2007; Jahre & Hatteland, 2004; Jantzen & Alexander, 1969; Johnsson, 1998; Lundström, 2009; Massaroni et al., 2014; Molina-Besch & Pålsson, 2016; Nilsson et al., 2011; Olsmats & Dominic, 2003; Pålsson & Hellström, 2016; Rundh, 2005; Saghir, 2002, 2004; Simms & Trott, 2010; Svanes et al., 2010; Verghese & Lewis, 2007). Table 1 summarizes selected milestones and related authors within the formation of the packaging logistics research stream.

More precisely, packaging logistics can be defined as follows (see Box 2):

Introducing the concept of "packaging functions" (Paine, 1981), in general, and LFP (Fulconis & Philipp, 2016), in particular, within packaging research and practice has the advantage of "emancipating" the examined packaging-related phenomenon from the particular supply chain actor (e.g. different supply chain actors can fulfil the same packaging function). This proceeding also enables to distinguish between, on the one hand, expected packaging function and its weight (coefficient) and, on the other, the effective performance score (Olsmats & Dominic, 2003). Using the spanning concept of LFP stresses the logistical aspects of packaging (as opposed to sole marketing and environmental requirements), in line with the purpose and orientation of this book. There is no unique generic definition of LFP, as they

Table 1. Selected milestones within the maturation of the packaging logistics research stream

Azzi et al. (2012)	• comprehensive literature review on packaging design elaborating on specific (keyword search) methodology • analysis regarding the impact of packaging design on supply chain cost and performance • description of interactions between globalization of supply chains and packaging industry • proposition of an integrated packaging design framework, covering safety, sustainability, marketing, logistics, and ergonomics
Chan et al. (2006)	• description of the logistics "role" of packaging within manufacturing processes, including costs-benefits analyses • elaboration of flow process charts via case studies, covering both physical and informational flows • identification of "team members" (HR, employees, experts, operators,..) with their respective responsibilities/ skills, to be assigned to the informational flow processes • characterization of particularities of the packaging within international logistics
Hellström and Saghir (2007)	• detailed and comprehensive mapping (flow process charts) of interactions between the packaging system and logistics processes along the retail supply chain, based on results of four case studies; process-oriented description of a packaging system • contribution to the evaluation of packaging systems, stressing on logistics performance • contribution to adopt a supply chain perspective of packaging systems
Olsmats and Dominic (2003)	• elaboration and test (via case studies) of a tailored and systematic packaging tool, called "packaging scorecard", measuring packaging performance ("contribution of packaging to efficiency and value creation in the product supply chain") • packaging scorecard based upon a search of functional packaging criteria and characterized by supply chain orientation and holistic nature
Pålsson and Hellström (2016)	• case study (and qualitative research) methodology development for the specific context of packaging logistics, e.g. necessity of defining product family categories • application of Olsmats and Dominic's (2003) packaging scorecard for various product category-specific cases, using three scorecards for each case, one per packaging level. Conduction of analyses for each supply chain actor or node (manufacturer, distribution center, retailer), divided into the whole packaging system ("system performance") and each packaging level • confirmation of the assignability/ conversion potential between the constructs packaging scorecard "criteria" (Olsmats & Dominic, 2003) and logistics functions of packaging (LFP) • observation that "the majority of the literature [*in packaging logistics*] is descriptive or exploratory with a limited amount of theoretical contributions"

Source: Personal elaboration.

Box 2. Definitions of packaging logistics embracing the concept of LFP

• Dominic et al. (2000) define Packaging Logistics as "An approach which aims at developing packages and packaging systems in order to support the logistical process and to meet customer/user demands".
• Saghir (2002) suggests the following definition of Packaging Logistics: "The process of planning, implementing and controlling the coordinated packaging system of preparing goods for safe, secure, efficient and effective handling, transport, distribution, storage, retailing, consumption and recovery, reuse or disposal and related information combined with maximizing consumer value, sales and hence profit".
• "Packaging Logistics should be considered as an integrated approach, where both systems of packaging and logistics interact, complement and adapt to each other" (Saghir, 2004, p. 12).

Sources: Dominic et al. (2000); Saghir (2002, 2004).

strongly correlate to the specific business situation where they are needed, but they typically include product protection (see Figure 1), flow of information, volume and weight efficiency, right amount and size, handleability, and other value-added properties (Johansson & Weström, 2000). Figure 1 shows product protection, a typical logistics function of packaging.

Figure 1. Product protection, a typical logistics function of packaging (or LFP)
Source: Dominic (2010).

Contextualization of LFP seems indeed indispensable according to the product categories, concerned actor, position within the supply chain (upstream, center, downstream) and so on. The business-side scope of LFP makes it difficult to propose a single definition or typology; academia is asked to clarify how far "functions" can be considered as either synonyms or distinct concepts with regards to related notions, such as "roles" (Jahre & Hatteland 2004), "requirements" (Rundh, 2005), "demands" (Lundström, 2009), "needs" (Molina-Besch & Pålsson, 2016), "imperatives" and "expectations" (Burgess, 2016), or "constraints" (Pålsson & Hellström, 2018).

In particular, both physical and informational logistical flows are covered by this concept. The logistics protection function occurs within transportation, handling, and storage operations; the logistics information function is materialized via bar-codes and RFID chips, enabling traceability along the supply chain. Furthermore, LFP is suitable for various theoretical frameworks used within extant packaging logistics research (Fulconis & Philipp, 2016). Indeed, LFP fits with theory that considers packaging as a logistical resource (Jahre & Hatteland, 2004) connected or interfacing with others (products, actors, infrastructures, skills, etc.), but is also compatible with alternative frameworks for interpreting packaging as a simple logistics activity.

Another benefit of approaching packaging via its functions is the fact that one can keep an abstract level of analysis when it comes to searching for its ideal design or solution. Following "functional analysis" principles that designers are familiar with (Perrin & Joly, 2018; Provost, 2010), the LFP approach enables managers to innovate by "thinking outside the box" (i.e., from scratch, liberated from any existing packaging solution). For example, suppliers completing (or replacing) their brick-and-mortar sales with emerging e-commerce channels try to adapt their existing packages to these new distribution settings, which most often results in unsatisfying and inappropriate solutions (Bemis Company, 2016; Pålsson 2018), instead of breaking new ground, emancipated from any premature constraint in terms of packaging material or shape.

LFP also articulates operational decision levels with tactical and strategic ones. First, the fulfilment of LFP—and its consecutive operational performance—impact satisfaction and loyalty of (intermediary) channel customers and (end) consumers. In other words, the competitive level of the overall supply chain refers to tactical and strategic spheres rather than solely operational ones. Second, the above-mentioned functional analysis principles—intrinsic to LFP—stress the conceptual dimensions, surpassing once again pure operational considerations. Third, the realization of LFP mobilizes various company resources, including strategic ones such as investments and infrastructure (e.g., filling lines.).

TRADITIONAL (EXTANT) TYPOLOGY AND DESIGN OF PACKAGING SYSTEMS: PRIMARY, SECONDARY, AND TERTIARY PACKAGING

Having introduced the main concepts at the intersection of “packaging” and “international supply chains”, we now will discover how packaging has been designed within classic supply chains. Traditionally, packaging has been perceived as a hierarchical system (Hellström & Saghir, 2007) involving three packaging levels or types: primary, secondary, and tertiary. According to this conceptualization, overall packaging performance is explained as a result of the interactions between these three levels, but also from interactions between the product and the packaging levels. This latter feature is also known as the product-packaging “pair” that packaging experts are strongly familiar with (CNE, 2015), translating the entangled and osmotic character between the container and its filling, calling for concurrent development of the packaging and the product (Chan et al., 2006). Table 2 summarizes the three packaging levels by mentioning typical functions and giving some concrete packaging examples used within international supply chains.

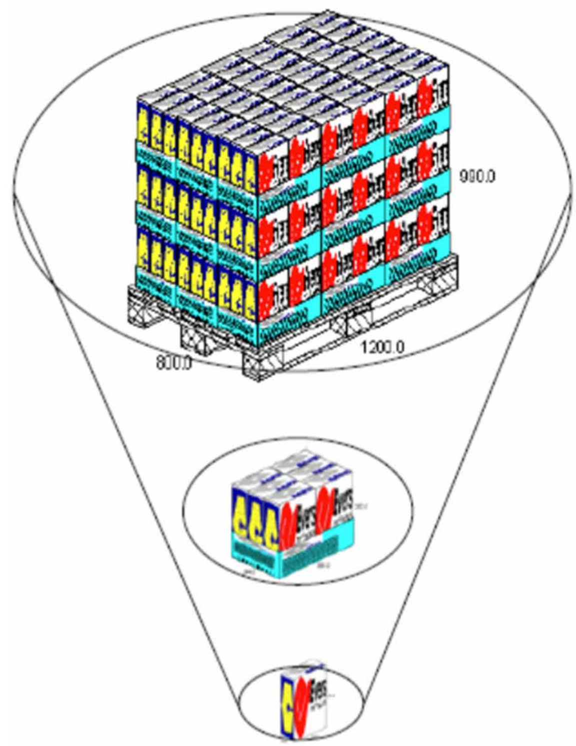
Figure 2 graphically represents the related packaging system according to this traditional view (Saghir, 2004).

Table 2. Ideal-typical presentation of packaging levels

Packaging level or type	Units of…	Main functions	Examples
[product level or stage]			
PRIMARY Packaging that most closely touches a product	... consumption (*consumer, sales or retail packaging*)	• Protection and conservation techniques • Distribution, marketing, and informational ones	Bag, bottle, can, flask, plastic pot, jar, tin can
SECONDARY It contains several primary packages	… distribution (*outer packaging, group packaging*)	• Marketing (product image) • Displaying the product at point of sale • Service and value-added properties (ergonomics, convenience, fractionated use) • Logistical (handling, manipulation)	Cardboard case, cardboard multi-pack, 12-packs of soda cans, plastic film, box, cardboard crate, tray
TERTIARY It contains several secondary packages	… transportation (*transportation packaging, industrial packaging, bulk packaging)*	• Grouping or bundling of several primary and secondary packages (parcel) • Product protection during its storage, shipping, and transportation	Corrugated board, cover sheet, retractable film, pallet, box pallet, containers, roll container, IBC (intermediate bulk container), tray, interlayer, stretched film
NB: Packaging performance is determined by performance on each packaging level, by interactions between the three packaging levels as well as by their interactions with the product. Overlaps between the levels are possible depending on the considered product.			

Source: personal elaboration inspired by Hellström and Saghir (2007), Pålsson (2018), and Fulconis and Philipp (2019).

Figure 2. The traditional packaging system
Source: Saghir (2004, p. 7).



This conceptualization should be considered as pedagogical and ideal-typical, as is already true for "traditional' supply chains. In the complex business reality, packaging levels can overlap; one of them might miss depending on the product. For instance, in some cases, the primary packaging also fulfils the functions of the secondary or tertiary packaging. In the same manner, this typology should be seen as complementary to others used in different contexts and for other purposes where the following packaging types can be found (Pålsson, 2018): shelf-ready packaging, "*prêt-à-vendre*", display packaging, one-way vs. multi-use packaging, used packaging, household packaging vs. industrial and commercial packaging, prepacked goods, etc. Below are the developed levels mobilized within traditional packaging designs. Packaging design is a complex process, involving various company departments and supply chain actors, evolving from more abstract and conceptual levels such as the definition of packaging functions, including LFP (see above), toward more concrete and materialized ones, such as the selection of materials, sizes, number of packs per grouping and graphic art design (Fulconis & Philipp, 2019; García-Arca & Prado Prado, 2008).

Somewhere in-between, when defining packaging alternatives, it is important to rely on the hierarchical structure of packaging as shown in Table 2 (García-Arca & Prado Prado, 2008). In other words, knowing, mastering, and applying LFP and packaging levels (as developed above) are important steps in the overall packaging design process according to the traditional understanding. In the following section, the authors discuss whether this classic approach is still valid for recent evolutions, particularly circular economy and closed-loop logistics requirements, and omnichannel trends, including e-commerce. It is true that academic literature helps in this context, but at the same time, it has not yet stabilized related terminology, as little distinction is made between "packaging design" and close notions, such as "redesign" (García-Arca & Prado Prado, 2008), "development" (Simms & Trott, 2010), "solution" (Hellström & Saghir, 2007), "choice / selection" (Molina- Besch & Pålsson, 2016), and "innovation" (Jahre & Hatteland, 2004). This reminds us of the already mentioned imprecision for the notion of packaging "function".

QUESTIONING THE TRADITIONAL PACKAGING TYPOLOGY AND DESIGN IN THE LENS OF CIRCULAR ECONOMY AND OMNICHANNEL TRENDS

Many traditional packaging solutions based on classic typology and design turn out to be inappropriate for conversion to new contexts of circular requirements or omnichannel settings, as witnessed by various professional ad-hoc solutions observed recently with regards to the linear versus circular contexts (Verghese et al., 2006; Walmart, 2006) and omnichannel contexts (Bemis Company, 2016; DS Smith-Forbes Insights, 2018; Pålsson, 2018).

Thus, the question becomes: How do we design and classify packaging solutions that meet the outlined new needs within international supply chains? It becomes urgent to develop theoretical concepts supporting this crucial and contemporary endeavour since extant academic literature on this issue is still scarce, whereas white papers and other professional studies begin publishing with regard to the circular driver (CNE, 2014; Ellen MacArthur Foundation, 2013; Institut Montaigne, 2016; Le Moigne, 2014; Martin, 2016; World Economic Forum, 2015) and with regard to the omnichannel driver (Ameripen, 2017; Bemis Company, 2016; BillerudKorsnäs, 2018; CNE, 2016; DS Smith-Forbes Insights, 2018). A unifying theoretical framework is needed that is characterized by global guidance, innovating from scratch. Let's have a closer look at the change drivers mentioned above before searching for related packaging solutions.

The first driver that questions traditional packaging designs and typologies are used within international supply chains and refer to the circular or closed-loop requirements for packaging. The circular economy paradigm describes a transition from one-way "make-use-dispose" linear economy toward the "make-use –recycle-remanufacture" concept wherein all materials are kept at high utility and "waste" outputs are useful inputs in the production process (Szaky, 2019). In academic literature and management practice, circular economy frequently overlaps with related notions such as sustainable development and sustainability and Corporate Social Responsibility (CSR); these different constructs certainly also reflect different maturity levels and perspectives, while sharing the triple dimensionality of economic, ecological, and societal elements.

Now, what about packaging reality and circular economy? At first sight, packaging is a factor for environmental and societal problems, since packaging waste is the waste source that the public opinion most noticeably perceives (Ellen MacArthur Foundation, 2013). Concerning plastics packaging, 95% of its value on the market is lost after its first use, equivalent to \$80 billion to \$120 billion of lost profit per annum (World Economic Forum, 2016). But both market and regulation incentives and pressures (e.g., the proposal for a directive of the European Parliament and the Council on packaging and packaging waste 2015/0276) has commenced a new era of closed-loop logistics and supply chain management.

Through an improved "circularity", packaging simultaneously could indeed reduce costs, create jobs through valorization (reuse, decomposition, recycling, biodegradability, etc.), and add value along the product life cycle (World Economic Forum, 2015). In other words, packaging could, via a novel design and typology, deliberately contribute to the transition toward a circular economy. In doing so, the packaging status would change from "problem" to "solution".

Within packaging logistics, this means we need to find out what LFP components are susceptible to fostering or hindering transition toward a circular economy (Fulconis & Philipp, 2018a, 2018b). Facing a circular economy, packaging performance also has to be redefined; the importance of some traditional LFP components might be reduced, whereas new LFP components might emerge. Existing "packaging scorecards" for both business-side (Walmart, 2006) and research-side (Olsmats & Dominic, 2003), have to be revisited, not only regarding their relevance regarding their constitutive LFP components and traditional weightings but also regarding their "checkpoints" that follow a linear conception of supply chains. Indeed, extant packaging scorecards generally represent a matrix, crossing LFP (or "criteria") and the considered supply chain actor measuring the respective packaging performance, as illustrated in Figure 3 that shows traditional ways of measuring packaging performance: the packaging scorecard. But this segmentation of supply chains is quite simplistic, as only few categories appear so far: (a) supplier, (b) transportation distribution and wholesale, (c) retail, and (d) consumer. Important reverse supply chain actors are missing, such as waste sorting centres, recyclers, pallet-pooling operators, eco-organisms, associations, and local authorities. Furthermore, consumers willing to invest in this novel function of supply and complete their traditional demand roles are also missing.

Therefore, the authors consider omnichannel settings as a second driver to question the traditional packaging typology and design. Knowing that supply chain management is often presented as the backbone for e-commerce or, more generally, omnichannel settings, we first have to recognize that there is no e-commerce without packaging. But what packaging type or level do we exactly talk about? Let's take the example of the e-commerce with home delivery: a parcel packaging in B2C shows features of a tertiary packaging as it is shipped to the online shopper's address, but also those of a secondary packaging (mono- vs. multi-references online order), and could even be considered as primary packaging (technical and marketing functions) at the same time (Fulconis & Philipp, 2019). The parcel packaging becomes the first touchpoint of the online shopper with the product they ordered, or even the only touchpoint between the online shopper and the e-retailer, conveying the brand message directly into

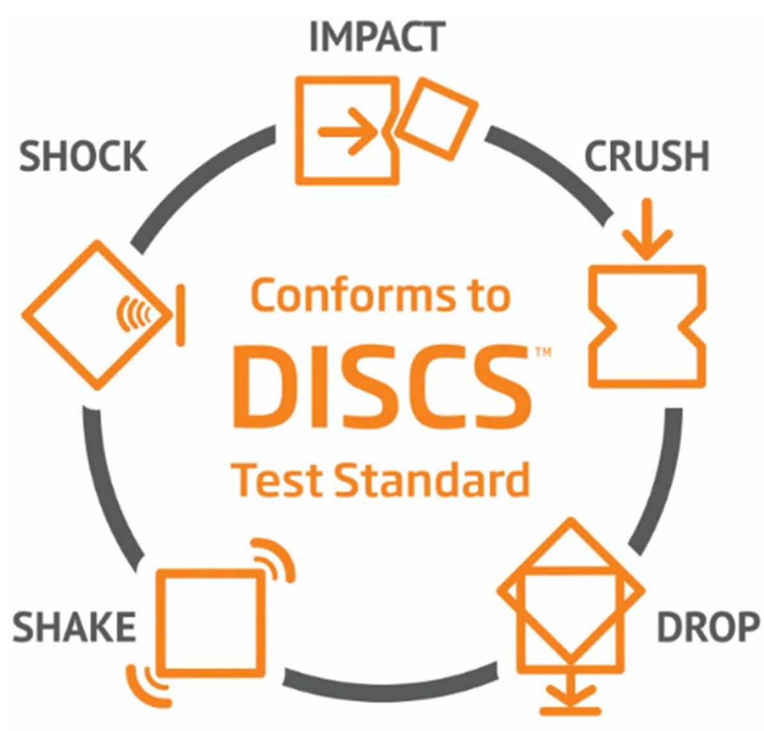
Figure 3. Traditional ways of measuring packaging performance: the packaging scorecard
Source: Olsmats and Dominic (2003).

Criteria	Supplier	Transportation distribution and wholesale	Retail	Consumer
Machinability	X			
Product protection	X	X	X	X
Flow information	X	X	X	
Volume and weight efficiency	X	X	X	
Right amount and size		X	X	X
Handleability		X	X	X
Other value-adding properties	X			X
Product information				X
Selling capability			X	X
Safety			X	
Reduced use of resources	X			
Minimal use of hazardous substance	X			X
Minimal amount of waste			X	X
Packaging costs	X			

their home ("unboxing"). Undoubtedly, the specific online shopper setting calls for an evolution of the above-mentioned traditional packaging typology that covers all packaging levels. Certainly, the parcel contributes increasingly to a novel offer format that relies on the triptych "product – parcel – deliverer". This new format is not limited to the product, but covers the quality of delivery, which becomes a veritable marketing lever; the parcel packaging indeed adds perceptible value for the online shopper. In the same manner, LFP are challenged, as the e-commerce supply chain can have three to ten times as many touchpoints compared to the brick-and-mortar ones (Bemis Company, 2016; Rousselle, 2018); they may have up to fifty touchpoints instead of five (e.g., due to unattended delivery or "not at home" situations, requiring multiple passages at the consumer's doorstep). To cope with these recent protection challenges occurring within the e-commerce, the British packaging supplier DS Smith has opened a specific laboratory simulating the typical journey of a parcel packaging along its way to the online consumer, using a sequence of industry tests called "DISCS" (Drop, Impact, Shake, Crush, and Shock), see Figure 4 that shows Logistics functions of packaging (LFP) within the e-commerce: development of specific industry test standards.

Table 3 summarizes the modalities related to the managerial choice "differentiation" versus "standardization". Recent research (Fulconis & Philipp, 2019) has applied this theoretical framework within traditional supply chains (Andersson, 1992; Jahre & Hatteland, 2004; Weick, 1982) to the parcel packages used within e-commerce supply chains or, in short, "e-supply chains".

Figure 4. Logistics functions of packaging (LFP) within the e-commerce: development of specific industry test standards
Source: DS Smith (2017), adapted by Albasini (2018).



In order to guide professionals (e-retailers, suppliers, packaging producers, logistics service providers, etc.) regarding their choice between differentiation and standardization in terms of what we might call now "e-packaging", the authors conducted an empirical study targeting millennial online shoppers, who are particularly familiarized with the e-commerce (i.e., "digital natives"). Table 3 served as an analysis model in order to study the packaging expectations of online shoppers; the initial results are presented in Box 3.

Finding adequate packaging solutions meeting recent evolutions seems a priority for international supply chains, especially since the above developed main change drivers do not act independently. Indeed, Box 4 illustrates contemporary examples that present numerous interactions between the circular requirements and omnichannel settings.

SOLUTIONS AND RECOMMENDATIONS: WHAT PACKAGING DESIGN MEETS RECENT TRENDS?

Theory-based guidance on the issue discussed in this chapter begin to emerge. Table 4 summarizes two contemporary contributions: Fulconis and Philipp's (2019) packaging-design view that has been developed above and Twede et al.'s (2000) process and structure design view. These two design approaches should be considered as complementary: Fulconis and Philipp (2019) adopt a packaging-centric view answering

Table 3. The conceptual opposition "differentiation" vs "standardization" for packaging

DIFFERENTIATION	STANDARDIZATION
Differentiation within a resource, a given supply chain, a system or a structure **"Differentiation"** means that the considered packaging is optimized and adapted for a given situation, vis-à-vis its main functions, namely: logistics (handling, storage, and transportation), marketing and environment (or more generally, societal ones). **Example:** differentiation within a product-packaging supply chain or loop. **Related notions:** adaptation, specialization, stability, tailored character, monomorphic character, integration.	**Inter-resources, inter-supply chains, inter-systems or inter-structures standardization** **"Standardization"** means that the considered packaging is able to accommodate easily to different contexts and could adapt optimally to upcoming situations, by exploiting future opportunities. **Example:** inter-supply chains/ inter-loops/ inter-networks standardization. **Related notions:** adaptability, agility, aptitude to transformation, polymorphic character, flexibility.

Source: adapted from Jahre and Hatteland (2004) in Fulconis and Philipp (2019).

Box 3. "Differentiation" or "standardization" for packaging deployed in e-supply chains? Results of an empirical study realized with millennial online shoppers in December 2017/ January 2018

The findings related to our exploratory study reveal four main expectations of the interviewed millennials online shoppers. *First*, online shoppers consider logistical functions as more important than marketing functions. E-commerce-specific features include the high perceived importance of logistics sub-functions related to delivery time and the delivery/ reverse infrastructure. *Second*, the parcel packaging should adopt certain functions traditionally performed by primary and secondary packages. This adoption concerns particularly their logistical functions (avoid over-packaging) and marketing (create the "wow" effect), thus pleading for "multi-functional" parcel packages. *Third*, when it comes to the choice between differentiation and standardization that supply chain professionals are confronted with, online shoppers prefer clearly the differentiation option, because of – again - the waste generated by oversized packages. *Forth*, online shoppers perceive as very important the compatibility of the parcel packaging with all other logistics resources (products, infrastructure, transportation modes, actors, etc.) it interfaces with. Particularly high scores are achieved by the delivery and reverse infrastructures according to the online shoppers who represent, on their turn, also logistical resources.

Source: Fulconis and Philipp (2019).

Box 4. Interactions of the two change drivers - circular economy requirements and omnichannel settings

- In Germany, paper packaging waste (including corrugated board and cardboard) has increased by 2.75 million tons in 10 years; the growing e-commerce is considered the main cause for this progression. It is true that paper is easily recyclable, but the energy and resource input for producing paper is comparable to that of steel production: 50 liters of water are necessary in order to produce 1 kg of paper from plant fibers, ranking paper production amongst the top energy-intensive industries. Plastics packaging waste has also progressed during the same period (from 2008 to 2018), although to a lesser extent - by 1.56 millions of tons.
- According to a recent study conducted by DS Smith-Forbes Insights (2018), shipping air due to packaging void fill is a major problem within contemporary supply chains. Packaging for e-commerce, or e-packaging, transports 43% of air in average (64% for glassware, 52% for toys, 51% for grocery, 50% for cookware, 43% for luminaires, 40% for small appliances, and 18% for clothes and shoes). Consecutively, e-commerce is the market segment that breaks all records in terms of shipping air (that companies are invoiced for..), far ahead of the maritime cargo containers segment, nevertheless shipping 24% of air, representing 61 millions of Twenty-Foot Equivalent Units. That's not exactly the definition of a circular economy!
- In January 2019, about 25 multinational companies (Procter & Gamble, Nestlé, PepsiCo, Unilever,..) have initiated, together with the recycling company TerraCycle, a deposit/ refund system for e-commerce delivery packages, via a dedicated electronic platform called "Loop". Various consumer goods are delivered in reusable parcel packages, taken back after consumption at the customer's doorstep. Starting in Paris and New York, this offer will be extended to other big cities throughout the world from 2020 on.
- In order to enhance overall consumer experience, Amazon has initiated a program of norms and certifications called APASS - Amazon Packaging Support and Supplier Network, targeting their packaging suppliers, product vendors, sellers, and producers. In particular, the constitutive certification called Frustration-Free Packaging (FFF) covers both the omnichannel setting ("easy to open" e-packaging) and the circular dimension (reduction of packaging waste). Since the beginning of this program in early 2018, the number of APASS certified suppliers does not stop growing.

Sources: Marr (2018); DS Smith-Forbes Insights (2018); Jadoul (2019); Albasini (2018).

"what and how questions" whereas Twede et al. (2000) assign packaging a more passive and reactive role, answering the "where and when questions" within global supply chains. In spite of their differences, both concepts share the holistic or system view—in line with the packaging logistics literature stream as developed above —and allow for a combinations of their respective modalities rather than proposing a rigid binary proceeding ("either… or"), which enables a high adaptation potential for a given packaging situation, case, or category. Indeed, "differentiation versus standardization" (Fulconis & Philipp, 2019) and "speculation versus postponement" (Twede et al., 2000) are understood as interval boundaries, allowing for a continuum of possibilities between their respective poles, including hybrid structures. The concurrent use of both concepts enables managers to find the adequate tune between logistical drivers (Fulconis & Philipp, 2019) and others, particularly marketing and manufacturing-related ones (Twede et al., 2000). Table 4 shows how to design packaging for international supply chains, using theoretical complementary concepts to support related decision-making.

For packaging, the authors' conceptual opposition "differentiation versus standardization" refers to the realization of its main functions related to logistics, marketing, and the environment (Fulconis & Philipp, 2019) and can accordingly be declined in order to meet the particular business setting. The tool can also be fine-tuned regarding international supply chains by creating a sub-category called "international logistics function", dedicated to its facilitating role for international trade. For example, security and anti-theft features might be more important within international supply chains than for domestic ones and thus represent a very specific "protection" function. Keeping the abstract level according to the authors' "differentiation versus standardization" concept, it is not necessary to make premature choices regarding the packaging level (primary, secondary, or tertiary) which would add complexity at this stage (high number of potential combinations), due to their cascading effect.

The authors are confident that their conceptual framework will contribute to design the "optimal" packaging within international supply chains, including those situations where it strongly impacts global trade, as illustrated in Box 5.

Table 4. Designing packaging for international supply chains – the rise of theoretical complementary concepts to support related decision-making

Fulconis and Philipp (2019): "differentiation versus standardization"	**Twede et al. (2000): "speculation versus postponement"**
The overall purpose of the conceptual opposition	
Within the packaging domain, the adequate choice between standardization and differentiation represents the optimal realization of its main functions related to logistics, marketing, and the environment	Develop global products for local markets (packaging and manufacturing postponement strategies are considered as an opportunity for international manufacturers to compete against regional suppliers)
Main question	
What looks like the optimal or ideal packaging solution/ design/ development/ innovation? [*packaging design*]	Where and when should packaging processes take place to add value (time, place and form utility) within an international manufacturer's supply chain in order to reduce cost (inventory, transport) and risk, enabling him to compete against regional suppliers? [*process and structure design*]
Role of packaging	
Active: Packaging and the LFP are at the heart of the decision-making process	Passive and reactive, visible through "packaging implications" of the different "speculation/ postponement" strategies
The concept's values or modalities	
Differentiation: exploit present opportunities. (perfect fitness for a specific product-packaging supply chain) Standardization: exploit future opportunities (easy accommodation to various supply chains)	Speculation: prefer decentralized inventories and "push" (or "make to inventory") flows Postponement: prefer centralized inventories and direct distribution, as well as "pull" (or "make and pack to order") flows
Potential of modalities' mix (combination)	
High: Continuum between the two interval boundaries "differentiation" and "standardization"; hybrid nature of the concept, comparable to leagile issues in SCM (Dayi and Mascle, 2015)	High: "speculation" and "postponement" can be combined, resulting in mass customization; combination of global efficiency and economies of scale with local responsiveness of customization and country-specific demands; simultaneous standardization and localizing (through modular product and packaging designs)
Relation with the logistics discipline	
Design and development of packaging solutions are mainly LFP-driven	Choosing the adequate modality aims to reduce risk, inventory and transportation costs and to improve the customer service level, but many other factors also have to be considered (product characteristics, market/ demand characteristics, and manufacturing characteristics, with numerous sub-categories respectively)
Theoretical framework and main concepts	
Packaging apprehended as a logistical resource (Jahre & Hatteland, 2004) interfacing other ones (products, logistics infrastructures, actors, etc.) Logistics functions of packaging (LFP)	Not specified; multi-theories (economies of scale; postponement vs speculation, etc.)

Source: personal elaboration, adapted from Twede et al. (2000) and Fulconis and Philipp (2019).

The drivers that question existing packaging designs developed in this chapter do not pretend to be exhaustive. Nevertheless, they perfectly reflect business concerns expressed by the executives involved in international supply chains. According to a recent study targeting 467 French respondents (both packaging suppliers and fillers/ packaging consuming companies), professionals perceived the following factors as "very important" or "quite important" regarding the evolution of their packaging: costs

Box 5. The importance of packaging on international trade: two recent examples

• A recent geopolitical example, the imminent Brexit, illustrates the importance of packaging on international trade, through a specific case of packaging standardization and LFP, namely protection. Every month, the United Kingdom uses three millions of wooden pallets for its importations and exportations with the (rest of the) European Union. However, in case of a no-deal Brexit, most of the pallets the United Kingdom has used until now will lose their approval for exportations towards Europe. If leaving the European Union, the United Kingdom will have to apply the same exchange norms as those valid for non-EU states, namely the international ISPM15 norms that stipulate thermal treatment and cleaning for so-called Wood Packing Material or WPM in order to avoid any contamination issue. Currently, only about a third of the concerned pallets comply with these norms, supply chain disruptions seem inevitable, resulting in augmented lead times, cost increase and/ or out-of-stock situations throughout Europe. • On January 1st, 2019, the cargo vessel MSC Zoe lost some 354 maritime containers in the German North Sea. The loss of so many containers is an exceptional event in navigation history. At this stage, the incident is explained by heavy weather during wintertime, developing enormous centrifugal forces, particularly in the high container tiers on deck. Facing these extreme weather conditions, several packaging elements (such as lashing rods, turnbuckle and/ or twist locks) failed regarding their product protection function as part of LFP.

Source: adapted from Cohen and Zéau, (2019) and Schütze (2019).

reduction; recyclability and materials recycling; regulation, implementation of norms; packaging reduction at source, eco-design; fight against waste; sustainability; time-to-market acceleration; packaging reuse; anti-counterfeiting; marketing, communication; new production technologies; new packaging materials; evolution of e-commerce; digitization of the supply chain; digitization of points of sale; digital printing (Freidinger-Legay, 2018). Almost all of these factors revealed in the field can be related to what the authors have conceptualized as "main drivers" within this chapter, namely circular trends and omnichannel settings.

CONCLUSION

This chapter's contribution is threefold. First, it develops the importance of packaging within international supply chains, mobilizing both scientific and professional literature. The lack of extant work at the cross-section "packaging x international supply chains" is surprising, as "packaging" appears as constitutive element or operation in numerous approved definitions of regular supply chain management or logistics (e.g., Vitasek/ CSCMP, 2013). Adding the international or global context to this issue, in line with the overall philosophy of this book, makes this paucity even more astonishing. Supply chains are increasingly international or global. Similarly, numerous interactions exist between, on the one hand, increasing globalization/ international trade and, on the other, the importance of the packaging industry and its heterogeneous "products" deployed within global supply chains, reminding us of the famous "chicken and the egg".

Second, this chapter identifies two main drivers that question existing packaging designs or solutions, which often fail with regard to the various novel requirements addressed by the heterogeneous stakeholders occurring along the supply chain (including the consumer as the ultimate downstream link), namely circular or closed-loop trends, and omnichannel settings. Indeed, packaging needs evolve within novel "reverse supply channels" that are visible through the touchpoints with "new" channel members such as waste sorting centres, recyclers, pallet-pooling operators, eco-organisms, associations, and local authorities. The overall concept of sustainable supply chain management that the scientific community is familiar with for more than a decade now (Seuring & Müller, 2008) has started to enter the scene of packaging logistics, through circular or closed-loop needs vis-à-vis the containers it mobilizes for its physical and informational flows. E-commerce, or more generally, omnichannel settings can be considered as another driver for major change regarding packaging design within modified supply chains. These two drivers do not act alone; rather, they interact: increased e-commerce implies proliferation of delivery locations with related environmental consequences in terms of resource and energy consumption, emission and waste levels, as well as risk exposure.

Third, the authors show that the mobilization of the spanning concept of "logistics functions of packaging" (LFP) is a useful starting point to initiate packaging design improvements in line with these two main "drivers of change". In this context, the LFP concept enables researchers to conciliate various works from several packaging logistics contributions. This is demonstrated in this chapter by accommodating the authors' own work with that of other researchers affiliated with this recent literature stream. To conclude, this chapter proposes a conceptual framework striving for improvement of packaging design. In this context, the authors argue that this endeavour is not limited to operational spheres, but also covers also tactical and strategic dimensions, both from a resource (input) and a result (output) perspective. In other words: yes, packaging contributes to global supply chain competitiveness more than most of us would have expected!

REFERENCES

Albasini, F. (2018). Le e-commerce et l'emballage: à la recherche de l'optimisation. *Emballages Digest (Machines & Technologies), 633* (November), 11–14.

AMERIPEN. (2017). *Optimizing packaging for an e-commerce world*. Saint-Paul, MN: White Paper - American Institute for Packaging and Environment.

Andersson, P. (1992). Analysing distribution channel dynamics: Loose and tight coupling in distribution networks. *European Journal of Marketing*, *26*(2), 47–68. doi:10.1108/03090569210010031

Azzi, A., Battini, D., Persona, A., & Sgarbossa, F. (2012). Packaging design: General framework and research agenda. *Packaging Technology & Science*, 1–22.

Bemis Company. (2016). *Packaging for a new era of Ecommerce - How e-commerce will transform the role of consumer packaging*. Neenah, WI. Retrieved from http://www.bemis.com/Bemis/media/ Library/pdf/restricted/Bemis-eBook-eCommerce.pdf

BillerudKorsnäs. (2018). *How packaging can add value in e-commerce*. Solna, Sweden. Retrieved from https://www.billerudkorsnas.com

Bjärnemo, R., Jönson, G., & Johnsson, M. (2000). *Packaging logistics in product development*. Paper presented at the 5th International Conference on Computer Integrated Manufacturing (ICCIM 2000), March, Singapore.

Burgess, P. (2016). Consumers' mindset: expectations, experience, and satisfaction. In P. Burgess (Ed.), Integrating the packaging and product experience in food and beverages - a road-map to consumer satisfaction (pp. 161–182). Cambridge, MA: Elsevier - Woodhead Publishing.

Chan, F. T. S., Chan, H. K., & Choy, K. L. (2006). A systematic approach to manufacturing packaging logistics. *International Journal of Advanced Manufacturing Technology*, *29*(9–10), 1088–1101. doi:10.100700170-005-2609-x

CNE. (2014). *Packaging and circular economy*. Paris, France: Conseil National de l'Emballage.

CNE. (2015). *Packaging as key element in product logistics*. Paris, France: Conseil National de l'Emballage.

CNE. (2016). *Packaging the development of consumption patterns and distribution channels*. Paris, France: Conseil National de l'Emballage.

CNUCED. (2017). *Étude sur les transports maritimes 2016*. United Nation Publication.

Cohen, C., & Zéau, P. (2019). Une pénurie de palettes en bois menace le Royaume-Uni en cas de "Brexit dur". Retrieved from http://www.lefigaro.fr/conjoncture/2019/02/27/20002-20190227ARTFIG00253-une-penurie-de-palettes-de-bois-menace-le-royaume-uni-en-cas-de-brexit-dur.php

Dayi, O., & Mascle, C. (2015). *Méthodologie d'amélioration leagile de la chaîne logistique*. Paper presented at the 11e CIGI2015 – Congrès International de Génie Industriel, October, Québec, Canada.

Dominic, C. (2010). Packaging logistics, functional demands, transport testing (Innventia document). Retrieved from https://www.kth.se/polopoly_fs/1.220326.1550158571!/Menu/general/column-content/attachment/Föreläsning%203.pdf

Dominic, C., Johansson, K., Lorentzon, A., Olsmats, C., Tiliander, L., & Weström, P. (2000). *Förpackningslogistik* (2nd ed.). Kista, Sweden: PACKFORSK.

Ellen MacArthur Foundation. (2013). *Towards the circular economy: opportunities for the consumer goods sector*. Retrieved from https://www.ellenmacarthurfoundation.org

Freidinger-Legay, A. (2018). La recyclabilité a le vent en poupe. *La Revue des Marques*, *104*(October), 62–66.

Fulconis, F., & Philipp, B. (2016). Packaging et chaîne logistique en boucle fermée: Contribution au passage d'une économie linéaire à une économie circulaire. *Logistique & Management*, *24*(3/4), 186–198. doi:10.1080/12507970.2016.1268936

Fulconis, F., & Philipp, B. (2018a). Packaging scorecard for closed-loop logistics systems: A sustainable development perspective. *Procedia - social and behavioral sciences*, Elsevier Editor, March, *238*, 19–28. doi:. doi:10.1016/j.sbspro.2018.03.003

Fulconis, F., & Philipp, B. (2018b). Quels packagings pour les supply chains du e-commerce. *Supply Chain Magazine*, *13*, 104–105.

Fulconis, F., & Philipp, B. (2019). La supply chain face aux défis de la livraison E-commerce: Entre intégration et flexibilité, quelles solutions packaging? *Logistique & Management*, *27*(2), 132–147. doi:10.1080/12507970.2018.1546127

García-Arca, J., & Prado Prado, J. C. (2008). Packaging design model from a supply chain approach. *Supply Chain Management: An International Journal*, *13*(5), 375–380. doi:10.1108/13598540810894960

García-Arca, J., Prado-Prado, J. C., & Gonzalez-Portela Garrido, A. T. (2014). Packaging logistics: Promoting sustainable efficiency in supply chains. *International Journal of Physical Distribution & Logistics Management*, *44*(4), 325–346. doi:10.1108/IJPDLM-05-2013-0112

Hellström, D., & Saghir, M. (2007). Packaging and logistics interactions in retail supply chains. *Packaging Technology and Science, 20*(3), 197–216. doi: 1099-1522. doi:10.1002/(ISSN)

Hult, T., Closs, D., & Frayer, D. (2014). How global should your supply chains be? *Global Edge Business Review*, *8*(2), 1–12.

Institut Montaigne. (2016). *Économie circulaire, réconcilier croissance et environnement. Rapport Novembre*. Paris, France: Institut Montaigne.

Jadoul, A. (2019). De la consigne dans l'e-commerce. *Emballages Magazine,* (1003: January/ February) 16.

Jahre, M., & Hatteland, C. J. (2004). Packages and physical distribution. *International Journal of Physical Distribution & Logistics Management*, *34*(2), 123–139. doi:10.1108/09600030410526923

Jantzen, N. R., & Alexander, M. (1969). A logistical view of packaging. In J. Schorr, M. Alexander, & R.-J. Franco (Eds.), *Logistics in Marketing* (pp. 129–155). New York: Pitman Publishing.

Johansson, K., & Weström, P. (2000). Measurement of packaging logistics parameters. In K. Sjöström (Ed.), *Packaging logistics review* (pp. 17–28). Econpap, Finland.

Johnsson, M. (1998). *Packaging logistics - A value-added approach*. Engineering Logistics Lund.

Le Moigne, R. (2014). *L'Économie circulaire - Comment la mettre en œuvre dans l'entreprise grâce à la reverse supply chain*. Paris, France: Dunod.

Lundström, A. (2009). *An approach for innovative packaging development*. (Master Thesis), Luleå University of Technology, Sweden.

Marr, A.-K. (2018). Onlinehandel führt zu mehr Papiermüll. Retrieved from https://www.spiegel.de/wissenschaft/natur/altpapier-und-pappe-online-handel-sorgt-fuer-immer-mehr-papiermuell-a-1234506.html

Martin, J.-L. (2016). *Entreprise et environnement – Les achats d'emballages*. Paris, France: Éditions Campus Ouvert.

Massaroni, E., Cozzolino, A., & Wankowicz, E. (2014). *Sustainable supply chain management needs sustainable packaging - An exploratory study*. Paper presented at the Atti del XXVI Convegno annuale di Sinergie, Cassino: Università de Cassino.

Meixell, M. J., & Gargeya, V. B. (2005). Global supply chain design: A literature review and critique. *Transportation Research Part E, Logistics and Transportation Review*, *41*(6), 531–550. doi:10.1016/j.tre.2005.06.003

Molina-Besch, K., & Pålsson, H. (2016). A supply chain perspective on green packaging development – Theory vs. practice. *Packaging Technology & Science*, *29*(1), 45–63. doi:10.1002/pts.2186

Nilsson, F., Olsson, A., & Wikström, F. (2011). *Toward sustainable goods flows: A framework from a packaging perspective*. Paper presented at the 23rd Nofoma Conference, Harstad, Norway.

Olsmats, C., & Dominic, C. (2003). Packaging scorecard - A packaging performance evaluation method. *Packaging Technology & Science*, *16*(1), 9–14. doi:10.1002/pts.604

Paine, F. (1981). *Fundamentals of packaging*. Leicester, UK: Brookside Press.

Pålsson, H. (2018). *Packaging logistics. Understanding and managing the economic and environmental impacts of packaging in supply chains*. London, UK: Kogan Page.

Pålsson, H., & Hellström, D. (2016). Packaging logistics in supply chain practice – current state, trade-offs and improvement potential. *International Journal of Logistics Research and Applications*, *19*(5), 351–368. doi:10.1080/13675567.2015.1115472

Pålsson, H., & Hellström, D. (2018). *Linking the packaging innovation process to logistics and supply chain performance in the food industry*. Paper presented at the 23rd Logistics Research Network (LRN) Annual Conference Proceedings, September, Plymouth, UK.

Perrin, A., & Joly, C. (2018). Élaboration du cahier des charges fonctionnel et du cahier des charges achats. In P. Dole (Ed.), *Dans Les 7 fonctions de l'emballage* (pp. 405–410). Paris, France: Lavoisier.

Provost, P. (2010). Élaboration d'un cahier des charges fonctionnel - Méthodologie et informatisation. *Techniques de l'Ingénieur*, Réf.: AG6060-V1, 10 Janvier, 1-19.

Rousselle, L. (2018). L'emballage ne manque pas d'air. *L'Usine Nouvelle*, *3583*(November), 48–50.

Rundh, B. (2005). The multi-faceted dimension of packaging. *British Food Journal*, *107*(9), 670–684. doi:10.1108/00070700510615053

Saghir, M. (2002). *Packaging logistics evaluation in the Swedish retail supply chain*. Lund: Lund University.

Saghir, M. (2004). The concept of packaging logistics. In *Proceedings of the 2nd World Conference on POM Production and Operations Management & 15th Annual POM Conference,* April, Cancun.

Schütze, G. (2019). An analysis of MSC Zoe's container loss. Retrieved from https://www.maritime-executive.com/editorials/an-analysis-of-msc-zoe-s-container-loss

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, *16*(15), 1699–1710. doi:10.1016/j.jclepro.2008.04.020

Simms, C., & Trott, P. (2010). Packaging development: A conceptual framework for identifying new product opportunities. *Marketing Theory*, *10*(4), 397–415. doi:10.1177/1470593110382826

Smith-Forbes Insights, D. S. (2018). *L'Économie de l'espace vide*. Jersey City, NJ: Forbes Insights.

Svanes, E., Vold, M., Möller, H., Pettersen, M. K., Larsen, H., & Hanssen, O.-J. (2010). Sustainable packaging design: A holistic methodology for packaging design. *Packaging Technology & Science*, *23*(3), 161–175.

Szaky, T. (2019). *The future of packaging – from linear to circular*. Oakland, CA: Berrett-Koehler Publishers.

Twede, D., Clarke, R. H., & Tait, J. A. (2000). Packaging postponement: A global packaging strategy. *Packaging Technology & Science*, *13*(3), 105–115. doi:10.1002/1099-1522(200005)13:3<105::AID-PTS503>3.0.CO;2-9

Verghese, K., Horne, R., Fitzpatrick, L., & Jordan, R. (2006). *PIQET A packaging decision support tool*. Paper presented at the 5th Australian Conference on Life Cycle Assessment, November, Melbourne.

Verghese, K., & Lewis, H. (2007). Environmental innovation in industrial packaging: A supply chain approach. *International Journal of Production Research*, *45*(18–19), 4381–4401. doi:10.1080/00207540701450211

Vitasek, K., & CSCMP. (2013). Supply chain management terms and glossary. Retrieved from https://cscmp.org/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx?hkey=60879588-f65f-4ab5-8c4b-6878815ef921

Walmart. (2006). *Wal-mart unveils "packaging scorecard" to suppliers*. Retrieved from http://corporate.walmart.com/_news_/news-archive/2006/11/01/wal-mart-unveils-packaging-scorecard-to-suppliers

Weick, K. E. (1982). Management of organizational change among loosely coupled elements. In P. S. Goodman (Ed.), *Change in organizations* (pp. 375–408). San Francisco, CA: Jossey-Bass.

World Economic Forum. (2015). Beyond supply chains: empowering responsible value chains. Cologny/Genève: World Economic Forum.

World Economic Forum. (2016). The new plastics economy: Rethinking the future of plastics. Cologny/Genève: World Economic Forum.

ADDITIONAL READING

Barnes, C. (2016). Omni-channel retail - Challenges and opportunities for packaging innovation. In Burgess. P (Ed), Integrating the Packaging and Product Experience in Food and Beverages - A Road-Map to Consumer Satisfaction (pp.59–76). Cambridge, MA: Elsevier – Woodhead Publishing.

Fontaine, M. (2016). *L'Emballage, ce bel inconnu*. Paris: Édition BoD.

Grant, D. B., Wong, C. Y., & Trautrims, A. (2017). *Sustainable logistics and supply chain management: Principles and practices for sustainable operations and management* (2nd ed.). London: Kogan Page.

Highland, M. (2018). Packaging to wow consumers. *Logistics Manager Magazine*, August, 12–14.

Lancioni, R. A., & Chandran, R. (1990). The role of packaging in international logistics. *International Journal of Physical Distribution & Logistics Management*, *20*(8), 41–43. doi:10.1108/09600039010000787

Park, J., Sarkis, J., & Wu, Z. (2010). Creating integrated business and environmental value within the context of China's circular economy and ecological modernization. *Journal of Cleaner Production*, *18*(15), 1494–1501. doi:10.1016/j.jclepro.2010.06.001

Prendergast, G., & Pitt, L. (1996). Packaging, marketing, logistics and the environment: Are there trade-offs? [DOI: 10.1108/09600039610125206]. *International Journal of Physical Distribution & Logistics Management*, *26*(6), 60–72. doi:10.1108/09600039610125206

Regattieri, A., & Santarelli, G. (2013). The important role of packaging in operations management. In M. M. Schiraldi (Ed.), *Operations Management* (pp. 183–219). Rijeka: IntechOpen. doi:10.5772/54073

Regattieri, A., Santarelli, G., Gamberi, M., & Mora, C., C. (2014). A new paradigm for packaging design in web-based commerce. *International Journal of Engineering Business Management*, *6*(14), 1–11.

Verhoef, P. C., Kannan, P. K., & Inman, J. J. (2015). From multi-channel retailing to omni-channel retailing: Introduction to the special issue on multi-channel retailing. *Journal of Retailing*, *91*(2), 174–181. doi:10.1016/j.jretai.2015.02.005

Wever, R. (2011). Design for Volume Optimization of Packaging for Durable Goods. *Packaging Technology & Science*, *24*(4), 211–222. doi:10.1002/pts.927

Zhu, Q., Sarkis, J., & Lai, K-H. (2008). Green supply chain management implications for 'closing the loop'. *Transportation Research Part E, Logistics and Transportation Review*, *44*(1), 1–18. doi:10.1016/j.tre.2006.06.003

KEY TERMS AND DEFINITIONS

Circular Economy: according to this paradigm, our supply, distribution, and consumption systems give up processing materials and other resources in a traditional "one-way" or linear manner, typically ending with their disposal. Instead, "waste" or other system outputs (secondary raw materials, valuables) are reinjected in the economy, allowing numerous additional cycles at high utility. In management literature and practice, circular economy frequently overlaps with related notions such as sustainable development/ sustainability and Corporate Social Responsibility (CSR). The supply chain management discipline can support - if not initiate - circular economy through closed-loop logistics principles.

Differentiation of Packaging: the considered packaging is optimized and adapted for a given situation, vis-à-vis its main functions. The authors consider packaging as differentiated if it is adapted or tailored regarding a specific product-packaging supply chain ("optimal fit").

E-packaging: a term that the authors use to designate containers fitting with novel e-commerce requirements as part of omnichannel settings. Instead of adapting existing brick-and-mortar packaging to these novel challenges that mostly results in unsatisfying solutions, we prefer to design e-packaging by adopting a more abstract level of reasoning, considering functional analysis principles. Breaking new grounds means emancipation from any premature constraint in terms of packaging material and/ or shape and results in optimized fulfilment of packaging functions, LFP, and others.

Logistics Functions of Packaging (LFP): they typically include product protection, the flow of information, volume and weight efficiency, right amount and size, handleability, and other value-added properties. Both physical and informational logistics flows are covered. Beyond the logistics scope, packaging also performs functions related to marketing and environmental/societal features.

Omnichannel Settings: consumer's shopping experience is integrated across all customer touchpoints and distribution channels, both brick-and-mortar and digital ones, including e-commerce/ m-commerce. Ideally, neither the consumer nor the supplier/retailer distinguish between channels anymore. Whereas the former enjoys a seamless shopping experience and increased delivery flexibility in terms of time and space, the latter profits from a holistic and optimized visibility of the supply chain.

Standardization of Packaging: the considered container easily accommodates different contexts and could adapt optimally to upcoming situations, by exploiting future opportunities. The authors consider packaging as standardized if it is easily adaptable to other product-packaging supply chains.

Chapter 5

Order Picking Optimization Based on a Picker Routing Heuristic:

Minimizing Total Traveled Distance in Warehouses

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ABSTRACT

This chapter details the performance evaluation of routing policies and proposes a routing heuristic to determine the minimum traveled distance for different warehouse configurations and pick-list sizes. Numerical experiments are performed considering warehouse configurations used in literature and list sizes are chosen proportional to the number of storage positions of each layout. The proposed heuristic method was shown to reduce the distance traveled by 7% for the evaluated instances. Furthermore, travel distance reductions of up to 30% were found in cases involving large warehouse and pick-list sizes. The proposed heuristic therefore is concluded to provide a more efficient solution than individual routing policies for the picker routing problem.

INTRODUCTION

Warehouses are responsible for efficiently retrieving customers' orders and managing inventory in a supply chain (Albareda-Sambola, Alonso-Ayuso, Molina, & De Blas, 2009). Likewise, warehouse management has a great influence on logistical costs, both in investment and direct operational costs (Chen, Cheng, Chen, & Chan, 2015). As such, warehouse optimization is of vital importance. In modern warehouses and distribution centers, it is common to receive a large variety of orders daily with a wide range of items to be delivered in quantities as small as one or two units per item (Bozer & Kile, 2008).

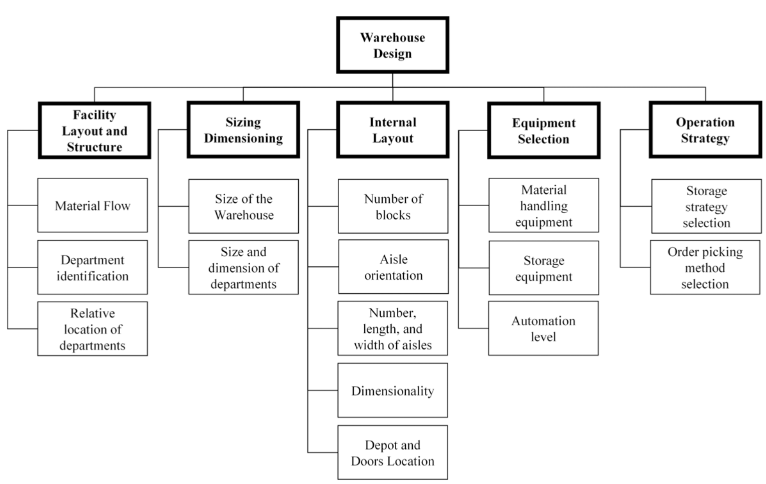
DOI: 10.4018/978-1-7998-1397-2.ch005

Furthermore, the rapid development of business-to-consumer (B2C) e-commerce has focused attention on warehouse operation efficiency and requires increased availability of a wide range of products and a processing capacity of large quantities of daily orders (Li, Huang, & Dai, 2017). Overall, a company's success is determined by their ability to respond to competitive markets with the right products at the right time (Roodbergen, Vis, & Taylor, 2015).

Additionally, warehouses and distribution centers often adjust or equalize sales offers in line with demand, thus soothing demand, consolidating and packaging products, and planning distribution activities (Manzini, Bozer, & Heragu, 2015). Business competitiveness requires continuous improvement in the design and operation of distribution networks, thus implying improved warehouse performance (Gu, Goetschalckx, & McGinnis, 2007), since efficiency and effectiveness within any distribution network is determined to a large extent by the operation of warehouses that must process diverse products and items, using limited picking vehicles (Cheng, Chen, Chen, & Yoo, 2015).

For this reason, this chapter aims to reduce the total traveled distance in warehouses for the order picking process through an easy-to-implement method that provide efficient solutions in very short computing time, so that programming and integration with information systems in companies such as warehouse management systems (WMS) and enterprise resource planning (ERP) can be feasible. Planning and controlling warehouse operations are crucial to the efficiency of supply chains, as poor performance results in unsatisfactory service and high logistics costs (Koch & Wäscher, 2016). To address these challenges, it is required to improve key factors affecting warehouse's efficiency, such as warehouse design, storage location, and warehouse operation (Li et al., 2017). Warehouse design involves many important strategic decisions, such as the general structure of the warehouse, the size of the warehouse and its departments, the distribution of spaces within each department (layout), the selection of storage equipment, and the selection of operational strategies, as summarized in Figure 1 (Gu, Goetschalckx, & McGinnis, 2010). Decisions on warehouse design are considered strategic and have been widely addressed by researchers aiming to minimize costs and operating time and increase the overall performance of the supply chain (Manzini et al., 2015).

Figure 1. Warehouse design process

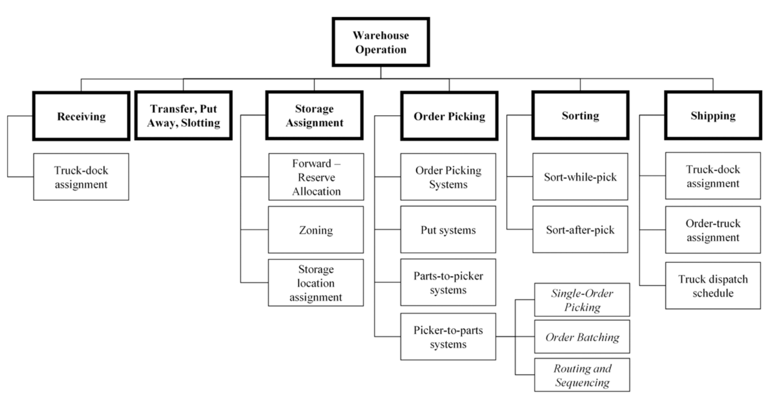


However, the modification of warehouse design and storage location is difficult and requires a high level of investment to change once operational, and is thus a costly way to increase storage productivity (Li et al., 2017). Rather, it is generally advised to focus on first increasing productivity with less radical methods, including the optimization of warehouse operations (Centeno & Sundaram, 2004; Chen, Huang, Chen, & Wu, 2005). As detailed in Figure 2, the main warehouse operations that define the flow of products are receiving products from suppliers, slotting and putting away the received products (Gómez-Montoya, Cano, & Campo, 2018), storage assignment, order picking, sorting and assembling orders (Rojas, Guisao, & Cano, 2011), and shipping, packing, and pallet loading (Salazar, Gomez, & Cano, 2017).

Among warehouse operations, order picking deals with the retrieval of stock-keeping units (SKU) from the warehouse to meet customer orders. This operation has increasingly been noted for its role in supply chain management from the point of view of both production systems (supplying manufacturing and assembly) and physical distribution (fulfillment and delivery of customer orders) (Dallari, Marchet, & Melacini, 2009), and is considered the most labor-intensive warehouse operation (Tompkins, White, Bozer, & Tanchoco, 2010), accounting for 50%–75% of a warehouse's operating costs (Bartholdi & Hackman, 2014; Pan & Wu, 2012). As such, improving the performance is of major interest to warehouse management, both in regular business or in business-to-consumer (B2C) e-commerce companies (Zhang, Wang, Chan, & Ruan, 2017), as the success of warehouse management depends on how customer orders are recovered in the order picking process.

In the order picking process, customer order or picking list is assigned to a picker, which moves from a depot to the necessary storage locations to retrieve the required items before returning to the depot to deliver the collected products (Roodbergen & Vis, 2006). Within order picking, several activities such as lifting, moving, searching, retrieving, loading, packing, and traveling are carried out, supported by a picking device and other material-handling equipment (Lee, Chang, Shim, & Cho, 2015). During this process, at least 50% of the order processing time and costs are consumed by traveling (De Koster, Le-Duc, & Roodbergen, 2007). As both the overall picking cost and travel time depend directly on the traveled distance (Karásek, 2013), then the order picking operations must be planned using a minimum traveled distance (Hsieh & Huang, 2011).

Figure 2. Warehouse operations



Order-picking systems can be divided into two categories according to their prevalence in practice: parts-to-picker systems and picker-to-parts systems. The parts-to-picker systems usually include a higher level of automation, utilizing automated guided vehicles (AGV) and/or automated storage/retrieval systems (AS/RS) to handle and transport the requested items to stationary order pickers or picking stations (Roodbergen & Vis, 2009). In picker-to-parts systems, order pickers move through aisles in a warehouse to retrieve items from storage locations to satisfy customer orders.

Both picking system categories can be supported by technologies related to the Internet of Things (IoT) such as RFID that provides data to a cloud-based system to identify, track, and trace all storage loads within the warehouse. Consequently, each storage load (containers, pallets, bins, totes, cartons, trays) is able to save, administrate and communicate storage process information, and interact with the WMS, switches, conveyors, and equipment for improving the picking routing planning (Prasse, Nettstraeter, & Ten Hompel, 2014), as well as for facilitating inventorying, loss prevention, (Tejesh & Neeraja, 2018). Likewise, the use of IoT facilitates locating shuttles in parts-to-picker systems and locating pickers and picking devices in picker-to-parts systems to assign them storage locations to visit to fulfill customer orders in an online environment, where customer orders are released to the warehouse in fixed or variable time windows. Therefore, the IoT allows the connection and collaboration of physical objects in a warehouse such as operators, picking devices, shelves and racks, shuttles, lifts, and products to optimize picking operations. Even, IoT prevents risks of hazardous accidents in warehouses by satisfying product compatibility constraints in shelves (Trab et al., 2015).

Parts-to-Picker Systems (Automated Picking)

Regarding parts-to-picker systems, there is a wide variety of AS/RS designed for different product configurations such as pallets, bins, cartons, trays, totes, and individual items. For pallet warehousing in high-bay warehouses, there are solutions such as aisle-bound cranes systems and carriers/lifts systems. Aisle-bound cranes systems consist of racks served by cranes running through aisles (rails) between fixed arrays of storage racks, putting products in storage and retrieving those products from storage to fulfill an order, delivering pallets at the end of the aisle to deliver them to forklifts, conveyor systems, or rail-guided vehicle systems. This AS/RS varies according to the type of crane used, which can be an aisle-captive system (one crane for each aisle) or a system with cranes capable of changing aisles providing the possibility to have fewer cranes than aisles. Cranes also can transport one pallet at a time or two loads at a time (double-shuttle cranes). Another AS/RS for pallets are the carriers/lifts systems, which use carriers to move pallets in each rack level, and lifts move pallets vertically to change from one rack level to other, utilize inbound and outbound buffers to move pallets following FIFO and LIFO movements. Likewise, AS/RS for pallets can be connected to an AS/RS for cartons by using a delayering system where a robot removes one layer of cases through side pressure and vacuum suction with a robotic arm. The carton layers can be sent to another picking system through a conveyor system.

On the other hand, there are robot-based and shuttle-based solutions for handling totes, cartons, bins, trays, and individual items. Some of these picking systems are miniload crane systems, shelf robot systems, one-level shuttle systems, 3D shuttle systems, shuttle grid systems, carousel systems, pick-by-robot systems, and robotic picking cells. A miniload crane system is an aisle-bound cranes system handling bins, trays, cartons or totes instead of full pallets, and is often referred to as an end-of-aisle system; the retrieved products are released on a conveyor system or delivered to human operators and the shuttle of the crane can handle two load handling devices at the same time. The shelf robot system is a rack lifting system that uses a network of barcodes on the floor guiding robots and AGV to navigate the warehouse and bring storage shelves to pickers and points the product to retrieve at the picking station utilizing colored lights. One-level shuttle systems use shuttles in each rack layer (2D shuttle-movement) rather than moving the shelves to a human worker, allowing double-deep storage and using lifts to move bins between rack layers. Moreover, 3D shuttle systems are based on warehouse robots that navigate by climbing shelves to collect orders, therefore, this free navigation system allows the robots to travel anywhere within the system (3D shuttle-movement) avoiding the use of lifts.

The shuttle grid systems consist of several robots working and moving along a grid system and shuttles move above racks retrieving bins from crates on the grid, which implies a compact storage system without aisles. Another automatic picking solution is the carousel system consisting of rotating racks (columns), and each level of a rack contains several levels and a bin in each layer. This picking system can be used as a stand-alone system or combined with other warehousing systems such as pick-to-tote systems and pick-to-light systems. Vertical lift systems are a goods-to-man concept for high-value items consisting of shelves rotating vertically containing several bins or cartons in each layer. The rotapick system is a vertical lift variation consisting of several independent modules rotating vertically and containing a bin or carton in each layer. The pick-by-robot system is based on mobile autonomous robots navigating and locating products by the use of 3D vision. Robots navigate to the shelf, pick the ordered items, put them in its on-board storage, and bring products to a picking wagon or directly to the shipping station. Similarly, in robotic picking cells, a robotic arm picks boxes from pallets and flowracks or picks individual items from bins and totes. These robotic arms use 2D and 3D visions systems and a suction and vacuum system to grab products that are released to conveyors or picking cases.

Generally, automatic picking systems offer several benefits such as maximum space usage (high-density storage), high throughput, high picking accuracy, real-time inventory, safer operations, improve inventory reliability, and improve workers conditions by automating repetitive tasks, allowing workers to focus on more rewarding value-added activities and the more complex tasks. Therefore, automatic picking systems can be an ideal solution for highly dynamic warehousing handling pallets, bins, cartons or products without the interference of an operator, especially when high accuracy of orders fulfillment, high picking speed, and labor costs reduction are required as the main targets. However, parts-to-picker systems present some disadvantages related to high investments costs, less flexibility and higher investments in control systems, therefore, for many companies, it is unfeasible to assume the implementation of an automated picking system. Additionally, the volume of products, number, and frequency of customer orders, and product unit costs neither justify the implementation of automatic systems, which leads to preferring the optimization of operations in manual warehouses.

Picker-to-Parts Systems (Manual Picking)

Despite efforts to automate picking processes, the use of human operators has prevailed on a large scale in practice (Henn & Schmid, 2013). Manual labor continues to be an important factor in warehouses, as human pickers can perform picking tasks with flexibility not yet available in automated systems (Lee et al., 2015). Additionally, low labor costs make the implementation of parts-to-picker systems in certain countries and regions still unviable. Even, recent estimates suggest that up to 80% of warehouses are operated manually, where the operator must move (driving or walking) through the warehouse to extract items from storage positions (Grosse, Glock, & Neumann, 2017). The main operating problems in picker-to-part systems are related to the assignment of products to storage locations, the grouping of customer orders in picking orders (i.e., order batching problem), and planning routes for pickers in the warehouse (i.e., picker routing problem) (Koch & Wäscher, 2016). The solutions of these order-picking problems are provided to pickers (operators) by using technologies such as RFID terminals, pick-to-voice systems, and pick-to-light systems that guide operators to perform optimal tasks, thus minimizing traveled distance, picking time, and operating costs.

The picker routing problem (PRP) has been considered as a traveling salesman problem (TSP) (Cano, Correa-Espinal, & Gómez-Montoya, 2019, 2017) that plans the shortest tour to minimize the travel time and distance and provides a route to recover all items in a picking list (Cheng et al., 2015). The PRP has also been addressed as a vehicle routing problem, in which the routes of the picking vehicles in the warehouse are designed such that the picking vehicle must deliver the products demanded by picking lists at the depot while minimizing the total cost of the route (Lin, Kang, Hou, & Cheng, 2016). In the industry, the PRP is solved utilizing commercial WMS and ERP systems which usually focus on transactions but not on process optimization. This leads to planning routing operations based on simple and empirical routing rules that do not provide efficient performance in terms of reducing travel distances and travel times. In many cases, the WMS and ERP systems become "black boxes" for warehouse managers, not knowing how the sequencing of picking positions works. In the worst case, some warehouse information systems do not suggest a picking route, so routing planning is based on the empiricism of pickers who decide how to visit picking positions based on the picking lists assigned to them. All this generates the need to create efficient algorithms that are easy to implement or integrate with WMS and ERP systems, bringing these information systems closer to the optimization of warehouse operations.

In order to obtain an optimal solution for the PRP, as the storage locations increase the solution time drastically increases and provides unfeasible computing times (Chen et al., 2015). Therefore, to solve the PRP, different routing strategies have been used, such as the combined, largest gap, and s-shape policies (Koch & Wäscher, 2016). Solutions based on metaheuristics have also been designed, such as the use of genetic algorithms (Cano, Correa-Espinal, Gómez-Montoya, & Cortés, 2019; Schrotenboer, Wruck, Roodbergen, Veenstra, & Dijkstra, 2017), ant colony optimization (De Santis, Montanari, Vignali, & Bottani, 2018), particle swarm optimization (Gómez-Montoya, Correa-Espinal, & Hernández-Vahos, 2016; Lin et al., 2016), and simulated annealing (Grosse, Glock, & Ballester-Ripoll, 2014). However, metaheuristics require high computational efforts and consume considerably more computing time than heuristics (Cano, Gomez, & Salazar, 2017), which must be considered for possible integration of the PRP with other order picking problems, such as order batching, batch sequencing, and batch assignment (Cano, Correa-Espinal, & Gómez-Montoya, 2018a).

Therefore, this chapter aims to evaluate the performance of different routing policies to determine the minimum total traveled distance for several warehouse layouts and pick-list sizes. Furthermore, a routing heuristic that integrates the most important features of the evaluated routing policies is proposed. The approaches developed here contribute to improving the practice of small, medium, and large-scale picker routing problems in warehouses. The remainder of this chapter is organized as follows. A discussion of the background related to the PRP and picking routing policies is presented in Section 2. In Section 3, a routing heuristic is proposed to minimize the total traveled distance in multiple parallel-aisle warehouses and the experimental design used to test the proposed routing heuristic is described. The resulting solutions obtained using the proposed heuristic are then discussed in Section 4. Suggestions for the direction of future work and conclusions are finally presented in Section 5 and Section 6, respectively.

BACKGROUND

The PRP minimizes the traveled distance by a picker in a tour to recover the items of the customer orders (Cano, Correa-Espinal, & Gómez-Montoya, 2018b). The PRP involves sequencing storage locations to visit on a pick list to generate a tour guiding pickers from the depot to the necessary storage locations and then returning to the depot (Hwang, Oh, & Lee, 2004). Generally, the tours generated to retrieve customer orders are supported by material-handling systems and are determined by routing strategies to minimize the traveled distance (Petersen & Aase, 2004).

The PRP is considered as a traditional TSP by calculating the minimum distance between all storage locations. In low-level picker-to-parts systems, the minimum distance between locations *i* and *j* (d_{ij}) can be previously calculated to solve the TSP as a Steiner TSP (STSP) (Cano et al., 2019). An STSP aims to find the shortest tour visiting a subset of vertices at least once (Valle, Beasley, & Salles da Cunha, 2016), and, unlike a classic TSP, it allows for some nodes to not be visited (storage locations) and other nodes (aisle extremes) to be visited more than once (Çelik & Süral, 2016).

To reduce computing times in a TSP for the PRP, the Manhattan distance between storage positions *i* and *j* (d_{ij}) is calculated in a matrix, considering the warehouse layout. A single-block 2D-warehouse is presented in Figure 3, where the coordinate of the lower-left corner of the warehouse is defined as $(0, B)$ (bottom of warehouse), the coordinate of the upper left corner of the warehouse is considered as $(0, T)$ (top of warehouse), and any pair of storage locations *i* and *j* are represented by their *x* and *y* coordinates, so that $i = (x_i, y_i)$ and $j = (x_j, y_j)$. Thus, the distance between two locations in 2D-warehouses is computed using Equation (1), which was formulated by Cano, Correa-Espinal, et al. (2017) and modified from Tsai, Liou, and Huang (2008).

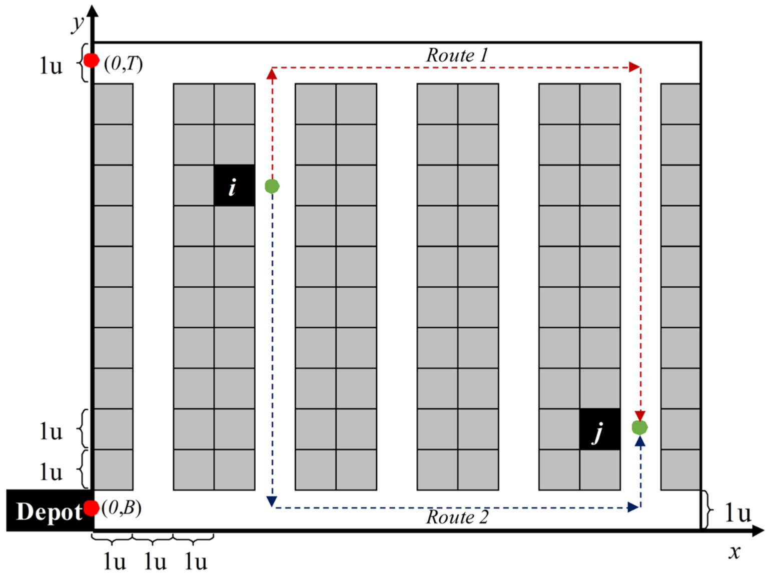
$$d_{ij} = \begin{cases} |x_i - x_j| + |y_i - y_j| & \text{if } i \text{and } j \text{ belong to he same aisle} \\ |x_i - x_j| + min\{|y_i - T| + |T - y_j|, |y_i - B| + |B - y_j|\} & \text{otherwise} \end{cases} \quad for 1 \le i \ne j \le L \tag{1}$$

Equation (2) is applied to calculate the travel time between locations *i* and *j* (t_{ij}), calculate the travel time between two storage positions *i* and *j* (t_{ij}), being V_h the speed of the picking device.

$$t_{ij} = \begin{cases} \dfrac{|x_i - x_j| + |y_i - y_j|}{V_h} & \text{if } i \text{and } j \text{ belong to the same aisle} \\ \dfrac{|x_i - x_j| + min\{|y_i - T| + |T - y_j|, |y_i - B| + |B - y_j|\}}{V_h} & \text{otherwise} \end{cases} \quad for 1 \le i \ne j \le L \tag{2}$$

For example, the distance between the storage positions *i* and *j* in Figure 3 using Route 1 would be 21 distance units, whereas Route 2 provides a distance between the same two positions of 19 distance units. Equation (1) ensures the shortest distance between two storage locations or 19 distance units in this case.

Figure 3. Layout of a single-block 2D-warehouse



Based on the proposals of Cano et al. (2019) using Equation (1) to minimize the total traveled distance or considering Equation (2) to minimize total traveled time, the PRP can be formulated as a TSP as follows:

Indices, sets, and parameters

$i, j \in L$ Storage locations

$S \subset L$ Subset of storage locations

d_{ij} Distance between position *i* and *j*

Decision variables

$$Y_{ij} = \begin{cases} 1, if\ a\ tour\ visits\ i\ just\ after\ visiting\ j \\ 0\ otherwise \end{cases}$$

$$Z_{i} = \begin{cases} 1, if\ a\ tour\ visits\ storage\ location\ i\ to\ retrieve\ an\ item \\ 0, otherwise \end{cases}$$

Model formulation

$$Min\ Z = \sum_{i \neq j \in L} \sum_{j \neq i \in L} d_{ij} * Y_{ij} \quad (3)$$

$$\sum_{j \in L,\ j \neq i} Y_{ij} = Z_i \qquad i \in L \tag{4}$$

$$\sum_{i \in L,\ i \neq j} Y_{ij} = Z_j \qquad j \in L \tag{5}$$

$$\sum_{i \in S,\ j \in L \setminus S} Y_{ij} \geq Z_i \qquad S \subset L \tag{6}$$

$$Y_{ij}, Z_i \in \{0,1\}\ \forall i \in L, j \in L \tag{7}$$

The objective function set in Equation (3) minimizes the total traveled distance in a tour. Equation (4) and Equation (5) ensure that each storage location can only be the starting or destination point once in each batch, and they enforce that each storage location can be visited only once in each batch. Similarly, Equation (6) prevents any routing with subsidiary loops. Equation (7) defines the variable domains. Likewise, this model involves $|L| + |L|^2$ binary variables, zero continuous variables, and $2|L| + 2|L|^2$ constraints. The number of constraints is highly affected by the constraint set in Equation (6). As the number of positions increases in an STSP, the solution time becomes infeasible (Cano, Gomez, et al., 2017). Then, the router picking problem is classified as an NP-hard combinatorial optimization problem (Li et al., 2017), which is generally unsolvable in polynomial time (Albareda-Sambola et al., 2009). Because of this, routing policies and heuristic procedures are often implemented rather than exact solutions to find the most appropriate routes for order picking.

Routing Policies for the Picker Routing Problem

Routing policies define the sequence in which an order picker retrieves items from storage locations, specifying the sequence in which items have to be picked and aisles have to be visited (Elbert, Franzke, Glock, & Grosse, 2016). Likewise, routing policies are fast to memorize, easy to follow, simple, and intuitive to the order picker (Cano et al., 2018a). Therefore, routing policies help reduce the risk of missing an item to be picked (Henn, Koch, Doerner, Strauss, & Wäscher, 2010) and reduce mistakes or deviations from the specified routes (Gademann & van de Velde, 2005). Unlike optimal solutions and sophisticated algorithms, routing policies provide logical routes to order pickers, allowing them to follow an easy-to-remember pattern (Grosse et al., 2014), and prevent the policies from being perceived as black boxes (Gademann & van de Velde, 2005). Additionally, as the routing problem cannot be optimally solved for large problems, especially as the number of picking aisles or the pick-list size increases, the use of routing policies provide a practical implementation benefit (van Gils, Ramaekers, Braekers, Depaire, & Caris, 2017).

Several straightforward routing policies have been proposed as an alternative to the optimal route (van Gils, Braekers, Ramaekers, Depaire, & Caris, 2016). The most common routing policies in are s-shaped, largest gap, midpoint, return, aisle-by-aisle, and composite policies (Cano, Correa-Espinal, et al., 2017); each of these routing policies are described below.

S-shape Policy

One of the simplest routing policy is the s-shape or traversal policy (Petersen, 1999). Here a picker begins at the depot, traverses every picking aisle and then ends at the depot (van Gils et al., 2016). Thereby, order pickers follow an s-shaped pattern, traversing all aisles containing items to be retrieved. For the last visited aisle, the picker returns to the front cross-aisle only when the number of picking aisles is odd (Theys, Bräysy, Dullaert, & Raa, 2010).

Largest Gap Policy

Under the largest gap routing policy, all aisles containing an item to be picked are exited on the same side as they were entered (Dukic & Oluic, 2007), except for the first and last aisle visited. The largest gap is the distance between two picking positions within an aisles, between the first picking position and the top cross-aisle, or between the last picking position and the bottom cross-aisle (Petersen, 1999). After identifying the largest gap in a picking aisle, the picker doesn't cross this part of the aisle, thus, a picker enters an aisle as far as the start of the largest gap within an aisle performing a return when the largest gap is defined by two adjacent picking positions (Cano, Gomez, et al., 2017).

Return Policy

In this simple strategy (Petersen, 1997), pickers enter picking aisles from the front aisle (Dukic & Oluic, 2007), perform the picking for items, and return to the front cross-aisle to enter the next picking aisle (Hwang et al., 2004). No single-aisle is entirely crossed (Theys et al., 2010).

Midpoint Policy

The midpoint routing policy divides picking aisles at its midpoint. The picker accesses a picking aisle only as far as the midpoint, then returns to the cross-aisle used to enter to this picking aisle (van Gils et al., 2016). This routing policy traverses the first and last picking aisles (Dukic & Oluic, 2007). An aisle can be visited again from the opposite cross-aisle depending on the items to be picked in this aisle.

Aisle-by-Aisle Policy

In the aisle-by-aisle heuristic proposed by Vaughan and Petersen (1999) for multi-block warehouses, each aisle is visited only once, i.e., all items in the first picking aisle are picked, then all in the second, and so on (Matusiak, 2014). Hence, all picking locations within an aisle are visited before changing to the next picking aisle. As such, this routing policy is considered as a lateral heuristic (Theys et al., 2010). After reaching the rightmost picking aisle, the picker moves to the depot. In the aisle-by-aisle heuristic, the decision to entirely traverse an aisle or enter and leave it via the same cross-aisle is derived through dynamic programming (Scholz and Wäscher, 2017).

Composite Policy

The composite policy minimizes the travel distance between the furthest picking locations in two contiguous aisles following the principles of the s-shape and return policies (Dukic & Oluic, 2007). The minimum distance generated between the last picked item and the next item determines if the traverse policy or the return policy is preferred for each picking aisle (Petersen, 1999; Theys et al., 2010).

Each of these routing policies has special characteristics that make them operate properly under certain circumstances. The s-shape and the largest gap policies are the most commonly used policies in real warehouses since order pickers are more inclined to follow straightforward routing schemes (Henn, 2012). Likewise, return and midpoint policies are prevalent in practice due to their ease of application

(Hwang et al., 2004). However, according to Petersen (1997), the return policy is ineffective for all pick-list sizes. Similarly, Dukic and Oluic (2007) determined that the return policy has the worst performance when compared to other routing strategies. Van Gils et al. (2016) also concluded that return and aisle-by-aisle policies are outperformed by other routing policies. Rather, the largest gap policy, which minimized the distance traveled within each aisle, is preferred to return policies.

It is, therefore, necessary to study the best performing routing policies to generate robust solutions to any warehouse configuration, pick-list size, the density of picking locations, and distribution of items in a warehouse. Therefore, a routing heuristic is proposed based on the composite, largest gap, and s-shape routing policies, each chosen for their straightforward routing schemes and good performance in prior studies.

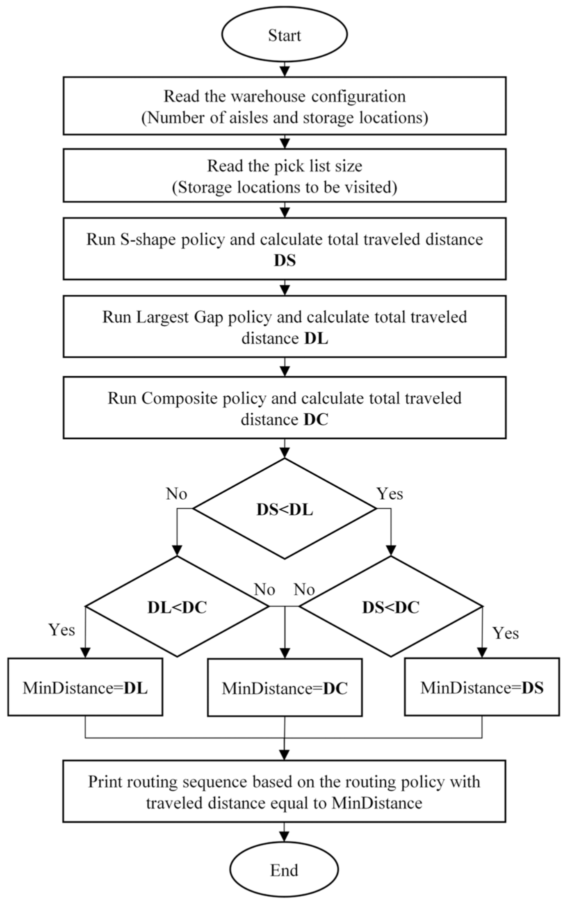
PROPOSED MODEL AND ASSUMPTIONS

A simple heuristic based on the s-shape, largest gap, and composite strategies, designated as the SLC heuristic, was therefore proposed to solve the PRP for any warehouse layout and pick-list size. The proposed heuristic chooses the route generated by the routing policy with the minimum total traveled distance. A logic flowchart of SLC heuristic that describes the procedure to select the route to be followed by pickers is presented in Figure 4.

The computing time of the SLC heuristic therefore directly depends on the computing time of the composite, largest gap, and s-shape routing policies and guarantees the minimum traveled distance between the most commonly used routing policies in the literature utilizing a simple procedure. Furthermore, the SLC heuristic was expected to provide a more robust solution than those obtained with a particular routing policy, since the performance of the individual routing policies used tend fluctuates according to warehouse configuration and pick-list size. The following practical assumptions were made during performance testing for each of the chosen routing policies and the SLC heuristic:

- The capacity of the picking device is greater than the pick-list size.
- Picking devices have a homogenous velocity and load capacity.
- Random storage assignment is used.
- The depot is the starting and destination node in a tour.
- Only one type of item can be stored in each storage location.
- Warehouse layouts are based on multiple parallel aisles and two cross-aisles.
- The distance between the sides of a picking aisle is negligible.

Figure 4. Flowchart of proposed SLC heuristic



- The width and depth of each storage location are both 1 m.
- Each aisle and cross-aisle is 1 m in width.
- Congestion or picker blocking is not considered.

The above assumptions regarding warehouse configuration are shown in Figure 5 when the s-shape policy is applied.

Simulation experiments using warehouse configurations chosen from prior works (see Table 1) were then performed to compare the s-shape, largest gap, composite, and SLC heuristic routing methods in several warehouse layouts and pick-list sizes.

As shown above, the warehouse configurations were sorted according to the number of aisles (*NA*), locations per aisle side (*LS*), storage locations (*SL*), and warehouse area (*WA*). Given *NA* and *LS*, a total number of *SL* can be calculated in a parallel-aisle warehouse using Equation (8); e.g., a warehouse with 5 aisles and 10 SL per aisle side contains 100 SL.

$$LS = a \times 2lps \tag{8}$$

Figure 5. Warehouse configuration and s-shape policy

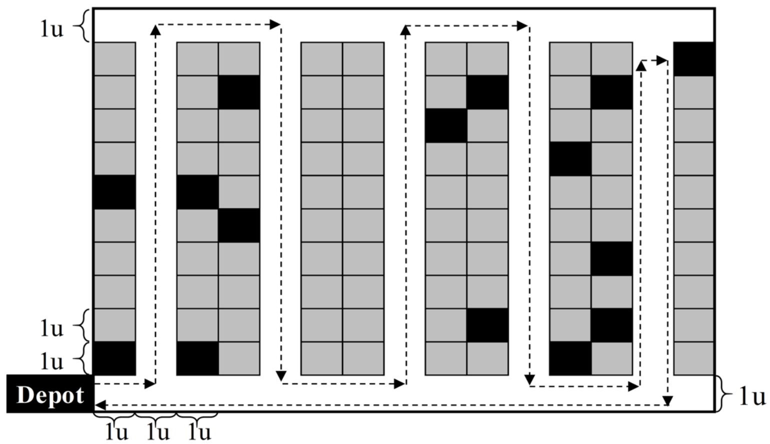


Table 1. Warehouse configurations proposed in the literature

Layout	NA	LS	SL	WA (m^2)	Authors
1	5	10	100	180	(Hsu, Chen, & Chen, 2005; Kulak, Sahin, & Taner, 2012)
2	4	30	240	384	(Albareda-Sambola et al., 2009; De Koster, Van Der Poort, & Wolters, 1999)
3	10	20	400	660	(Albareda-Sambola et al., 2009; De Koster et al., 1999)
4	10	45	900	1,410	(Henn et al., 2010; Henn, 2012)
5	25	25	1,250	2,025	(Albareda-Sambola et al., 2009; De Koster et al., 1999)

The pick-list size is computed as a percentage of *SL* and is thus proportional to the size of the warehouse. The pick-list sizes used corresponded to 5%, 10%, 15%, 20%, and 25% of the number of SL of each selected warehouse configuration, i.e., 100 simulation scenarios were provided by the five warehouse configurations, five pick-list sizes, and four routing methods studied (5 x 5 x 4). Then, 1,000 replications were performed for each scenario to provide reliable information, creating a total of 100,000 instances. The results were then analyzed in terms of their average traveled distance for each routing policy and the generated savings by the SLC heuristic over the other routing policies. The routing policy heuristics and other factors for the experimental runs were coded in Visual Basic for Applications for Microsoft Excel® 2017 on a 2.8 gigahertz CPU with 8 GB memory.

The performance of the proposed SLC heuristic was measured using Equation (9), comparing the total travel distance provided by the SLC heuristic and the routing policies.

$$Savings = \frac{Routing\, policy\, performance - SLC\, heuristic\, performance}{Routing\, policy\, performance} \tag{9}$$

SOLUTIONS AND RECOMMENDATIONS

A summary of the results for the evaluated instances is shown in Table 2, where the composite routing presents the best performance on average traveled distance (295 m) for the different instances of warehouse layouts and pick-list sizes. Similarly, the composite policy presents the lowest value of the maximum distances generated in all the scenarios when compared to the largest gap and s-shape; these values correspond to the scenario where the pick-list size is equal to 25% of the SL for layout 5. Regarding the minimum distance generated, the three routing policies present the same value, which corresponds to a pick-list size equal to 5% of the SL for layout 1.

Additionally, the SLC heuristic presented a 30.3% distance savings over the largest gap policy and lower but significant savings over the composite policy (10.9%). Moreover, the SLC heuristic did not present savings on the evaluated policies in some of the evaluated scenarios, which means that the composite, largest gap or s-shape policy were used in the SLC heuristic as a reference to select the route of minimum distance. These results indicate that no routing policy was found to be superior for every instance. Rather, under certain conditions, each policy has a good performance but when warehouse configuration or pick-list size change, the performance may decrease.

The composite (CO), largest gap (LG) and s-shape (SS) policies provided a similar average traveled distance for the small to medium-sized layouts of layouts 1, 2, and 3 (from 100 to 400 SL), as shown in Figure 6. The difference in the average traveled distance became more noticeable for the larger layouts with 900 and 1,250 SL (layouts 4 and 5), as the composite policy demonstrated a lower traveled distance, followed by the s-shape and LG policies.

As such, Figure 7 shows that the SLC heuristic generated greater savings over the s-shape and LG policies than for the composite policy.

The LG policy presented the lowest average distance for small pick-list sizes (5%, 10%), whereas the composite and s-shape policies showed better performance on average traveled distance for large pick-list sizes (20%, 25%), as shown in Figure 8.

As shown in Figure 9, the SLC heuristic provided greater savings over the s-shape policy for small pick-list sizes and greater savings over the LG policy for large pick-list sizes. The composite policy presented a balanced performance when compared with the s-shape and LG; hence, the SLC heuristic generated moderate savings on the average traveled distance over the composite policy.

Based on these results, the composite policy offers more consistent performance for the experimental scenarios compared with the s-shape and LG policies. Besides, none of the routing policies generated the shortest travel distance for each evaluated instance. As such, it is recommended to simultaneously test

Table 2. Overall results from the routing policies

Performance measures	Composite	Largest Gap	S-shape
Average travelled distance	295	325	312
Max travelled distance	815	1.072	818
Min travelled distance	26	26	26
SLC heuristic average savings	3.7%	7.8%	9.4%
Max Savings	10.9%	30.3%	25.0%
Min Savings	0.0%	0.0%	0.0%

Figure 6. Traveled distance by warehouse configuration (layout)

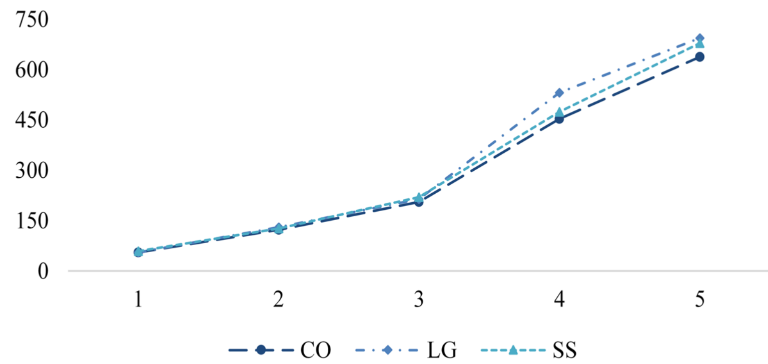


Figure 7. SLC heuristic savings by warehouse configuration (layout)

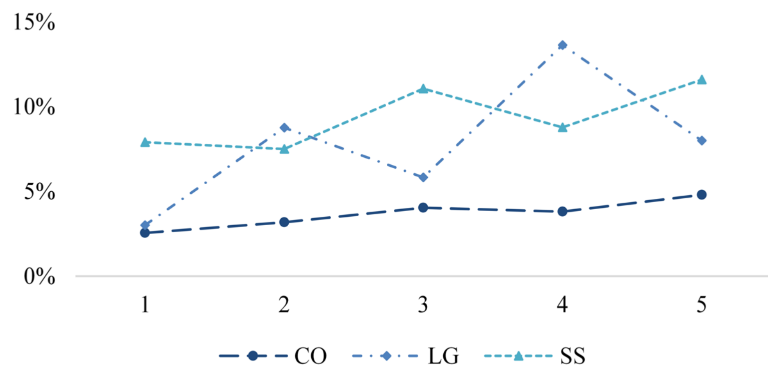
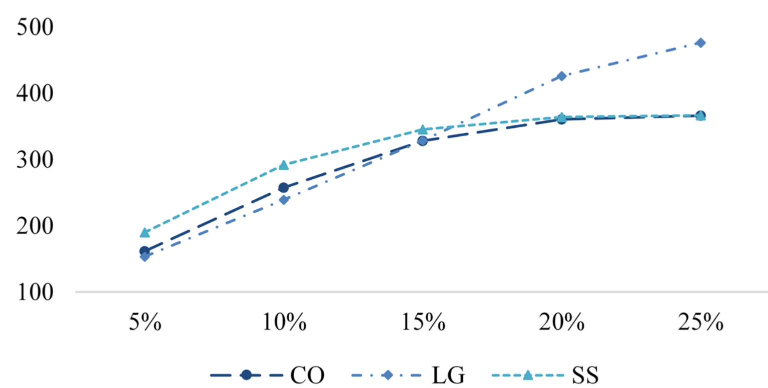
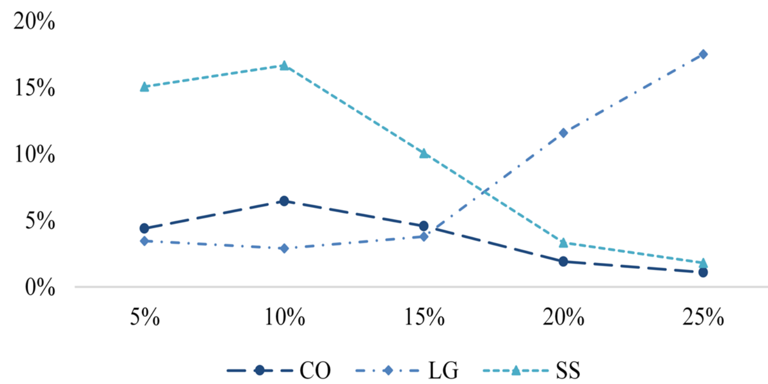


Figure 8. Traveled distance by pick-list size



these routing policies, as the proposed SLC heuristic does to obtain reliable and good quality solutions for any warehouse configuration and pick-list size. The proposed SLC heuristic offered an average savings of 7% of the traveled distance when compared with the routing policies evaluated, and a savings of around 30% for large layouts and picking list sizes when compared with the LG policy. Consequently, the

Figure 9. SLC heuristic savings by pick-list size



proposed SLC heuristic allows warehouse managers to determine the shortest travel distance taking into account picking policies, layout configurations, and pick-list sizes, optimizing the overall performance of warehouses and distribution centers.

Since the travel time is a function of traveled distance when considering constant velocity for picking devices, the SLC heuristic is a well-performing solution method to minimize the picking time in warehouses, supporting the improvement of customer service objectives, such as the completion time and tardiness. Likewise, as the proposed routing method is based on routing policies, the computing time of the SLC heuristic can be neglected, since the computing time for all experimental runs was 37 milliseconds on average. Therefore, the proposed routing heuristic is recommended for use in daily operations in warehouses and distribution centers, providing good quality solutions in short computing times and generating easy routing patterns.

For the successful implementation of the SLC heuristic in real warehouse environments, it is recommended to integrate it into the current WMS by coding the algorithms of the s-shape, largest gap, and composite policies, and choosing for each picking list the routing policy providing the shortest travel distance, or it can also be done by exporting the storage positions to visit on each tour from the WMS to a .cvs or .txt file and execute the SLC heuristic in a programming language such as VBA, C++, Java, or Python, and then import to the WMS the sequence of the picking positions to be visited. It is very important to emphasize that the SLC heuristic must be previously parameterized with the specific measures of the warehouse with respect to the number and width of aisles, width and depth of racks, number of storage locations per aisle side, so that the algorithm generates the minimum travel distance according to the current warehouse configuration. Once the picking route is obtained, these instructions can be transmitted to the pickers through RFID terminals or pick-to-voice systems, where pickers are forced to follow the suggested picking routes, showing only one picking location to visit at a time, which is enabled after retrieving the items of the current picking location.

FUTURE RESEARCH DIRECTIONS

Both practitioners and academic researchers in warehouse management are recommended to implement the proposed SLC heuristic in order batching models that currently use a single heuristic routing policy, thus grouping customer orders in batches to plan the best routing according to the warehouse size and the number of SL to visit in a tour. Likewise, a promising research area is related to the use of the SLC heuristic in warehouse environments considering horizontal and vertical movements and multiple blocks.

It is also recommended considering due dates in customer orders, facilitating the creation of multi-objective models to minimize the tardiness and total picking time, prioritizing the attention of the customers' requirements, and using warehouse resources efficiently. Thus, minimizing the total travel time using the SLC heuristic would allow the creation of multi-objective order picking models, providing an adequate balance between efficiency and customer service.

CONCLUSION

In this chapter, a performance evaluation of a proposed routing heuristic (SLC) based on the s-shape, LG, and combined routing policies was conducted. Since no routing policy achieved the best performance on all tested instances, the SLC heuristic was shown to guarantee the minimum travel distance offered by s-shape, LG and composite policies for any warehouse configuration and pick-list size, providing an average reduction of 7% of the traveled distance for all evaluated instances. Likewise, the distance reductions become more prominent as the warehouse size and picking list size increased, providing up to 30.3% savings when comparing the SLC heuristic with the LG policy.

On the other hand, the s-shape policy was shown to achieve the lowest total traveled distance when the picking list size was large, requiring that 20%–25% of the SL of a warehouse per tour be visited. On the contrary, the LG policy performed well when the picking list size was small, requiring only 5%–10% of the SL of a warehouse be visited per tour. However, both the s-shape and LG policies were very susceptible to performance changes as the picking list size changed. In contrast, the composite policy presented a steadier and less fluctuating performance for different warehouse and picking list sizes.

The proposed routing heuristic allows highlighting the best benefits of each routing policy by solving the discussion about which policy performs better and which should be used according to the configuration and size of the warehouse, and the number and distribution of picking locations. All this is achieved by simultaneously using the routing policies and deciding which provides more efficient results according to the conditions of each tour. Similarly, the SLC heuristic is an efficient solution method that consumes very short computing time, which can easily be adapted to any WMS or ERP for its conceptual and programming simplicity.

ACKNOWLEDGMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

Albareda-Sambola, M., Alonso-Ayuso, A., Molina, E., & De Blas, C. S. (2009). Variable neighborhood search for order batching in a warehouse. *Asia-Pacific Journal of Operational Research*, *26*(5), 655–683. doi:10.1142/S0217595909002390

Bartholdi, J. J., & Hackman, S. T. (2014). *Warehouse & Distribution Science Release 0.96 (0*.96th ed.). Atlanta, GA: Georgia Institute of Technology, School of Industrial and Systems Engineering, The Supply Chain and Logistics Institute.

Bozer, Y. A., & Kile, J. W. (2008). Order batching in walk-and-pick order picking systems. *International Journal of Production Research*, *46*(7), 1887–1909. doi:10.1080/00207540600920850

Cano, J. A., Correa-Espinal, A., & Gómez-Montoya, R. A. (2018b). Solución del problema de conformación de lotes en almacenes utilizando algoritmos genéticos. *Información Tecnológica*, *29*(6), 235–244. doi:10.4067/S0718-07642018000600235

Cano, J. A., Correa-Espinal, A. A., & Gómez-Montoya, R. A. (2017). An evaluation of picking routing policies to improve warehouse efficiency. *International Journal of Industrial Engineering and Management*, *8*(4), 229–238.

Cano, J. A., Correa-Espinal, A. A., & Gómez-Montoya, R. A. (2018a). A review of research trends in order batching, sequencing, and picker routing problems. *Espacios*, *39*(4), 3.

Cano, J. A., Correa-Espinal, A. A., & Gómez-Montoya, R. A. (2019). Mathematical programming modeling for joint order batching, sequencing and picker routing problems in manual order picking systems. *Journal of King Saud University - Engineering and Science*.

Cano, J. A., Correa-Espinal, A. A., Gómez-Montoya, R. A., & Cortés, P. (2019). Genetic algorithms for the picker routing problem in multi-block warehouses. In W. Abramowicz, & R. Corchuelo (Eds.), *Lecture notes in business information processing* (Vol. 353, pp. 313–322). Cham, Switzerland: Springer.

Cano, J. A., Gomez, R. A., & Salazar, F. (2017). Routing policies in multi-parallel warehouses: An analysis of computing times. *Espacios*, *38*(51), 23.

Çelik, M., & Süral, H. (2016). Order picking in a parallel-aisle warehouse with turn penalties. *International Journal of Production Research*, *54*(14), 4340–4355. doi:10.1080/00207543.2016.1154624

Centeno, M. A., & Sundaram, R. (2004). Considering due time in manual order picking operations. In *IIE Annual Conference and Exhibition 2004* (pp. 1215–1220). Houston, TX.

Chen, M.-C., Huang, C.-L., Chen, K.-Y., & Wu, H.-P. (2005). Aggregation of orders in distribution centers using data mining. *Expert Systems with Applications*, *28*(3), 453–460. doi:10.1016/j.eswa.2004.12.006

Chen, T. L., Cheng, C. Y., Chen, Y. Y., & Chan, L. K. (2015). An efficient hybrid algorithm for integrated order batching, sequencing and routing problem. *International Journal of Production Economics*, *159*, 158–167. doi:10.1016/j.ijpe.2014.09.029

Cheng, C.-Y., Chen, Y.-Y., Chen, T.-L., & Yoo, J. J.-W. (2015). Using a hybrid approach based on the particle swarm optimization and ant colony optimization to solve a joint order batching and picker routing problem. *International Journal of Production Economics*, *170*, 1–10. doi:10.1016/j.ijpe.2015.03.021

Dallari, F., Marchet, G., & Melacini, M. (2009). Design of order picking system. *International Journal of Advanced Manufacturing Technology*, *42*(1-2), 1–12. doi:10.100700170-008-1571-9

De Koster, R., Le-Duc, T., & Roodbergen, K. J. (2007). Design and control of warehouse order picking: A literature review. *European Journal of Operational Research*, *182*(2), 481–501. doi:10.1016/j.ejor.2006.07.009

De Koster, R., Van Der Poort, E. S., & Wolters, M. (1999). Efficient orderbatching methods in warehouses. *International Journal of Production Research*, *37*(7), 1479–1504. doi:10.1080/002075499191094

De Santis, R., Montanari, R., Vignali, G., & Bottani, E. (2018). An adapted ant colony optimization algorithm for the minimization of the travel distance of pickers in manual warehouses. *European Journal of Operational Research*, *267*(1), 120–137. doi:10.1016/j.ejor.2017.11.017

Dukic, G., & Oluic, C. (2007). Order-picking methods: Improving order-picking efficiency. *International Journal of Logistics Systems and Management*, *3*(4), 451–460. doi:10.1504/IJLSM.2007.013214

Elbert, R. M., Franzke, T., Glock, C. H., & Grosse, E. H. (2016). The effects of human behavior on the efficiency of routing policies in order picking: The case of route deviations. *Computers & Industrial Engineering*, *111*(1), 537–551.

Gademann, N., & van de Velde, S. (2005). Order batching to minimize total travel time in a parallel-aisle warehouse. *IIE Transactions*, *37*(1), 63–75. doi:10.1080/07408170590516917

Gómez-Montoya, R. A., Cano, J. A., & Campo, E. A. (2018). Efficient slotting management in an agribusiness distribution center. *Espacios*, *39*(16), 23.

Gómez-Montoya, R. A., Correa-Espinal, A. A., & Hernández-Vahos, J. D. (2016). Picking routing problem with K homogenous material handling equipment for a refrigerated warehouse. *Revista de la Facultad de Ingeniería*, (80): 9–20.

Grosse, E. H., Glock, C. H., & Ballester-Ripoll, R. (2014). A simulated annealing approach for the joint order batching and order picker routing problem with weight restrictions. *International Journal of Operations and Quantitative Management*, *20*(2), 65–83.

Grosse, E. H., Glock, C. H., & Neumann, W. P. (2017). Human factors in order picking: A content analysis of the literature. *International Journal of Production Research*, *55*(5), 1260–1276. doi:10.1080/00207543.2016.1186296

Gu, J., Goetschalckx, M., & McGinnis, L. F. (2007). Research on warehouse operation: A comprehensive review. *European Journal of Operational Research*, *177*(1), 1–21. doi:10.1016/j.ejor.2006.02.025

Gu, J., Goetschalckx, M., & McGinnis, L. F. (2010). Research on warehouse design and performance evaluation: A comprehensive review. *European Journal of Operational Research*, *203*(3), 539–549. doi:10.1016/j.ejor.2009.07.031

Henn, S. (2012). Algorithms for on-line order batching in an order picking warehouse. *Computers & Operations Research*, *39*(11), 2549–2563. doi:10.1016/j.cor.2011.12.019

Henn, S., Koch, S., Doerner, K. F., Strauss, C., & Wäscher, G. (2010). Metaheuristics for the order batching problem in manual order picking systems. *Business Research*, *3*(1), 82–105. doi:10.1007/BF03342717

Henn, S., & Schmid, V. (2013). Metaheuristics for order batching and sequencing in manual order picking systems. *Computers & Industrial Engineering*, *66*(2), 338–351. doi:10.1016/j.cie.2013.07.003

Hsieh, L.-F., & Huang, Y.-C. (2011). New batch construction heuristics to optimise the performance of order picking systems. *International Journal of Production Economics*, *131*(2), 618–630. doi:10.1016/j.ijpe.2011.02.006

Hsu, C.-M., Chen, K.-Y., & Chen, M.-C. (2005). Batching orders in warehouses by minimizing travel distance with genetic algorithms. *Computers in Industry*, *56*(2), 169–178. doi:10.1016/j.compind.2004.06.001

Hwang, H., Oh, Y. H., & Lee, Y. K. (2004). An evaluation of routing policies for order-picking operations in low-level picker-to-part system. *International Journal of Production Research*, *42*(18), 3873–3889. doi:10.1080/00207540410001696339

Karásek, J. (2013). An overview of warehouse optimization. *Journal of Advances in Telecommunications, Electrotechnics, Signals, and Systems*, *2*(3), 7.

Koch, S., & Wäscher, G. (2016). A grouping genetic algorithm for the order batching problem in distribution warehouses. *Journal of Business Economics*, *86*(1), 131–153. doi:10.100711573-015-0789-x

Kulak, O., Sahin, Y., & Taner, M. E. (2012). Joint order batching and picker routing in single and multiple-cross-aisle warehouses using cluster-based tabu search algorithms. *Flexible Services and Manufacturing Journal*, *24*(1), 52–80. doi:10.100710696-011-9101-8

Lee, J. A., Chang, Y. S., Shim, H.-J., & Cho, S.-J. (2015). A study on the picking process time. In *6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015* (Vol. 3, pp. 731–738). Las Vegas, NV: Elsevier B.V. 10.1016/j.promfg.2015.07.316

Li, J., Huang, R., & Dai, J. B. (2017). Joint optimisation of order batching and picker routing in the online retailer's warehouse in China. *International Journal of Production Research*, *55*(2), 447–461. doi:10.1080/00207543.2016.1187313

Lin, C.-C., Kang, J.-R., Hou, C.-C., & Cheng, C.-Y. (2016). Joint order batching and picker Manhattan routing problem. *Computers & Industrial Engineering*, *95*, 164–174. doi:10.1016/j.cie.2016.03.009

Manzini, R., Bozer, Y., & Heragu, S. (2015). Decision models for the design, optimization and management of warehousing and material handling systems. *International Journal of Production Economics*, *170*(1), 711–716. doi:10.1016/j.ijpe.2015.08.007

Matusiak, M. (2014). *Optimizing warehouse order batching when routing is precedence constrained and pickers have varying skills.*

Pan, J. C. H., & Wu, M. H. (2012). Throughput analysis for order picking system with multiple pickers and aisle congestion considerations. *Computers & Operations Research*, *39*(7), 1661–1672. doi:10.1016/j.cor.2011.09.022

Petersen, C. G. II. (1997). An evaluation of order picking routeing policies. *International Journal of Operations & Production Management*, *17*(11), 1098–1111. doi:10.1108/01443579710177860

Petersen, C. G. II. (1999). The impact of routing and storage policies on warehouse efficiency. *International Journal of Operations & Production Management*, *19*(10), 1053–1064. doi:10.1108/01443579910287073

Petersen, C. G., & Aase, G. (2004). A comparison of picking, storage, and routing policies in manual order picking. *International Journal of Production Economics*, *92*(1), 11–19. doi:10.1016/j.ijpe.2003.09.006

Prasse, C., Nettstraeter, A., & Ten Hompel, M. (2014). How IoT will change the design and operation of logistics systems. *2014 International Conference on the Internet of Things, IOT 2014*, 55–60. 10.1109/IOT.2014.7030115

Rojas, M., Guisao, E., & Cano, J. A. (2011). *Logística Integral: Una propuesta práctica para su negocio*. Medellín: Universidad de Medellín.

Roodbergen, K. J., & Vis, I. (2006). A model for warehouse layout. [Institute of Industrial Engineers]. *IIE Transactions*, *38*(10), 799–811. doi:10.1080/07408170500494566

Roodbergen, K. J., & Vis, I. F. A. (2009). A survey of literature on automated storage and retrieval systems. *European Journal of Operational Research*, *194*(2), 343–362. doi:10.1016/j.ejor.2008.01.038

Roodbergen, K. J., Vis, I. F. A., & Taylor, G. D. Jr. (2015). Simultaneous determination of warehouse layout and control policies. *International Journal of Production Research*, *53*(11), 3306–3326. doi:10.1080/00207543.2014.978029

Salazar, F., Gomez, R. A., & Cano, J. A. (2017). Pallet loading problem in distribution centers using mixture experiments. *Espacios*, *38*(2), 2.

Scholz, A., & Wäscher, G. (2017). Order batching and picker routing in manual order picking systems: The benefits of integrated routing. *Central European Journal of Operations Research*, *25*(2), 491–520. doi:10.100710100-017-0467-x

Schrotenboer, A. H., Wruck, S., Roodbergen, K. J., Veenstra, M., & Dijkstra, A. S. (2017). Order picker routing with product returns and interaction delays. *International Journal of Production Research*, *55*(21), 6394–6406. doi:10.1080/00207543.2016.1206982

Tejesh, B. S. S., & Neeraja, S. (2018). Warehouse inventory management system using IoT and open source framework. *Alexandria Engineering Journal*, *57*(4), 3817–3823. doi:10.1016/j.aej.2018.02.003

Theys, C., Bräysy, O., Dullaert, W., & Raa, B. (2010). Using a TSP heuristic for routing order pickers in warehouses. *European Journal of Operational Research*, *200*(3), 755–763. doi:10.1016/j.ejor.2009.01.036

Tompkins, J. A., White, J. A., Bozer, Y. A., & Tanchoco, J. M. A. (2010). *Facilities planning* (4th ed.). Hoboken, NJ: Wiley.

Trab, S., Bajic, E., Zouinkhi, A., Abdelkrim, M. N., Chekir, H., & Ltaief, R. H. (2015). Product allocation planning with safety compatibility constraints in IoT-based warehouse. *Procedia Computer Science*, *73*, 290–297. doi:10.1016/j.procs.2015.12.033

Tsai, C.-Y., Liou, J. J. H., & Huang, T.-M. (2008). Using a multiple-GA method to solve the batch picking problem: Considering travel distance and order due time. *International Journal of Production Research*, *46*(22), 6533–6555. doi:10.1080/00207540701441947

Valle, C. A., Beasley, J. E., & Salles da Cunha, A. (2016). Modelling and solving the joint order batching and picker routing problem in inventories. In *International Symposium on Combinatorial Optimization* (Vol. 9849, pp. 81–97). Salerno, Italy: Springer International Publishing. 10.1007/978-3-319-45587-7_8

van Gils, T., Braekers, K., Ramaekers, K., Depaire, B., & Caris, A. (2016). Improving order picking efficiency by analyzing combinations of storage, batching, zoning, and routing policies. In *Proceedings 7th International Conference on Computational Logistics, ICCL 2016*. Hasselt University, Diepenbeek, Belgium: Springer Verlag. 10.1007/978-3-319-44896-1_28

van Gils, T., Ramaekers, K., Braekers, K., Depaire, B., & Caris, A. (2017). Increasing order picking efficiency by integrating storage, batching, zone picking, and routing policy decisions. *International Journal of Production Economics*, *197*(1), 243–261.

Vaughan, T. S., & Petersen, C. G. (1999). The effect of warehouse cross aisles on order picking efficiency. *International Journal of Production Research*, *37*(4), 881–897. doi:10.1080/002075499191580

Zhang, J., Wang, X., Chan, F. T. S., & Ruan, J. (2017). On-line order batching and sequencing problem with multiple pickers: A hybrid rule-based algorithm. *Applied Mathematical Modelling*, *45*(1), 271–284. doi:10.1016/j.apm.2016.12.012

ADDITIONAL READING

Adil, G. K., Muppani, V. R., & Bandyopadhyay, A. (2010). A review of methodologies for class-based storage location assignment in a warehouse. *International Journal of Advanced Operations Management*, *2*(3-4), 274–291. doi:10.1504/IJAOM.2010.038341

Choy, K. L., Sheng, N., Lam, H. Y., Lai, I. K. W., Chow, K. H., & Ho, G. T. S. (2014). Assess the effects of different operations policies on warehousing reliability. *International Journal of Production Research*, *52*(3), 662–678. doi:10.1080/00207543.2013.827807

Damayanti, D. D., Setyawan, E. B., Andrawina, L., & Santosa, B. (2018). Warehouse picking model for single picker routing problem in multi dimensional warehouse layout using genetic algorithm approach to minimize delay. *Advances in Intelligent Systems and Computing*, *700*(1), 124–134. doi:10.1007/978-3-319-72550-5_13

Öncan, T. (2013). A Genetic Algorithm for the Order Batching Problem in low-level picker-to-part warehouse systems. In *Lecture Notes in Engineering and Computer Science* (Vol. 2202, pp. 19–24). Kowloon: Newswood Limited.

Öncan, T. (2015). MILP formulations and an Iterated Local Search Algorithm with Tabu Thresholding for the Order Batching Problem. *European Journal of Operational Research*, *243*(1), 142–155. doi:10.1016/j.ejor.2014.11.025

Ong, J. O., & Joseph, D. T. (2014). A Review of Order Picking Improvement Methods. *J@TI Undip (Jurnal Teknik Industri), 9*(3), 135–138.

Staudt, F. H., Alpan, G., Di Mascolo, M., & Rodriguez, C. M. T. (2015). Warehouse performance measurement: A literature review. *International Journal of Production Research*, *53*(18), 5524–5544. doi: 10.1080/00207543.2015.1030466

van Gils, T., Ramaekers, K., Caris, A., & de Koster, R. B. M. (2018). Designing Efficient Order Picking Systems by Combining Planning Problems: State-of-the-art Classification and Review. *European Journal of Operational Research*, *267*(1), 1–15. doi:10.1016/j.ejor.2017.09.002

Xu, X., Liu, T., Li, K., & Dong, W. (2014). Evaluating order throughput time with variable time window batching. *International Journal of Production Research*, *52*(8), 2232–2242. doi:10.1080/00207543.2013.849009

KEY TERMS AND DEFINITIONS

Depot: A point in a warehouse or distribution center where all picking tours start and end.

Heuristic: Is any approach to problem-solving that employs a practical method, sufficient for reaching an immediate goal within reasonable computing times. A heuristic does not guarantee an optimal solution.

Manhattan Distance: The distance between two points measured along axes at right angles.

Order Picking: Is the process in which the items that were ordered by customers are selected from the warehouse.

Picker Routing Problem: Is the problem in which the traveled distance by a picker in a tour is minimized.

Picking Aisle: Is an aisle in a warehouse containing picking locations, i.e., containing storage locations with items to be picked

Pick List: A set of order lines, where each line denotes an item requested by a customer, the location in the warehouse, and the quantity of such item.

Routing Policy: Is a technique used to make routing decisions in warehouses and distribution centers based on policies set by logical procedures

Traveling Salesman Problem: A problem formulated to find the shortest possible route to visit a given a list of storage positions in a warehouse or distribution center and returning to the depot.

Chapter 6
The Concept of Logistics Performance in International Trade Framework:
An Empirical Evaluation of Logistics Performance Index

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ABSTRACT

An increased need for international logistics has emerged with a higher degree of globalization. The quality of logistics services determines the degree of a country's involvement in global trade. In this chapter, the concept of logistics performance in the international trade context is discussed, then the measurement problems of logistics performance are discussed. The links between logistics, trade, and growth are evaluated theoretically. Policymakers and researchers have been widely using Logistics Performance Index (LPI) developed by the World Bank. LPI provides a general information of logistics costs, customs processes, and the quality of the necessary infrastructure for transportation for each country. In this chapter, the definition, the methodology, and the aspects of the indicator LPI, its content and components, and the relations between LPI and some economic factors such as growth and foreign trade, are elaborated. The econometric modelling methods are used to analyze the relations between LPI and economic factors.

INTRODUCTION

Trade among countries has been growing over the last decades, which was headed by the globalization process. Before the globalization, regional competition was the prevalent economic concerns for countries. With the arising of globalization, countries all over the world has become the real actors of this economic game. Accordingly, the importance of logistics in international trade has been increased. The

DOI: 10.4018/978-1-7998-1397-2.ch006

need for a logistics performance measuring system was then generated since logistics has become one of the main elements of the economic performances of the countries (Martí et. al., 2014; Razzaque, 1997). There has been increasing trend in global logistics even if there are some disparities between developed countries and developing countries. As global changes in demand, industry and related issues has forced governmental interventions and regulations to promote competitiveness of countries in international trade, logistics which is a core working field of trade came forward prominently.

As a country improves its external competitiveness, it will find an opportunity to attain more foreign resources supporting the sustainability of its economic growth and thus enhancing the welfare. Therefore, it is obvious that a functional logistics system stimulating competitiveness has a promoting effect on economic competence. On the contrary, the logistics system running in an inefficient way can generate adverse effects for business by raising the costs; thus, the inefficient logistics structure may cause undesirable consequences for the international and domestic integration. This situation may deteriorate the external conditions of the developing countries that are striving to compete in international arena. Hence, it can be undoubtedly asserted that the degree of competitiveness and the level of economic development of a country are greatly affected by its logistics performance.

In this chapter, first, the concept of logistics performance in the international trade context will be discussed, and then the measurement problems of logistics performance from the same perspective will be handled. Besides, the links between logistics, trade, and growth are to be evaluated theoretically. The definition, the methodology and the aspects of the indicator Logistics Performance Index presented by the World Bank, its content and components, the relations between LPI and some economic factors such as growth, foreign trade, competitiveness are all to be elaborated. Furthermore, the econometric modelling techniques will be used to analyze the relations between LPI and the economic factors.

LITERATURE REVIEW

An increased need for international freight transportation and thus international logistics has emerged with a higher degree of globalization. The efficiency of moving goods across and within borders is directly related to logistics. The participating manners of countries in international marketplace has been shaped by their performance in this area. It can be said that the pillars of global trade are logistics since the supply chains are being diversified globally. The quality of logistics services determines the degree of a country's involvement in global trade. The influential countries in today's international trade are the ones who have managed to impose significant logistics-related reforms. While developing countries have made notable progress in this field in recent years, their logistics performances are comparatively inadequate. The lack of substantial reforms in some countries has been claimed as the sources of the differences in logistics performances between high and low-income countries. Moreover, logistics performances of countries are significantly related to economic growth and competitiveness in global trade. Countries having inefficient logistics services are likely to be exposed to higher costs of doing business. This situation implies financial barriers to the efficient integration of the countries with international value chains. Additionally, the case of higher costs is likely to reduce the potential competitiveness of the countries in global marketplace.

The exchanging and trading goods physically across borders and moving them within borders are sustained by a network of services is called logistics. Specifically, the services such as warehousing, brokerage, express delivery, critical infrastructure services are defined within this network. Besides, multiservice logistics providers offer more diversified solutions for trade, commerce, and manufacturing sectors for upper competitive powers in the context of international trade (Arvis et. al., 2018).

According to Puertas and Marti (2013), logistics used to point out the research fields, which are mainly interested in evaluating supply chain in order to obtain an optimum flow of components required for efficient production processes. However, with the recent developments of market globalization and modernization, scope of logistics has been expanded in such a way of including spatial and temporal relations. Buyers and sellers deal with logistics services to carry shipment from the point of source to the point of destination. The meaning of the concept of logistics have been upgraded by Langley et. al. (2008), Mangan et. al. (2008), Rushton et al. (2009). They agree that logistics is an integrated system including information, packaging, storage and transport; this system is expected to carry out the claims in terms of time, quality, quantity and cost, and its performance on managing this task is highly related with competitiveness.

Measuring logistics performances of countries from the international trade perspective is an important issue in this field. In 2007, World Bank created the Logistics Performance Index (LPI) to assess countries with regard to their overall logistics performance. Policymakers and researchers have been widely using LPI in their analyses of logistics performances for different groups of countries. LPI provides a general information of logistics costs, customs processes and the quality of the necessary infrastructure for transportation for each country. In this manner, policymakers and researchers can assess their countries' progress over time and in comparison to similar countries.

Starting with logistics performance as an important issue, the essential contents of logistics will be evaluated. Efficiency of logistics sector is directly related to logistics performance. More efficient logistics and thus higher logistics performance crate some advantages and benefits for countries in international trade such as promoted competitiveness. These improvements support the integration of a country to global trade network, thus they strengthen the economic developments of the country.

Therefore, logistics performance should be evaluated firstly with regard to its theoretical background. Then, performance measurement problem should be discussed since it emerges as a practical issue in the field. Accordingly, as the main and the most used macro measurement of logistic performance, LPI should be analyzed not only conceptually but also empirically using some statistical methods. For this aim, the relationships between LPI and the most related economic factors are to be modelled and the results derived from the models are to be discussed.

The Issue of Logistics Performance

Logistics performance can be simply defined as the efficiency of supply chains in increasing the capabilities of firms to attain domestic and international trade opportunities. The main point for a country is here its level of logistic accessibility, or in other words, country's level of competence for accessing to the physical network of global logistics. Logistics is in effect a business to business phenomenon; the events in logistics are the activities from private companies to private companies. Therefore, it seems that logistics performance is much related to the qualities of interrelations among the companies. Yet, it can be argued that public interventions and policies have strong potential effects on the level of logistics performance. Specifically, public policies of regulation, policies and investments on transportation and infrastructure, the implementations of controls by public authorities for international goods, the regulating and controlling policies on quality of public–private partnership and dialogue are among these policies. Logistics performance is expected to increase, as these policies are well planned, organized and effective (Arvis et. al., 2018).

The policies are generally related to trading problems and constraints about exchanging over borders. Spatial planning, greening the supply chain and maintaining run of the supply chain system properly even after disruption are some of the main examples of these policies. The countries praising the contribution of logistics to economic growth and economic integration consider the policies that are enhancing skills and talents in logistics sector as complementary features. In recent years, domestic logistics and international logistics are fairly interconnected with each other; thus, the scope of policies that policymakers should impose are likely much wider than ever before. Maintaining sustainability of supply chain with regard to environmental, economic and social concerns appears to be the core of these policies. The sustainability has much to do with spatial planning, training and skills, and the resilience of supply chain to disruption. It is obviously point out that sound domestic and international logistics cause national competitiveness to be promoted.

Application of effective policies improving logistics performance is more challenging than ever before. The advances in global trade and logistics environment are compelling a more extensive scope of policy implementation so that the conventional view of assuming that infrastructure and trade facilitation take place a central role in policies is not adequate anymore. The emerging fields of policy in logistics within this scope are mainly sustainability, resilience, development of skills, training, spatial concerns of logistics, the regulatory and legal framework. The regulatory policies that are targeting to improve the quality of service delivery focus on supporting market mechanisms and expanding private sector participation in the sectors of trucking, brokerage, terminal, warehousing operations. In addition to this comprehensive scope of policies, implementations of reforming policies might be troublesome because of weak coordination mechanisms and private sector constituencies in logistics sectors. Under these circumstances, public sector may play an essential role to improve the competitiveness of logistics sectors. Moreover, administrative reforms in facilitation of trade and transport with a strong political will are likely to have a considerable impact on logistics performance. At this point, it is obvious that public policies are seen as the instruments of public interventions promoting logistics performance; the leading feature of these policies is the responsibility of public institutions on education and training or it is financial support for training and education. The other essential policies improving logistics performance are specifically the policies fortifying public–private dialogue and multilateral cooperation, regulation policies of transport and logistics services, setting and according competency standards for different jobs, raising skill levels in state-owned logistics enterprises, and investing in human capital as a component of the development of logistics infrastructure (Arvis et.al., 2018).

In recent years, the researchers have been considering the term of trade facilitation as a significant notion in international trade. Trade facilitation is defined as the "simplification and harmonization of international trade procedures" by the World Trade Organization (WTO). The other definition of trade facilitation encompasses the key activities, practices and procedures to submit, collect and process the compulsory information for international goods trade. After all, all the definitions embrace the fact that the quality of the trade environment and its impact on trade operations are enormously important factors with regard to trade facilitation. As a final point, it could be clearly said that the contents of the definition of trade facilitation underlines the intimate relationship between trade facilitation and logistics (Puertas and Marti, 2013).

According to Arvis et. al. (2014), the essential part of international trade and commerce is supply chains. Merchandise transport, warehousing, customs operations, payment systems, and the operations externalized by producers and sellers are among the components of the logistics of these chains. An efficient logistics performance leads to an acceleration in economic growth; it increases diversification and causes poverty reduction; that is why logistics is now a preeminent field for governments and regional-international organizations. The efficiency of logistics, on the other hand, rests on public policies directed to infrastructure, logistics services, and the facilitation of cross border commerce.

Inefficient logistics services infer additional cost on trade in terms of time as well as money. In fact, it is obvious that trade is expedited by an efficient trade logistics. The high-qualified logistics service is likely to increase international competitiveness of a country by reducing the costs of transportation. This situation becomes far more important especially for the countries locating far from major market.

Efficiency of logistics mainly rests on logistics performance; as the degree of logistics performance is higher, logistics sector becomes naturally more efficient. Therefore, it is undoubtedly important to dwell on the determinants of logistics performance. At first, it should be noted that supply chain reliability is the main part of logistics performance. The level of lucidity about timing and process of deliveries in global trade affect the degree of the reliability positively. In other words, the reliability of supply chain requires a greater predictability about time, cost and shipment quality.

It should be pointed out that there is not a simple way of making a definition for logistics performance. Chow, Heaver, and Henriksson (1993) argue that the fact that firms have several and frequently contradictory goals makes difficulties for defining logistic performance. According to Mentzer and Konrad (1991) logistics performance implies effectiveness and efficiency in performing activities. By extending this approach, Fugate, Mentzer, and Stank (2010) presents a multi-dimensional form of definition of logistics performance denoting the degree of efficiency, effectiveness, and differentiation of logistics activities. At this point, it is noteworthy that logistics performance is not only important for firms but also very crucial for the industries and countries pursuing to improve their competitiveness.

Logistics performance is much affected by the proficiency of information and communications technology and transportation infrastructure. Besides, it is noteworthy that supply chain reliability and predictability of shipment are interrelated with the degree of logistics performance. Countries have responsibilities for some defects of supply chain such as delays and low quality of logistics services and the costly and slow clearance processes. Yet, some issues such as dependence on indirect maritime routes are out of the control for them.

It can be clearly claimed that predictability and reliability of supply chains are the key features of competent logistics performance. The serious uncertainties in lead times may be detrimental to the processes of production and exporting so that firms will be confined the costly strategies such as express shipping or higher inventories. Thus, the competitiveness within global and regional value chains is likely to decrease in the context of immensely extensive network of global and regional trade. If a little problem occurs at one link within the network, it may spread swiftly through the links; it clearly makes the other links unpredictable. Under these circumstances, a phenomenon of systemic risk comes out as an important fact. By definition, systemic risk refers to the vulnerability of the general structure to minor shocks. Consequently, as a vital mission, countries pursue to have predictable and reliable supply chains. Otherwise, the countries having inadequate, unpredictable or unreliable supply chains, are likely to be disconnected from international markets (Arvis et. al., 2018).

Arvis et. al. (2014) suggest that logistics performance is directly linked to service quality in practice. In a global context, supply chain matters are getting much more complex and thus managing logistics activities becomes increasingly formidable. Accordingly, manufacturers and traders tend to favor of transferring most of their logistics operations to external providers. Outsourcing logistics services ensures the manufacturers to focus on their own business. However, the extent of outsourcing services depends on the obtainability of such advanced services at lower costs; it gets more extensive as the chances to attain these services at more reasonable costs increase. On the contrary, if there are not enough reliable, inclusive and affordable services provided by the external constitutions, manufacturers would have to prefer to handle their logistics issues by themselves; this situation hence would cause the scope of outsourcing to contract in general.

In recent years, global supply chains seem to have more complicated contents than ever before. There are more regulatory requirements for traders and operators to fulfill because of the increasing safety, environmental and social concerns. Besides, it is noteworthy that private and public sectors share the same responsibility of providing the solutions for an efficient management and information technology supporting a qualitative logistics sector. With this more qualified logistics sector, a country will be able to attain the strength to compete effectively in a challenging global business and trade environment. It should be noted that the conditions of global trade are getting more compelling. At first, the 2008 financial crisis has ceased the phase of fast growing global trade; this transformation has generated adverse effects for the operators of international trade. Moreover, there are new players and new business models to cope with for the current trade actors. Finally, logistics sector is being forced to change and to redesign the policy program by advancing technology and new developments in supply chain resilience (Arvis et. al., 2018).

A publication by World Economic Form attracts attention to some prospective great changes in logistics. According to WEF (2017), the expected megatrends leading logistics in the future are mainly lacks logistics skills, transformation of global value chains, supply risk and resilience problems, digital renovation of supply chains, sustainability of supply chains, e-commerce shaping demand chains, logistics property and infrastructure, cooperative business models. A World Bank report exhibits that the supply of skilled labor in logistics do not seem adequate with regard to the needs of sector. McKinon et al. (2017) suggests that these shortages are present in both developed and developing countries. They expect that the problem will not disappear and conversely it will deteriorate over the near future. Developing countries suffer from the skill shortages at the managerial level whereas there is severe shortage for blue-collar workforce in developed countries.

Naturel calamities and man-made disasters have been devastating production and trade. With the increasing globalization, the scope of supply chains has expanded and thus interdependence among them have been elevated. Therefore, local events causing supply chains to be adversely affected may create disorders much beyond the area in which the first effects emerge. Consequently, in most countries resilience of international and domestic supply chains is now a critical issue of policy for public and private sectors.

In the framework of environmental concerns, several organizations concerned specific modes of transport reference the United Nations Sustainable Development Goals (SDGs). International Civil Aviation Organization in its 2030 Agenda for Sustainable Development is one of them; the organization focuses on promoting sustainable air transport. The other one is the International Maritime Organization whose mission is to formulate maritime policies embraced an initial strategy in April 2008 to halve emissions from maritime transport by 2050. Other international bodies taking the responsibilities of green logistics and transport include World Ports Sustainability Program, the International Road Transport Union, the International Energy Agency (IEA) and the International Transport Forum (ITF). The policy reforms focusing on infrastructure and trade facilitating still are important for developing countries. Besides, countries trying to improve their logistics performance should realize logistics as a cross-cutting policy issue. The activities cross managerial boundaries of transportation, trade, infrastructure, industry, finance, and the environment; they also include private sector efforts (Arvis et.al, 2018).

The Measurement Problem of Logistics Performance

Logistics obviously seem to have an essential role in economics context. As an important task, managers in manufacturing sector try to find the ways to reduce logistics costs under the circumstances of cutbacks and increasing labor costs. The cost of logistics operations is almost worth to half of the value of commodities because of the complexity in supply chains and globalization. Yet, the new methods related to cost-cutting opportunities emerge with the help of technological development (Dianwei 2006).

Reducing logistics costs is fairly important for both regional-national and global levels. On the one hand, these costs play substantial roles in policymaking, infrastructure development and other investments; they have the one core effect of lowering logistics costs. On the other hand, logistics costs have the determinative feature when shaping the competitiveness of nations (UN ESCAP 2002). Likewise, logistics cost is identified as one of the foremost drivers affecting competitiveness by several regional studies such as Guasch and Kogan (2006), Barbero (2010) and Guerrero, Lucenti and Galarza (2010). Lower logistics costs imply naturally a more efficient logistic performance which is to promote competitiveness of international trade. However, attaining logistics performance efficiency is not a simple issue just focusing on logistics costs; it has a multi-dimensional and multilateral task to conduct. Hence, it seems to be necessary to elaborate the measurement issue of logistics performance.

The primary problem in measuring logistics performance has close relevance to content and nature of logistics. In logistics sectors, transactions and activities are not simple, on the contrary they include multifaceted processes. Moreover, deriving transparent information about these various processes and computing the depreciation of all the property and equipment involved would generate difficulties (Farahani et al. 2009).

Measuring logistic performance appears in different levels; measurement in micro level and macro level refer different scales. In micro level, a single logistic firm or even a department within the firm would be taken as a unit to measure its logistics performance. When it comes to the case of macro level, the issue in question is the measurement of logistics performance of a country or of an entire continent.

For this aim, it can be pointed out that there are several proposed methods; some of them are called as hard metric measures such as trade flows and productivity and the others are titled as soft metrics such as customer satisfaction (Chow et al., 1994). As one of these measures, Logistics Performance Index was presented by World Bank to measure and compare the logistics performances in country levels.

Micro level metrics and methods for measuring logistics do not provide appropriate information for macro level estimation. The reason is that micro level metrics refer a firm level information while macro level ones indicates national level information. It should be noted that firm level information has some intrinsic features that perplexes the interpretation of data in national level. Rantasila and Ojala (2012) points out that the collected information by firms are closely related to firms' internal and external accounting requirements such as cost accounting and process development, bookkeeping and taxation. It is obvious that these firm level statistics are not suggesting valuable and functional information for national level.

Three types of metrics can be defined as to macro level information about logistics costs. These are percentage of sales or turnover, percentage comparison with the GDP level, absolute costs (Rantasila 2010). Logistics costs are taken as percentage of sales or turnover by some studies. The others explain logistics costs as a percentage of the gross domestic product. Then, there is this level of absolute costs. Yet, if we prefer the first two types, the difference between costs as percentage of turnover and percentage of GDP seem to be important; the value of export is not included by GDP while it is covered by firms in their turnover (Rantasila and Ojala, 2012).

Macro level logistics costs are measured dominantly through three main approaches; statistics based approach, survey based approach and case studies approach (Rantasila 20100). The first is to collect available data from different statistical sources and analyzing the them by using empirical methods such as econometric modeling and simulation. The second kind of studies would be classified as surveys. Respondents are supposed to answer some crucial questions in surveys, thus data about the issue is obtained directly from the respondents. The last one is the case-study method; there has been substantial amount of researches on supply chain management in this type.

The availability or reliability of data is a significant issue of macro-level cost measurements. According to Rantasila and Ojala, (2012) each method of macro level approaches namely statistical-based, survey based and case studies has specific problems. If cost estimates are derived by modelling or case-based method, statistical inference is enormously important. Reliability plays a considerable role in case of surveys and it rests on the sample size, the sampling methods and the clarity of the questionnaire. It seemed that each approach has its own methodical problems to be solved with care for the sake of reliability of data.

The comprehensive understanding of logistics performance helps immensely for policy efforts to be effective across sectors. If it is achieved to decrease the costs of national and international products deliveries, a country would experience fairly positive developments; sales of the country would be boosted, its trade would be increased, there would be opportunities like new markets for the country, overall commerce of the country would be stimulated.

THE LOGISTICS PERFORMANCE INDEX

A measurement of logistics performance in a large scale was needed since it was very important for a country to evaluate the effect of the logistics on its economy. The researchers at the World Bank created Logistics Performance Index (LPI) in 2007 to satisfy this need. The LPI help countries to recognize likely challenges and opportunities in their trade logistics performance.

The first of the logistics performance index (LPI) was issued in 2007 by the World Bank and it keeps being published in each two years after 2010. LPI was built on the basis of the surveys. The surveys include the questions which are responded by approximately 1000 professionals working for international logistics firms. Among the respondents, 45% of them are the executives who works for the firms in middle income countries; 10% of them are the executives who works for the firms in the low-income countries and 45% of them are the executives in the firms in high income countries. Among these executives 35%, 25%, 24% and 26% of them are the top level, site, department and low-level executives respectively (Burmaoğlu, 2012).

World Bank presents an indicator of logistics performance implying a country's supply chains' performance and it is named logistics performance index. The indicator provides information for the public to evaluate the effectiveness of domestic supply chains and to compare the performance of national supply chains with other supply chains. Comparative advantage promotes with the supply chains' performance; thus, this performance is an essential factor for all public policies, business actors' and stakeholders' interventions (Arvis et. al., 2014).

As a prominent measure of logistics performance, Logistics Performance Index (LPI) is a survey in which logistics professionals evaluate the logistics environments of their countries. LPI offers essential and detailed information on logistics environments, processes, and institutions for each country. In addition, this measurement of logistics performance also takes the logistics constraints of countries into account. In context of this index, infrastructure, services, border procedures, and supply chain reliability are perceived as the leading determinants of general logistics performance.

The LPI is a multi-dimensional assessment of logistics performance. The index offers an international benchmark underlining the friendliness level of the facilities of trade and transport for a particular country. Therefore, LPI helps countries to determine the critical barriers against the developments of their trades and to evaluate the opportunities to improve their international competitiveness (Ojala and Çelebi, 2015, 6).

In addition, this indicator makes possible to compare countries in terms of logistics performances and it helps them to overcome the obstacles that limit their economic developments. For that lacks and flaws in countries' logistics performances have substantial effects on their capacities of exports and imports it is getting very essential to identify them and that is why trade enabling measures are becoming so significant.

The LPI has been generated in 2007, 2010, 2012, 2016 and 2018 periodically. These versions have the property of ranking the countries based on logistics performance. The most recent LPI data and ranking includes 160 countries. The score of each country is determined by deriving the scoring responds of experts from all over the world on six components. Each expert scores eight different countries on each component. The scores range from 1 (poor performance) to 5 (excellent performance) on each component (Rezaei et.al., 2018).

Theoretical and empirical research and the experience of logistics professionals have provided the framework for the components. These components are indicated by Table 1.

The components are mapped onto two main categories. The first one is areas for policy regulation; it implies main inputs to the supply chain. The second one is supply chain performance outcomes; it indicates time, cost and reliability. The areas of policy regulation include customs, infrastructure, and services. The supply chain performance outcomes cover timeliness, international shipments, and tracking and tracing.

The LPI uses standard statistical methods to sum the data into a single indicator. Principal component analysis (PCA) is used to construct the LPI from these six components. Country scores on questions 10–15 averaged across all respondents are taken as inputs for PCA. Scores are normalized before conducting PCA. The LPI is finally the output from PCA; it is a single indicator which is a weighted

Table 1. The components of logistics performance

	Component	LPI 2018 Loadings	Definition
Areas for Policy Regulations	Customs	0.4072	The efficiency of customs and border management clearance
	Infrastructure	0.4130	The quality of trade-and-transport related infrastructure
	Services quality	0.4166	The competence and quality of logistics services
Supply Chain Performance Outcomes	Timeliness	0.4056	The frequency with which shipments reach consignees
	International shipments	0.3961	The ease of arranging competitively priced international shipments
	Tracking and tracing	0.4106	The ability to track and trace consignments

Source: Arvis et al. 2018

average of those scores. The percentage of variation in the LPI's original six indicators is maximized by the chosen weights. In other words, normalized scores for each of the six indicators are multiplied by their component loadings and they summed to build the international LPI. The component loadings characterize the weight for each original indicator. The loadings are similar for all six indicators, the international LPI is somehow a simple average of them and the weights remain stationary from year to year. Therefore, all LPI editions give us a comparable information (Arvis et.al., 2018).

In table 1, the loadings for each component of logistics performance index in 2018 are being presented. Although the greatest weights are the ones belonging to service quality an infrastructure, they are not so different from other loading estimates.

Companies can use LPI to recognize challenges and opportunities to a country's transport infrastructure, logistics proficiency, and readiness of efficient supply chains since the LPI provides the comparisons across 160 countries. It is a proper manner to perceive the LPI as beneficial indicator for trade logistics performance of a country, and it gives a benchmark for choosing locations of various types of operations. Ojala and Çelebi (2015) points out that countries prefer to focus on advancement in their LPI ranking instead of the improvements on their LPI values. Yet, many countries declare definite targets of LPI score or LPI rank. Furthermore, they tend to increase their attractiveness by launching major projects improving their LPI position.

The LPI has been published 6 times so far in 2007, 2010, 2012, 2014, 2016, and 2018; it starts to be derived once in every two years from 2010. The Table 2 presents overall LPI scores for the different regions in the world.

The largest value was initially appearing in East Asia & pacific, the latest results in 2018 show that Europa & Central Asia has the slightly greater value. The scores of Sub-Saharan Africa and South Asia are always the worst ones. Besides, between 200 and 2018, the highest percentage increase of LPI is seen in Europa & Central Asia by 31.7%. Unfortunately, the LPI value increased in Latin America & Caribbean only by the amount of 3.5% during the same period. All these values can be tracked by checking Figure 1. This figure was built on these LPI values.

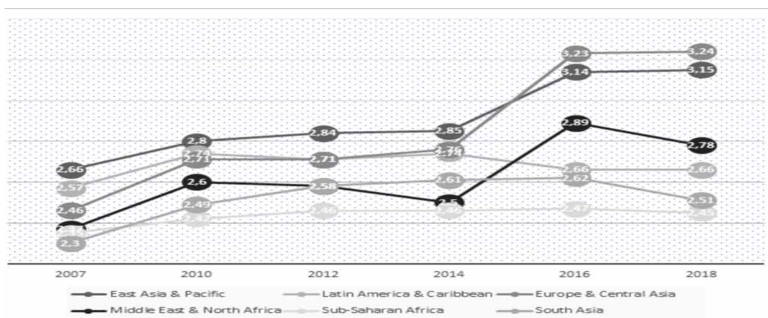
The two regions, namely East Asia & Pacific and Europa & Central Asia have both experienced an important advancement after 2014. At the same time, the leadership in scores shifted from the region of East Asia & Pacific to the region of Europa & Central Asia. Even though the group of Middle East & North Africa performed the similar leap in, it could not keep this increasing trend.

Table 2. The scores of international LPI for regions

R e g i o n s	2007	2010	2012	2014	2016	2018
East Asia & Pacific	2,66	2,8	2,84	2,85	3,14	3,15
Latin America & Caribbean	2,57	2,74	2,71	2,74	2,66	2,66
Europe & Central Asia	2,46	2,71	2,71	2,76	3,23	3,24
Middle East & North Africa	2,37	2,6	2,58	2,5	2,89	2,78
Sub-Saharan Africa	2,35	2,42	2,46	2,46	2,47	2,45
South Asia	2,3	2,49	2,58	2,61	2,62	2,51

Source: (Arvis et al. 2018)

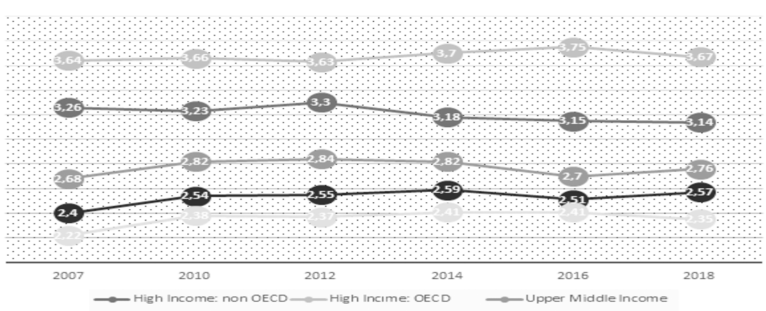
Figure 1. Developments of LPI for each region
Source: World Bank LPI Dataset https://lpi.worldbank.org/



When the LPI values were analyzed with regard to income groups for countries, the picture appears somewhat different. Figure 2 gives us the idea that LPI scores have always been greater in high income countries than the ones in lower income countries.

Specifically, the LPI numbers fall as the income level of countries decreases during the whole period. Moreover, the scores do not show big fluctuations within the income groups; they increase and decrease moderately. When it comes to the growth rates of the numbers during the period of 2007-2018, the great-

Figure 2. The LPI values for the income groups
Source: World Bank LPI Dataset



est growths have been observed interestingly in the groups of lower middle income and low income with 7.1% and 5.9% respectively. On the other hand, the LPI in high income-non OECD decreased by 3.7% while the one in high income-OECD increased by only 0.8%.

The details of the situation can be seen clearly by using different perspective of LPI. Instead of using LPI values to compare countries, the rankings of them presented by the World Bank can be valuable for comparisons. At first, the leader of the rankings has changed from 2007 to 2018; it was Singapore which was at the first rank, but 2018 Germany has taken the leadership. During this period, on the one hand, Germany has ascended from the rank of 3 to the rank of 1, on the other hand Singapore has fallen from the 1st place to the 7th one. It is noteworthy that there is not huge change in the first 10; Hong Kong and Canada went out, Belgium and Denmark came in from 2007 to 2018. The big change appears at the bottom; there is only one left at the worst 5, Afghanistan in 2018; the others are not at the bottom any more. Table 3 indicates all of this information.

At this point, it would be interesting to look at the rapidly ascending and descending countries during the period of 2007-2018. Figure 3 shows the top ten of the climbing countries and worst ten of the falling countries from 2007 to 2018.

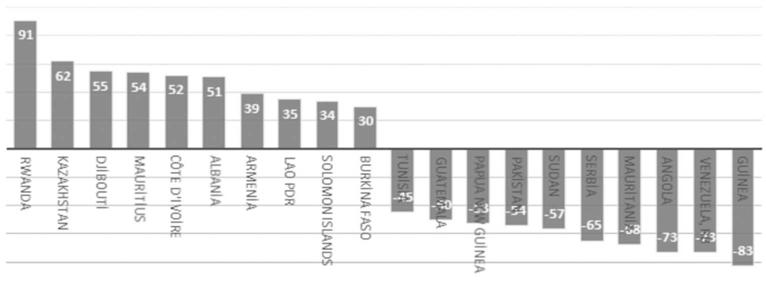
The most rapidly ascending country has been Rwanda; it goes up by 91 rows. Rwanda climbed up from the 148th place in 2007 to the 57th place in 2018. The second and third best performing countries are Kazakhstan and Djibouti. Kazakhstan rose up from the rank of 133 to the one of 71 and the rank of Djoubuti climbed up from 145 to 90. The worst lost in ranking is seen in Guinea; it went down from 62 to 145. It seems that significant changes in ranks take place in countries at the bottom or middle

Table 3. LPI ranking changes in countries

2007			2018		
Country	**Score**	**Rank**	**Country**	**score**	**rank**
Singapore	4,19	1	Germany	4,20	1
Netherlands	4,18	2	Sweden	4,05	2
Germany	4,10	3	Belgium	4,04	3
Sweden	4,08	4	Austria	4,03	4
Austria	4,06	5	Japan	4,03	5
Japan	4,02	6	Netherlands	4,02	6
Switzerland	4,02	7	Singapore	4,00	7
Hong Kong, China	4,00	8	Denmark	3,99	8
United Kingdom	3,99	9	United Kingdom	3,99	9
Canada	3,92	10	Finland	3,97	10
Tajikistan	1,93	146	Sierra Leone	2,08	156
Myanmar	1,86	147	Niger	2,07	157
Rwanda	1,77	148	Burundi	2,06	158
Timor-Leste	1,71	149	Angola	2,05	159
Afghanistan	1,21	150	Afghanistan	1,95	160

Source: World Bank LPI Dataset

Figure 3. Change in rankings of countries 2007-2018
Source: World Bank LPI Dataset



ranging positions. Top ranking countries experience respectively slight changes in rank; Austria from 5 to 4, Belgium from 12 to 3, Denmark from 13 to 8, Finland from 15 to 10, Germany from 3 to 1 etc.

Recalling the components of LPI and the weights of each component suggests us to evaluate the scores of the components. Even if each component has close estimated loadings to each other, it would be attracting to compare the component scores of the best and the worst countries in terms of overall scores. Table 4 was arranged by using the World Bank LPI data set.

This table gives the score values and ranks of the components of the LPI indicator. As it was expected, there is no big difference between the overall rankings and the component rankings. Germany takes the first place in 3 of 6 component rankings. The other leaders are Belgium and Finland. All three countries are in the top ten of overall scores. The components score of Germany and Rwanda can be compared to discover the effects of component score on overall score. It is well known that Germany

Table 4. Ranking of components scores for countries

Customs			**Infrastructure**			**International Shipments**		
	score	*rank*		*score*	*rank*		*score*	*rank*
Germany	4,09	1	Germany	4,37	1	Belgium	3,99	1
Sweden	4,05	2	Japan	4,25	2	Sweden	3,92	2
Japan	3,99	3	Sweden	4,24	3	Austria	3,88	3
Denmark	3,92	4	Netherlands	4,21	4	Germany	3,86	4
Netherlands	3,92	5	Austria	4,18	5	United Arab Emirates	3,85	5
Logistics Quality and Competence			**Tracking and Tracing**			**Timeliness**		
	score	*rank*		*score*	*rank*		*score*	*rank*
Germany	4,31	1	Finland	4,32	1	Belgium	4,41	1
Belgium	4,13	2	Germany	4,24	2	Denmark	4,41	2
Singapore	4,10	3	Denmark	4,18	3	Germany	4,39	3
Japan	4,09	4	United Kingdom	4,11	4	United Arab Emirates	4,38	4
Netherlands	4,09	5	Switzerland	4,10	5	United Kingdom	4,33	5

Source: World Bank LPI Dataset

has the best score in 2018 and even if Rwanda is the fastest climber in rank and it is located somewhere in the middle, 57th place in ranking.

Figure 4 indicates the component scores of the two countries.

The difference between the scores of infrastructure components of the two countries turned out to be the biggest difference; the values are 4.37 for Germany and 2.76 for Rwanda. The value for Germany is greater than the value for Rwanda by the amount of almost 59% of the value of Rwanda. The other significant differences appear to be between the values of logistics competence and tracking & tracing.

Figure 5 includes more countries; Germany, China, Vietnam and Rwanda. Germany is the best logistics performer of all countries, China is the best performer of the upper middle-income group countries, Vietnam is the best of the lower middle-income group countries and finally Rwanda is the best of the low-income countries. This figure seems to support the results derived from the previous figure.

The score of component is regularly increasing as overall country scores increases for infrastructure, logistic competence and tracking & tracing. Therefore, the components of infrastructure and logistic competence and tracking & tracing make significant differences for logistic performance. In other words, these components have the serious effects of the LPI of countries. The better infrastructure, the stronger logistics competence and the effective tracking & tracing processes would generate the greater level of Logistics Performance Index for countries.

Figure 4. Component scores of Germany and Rwanda
Source: World Bank LPI Dataset

Figure 5. Component scores of Germany, China, Vietnam and Rwanda
Source: World Bank LPI Dataset

DATA AND ECONOMETRIC MODELS

As it was specified before, the better logistics performance of a county has the potential to increase the country's competitiveness. Thus, the improvement in logistic performance would have a constructive effect on general economy. As indicators of logistic performance and economic growth, LPI and Gross Domestic Product per capita respectively will be handled to evaluate the relation between logistic performance and economic growth. Moreover, the effect of logistics performance on export is to be searched by modeling the LPI and Export as percentage of GDP. The variables used in all of the estimations are LPI, GDPPC, and EXPGDP denoting logistic performance index, Gross Domestic Product per capita, export as percentage of gross domestic product respectively. LPI obtained from the logistic performance index report in 2018 of the World Bank, the other variables were extracted from the World Development Indicators of the World Bank as the available latest data.

First, the correlations among the variables are shown by Table 5.

Correlation coefficient measures the degree of a linear relationship between a pair of variables. Three benchmarks are defined for the coefficient as 1, 0 and -1. If the correlation coefficient is -1, it is said that there is a perfect negative linear relation between the variables. If the coefficient is 1, then there is a positive linear relation between the variables. If it is 0, there is no liner relationship. As the value of the coefficient gets closer to 1 or -1, there would be stronger relation between the variables (Lee et.al., 2000) The first numbers appeared at the table are the estimated correlation coefficients, just below them are t-statistic values and the last ones are p-values. If the p-values is less than 0.01 and 0.05, we can conclude that the related correlation coefficient is statistically significant at 1% and 5% significance levels respectively. The table put out that there is a strong positive relation between LPI and GDPPC since the value is close to 1 as being 0.77 and its p-value refers that it is statistically significant at 1% significance level. All other p-values at the table indicates that the correlation coefficients are significant at 1% significance level, since they are all less than 0.01. There is some moderate positive relation between LPI and EXPGDP; the figure is 0.39 which is less than 0.5 but it is not so close to zero.

Model 1: The Effect of Economic Growth on Logistics Performance

The relation between the gross domestic product per capita (GDPPC) and logistic performance (LPI) is being analyzed by estimating an econometric regression model. Even if correlations provide the information of the relation between the variables, they do not say about the causalities between them.

Table 5. Correlations among the variables

Correlation (t-statistic) [probability]	**LPI**	**GDPPC**	**EXPGDP**
LPI	1.000	…..	…..
GDPPC	0.771 (14.45) [0.000]	1.000	…..
EXPGDP	0.394 (5.103) [0.000]	0.491 (6.709) [0.000]	1.000

The regression analysis is therefore a useful method the search the causal relations. (Wooldridge, 2002) The data is cross section data, so we used ordinary least squares method of estimation. After deleting some missing observations, the model includes the data of 153 countries. Table indicate the results of the estimated model.

Figure 6 indicates the scatter diagram between logistic performance and economic growth.

The relation between the variables of LPI and GDPPC is clearly seen when we take logarithms of the variables. In other words, the vertical axis denotes the natural logarithm of GDPPC and the horizontal axis represents the natural logarithm of LPI. The Figure 6 points out a strong positive relation between the logs of the variables.

The model is in log-log form so that the estimated slope coefficient denotes the percentage relation between the variables of LPI and GDPPC. The dependent variable and independent variable are chosen as LPI and GDPPC respectively. Table 6 gives the results of the estimated model.

The estimated value of R-square, 0.62, is fairly enough given that the expectation of moderate values for this kind of cross section estimated models. The p-value of the F-statistic suggests that the model is overall statistically significant at even 1% significance level since it is less than 0.01. The Durbin-Watson statistic, 1.95, is very close to the benchmark value of 2, so that autocorrelation problem does not seem to be exist for the estimated model. The most troublesome diagnostic test is conventionally the one of testing heteroscedasticity in these kind of cross-section estimations (Brooks, 2002). The statistic value of Breusch-Pagan-Godfrey (BPG) test of heteroscedasticity comes out as 0.79, and its p-value is bigger than 0.01, 0.05 and 0.10; thus we do not reject the null hypothesis saying that there is no heteroscedasticity in the significance levels of 1%, 5% and 10%. Besides, Jarquae-Bera (JB) test statistic is 3.51 and its p-value is 0.17 which is greater than 0.01, 0.05 and 0.10; the null hypothesis of normal distribution of residual is not rejected. Thus the estimated residuals are normally distributed as we expected.

The estimated slope coefficient is approximately 0.09 and its p-value is 0.000 which is much less than 0.01, thus the slope coefficient is statistically significant at 1% level. Besides, the estimated slope coefficient suggests that if income per capita increases by 1%, logistics performance index increases by 0.09%. Even if logistic performance reacts to the change in income per capita slightly, there is a positive statistically significant relation between them. Therefore, greater income values generate better logistics performance; in other words, economic growth has positive effect on logistics performance.

Figure 6. The scatter diagram between logistic performance and income level
Source: World Bank LPI Dataset

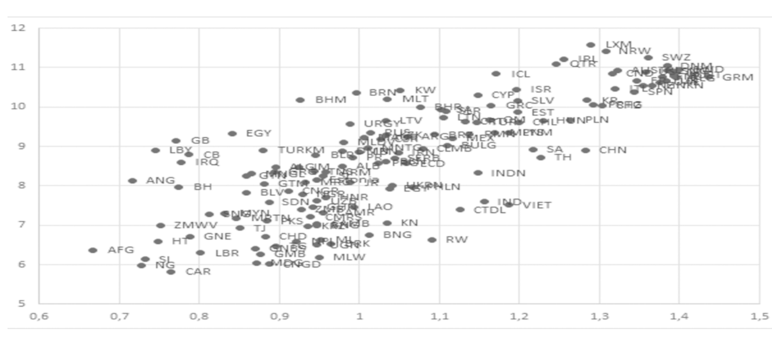


Table 6. The estimated regression model of GDPPC on LPI

Dependent Variable: LOG(LPI)				
Included observations: 153				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.1828	0.0558	3.2730	0.0013
LOG(GDPPC)	0.0989	0.0063	15.568	0.0000
R-squared	0.6161	Mean dependent var		1.0398
Adj. R-squared	0.6135	S.D. dependent var		0.1905
F-statistic	242.36	Durbin-Watson stat		1.9497
Prob(F-statistic) 0.0000 BPG 0.7970 JB statistic 3.5162 Prob(BPG-statistic) 0.3720 Prob(JB st.) 0.1723				

Model 2: The Effect of Logistic Performance on Economic Growth

The second model assumes that the different causal relation between GDPPC and LPI; now the dependent variable is GDPPC and the independent variable is LPI. Accordingly, the model searches the effect of logistics performance on income per capita. After estimating the model, one of the diagnostic test, specifically BPG test of heteroscedasticity points out that there is a heteroscedasticity problem in the model. Therefore, the weighted least squares estimation method has been used to fix the heteroskedastic problem. The estimated weighted model is in Table 7.

The BPG test statistic from the estimated weighted model is 0.976 and p-value of this statistic is 0.323 which is greater than 0.10, 0.05 and 0.01, thus the null hypothesis of no heteroscedasticity is not rejected all significance levels. The p-value of F-statistic, 0.0000, is much less than 0.01 meaning that the null hypothesis saying the model is overall insignificant is rejected at 1% significance level, then the model is overall statistically significant. R-square is fairly food as being 0.66, the estimated slope coefficient is statistically significant since its p-value, 0.0000, is less than 0.01. JB statistic is derived as 0.8220 and its p-value is 0.6629; the residuals are normally distributed.

All the diagnostic tests suggest that there is significant relation between the logistic performance and the income per capita where the income per capita is taken as dependent variable. As the logistic performance increases by 1%, the income per capita would increase by almost 6.3%. According to this estimated model, an improvement in logistic performance seem to promote substantially income level or economic growth.

Table 7. The estimated regression model of LPI on GDPPC

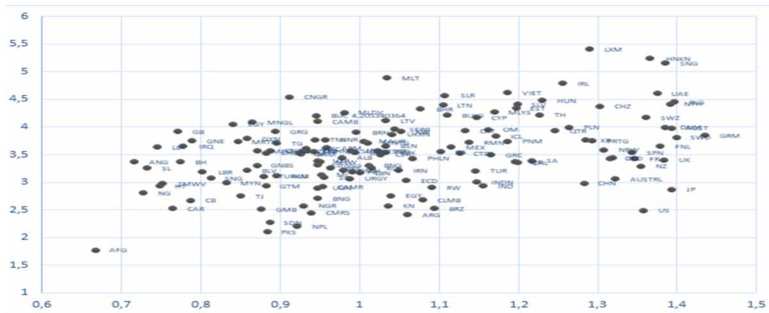
Dependent Variable: LOG(GDPPC)				
Included observations: 153				
Weighting series: LOG(LPI)				
Weight type: Inverse standard deviation				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.0560	0.4146	4.9585	0.0000
LOG(LPI)	6.3489	0.3683	17.237	0.0000
	Weighted Statistics			
R-squared	0.6625	Mean dependent var		8.8799
Adj. R-squared	0.6603	S.D. dependent var		3.0115
F-statistic	296.51	Durbin-Watson stat		1.9371
Prob(F-statistic)	0.0000	Weighted mean dep.		9.0877
	Unweighted Statistics			
R-squared	0.6158			
Adj. R-squared	0.6133			
Durbin-Watson stat	1.9389			

Model 3: The Effect of Logistics Performance on Export Share of Gross Domestic Product

This model focuses on the effect of logistic performance index on the export share in gross domestic product. After deleting the missing observations, the data over 146 countries makes the basis for the model. Figure 7 shows the relationship between the natural logarithm of LPI and EXPGDP.

It seems some moderate relation between the variables. Thus, the data suggests a significant relation between logistic performance index and export as we expected.

Figure 7. The scatter diagram between logistic performance and export
Source: World Bank LPI Dataset



The dependent variable is the export as a percentage share of gross domestic product and the independent variable is the logistic performance. The following Table 8 gives the results of the estimated model.

F-statistic suggests that the model is overall significant. JB test statistic and its p-value suggests that the estimated residuals are normally distributed. BPG test statistic shows that there is no heteroskedastic problem in the model. R-square value, 0.17, is less than we expected, but the estimated slope coefficient is statistically significant at 1% significance level implying that there is significant relation between EXPGDP and LPI. Thus, a 1% increase in the logistic performance index causes 1.39% increase in the

Table 8. The estimated regression model of LPI on EXPGDP

Dependent Variable: LOG (EXPGDP)				
Method: Least Squares				
Included observations: 146				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.0673	0.2712	7.6205	0.0000
LOG(LPI)	1.3962	0.2545	5.4862	0.0000
R-squared	0.1728	Mean dependent var		3.5320
Adj. R-squared	0.1671	S.D. dependent var		0.6367
F-statistic	30.099	Durbin-Watson stat		1.6763
Prob(F-statistic) 0.0000 BPG 2.5173 JB-st. 0.1375 Prob (BPG) 0.1126 Prob (JB-st.) 0.9335				

export share. It is worth to say that there is almost one to one relation between the logistic performance and the export. The favorable developments in logistics performance increases competitiveness of a country so that its export would be stimulated.

Model 4: The Effect of Export Share of GDP on Logistics Performance

This time the effect of export share on logistics performance index is studied for this model. Table 9 indicates the estimated model whose dependent and independent variables are defined as export share in gross domestic product and logistics performance index respectively.

P-value of the F-statistic is less than 0.01 that implies the estimated model is overall significant. BPG test statistic value is 0.1648 and the related p-value is 0.6848 which is greater than 0.01; so there is no heteroscedasticity in the model. JB statistic is obtained as 6.2941 ant its p-value0.0429; p-value is greater than 5% and so the residuals are normally distributed in 5% significance level. The estimated value the slope coefficient is 0.61 and it is statistically significant. As the export share in gross domestic product increase by 1%, then the logistic performance index would increase by 0.61% according to this estimated model.

RECOMMENDATIONS

The influential countries in today's international trade are the ones who have managed to impose significant logistics-related reforms. While developing countries have made notable progress in this field in recent years, their logistics performances are comparatively inadequate. The lack of substantial reforms

Table 9. The estimated regression model of EXPGDP on LPI

Dependent Variable: LOG(LPI)				
Method: Least Squares				
Included observations: 146				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EXPGDP)	0.1238	0.0225	5.4862	0.0000
C	0.6110	0.0809	7.5527	0.0000
R-squared	0.1728	Mean dependent var		1.0490
Adj.R-squared	0.1671	S.D. dependent var		0.1896
F-statistic	30.099	Durbin-Watson stat		1.6443
Prob(F-statistic)	0.0000			

in some countries has been claimed as the sources of the differences in logistics performances between high and low-income countries. Moreover, logistics performances of countries are significantly related to economic growth and competitiveness in global trade. Countries having inefficient logistics services are likely to be exposed to higher costs of doing business. This situation implies financial barriers to the efficient integration of the countries with international value chains. Additionally, the case of higher costs is likely to reduce the potential competitiveness of the countries in global marketplace.

From this point of view, the effective performance of logistic system is essentially important for countries. Public policymakers who pursue to support economic development and to increase economic growth, should be aware of their country's level of logistics performance. In addition to the theoretical explanations, the results from the estimated models in this chapter suggest that better logistic performance generates higher income level and greater amount of exports for a country. Therefore, it is possible to say that increasing logistic performance stimulates economic growth. A healthy and effective measure of logistics performance as being a beneficial instrument makes possible for policymakers to comprehend the conditions of the logistics sector and thus provides the opportunities to promote the general economic performance

FUTURE RESEARCH DIRECTIONS

Logistics sector does not only have serious problems in present, but it will have to face real challenging issues in the near future. The mega trends, which are expected to drive logistics, are mentioned before within this chapter. The first one is related to the labor skills in logistics sector. The workforce in the sector does not have proper skills to overcome more sophisticated logistics dynamics. Besides, logistics sector is being increasingly exposed to problems in transformation of global value chains, supply risk and resilience problems. Moreover, the transformation of supply chains in the context of digital developments and e-commerce as a natural result of this transformation change the logistics trade network. Sustainability of supply chains under these new conditions is getting more challenging. Infrastructure investments and cooperative business models which are required to cope with the changing trade environment put more responsibilities on public and private sectors. Therefore, contemplating about these prospective developments and focusing to develop better and stronger measurements of logistics performance is going to be on the agenda in the future. In this framework, the field of logistics in general and the subject of logistic performance specifically appear to promise plentiful research areas.

CONCLUSION

An increased need for international freight transportation and thus international logistics has emerged with a higher degree of globalization. The efficiency of moving goods across and within borders is directly related to logistics. The participating manners of countries in international marketplace has been shaped by their performance in this area. It can be said that the pillars of global trade are logistics since the supply chains are being diversified globally. The quality of logistics services determines the degree of a country's involvement in global trade.

In this chapter, first of all, the concept of logistics performance in the international trade context were discussed, and then the measurement problems of logistics performance from the same perspective was handled. Besides, the links between logistics, trade, and growth were evaluated theoretically. Furthermore, these relations were analyzed empirically by using econometrics modelling methods. For this purpose, firstly Logistics Performance Index (LPI) developed by the World Bank was compared with the Gross Domestic Product per capita as a proxy of economic growth. Then the relationship between the variable of LPI and the Percentage Share of Export in Gross Domestic Product were searched through the econometric modeling.

The estimated models have given us the results consistent with the theoretical expectations. From the first model, we concluded that the estimated slope coefficient denotes that if income per capita increases by 1%, logistics performance index increases by 0.09%. Logistic performance reacts to the change in income per capita slightly, yet there is a positive statistically significant relation between them. Accordingly, greater income values cause better logistics performance; economic growth has positive effect on logistics performance. The greater income levels for countries may create productive opportunities and sources for the investments and public policies regulating the logistics sectors. The estimated second model suggests that as the logistic performance increases by 1%, the income per capita would increase by almost 6.3%. According to the model, an improvement in logistic performance seem to promote substantially income level or economic growth. This is consistent with our theoretical expectations; more efficient logistics sector for a country is supposed to increase international competitiveness and thus it may create a progressive effect on the economy of the country.

The third estimated model argues that a 1% increase in the logistic performance index causes 1.39% increase in the export share; there is almost one to one relation between the logistic performance and the export. The positive developments in logistics performance increases competitiveness of a country causing its export to be stimulated. The final model says that the estimated value the slope coefficient is 0.61 and it is statistically significant. As the export share in gross domestic product increase by 1%, then the logistic performance index would increase by 0.61%. Even if it is less than one, it still points out a significant relation between export and logistics performance. The increase in export of a country, on the one hand, raises up its income level. On the other hand, increase in export implies the trade openness of a country by causing more efficiently integration of country to the international trade. Finally, this improvement in connection to the global trade promotes the productivity in the logistics sector, thus a country benefits from more efficient logistics sector.

REFERENCES

Arvis, J. F., Mustra, M., Ojala, L., Shepherd, B., & Saslavsky, D. (2014). *Connecting to compete: Trade logistics in the global economy*. Washington: World Bank.

Arvis, J. F., Mustra, M., Ojala, L., Shepherd, B., & Saslavsky, D. (2016). Connecting to compete: Trade logistics in the global economy. Washington: World Bank.

Arvis, J. F., Mustra, M., Ojala, L., Shepherd, B., & Saslavsky, D. (2018). *Connecting to compete: Trade logistics in the global economy*. Washington: World Bank. doi:10.1596/29971

Barbero J A (2010). Freight logistics in Latin America and the Caribbean: An agenda to improve performance. *Inter-American Development Bank Infrastructure and Environment Department*, Technical Notes No. IDB-TN-103

Brooks, C. (2002). *Introductory econometrics for finance*. Cambridge, UK: Cambridge University Press.

Burmaoğlu, S. (2012). Ulusal İnovasyon Göstergeleri ile Ulusal Lojistik Performansı Arasında İlişki:AB Ülkeleri Üzerine Bir Araştırma . *Ege Akademik Bakış*, 193-208.

Chow, G., Heaver, T. D., & Henriksson, L. E. (1993). Logistics performance: Definition and measurement. *International Journal of Physical Distribution & Logistics Management*, *24*(1), 17–28. doi:10.1108/09600039410055981

Dianwei, Q. (2006). The research on logistics cost accounting and management in China. In *Proceedings of 2006 International Conference on Management of Logistics and Supply Chain*, Sept. 20-22, 2006, Sydney, Australia.

Farahani, R. Z., Asgari, N., & Davarzani, H. (2009) *Supply chain and logistics in national, international and governmental environment – concepts and models*. Berlin, Germany: Physiga-Verlag.

Fugate, B. S., Mentzer, J. T., & Stank, T. P. (2010). Logistics performance: efficiency, effectiveness, and differentiation. *Journal of Business Logistics*, *31*(1), 43–62. doi:10.1002/j.2158-1592.2010.tb00127.x

Guasch, J. L., & Kogan, J. (2006). Inventories and logistic costs in developing countries: levels and determinants—a red flag for competitiveness and growth. *Policy Research Working Paper* 2552. Washington DC: World Bank.

Korinek, J., & Sourdin, P. (2011) To what extent are high-quality logistics services trade facilitating? *OECD Trade Policy Working Papers* 108. OECD Publishing.

Langley, C., J. Coyle, B. Gibson, R. Novak, & E. Bardi. (2008). *Managing supply chain: A logistics approach*. South-Western Cengage Learning (8th ed.).

Lee, C. F., Lee, J. C., & Lee, A. C. (2000). *Statistics for business and financial economics*. Singapore: World Science Publishing.

Martí, M. L., Puertas, R., & García, L. (2014). Relevance of Trade facilitation in Emerging Countries Export. *The Journal of International Trade & Economic Development*, *23*(2), 202–222. doi:10.1080/09638199.2012.698639

Mentzer, J. T., & Konrad, B. P. (1991). An efficiency/effectiveness approach to logistics performance analysis. *Journal of Business Logistics*, *12*(1), 33–62.

Ojala, L., & Celebi, D. (2015). The World Bank's Logistics Performance Index (LPI) and Drivers of Logistics Performance. *Paper prepared for the International Trade Forum Roundtable on Logistics Development Strategies and their Performance Measurements*, Queretaro, Mexico, March 9–10. Forum and Chief Executives Meeting.

Puertas, R., Marti, L. & García, L. (2013). Logistics performance and export competitiveness: European experience. *Empirica Journal of European Economics*, on line, doi:10.100710663-013-9241-z

Rantasila, K. (2010). *Measuring national logistics costs: designing a generic model for assessing national logistics costs in global context,* Turku School of Economics, (Master's Thesis). Retrieved from http://info.tse.fi/julkaisut/Thesis2010/12927.pdf

Rantasila, K., & Ojala, L. (2012). Measurement of national-level logistics costs and performance, *Discussion Paper* No. 2012–4, International Transport Forum, Paris.

Razzaque, M. A. (1997). Challenges to logistics development: The case of a Third World country - Bangladesh. *International Journal of Physical Distribution & Logistics Management*, *27*(1), 18–38. doi:10.1108/09600039710162268

Rezaei, J., Roekel, W. S., & Tavasszy, L. (2018). Measuring the relative importance of the logistics performance index indicators using best worst method. *Transport Policy*, *68*, 158–169. doi:10.1016/j.tranpol.2018.05.007

Wooldridge, J. M. (2002). *Econometric analysis of cross section and panel data*. The MIT press.

ADDITIONAL READING

Anderson, J. E., & van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *The American Economic Review*, *93*(1), 170–192. doi:10.1257/000282803321455214

Arvis, J. F., Mustra, M., Panzer, J., Ojala, L., & Naula, T. (2007). *Connecting to compete: Trade logistics in the global economy*. Washington: World Bank.

Behar, A., & Manners, P. (2008). Logistics and exports. *African Economics Working Paper Series* 293. CSAE WPS/2008-13. Oxford, UK: University of Oxford.

Civelek, M. E., Uca, N., & Cemberci, M. (2015). The mediator effect of logistics performance index on the relation between global competitiveness index and gross domestic product. *European Scientific Journal*, *11*(13), 368–375.

Erkan, B. (2014). The importance and determinants of logistics performance of selected countries. *Journal of Emerging Issues in Economics*, *Finance, and Banking*, *3*(6), 1237–1254.

Guner, S., & Coskun, E. (2012). Comparison of impacts of economic and social factors on countries', logistics performances: a study with 26 OECD countries. *Research in Logistics & Production*, *2*, 329–343.

Hoekman, B., & Nicita, A. (2008). Trade policy, trade costs, and developing country trade. *World Bank Policy Research Working Paper* No. 4797.

Mangan, J., Lalwani, C., & Butcher, C. (2008) *Global logistics and supply chain management*. Wiley Higher Education.

Martí, M. L., Puertas, R., & García, L. (2014). Relevance of trade facilitation in emerging countries export. *The Journal of International Trade & Economic Development*, *23*(2), 202–222. doi:10.1080/09638199.2012.698639

Martinez-Zarzoso, I., & Suarez Burguet, C. (2000). The determinants of trade performance: Influence of R&D on export flows. *Applied Economics*, *32*(15), 1939–1946. doi:10.1080/00036840050155869

Soloaga, I., Wilson, J. S., & Mejía, A. (2006). Trade facilitation reform and Mexican competitiveness. *World Bank Policy Research Working Paper*, *3953*(June).

Wilson, J. S., Mann, C., & Otsuki, T. (2005). Assessing the benefits of trade facilitation: a global perspective. *World Economy*, *28*(6), 841–871. doi:10.1111/j.1467-9701.2005.00709.x

KEY TERMS AND DEFINITIONS

Logistics: A network of services for exchanging and trading goods physically across borders and moving them within borders

Logistics Performance: Efficiency of supply chains in increasing the capabilities of firms to attain domestic and international trade opportunities A belief that one's own culture is superior to other cultures.

Logistics Performance Index: A survey in which logistics professionals evaluate the logistics environments of their countries conducted by the World Bank. LPI offers essential and detailed information on logistics environments, processes, and institutions for each country.

Outsourcing Logistics Services: Transferring most of the logistics operations to external providers by manufacturers and traders so ensuring the manufacturers to focus on their own business.

Services Quality: The competence of logistics services to fulfill the requirements for an efficiency logistics sector.

Systemic Risk: The vulnerability of the general structure to minor shocks because of the fast spreading potentialities of the shocks.

Trade Facilitation: Simplification and harmonization of international trade procedures; the main activities, practices and procedures to submit, collect and process the compulsory information for international goods trade.

Chapter 7

Analysing Transportation-Induced Economic Growth, Energy Use, and CO2 Emissions:

An Empirical Investigation From EU Countries

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ABSTRACT

This chapter concentrates on the linkage among transportation, energy usage, GDP, and Co2 emissions in EU countries during the period 1970-2014 by analysing the EKC hypothesis. The data is derived from the World Bank's official website to point out environmental consciousness of EU countries by implementing panel data analysis. In this sense, the findings indicate that environmental consciousness is quite low for EU countries from 1970 to 1997. Besides, the environmental issues of EU countries are taken into account from 1997 to 2014. The findings of research demonstrate that their sensitiveness has risen significantly, which is consistent with the inverse-U shape of the EKC hypothesis from 1997 to 2014. Thus, these empirical results support the Kyoto protocol's political aims and goals. Furthermore, Johansen co-integration test is implemented to reveal the long-term linkage among economic growth, air transportation, carbon emissions, and energy usage.

1. INTRODUCTION

International trade has been sustained throughout history via barter economy, even before money was founded between tribes and countries. In this context, the economic, political and social significance of IT has been gaining speed during the last decades of the last century, notably expediting the existence of industrialization, globalization and transportation systems including air transportation, railroads, travel, highways, maritime and pipelines.

DOI: 10.4018/978-1-7998-1397-2.ch007

The irrevocable element of the sustainable economic development is definitively transportation which is so crucial for international trade. In this respect, the factors (independent variables) that influence the transportation sector (dependent variable) have been determined by examining the academic literature (Kalayci, 2015).

The international actors play a crucial role in addressing global warming owing to CO2 emission by funding appropriate training, collecting data and policy reforms. Since the 1990s, many international institutions have failed to develop novel methods to overcome these catastrophic problems. For this reason, the Kyoto Protocol Agreement was signed in 1997 to eliminate CO2 emission and thus encourage economic benefits which will lead to increased employment area (Bhat and Mishra, 2018).

The transportation sector plays a vital role for countries which sustains both high standards of living and economic growth. Owing to this fact, transportation technology has become popular when taking into account several works in the academic literature. These papers are concentrating more on efficient and effective management of energy use and its sector and the connection between international trade and the transportation sector (Al-Ghandoor, Jaber, Al-Hinti and Abdallat, 2013).

2. LITERATURE REVIEW

Many researchers have studied the widespread impact of carbon, and these models have found that the transportation sector is not decisive in determining carbon prices compared to other sectors. For example, the sectoral and financial impact of the American energy and security law has comprehensively analyzed energy information management. GHG emissions are projected to be reduced by 17% by 2020 by the US government; in 2050, it is aimed to decrease by 83%. The emission level in the transport sector was aimed to be reduced from 1% to 3.5% by 2020 and from 2.6% to 8.5% by 2030, mainly due to the fact that a large part of the total GHG emission in the US was realized in the transport sector (Rubin and Leiby, 2013).

Global energy consumption increased from 4676 million tons in 1973 to 8429 MTOE in 2008 and the share of the transportation sector increased from 23.1% in 1973 to 27.3% in 2008 all over the world. The main reason for this is the continuous increase in the quantity of vehicles and family income. On the other hand, carbon emissions from global carbon dioxide rose from 21 billion tons in 1990 to 29.4 billion tons in 2008. The transport sector contributed to 6.6 billion tons of CO2 emissions, which corresponds to 22.5% of total CO2 emissions in 2008 (Ghandoor, 2013).

In this sense, the EKC hypothesis verifies an inverted U-shape among environmental dirtiness and real income. Air pollution and GDP rise at the beginning, and, afterwards, the trend sizably reverses some level of income. Thus, environmental consciousness is increased at high income levels. The famous model was founded by Grossman and Krueger (1991). Afterwards, the theory was specified by Panayotou (1993) as the Environmental Kuznet Curve. Besides, the inverted U model designated in 1955 by Kuznets (1955) expresses that the injustice of the income distribution increases in the early terms of evolution and falls subsequently.

Bese and Kalayci (2019) reveal that energy consumption causes CO2 emission for Denmark. However, there is no effect caused by energy consumption on CO2 emission for the UK and Spain, which means that Denmark should consider the issue of energy efficiency in terms of the transportation sector in order to decrease environmental damage. Furthermore, they also state that Denmark should concentrate more on electricity consumption using alternative energy sources rather than carbon-based means of transport by using more electric vehicles and ensuring higher energy efficiency policy incentives, including road and air transport. Denmark's government should increase the use of natural gas to decrease environmental damage as well. The other significant solution is supporting battery technology to increase the share of electricity usage in the transport sector from green energy, including tidal and wind energy.

Danish, and Zhaohua Wang (2018) state that the BRICS countries are recommended to utilize energy-efficient green transportation in high-density tourist destinations. In addition, enhancing green transportation through electronic media is an important way to prevent climate change and would resolve environmental problems. Moreover, BRICS countries have to support folk media through TV, the internet, and magazines to send an affirmative message to both their communities and international tourists regarding how to keep tourist locations convenient and environmentally friendly. Similarly, green transportation should be supported by the French government due to high CO_2 emission which is determined by empirical results of this manuscript at Table 3 and in Figure 2. According to the empirical results of the variance decomposition and impulse response tests (Table 3, Figure 2.), the impact of CO_2 emissions is relatively more than that of energy consumption and GDP on air transportation which supports the Environmental Kuznet Curve hypothesis. The fates of the BRICS countries are similar with France in terms of the EKC hypothesis. However, remaining countries including Austria, Belgium, Netherlands Spain and the United Kingdom do not face this issue.

Mikayilov, Mukhtarov, Mammadov and Azizov (2019) address the issue of EKC hypothesis in terms of environmental degradation and tourism by implementing the VAT, ADF unit root, bounds and Engle-Granger tests to reveal the long-run relationship between variables. The findings of the estimations performing the conventional cubic functional form found that the best fit for the relationship, in the case of Azerbaijan, is a quadratic functional form. Furthermore, they also analyzed relevant variables including energy usage, urbanization, measures of administrative quality and trade capacity. According to their results, all other variables were found to have important effects on ecological footprint except measures of administrative quality and urbanization. On the other hand, the findings of the estimations, based on the ARDL model, demonstrate that, numerically, a 1% increase in trade capacity and energy usage causes environmental pollution to increase by 0.17% and 0.55%.

Imamoglu (2019) analysed the role of financial sector development in the energy sector and its impact on climate change for 176 countries, both developing and developed, by using panel data from 1960 to 2014. The empirical results indicate that CO_2 emissions in both groups of countries have long-run equilibrium relationships through the financial sector; trade and finance sectors have substantial long-run effects on CO_2 emissions. Thus CO_2 emissions converge to their long-run equilibrium levels via finance and trade sectors. In addition, impulse response determined that finance and trade sectors have negative effects on CO_2 emissions in the case of developed economies while they have positive effects in the case of developing economies. These sectors also exert substantial effects on the energy usage of countries. Developed countries are more successful in terms of effective energy consumption and green energy production in comparison to developing countries. Consequently, developing countries have to adopt appropriate policies by supporting investments in alternative energy to prevent increases in CO_2 emission following expansion in financial and trade sectors.

Ozkan, Yanginlar and Kalayci (2019) work on the linkages among CO_2 emissions, economic growth, air transportation and energy consumption for 8 developed and 8 developing countries from 1980 to 2013 by taking into account the EKC hypothesis. They implement PDA analysis to indicate environmental consciousness of the two groups of countries. In addition, the empirical findings prove that environmental consciousness is extremely low for the two groups of countries from 1980 to 2000.

Furthermore, environmental matters of the two groups of countries are considered from 2001 to 2013, and the empirical findings testify that their environmental consciousness had raised considerably, which is consistent with the inverseU-shape of the Environmental Kuznet Curve. These research findings support the Kyoto Protocol's political goals and aim which is consistent with this manuscript's empirical finding except for France.

Fotis and Pekka (2017) demonstrate that the use of renewable green energy negatively influences environmental pollutants. Therefore, more renewable green sources contribute less to air pollution. This is due to the fact that energy intensity usage, especially in the transportation sector, causes more air pollution. Electricity consumed from alternative energy sources makes a great contribution to the elimination of CO_2 emissions. However, more impact is revealed by the contribution of the share of green energy in aggregate energy usage. Moreover, renewable green energy should be at the center of the EU's sustainable energy policy, and the implementation of the recent update by the European Commission regarding the 30% energy efficiency target for 2030 must be the paradigm for the future.

Katircioglu, Cizreliogullari and Katircioglu (2019) states that rise in tourism capacity leads to increase in the demand for energy consumption for diverse functions such as transportation and the administrative issues of tourist attractions. Furthermore, they also express that environmental problems around the world would rise with inbound foreign tourist travel. Therefore, island states are expected to adapt green energy infrastructure into tourist investment. They also determined that energy usage exerts positive impact on tourist arrivals, revealing that an expansion in traditional energy usage will be positively associated with tourist flow.

Katircioğlu and Katircioğlu (2018) analyzed the urbanization-induced Environmental Kuznet Curve hypothesis, and find the long-run relation among urban development and carbon emissions from energy usage and real income growth in Turkey. In addition, the empirical findings demonstrate that Turkey did not have an inverted U-shaped Environmental Kuznet Curve in respect of urbanization. On the other hand, urbanization in Turkey exerted an importantly positive impact on carbon emissions. As a result, the empirical findings reveal that urbanization in Turkey was misruled as far as "Green Energies and Green Environment" are concerned.

Katircioglu, Katircioglu and Kilinc (2018) investigate the factor of urbanization in the conventional Environmental Kuznet Curve of the globe. They demonstrate that the conventional Environmental Kuznet Curve of the globe is not an inverted U-shape but becomes downward sloping when urban development is added and inverted U-shapes when the overall population and rural population volumes are added. The empirical findings of their work indicate that increase in population and urbanization in the globe was victoriously managed as far as Green Energies are concerned. This research topic can replicate their methods for regional analysis around the globe. In addition, alternative econometric methods can also be used again for comparison purposes to ensure the level of robustness of their current findings.

Wen and Huang (2019) suggest factors influencing CO_2 emissions and acquired the current and future impact degree of various factors, which is of great importance to the low CO_2 emissions in China. CO_2 emissions from 2000 to 2014 in China are tested by implementing the Markov model and projection pursuit. Furthermore, per capita GDP was the critical factor for decreasing CO_2 emissions. Industrial structure and population intensified CO_2 emissions. The energy structure had seldom affected CO_2 emissions. Consequently, energy consumption obviously inhibited CO_2 emissions.

Marcotullio, Williams and Marshall (2005) clarify the environmental issues in terms of the long-run relationship among road and air transportation and CO_2 emission (intensity of electricity) for the USA and 26 developing countries from 1960 to 2000. According to the empirical results of their research paper, when GDP (per capita income) is taken into account, the USA's CO_2 emission is relatively more than the 26 developing countries. However, the USA is comparatively lower than Hong Kong, Singapore, South Korea and Malaysia in terms of GDP induced CO_2 growth within the 30 year period. In fact, GDP alone is not an effective factor in CO_2 emissions per capita in terms of transportation.

Saleem, Jiandong, Zaman, Elashkar and Shoukry (2018) explore the interactions between energy demand, population density, bilateral aid flows, air transportation and environmental pollution for 11 countries by using correlation matrix, panel unit root, Johansen Fisher panel cointegration, variance decomposition, non-linear regression, plots of differenced data and Dumitrescu Hurlin panel causality tests from 1975 to 2015. According to the empirical findings, there is an effect by air transportation on CO2 emission. For this reason, air transportation is not a convenient vehicle for providing low carbon emission and green vehicle policies. Air transportation is mostly affected due to natural resource deficiency as civil aviation raises natural resource requirements while transport of goods and energy consumption respectably decreases the share of essential resources. Therefore, the policy should be implemented in order to perform the Kyoto Protocol's political aims through green energy production.

Jovanovic and Vracarevic (2016) discuss the impact of air transportation on CO_2 emissions by giving some examples from an International Civil Aviation Organization's report. The main way to reduce air transportation's carbon emission is for the government to reduce total energy consumption by reducing vehicle-kilometers of travel. Unfortunately, technical development of aviation engines will be insufficient to decrease total emissions due to the high volume of civil aviation travel. They give some reasonable solutions to solve high carbon emission problems. For instance, government policymakers should provide incentives to improve and use low-emission technologies by investing in more R&D. In addition, the other significant way to reduce CO_2 emissions is decreasing the demand for travel.

3. METHODOLOGY AND DATA ANALYSIS

The major goal of this manuscript is to examine the long-run relationship between variables including air transportation, GDP, CO_2 and energy consumption from 1970 to 2014. The annual data is derived from the World Bank's official website in order to perform the cointegration test, VAR analysis, impulse response and variance decomposition (World Bank, 2019).

In order to comprehend the research questions about both their long-run relationship and effects of the independent variables including CO_2, GDP and energy consumption on air transportation, the Johansen cointegration test is implemented clearly.

The ADF unit root test is implemented for energy consumption, economic growth, air transportation and CO2 emissions variables to analyze for stability. (The AIC Akaike Information Criterion has been accounted for). The maximum lag length is selected to be 2 which is consistent with Serena and Perron's (2001) suggestion.

According to the Augmented Dickey Fuller (ADF) test results in Table 1 above, the series are non-stationary. Converting the data in Table 1 from non-stationary I(0) to stationary I(1), the series have been performed in the Johansen cointegration test (Table 2). The empirical findings indicate that there is a long-run relationship among air transportation, CO_2, energy consumption and GDP. Besides, according to Table 2 below, there is a long-term relationship between relevant variables which is scored less than 0.05 for 6 EU member countries including the United Kingdom, Netherlands, Belgium, France, Spain and Austria.

Table 1. EU countries ADF test results from 1970 to 2014

Countries	*Variables*	**Series at I (0)**	**Series at I (1)**
		t-stat/crit-value %5/p-value	**t-stat/crit-value %5/p-value**
	Transport	*3.72 / -2.94 / 1.0000*	*-7.01 / -2.93 / 0.0000*
	GDP	*0.58 / -2.92 / 0.9878*	*-5.51 / -2.93 / 0.0000*
Austria	*Energy*	*-1.73 / -2.92 / 0.4052*	*-7.45 / -2.93 / 0.0000*
	Co2	*-2.63 / -2.92 / 0.0936*	*-8.48 / -2.93 / 0.0000*
	Transport	*-0.71 / -2.92 / 0.8317*	*-5.02 / -2.93 / 0.0002*
Belgium	*GDP*	*0.49 / -2.92 / 0.9848*	*-5.33 / -2.93 / 0.0001*
	Energy	*-1.91 / -2.92 / 0.3246*	*-6.63 / -2.93 / 0.0000*
	Co2	*-0.87 / -2.92 / 0.7878*	*-7.27 / -2.93 / 0.0000*
	Transport	*-0.40 / -2.92 / 0.8995*	*-5.72 / -2.93 / 0.0000*
France	*GDP*	*0.17 / -2.92 / 0.9675*	*-5.63 / -2.93 / 0.0000*
	Energy	*-2.05 / -2.92 / 0.2617*	*-7.07 / -2.93 / 0.0000*
	Co2	*-0.48 / -2.92 / 0.8851*	*-7.67 / -2.93 / 0.0000*
	Transport	*1.64 / -2.92 / 0.9994*	*-6.20 / -2.93 / 0.0000*
	GDP	*0.41 / -2.92 / 0.9814*	*-5.54 / -2.93 / 0.0000*
Netherlands	*Energy*	*-2.84 / -2.92 / 0.0615*	*-6.15 / -2.93 / 0.0000*
	Co2	*-2.43 / -2.92 / 0.1393*	*-4.90 / -2.93 / 0.0003*
	Transport	*-0.21 / -2.92 / 0.9289*	*-5.66 / -2.93 / 0.0000*
	GDP	*-0.39 / -2.93 / 0.9006*	*-4.47 / -2.93 / 0.0008*
Spain	*Energy*	*-1.79 / -2.93 / 0.3797*	*-4.14 / -2.93 / 0.0022*
	Co2	*-2.00 / -2.93 / 0.2823*	*-4.57 / -2.93 / 0.0006*
	Transport	*2.26 / -2.92 / 0.9999*	*-4.86 / -2.93 / 0.0003*
UK	*GDP*	*1.57 / -2.94 / 0.9992*	*-4.51 / -2.93 / 0.0008*
	Energy	*0.24 / -2.92 / 0.9728*	*-7.16 / -2.93 / 0.0000*
	Co2	*0.09 / -2.93 / 0.9619*	*-8.84 / -2.93 / 0.0000*

In this manuscript, the VAR model is implemented in order to obtain detailed analysis regarding the trend of four variables. Thus, The GDP, air transportation, energy consumption and CO_2 are determined as endogenous variables, and lag order starts from lag 1 to the end of lag 2, which indicates the VAR. On the other hand, after implementing inverse roots of speciality polynomial, all the features of the root mean are located within the boundaries of the circle. In this way, the VAR model is stationary at Fig. 1 above which gives an opportunity to implement both impulse response analysis and variance decomposition. Subsequently, the impulse response model is carried out to analyze the tenor of the linkage among relevant variables. The empirical findings indicate that the effect of GDP is relatively more than CO_2 and energy consumption on air transportation except in France (See Figure. 2 and Table 3 below).

Table 2. Results of Johansen co-integration for EU countries from 1970 to 2014

County	Hypths	Eigen	T-Statistics	Critical Val	p-Val
	None *	0.620117	93.15336	47.85613	0.0000
	At most 1	0.450754	52.50186	29.79707	0.0000
Austria	At most 2 *	0.325483	27.33509	15.49471	0.0005
	At most 3 *	0.226692	10.79725	3.841466	0.0010
	None *	0.571739	84.25984	47.85613	0.0000
Belgium	At most 1	0.424444	48.64290	29.79707	0.0001
	At most 2 *	0.289518	25.44131	15.49471	0.0012
	At most 3 *	0.231976	11.08524	3.841466	0.0009
	None *	0.502609	78.50429	47.85613	0.0000
France	At most 1	0.431426	49.17235	29.79707	0.0001
	At most 2 *	0.362106	25.45816	15.49471	0.0012
	At most 3 *	0.144922	6.575644	3.841466	0.0103
	None *	0.412303	69.16856	47.85613	0.0002
	At most 1	0.397175	46.84372	29.79707	0.0002
Netherlands	At most 2 *	0.303083	25.58636	15.49471	0.0011
	At most 3 *	0.219725	10.42060	3.841466	0.0012
	None *	0.553785	72.83828	47.85613	0.0001
	At most 1	0.394900	38.94622	29.79707	0.0034
Spain	At most 2 *	0.259115	17.84704	15.49471	0.0217
	At most 3 *	0.117521	5.250847	3.841466	0.0219
	None *	0.577869	89.11736	47.85613	0.0000
UK	At most 1	0.405184	52.89492	29.79707	0.0000
	At most 2 *	0.342982	31.07579	15.49471	0.0001
	At most 3 *	0.273747	13.43398	3.841466	0.0002

Figure 1a. VAR analysis of EU countries

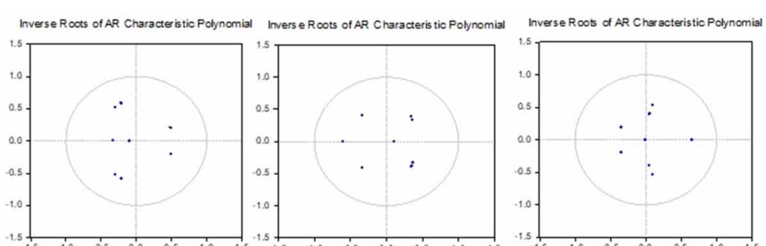
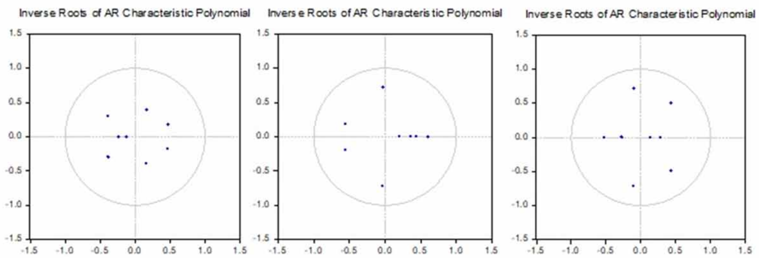


Figure 1b. VAR Analysis of EU countries (cont.)



Variance decomposition and impulse response analysis is carried out to reveal the tenor of the relationship between relevant variables. In addition, the empirical results indicate that the impact of GDP is relatively more than CO_2 and energy consumption on air transportation except in France (See Figure. 2 and Table 3 above). It has been found that the impact of Austria's GDP is scored as **15.82**, CO_2 is 3.84 and energy is 2.72 which is similar with the UK, Spain, Netherlands and Belgium's score and different from France.

The Pooled PDA model is implemented in order to reveal the effect of GDP, energy consumption and CO_2. For this reason, the Hausman test is implemented to understand whether a fixed or random impact is present in the research model. The Hausman test specifies infringement of the random effects analyzes that the illustrative variables are orthogonal to the unit impact. According to the P-value of the Hausman test, P-value < 0.05 (Table 4), so the null hypothesis H0 is rejected and a fixed effects model

Figure 2. Impulse response analysis of EU countries

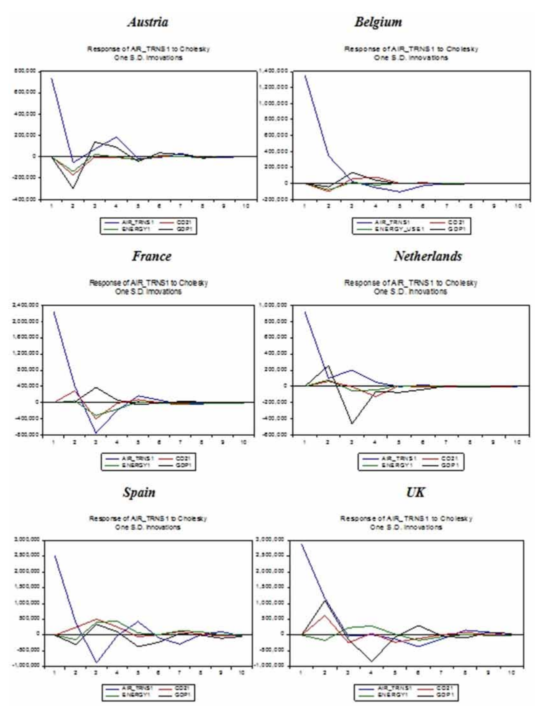


Table 3. Variance decomposition of EU countries (Austria)

	S E	Transport	Carbon	Energy	GDP
1	738999.3	100	0.00	0.00	0.00
2	828258.9	80.06658	4.170546	2.792248	12.97063
3	843155.7	77.96583	4.025062	2.758381	15.25073
4	867782.7	78.12700	3.805883	2.604255	15.46286
5	869953.3	77.79215	3.858173	2.708316	15.64136
6	870822.4	77.64082	3.850526	2.721405	15.78725
7	871630.8	77.61844	3.848648	2.717471	15.81544
8	871814.7	77.60195	3.848345	2.721930	15.82778
9	871855.9	77.59955	3.848000	2.723417	15.82903
10	871879.7	77.59859	**3.848387**	**2.723464**	**15.82956**

Table 4. Belguim

	S E	Transport	Carbon	Energy	GDP
1	1352797.	100	0.00	0.00	0.00
2	1401797.	99.06992	0.515837	0.326042	0.088196
3	1409994.	97.95060	0.681799	0.333052	1.034547
4	1413864.	97.55725	0.979730	0.355886	1.107135
5	1417806.	97.56844	0.974372	0.354845	1.102343
6	1418125.	97.56307	0.978582	0.354708	1.103641
7	1418158.	97.55853	0.978985	0.354883	1.107605
8	1418173.	97.55680	0.980209	0.354884	1.108107
9	1418190.	97.55677	0.980204	0.354928	1.108100
10	1418193.	97.55674	**0.980202**	**0.354953**	**1.108100**

is used. Additionally, the empirical findings of the Hausman test indicate that as long as air transportation is increasing, the EU countries' consciousness for the environment is quite low owing to high CO_2 emissions, GDP and energy usage from 1970 to 1997. In other words, there is a considerable effect of CO_2 emissions, GDP and energy usage on civil aviation from 1970 to 1997 which is a significant econometric finding (See Table. 5).

As already demonstrated, civil aviation is the dependent variable and energy consumption, CO_2 emissions and GDP are independent variables. The PDA test results are indicated in Table 5 above. The R2 = "0.96", which explains that 96% of environmental consciousness, can be clarified by air transportation, energy usage, GDP and CO_2 emissions. In addition, the coefficient estimates fixed and random impacts and provides more information. The probability performs the rejection of the hypothesis. Besides, the least square dummy variable for the ensured variables are performed with F = "586.25" and the probability of F is 0. Thus, the H0 is rejected and consciousness for the environment is not due to random chances; rather, it can be pointed out by the other test.

Table 5. France

	S E	Transport	Carbon	Energy	GDP
1	2244737.	100	0.00	0.00	0.00
2	2300111.	98.37622	1.579297	0.039566	0.004916
3	2501115.	92.22671	3.879043	1.620209	2.274037
4	2514786.	91.81712	3.841173	2.017150	2.324561
5	2522063.	91.72752	3.904827	2.015148	2.352507
6	2522934.	91.72456	3.902137	2.022402	2.350898
7	2523516.	91.70043	3.904685	2.034747	2.360136
8	2523872.	91.68814	3.905314	2.041256	2.365287
9	2523887.	91.68723	3.905384	2.042050	2.365339
10	2523900.	91.68709	**3.905377**	**2.042220**	**2.365315**

Table 6. Netherlands

	S E	Transport	Carbon	Energy	GDP
1	919006.9	100	0.00	0.00	0.00
2	965197.9	91.76005	0.424835	0.698893	7.116225
3	1090272.	75.31220	0.333811	0.781209	23.57278
4	1101386.	74.02837	1.615224	0.934537	23.42186
5	1103945.	73.68678	1.616165	0.940995	23.75606
6	1104786.	73.60181	1.623533	0.940477	23.83418
7	1104863.	73.59445	1.625699	0.945197	23.83466
8	1104909.	73.58835	1.625776	0.945474	23.84040
9	1104915.	73.58769	1.626465	0.945468	23.84038
10	1104916.	73.58768	**1.626497**	**0.945497**	**23.84032**

The environmental sensitivity of EU countries has risen considerably from 1997 to 2014 and the results of the Pooled Panel Data Regression model in terms of CO_2 supports this finding empirically which is found as 0.1118 (see Table 7 below). The correlation between GDP, energy consumption and air transportation is quite high except CO2 emissions. The P- values of energy consumption and GDP are 0.0037 and 0.0000 respectively, which is indicated in Table 7 below. The empirical findings reveal that EU countries' environmental sensitivity rose significantly in the second period from 1997 to 2014 except in France. It can be interpreted that these empirical results support the Kyoto Protocol's political goals and aims as well.

Table 7 above demonstrates that the coefficient of the energy consumption's variable is negative. In addition, the predicted coefficients for GDP and energy consumption are important at the 1% level. Besides, the empirical findings of the PDA indicate that energy usage and GDP affect air transportation excepting CO_2 from 1997 to 2014 in Austria, Belgium, France, Netherlands, Spain and the United Kingdom.

Table 7. Spain

	S E	Transport	Carbon	Energy	GDP
1	2508226.	100	0.00	0.00	0.00
2	2574151.	97.45954	0.911632	0.296893	1.331939
3	2819968.	90.97676	4.049101	2.347061	2.627076
4	2868498.	87.93010	4.744807	4.646552	2.678544
5	2925078.	86.74263	4.592019	4.522726	4.142626
6	2935025.	86.23584	4.562873	4.495393	4.705891
7	2954169.	86.04171	4.635202	4.649767	4.673320
8	2956419.	85.91226	4.642216	4.779063	4.666460
9	2960364.	85.82687	4.638876	4.766506	4.767745
10	2960903.	85.81066	**4.637188**	**4.764802**	**4.787346**

Table 8. UK

	S E	Transport	Carbon	Energy	GDP
1	2887665.	100	0.00	0.00	0.00
2	3364901.	85.66857	3.430196	0.241131	10.66010
3	3384599.	84.68352	3.902823	0.729410	10.68425
4	3499174.	79.23007	3.677350	1.378167	15.71441
5	3509214.	78.89994	4.064834	1.378404	15.65683
6	3546897.	78.27275	4.072507	1.566260	16.08849
7	3549507.	78.27658	4.067782	1.586380	16.06925
8	3555123.	78.21849	4.114058	1.583785	16.08367
9	3557487.	78.18635	4.109971	1.581893	16.12179
10	3557885.	78.17195	**4.109249**	**1.581690**	**16.13711**

The model equalities are represented below;

$$\ln (CO2)t = \alpha 0 + \alpha 1 \ln (GDP)t + \alpha 2 \ln (EC)t + et \quad (1)$$

$\alpha 0$, $\alpha 1$, $\alpha 2$ are the estimated parameters, t is the time index, and e is the error term.

$$\ln (CO2)t = \alpha 0 + \alpha 1 \ln (GDP)t + \alpha 2 \ln (Air\_trns)t + \alpha 3 \ln (EC)t + et \quad (2)$$

$\alpha 0$, $\alpha 1$, $\alpha 2$, $\alpha 3$ are the predicted parameters, *e* is the error term and *t* is the time index.

Table 9. EU countries CSR-effects test results (Hausman test) 1970 – 1997

Correlated Random Effects - Hausman Test Pool: PDA Test cross-section random effects				
Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random		102.683111	3	0.0000
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
GDP?	0.000031	0.000037	0.000000	0.0000
ENERGY?	-2817	-6642	398724	0.0000
CO2?	789903	1997624	24160175568	0.0000
Cross-section random effects test equation: Dependent Variable: AIR? Method: Panel Least Squares Sample: 1970 1997 Included observations: 28 Cross-sections included: 6 Total pool (balanced) observations: 168				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5950535.	2844621.	2.091855	0.0380
GDP?	3.08E-05	1.11E-06	27.74364	0.0000
ENERGY?	-2817.352	839.4582	-3.356155	0.0010
CO2?	789903.6	261233.8	3.023742	0.0029
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.967210	Mean dependent var		14270264
Adjusted R-squared	0.965560	S.D. dependent var		14072388
S.E. of regression	2611540.	Akaike info criterion		32.44086
Sum squared resid	1.08E+15	Schwarz criterion		32.60822
Log likelihood	-2716.032	Hannan-Quinn criter.		32.50878
F-statistic	586.2592	Durbin-Watson stat		0.619015
Prob(F-statistic)	0.000000			

4. CONCLUSION

The vast majority of the academic articles have focused on the relationship between environmental issues and economic growth. The linkage among transportation, energy consumption, CO_2 emissions and economic growth is a new research subject and there is a lack of academic work on this subject for some countries especially in terms of the transport sector. Therefore, this manuscript addresses the effect of energy consumption, CO_2 emissions and economic growth on civil aviation. The Pooled Panel Data Regression is implemented for 6 EU countries, including 2 time periods from 1970 to 1997 and from 1997 to 2014. The actual reason to divide the series as two periods is to reveal the Environmental Kuznet Curve hypothesis and to analyse the Kyoto Protocol's political results and its effects. According to the findings of this manuscript, air transportation, GDP, CO_2 emissions and energy consumption are correlated certainly from 1970 to 1994 (see Table 5). In addition, between 2000 and 2014, the coefficient of correlation reduced considerably which demonstrates that the objectives of the Kyoto Protocol are achieved except in France since both impulse response and variance decomposition analysis of France proves that the impact of CO_2 is relatively more than GDP and energy consumption on air transportation which pollutes the environment. PDA analysis is also consistent with impulse response and variance decomposition analysis of France.

Table 10. Panel data analysis results (pooled panel data regression) 1970 – 1997

Dependent Variable: AIR?
Method: Pooled Least Squares
Sample: 1970 1997
Included observations: 28
Cross-sections included: 6
Total pool (balanced) observations: 168

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5950535.	2844621.	2.091855	**0.0380**
GDP?	3.08E-05	1.11E-06	27.74364	**0.0000**
ENERGY?	-2817.352	839.4582	-3.356155	**0.0010**
CO2?	789903.6	261233.8	3.023742	**0.0029**
Fixed Effects (Cross)				
_AUSTRIA--C	-4540503.			
BELGIUM--C	-3652244.			
FRANCE--C	-1786075.			
_NETHERLANDS--C	-1492592.			
SPAIN--C	2797725.			
UK--C	8673689.			

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.967210	Mean dependent var	14270264
Adjusted R-squared	0.965560	S.D. dependent var	14072388
S.E. of regression	2611540.	Akaike info criterion	32.44086
Sum squared resid	1.08E+15	Schwarz criterion	32.60822
Log likelihood	-2716.032	Hannan-Quinn criter.	32.50878
F-statistic	586.2592	Durbin-Watson stat	0.619015
Prob(F-statistic)	0.000000		

The empirical findings confirm that there is cointegration and a long-term relationship between air transportation, GDP, CO_2 emissions and energy consumption in this work. Energy consumption, air transportation and the associated CO_2 emissions have risen considerably in EU countries including Belgium, Austria, Spain, Netherlands and the United Kingdom. Given the latest trends, the ability to reduce CO_2 emissions from air transportation does not seem encouraging. By EU countries civil aviation sector, these countries will decrease their CO_2 emissions and provide a better environmental consciousness and sustainable economic growth. The relevant countries should provide intelligent urbanisation and green energy production such as clean and intelligent air transportation systems. In addition, economic development acts as a significant driver leading to air transportation development, which should be considered when projecting environmental applications Therefore, governments should also support R&D in transportation by providing new eco-friendly technologies.

Kalayci and Yazici (2015) find the same empirical results on the subject of the relationship between civil aviation and GDP, confirming the findings of this manuscript. Furthermore, Kalayci and Koksal (2015) demonstrate that the United States of America's GDP has a significant impact on air transportation from 1980 to 2012. The findings of this manuscript are consistent with their research results. In addition, the Granger causality test of their manuscript demonstrates the bidirectional relationship between

Table 11. EU countries CSR effects test results (Hausman Test) 1997 – 2014

Correlated Random Effects - Hausman Test				
Pool: PDA				
Test cross-section random effects				
Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random		36.213011	3	0.0000
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
GDP?	0.000020	0.000026	0.000000	0.0000
ENERGY?	-14902	-16763	20880140	0.6838
CO2?	2638313	4823904	1972361859557	0.1197
Cross-section random effects test equation:				
Dependent Variable: AIR?				
Method: Panel Least Squares				
Date: 06/15/19 Time: 15:31				
Sample: 1997 2014				
Included observations: 18				
Cross-sections included: 6				
Total pool (balanced) observations: 108				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	54931327	11701000	4.694584	0.0000
GDP?	1.97E-05	1.67E-06	11.78926	0.0000
ENERGY?	-14902.42	5016.071	-2.970935	0.0037
CO2?	2638313.	1644266.	1.604554	0.1118
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.969417	Mean dependent var		39025047
Adjusted R-squared	0.966946	S.D. dependent var		30907204
S.E. of regression	5619168.	Akaike info criterion		34.00092
Sum squared resid	3.13E+15	Schwarz criterion		34.22443
Log likelihood	-1827.050	Hannan-Quinn criter.		34.09155
F-statistic	392.2654	Durbin-Watson stat		0.365718
Prob(F-statistic)	0.000000			

GDP and air transportation at lag 1 and lag 2. The two main research questions are proved empirically including whether there are any long-term relationships among air transportation, CO_2 emission, GDP, energy consumption and which independent variables more greatly affect the dependent varible by using econometric models (variance decomposition, impulse response and Johansen cointegration test). The suggestion of this manuscript is that production facilities ought to be established in the optimal regions of target countries so that energy usage, CO_2 emissions and logistic costs would be decreased clearly, and GDP and trade volume would considerably increase among the nations.

Table 12. Panel data analysis results (Pooled Panel Data Regression) 1997 – 2014

Dependent Variable: AIR?				
Method: Pooled Least Squares				
Date: 06/15/19 Time: 15:34				
Sample: 1997 2014				
Included observations: 18				
Cross-sections included: 6				
Total pool (balanced) observations: 108				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	54931327	11701000	4.694584	**0.0000**
GDP?	1.97E-05	1.67E-06	11.78926	**0.0000**
ENERGY?	-14902.42	5016.071	-2.970935	**0.0037**
CO2?	2638313.	1644266.	1.604554	**0.1118**
Fixed Effects (Cross)				
AUSTRIA--C	-15769412			
BELGIUM--C	-2521220.			
_FRANCE--C	2822865.			
NETHERLANDS--C	633591.1			
SPAIN--C	-5184935.			
_UK--C	20019110			
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.969417	Mean dependent var		39025047
Adjusted R-squared	0.966946	S.D. dependent var		30907204
S.E. of regression	5619168.	Akaike info criterion		34.00092
Sum squared resid	3.13E+15	Schwarz criterion		34.22443
Log likelihood	-1827.050	Hannan-Quinn criter.		34.09155
F-statistic	392.2654	Durbin-Watson stat		0.365718
Prob(F-statistic)	0.000000			

REFERENCES

Al-Ghandoor, A., Jaber, J., Al-Hinti, I., & Abdallat, Y. (2013). Statistical assessment and analyses of the determinants of transportation sector gasoline demand in Jordan. *Transportation Research Part A, Policy and Practice*, *50*, 129–138. doi:10.1016/j.tra.2013.01.022

Bese, E., & Kalayci, S. (2019). Environmental Kuznets Curve (EKC): Empirical relationship between economic growth, energy consumption, and CO2 emissions: evidence from 3 developed countries. *Panoeconomicus*, 1–26.

Bhat, A. A., & Mishra, P. P. (2018). The Kyoto Protocol and CO2 emission: Is India still hibernating? *Indian Growth and Development Review*, *11*(2), 152–168. doi:10.1108/IGDR-10-2017-0080

Danish, & Wang, Z. (2018). Dynamic relationship between tourism, economic growth, and environmental quality. *Journal of Sustainable Tourism, 26*(11), 1928-1943.

Fotis, P. N., & Pekka, V. (2017). The effect of renewable energy use and economic growth on pollution in the EUROZONE. *Economics and Business Letters*, *6*(3), 88–99. doi:10.17811/ebl.6.3.2017.88-99

Ghandoor, A. (2013). An approach to energy savings and improved environmental impact through restructuring Jordan's transport sector. *Renewable & Sustainable Energy Reviews*, *18*, 31–42. doi:10.1016/j.rser.2012.09.026

Grossman, G. M., & Krueger, A. B. (1991). Environmental impacts of a North American Free Trade Agreement. NBER. Working Paper 3914.

Imamoglu, H. (2019). The role of financial sector in energy demand and climate changes: Evidence from the developed and developing countries. *Environmental Science and Pollution Research International*, 1–18. PMID:31175568

Jovanovic, M. M., & Vracarevic, B. R. (2016). Challenges ahead: Mitigating air transport carbon emissions. *Polish Journal of Environmental Studies*, *25*(5), 1975–1984. doi:10.15244/pjoes/62700

Kalayci, S. (2017). Dışsal Faktörlerin Ulaşım Sektörüne Etkisi: Lojistik Firmalarından Kanıtlar. *Finans Politik & Ekonomik Yorumlar*, *54*(633), 41–59.

Kalayci, S., & Koksal, C. (2015). The relationship between China's airway freight in terms of carbondioxide emission and export volume. *International Journal of Economic Perspectives*, *9*(4), 60–68.

Kalayci, S., & Yazici, S. (2016). The impact of export volume and GDP on USA's civil aviation in between 1980-2012. *International Journal of Economics and Finance*, *8*(1), 229–235. doi:10.5539/ijef.v8n1p229

Katircioglu, S., Cizreliogullari, M. N., & Katircioglu, S. (2019). Estimating the role of climate changes on international tourist flows: Evidence from Mediterranean Island States. *Environmental Science and Pollution Research International*, 1–7. PMID:30868454

Katircioğlu, S., & Katircioğlu, S. (2018). Testing the role of urban development in the conventional environmental Kuznets curve: Evidence from Turkey. *Applied Economics Letters*, *25*(11), 741–746. doi:10.1080/13504851.2017.1361004

Katircioglu, S., Katircioglu, S., & Kilinc, C. C. (2018). Investigating the role of urban development in the conventional environmental Kuznets curve: Evidence from the globe. *Environmental Science and Pollution Research International*, *25*(15), 15029–15035. doi:10.100711356-018-1651-9 PMID:29552719

Kuznets, S. (1955). Economic growth and income inequality. *The American Economic Review*, *65*, 1–28.

Marcotullio, P. J., Williams, E., & Marshall, J. D. (2005). Faster, sooner, and more simultaneously: How recent road and air transportation CO_2 emission trends in developing countries differ from historic trends in the United States. *Journal of Environment & Development*, *14*(1), 125–148. doi:10.1177/1070496504273716

Mikayilov, J. I., Mukhtarov, S., Mammadov, J., & Azizov, M. (2019). Re-evaluating the environmental impacts of tourism: Does EKC exist? *Environmental Science and Pollution Research International*, 1–14.

Ozkan, T., Yanginlar, G., & Kalayci, S. (2018). Testing the transportation-induced environmental Kuznets curve hypothesis: evidence from eight developed and developing countries. *International Journal of Energy Economics and Policy*, *9*(1), 174–183.

Panayotou, T. (1993). Empirical tests and policy analysis of environmental degradation at different stages of economic development. World Employment Programme Working Paper Number WP238. Geneva, Switzerland: International Labor Office.

Rubin, J., & Leiby, P. N. (2013). Tradable credits system design and cost savings for a national low carbon fuel standard for road transport. *Energy Policy*, *56*, 16–28. doi:10.1016/j.enpol.2012.05.031

Saleem, H., Jiandong, W., Zaman, K., Elashkar, E. E., & Shoukry, A. M. (2018). The impact of air-railways transportation, energy demand, bilateral aid flows, and population density on environmental degradation: Evidence from a panel of next-11 countries. *Transportation Research Part D, Transport and Environment*, *62*, 152–168. doi:10.1016/j.trd.2018.02.016

Serena, N., & Perron, P. (2001). Lag length selection and the construction of unit root tests with good size and power. *Econometrica*, *69*(6), 1519–1554. doi:10.1111/1468-0262.00256

Wen, L., & Huang, L. (2019). Analysis of influencing factors of Chinese provincial carbon emissions based on projection pursuit model and Markov transfer matrix. *International Journal of Climate Change Strategies and Management*, *11*(3), 406–423. doi:10.1108/IJCCSM-05-2017-0116

World Bank. (2019). Air transport, passengers carried. Retrieved from https://data.worldbank.org/indicator/IS.AIR.PSGR

World Bank. (2019). CO2 emissions (Metric tons per capita). Retrieved from https://data.worldbank.org/indicator/en.atm.co2e.pc

World Bank. (2019). Energy use (kg of oil equivalent per capita). Retrieved from https://data.worldbank.org/indicator/EG.USE.PCAP.KG.OE

World Bank. (2019). GDP (Current US$). Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

Chapter 8
The Impacts of Liner Shipping Connectivity and Economic Growth on International Trade Case of European Countries and Turkey

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ABSTRACT

Sea transportation and maritime transport networks have commonly been used with the development of international trade. Maritime transportation is more widely used for the transportation of high-volume cargoes in international trade particularly, since sea transportation is cheaper and safer than road and railway transportation. This chapter investigates the relationship among exports, liner shipping connectivity index, and economic growth in European countries and Turkey. Analysis found that liner shipping connectivity index and economic growth have a positive effect on the exports in European countries and Turkey. It is revealed that 1% increase in liner shipping connectivity index provides the increment 0.21% in the exports. In addition, 1% increment in gross domestic product ensures the increase 1.05% in the exports.

INTRODUCTION

Continents and lands are all around the world surrounded by seas and oceans. In this regard, international trade between countries rely mostly on sea transportation nowadays. Advancements in international trade has led maritime transportation usage to rise. Countries attach particular importance to maritime transportation since more carriage can be transported cheaper and safer against other types of transportation (Saban & Güğercin, 2009).

DOI: 10.4018/978-1-7998-1397-2.ch008

Having more advantages than disadvantages, maritime transportation is the most preferred among transportation types. Maritime transportation has an important place in countries international trade not only by transportable hauling capacities but also by availability of international trade transactions at the ports, and by appearing safe transportation way (Tunalı & Arakçay, 2018: 112). Ports are significant in maritime transportation by knitting the continents together. Maritime transportation went through some structural changes by distributing bigger ships into fewer intermediate ports hence changing maritime transportation network (Kang & Woo, 2017: 274).

Maritime transportation mainly occurs in two ways. These two ways can be classified as overseas and coastal regional transportations. While countries use coastal regional transportation in regional and national trades, overseas transportation is used in international trade (Korkmaz, 2012: 100). Another classification of maritime transportation takes regularity of maritime transportation into account by dividing them into being regular and irregular. Ships of maritime transportations following fixed schedules can be described as liner shipping whereas tramp shipping does not have a fixed schedule (Yenal, 2011: 2).

Global production procedures, international trade and international finance transactions, companies, and countries to connect can be enabled by maritime transportation. Considering the growing internationalization level in international economy, maritime transportation becomes more significant. Maritime transportation and logistics performance are deterministic for international trade considering geographical distances. Advanced liner shipping connectivity can help reducing trade costs and positively related to trade volumes (Lun & Hoffmann, 2016: 3). Therefore, most of the developing countries prefers maritime transportation in international trade. This situation can be verified by various researches on international trade, port and maritime network.

BACKGROUND

Manufactured products mostly transported by liner container transportation. Container ships follows a fixed schedule and visits few ports on transportation. Different carriers' goods loaded, transferred and unloaded on each port. Liner transportation services are preferred due to country interconnectivity, and reachability to oversee export markets by consulting in ship schedules and liner cargo network.

Liner Shipping Connectivity Index is established by UNCTAD in 2004 in order to compare and analyze countries' position on global maritime transportation. Liner shipping connectivity index aims to reveal a country's integration level to current maritime transportation network by measuring its maritime connections. Generated by international container transportation data, the index is consistent of five components. These components can be described as follows: each countries' deployment levels of ships at ports, container carriage capacities of these ships, number of companies providing regular services, number of services and the size of the biggest ship (Bartholdi et al., 2016: 235).

Having a high value on liner shipping connectivity index represents better access to port and hinterland facilities and requires necessary frequent connection between ports. Liner shipping connectivity index indicates both level of network connectivity in transportation and level of ease on international trade. Connecting to transportation network allows achieving higher market shares as well as strategical goals to reach wider geographical regions. After all, countries with high liner shipping connectivity index score deal with international trade actively (Varbanova, 2017: 193).

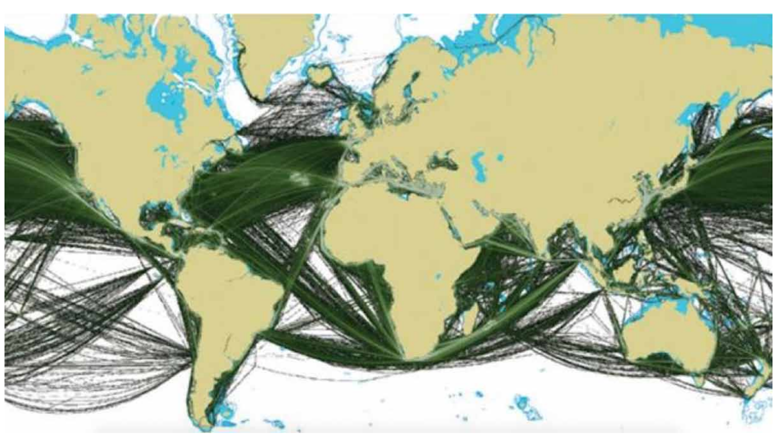
Figure 1 reveals a map on density of container ships in 2016. Malacca, Panama, the Bay of Gibraltar, and the Suez Canal in northern hemisphere are denser than the ones in southern hemisphere. It can be seen that some regions are favorable in transportation network than others.

Level of liner transportation connectivity measured by liner transportation connectivity index also indicates tendency of current widening regional cargo transportation. Liner transportation network ensures a better connection within ports and safe hinterland connections. Liner transportation connectivity index exhibits long-term benefits of lower transportation costs and prosperity as of income by wide export markets. In spite of economic crisis and negative effect of market supply, density of transportation services and widening geographical regions reveals a distinct international trade volume. Having said that, liner transportation network is significantly important in international trade (Fugazza and Hoffmann, 2017: 1).

Formation of liner transportation networks is affected by systematic cargo companies' strategic goals depending on senders' requests on services. In this reason, location of a port or region in liner transportation is determined by trade flow to and from a region. Structure of liner transportation networks depends on the number of ships and service frequency, capacity of ports and cargo volumes, and specifications. According to these determinants, frequency of the transportation services depends on the loading capacity of transportation equipment, number of port searches from and to a port, and stopping at intermediate ports (Varbanova, 2017: 192). Volume of maritime transportation may hinge on transportation costs and accessibility of transportation services. Connectivity of transportation networks is attached to infrastructure and location of ports as well as facilitating measures of international trade.

Ports accessibility to hinterland, infrastructure and superstructure of ports and its capacity, characteristics of a dock's / pier's accessibility, and location within a region are the most important factors of a port. Besides, customs transactions, international and regional regulations for transportation corridors, regulations of port management are also significant in international transportation network. Accessibility to ground transportation from a port, advanced logistics networks, and safety of hinterland transportations are important to reduce international trade costs.

Figure 1. Density map of container ship movements
Source: UNCTAD by Marine Traffic



MARITIME TRANSPORT, EXPORTS AND ECONOMIC GROWTH

Liner transportation connectivity has been rising steadily in recent years. Using bigger ships as a scale economy and reducing the number of low capacity ships are effective in this rise (Reza et al., 2015: 44). Alongside, liner transportation activities require capital-intensive investments. Due to 2008 global crisis and economic contraction, companies offering liner transportation services suffered from significant losses. Following the economic crises global maritime transportation has gained an acceleration nowadays. Global maritime trade has risen by 4% especially in the last five years.

Mergers and acquisitions in liner maritime transportation industry and restructure of global economic collaborations has led to consolidations more. Additionally, in spite of the concentration trend in international markets, average number of maritime transportation service company per country has risen. Alliances of global maritime transportation stands for 93% of total capacity. Companies in alliances compete on prices. Productivity in activities and higher levels of capacity utilization results in lower freight prices (Ünver, 2016: 272).

Developing countries in global trade account for a high margin of world maritime transportation both in import and in export. Nearly developing countries conduct 60% of total world global trade. On the contrary, share of developed countries in world maritime trade accounts for nearly 35%. Besides, transition economies prefer global maritime transportation on raw material and commodity exports by 6%.

Liner transportation activities made transportation lines and connections between ports more complicated. This situation resulted in new relationships where transportation lines have more bargaining power and influences. Usage of bigger size ships in maritime transportation and higher collaborations between transportation companies made it necessary for ports to comply with the change. While higher productivity levels were achieved by restructures in liner transportation network and collaborations, advantages for ports were not as fast. Accordingly, considering rising global trade volume, countries need to refine both their liner transportation network connections and port infrastructure to ramp up export levels.

Global economic advancements are another factor of higher demand on maritime transportation. Economic constriction after 2008 global economic crisis affected global maritime transportation negatively and recovered by positively accelerated global economy. Macroeconomic indicators such as global investment as of economic growth, production activities, and international trade are significantly important for global maritime trade and maritime transportation. Accordingly, economic growth is effective on both countries' export levels and global maritime transportation.

EMPIRICAL ANALYSIS

The aim of this paper is to examine the relationships between liner shipping connectivity index, gross domestic product, and exports of European countries and Turkey. In this respect, it is going to find out how liner shipping connectivity index and gross domestic product have impact on the exports of countries carried out by European countries and Turkey. It will focus on the results that will be obtained from infrastructure development of ports in European countries and Turkey within boosting export volume.

The paper analyses the relationship between liner shipping connectivity index, gross domestic product and exports of European countries and Turkey by panel time series models within the context of this study. Whereas dependent variable is exports of both European countries and Turkey, liner shipping connectivity index and gross domestic product of both European countries and Turkey involved as independent variables in the research model.

Data on countries' liner shipping connectivity index, gross domestic products and exports are obtained from the database of the World Bank. Series used in the paper are annually between 2004 and 2017. The information about the variables used in the study is as follows;

ln(EXP) : Exports of European Countries and Turkey
ln(LSCI) : Liner Shipping Connectivity Index of European Countries and Turkey
ln(GDP) : Gross Domestic Product of European Countries and Turkey

Depending on this information, the panel time series model has been created for European countries and Turkey to analyze the relationship between liner shipping connectivity index, gross domestic product and export (1);

$$\ln(EXP)_{it} = \beta_0 + \beta_1 \ln(LSCI)_{it} + \beta_2 \ln(GDP)_{it} + \in_{it} \tag{1}$$

Research hypothesis of the paper is investing the more infrastructure investments of ports of European countries and Turkey contributes positively to the economies and enhances the exports of these countries. The relationships between liner shipping connectivity index, gross domestic product and exports of both European countries and Turkey will be tested by the panel time series analyses but initially, it is necessary to examine the stationarity of the panel time series.

Cross-Sectional Dependence and Unit Root Tests

The panel unit root and panel cointegration tests do not account for the cross-sectional dependence of the contemporaneous error terms. Literature reveals that failing to take in consideration cross-sectional dependence may cause major distortions in panel unit root tests. In the presence of cross-sectional dependence, an analysis that takes into account cross-sectional dependence will generate results that are more accurate. Therefore, Breusch-Pagan (1980) LM test and Pesaran CD-LM (2004) tests are implemented to panel time series analysis to test for cross-sectional dependence.

According to the results in Table 1, the null hypothesis which refers to cross-sectional independence is rejected for ln(EXP), ln(LSCI) and ln(GDP) variables. Accordingly, cross-sectional dependence in all panel time series are valid. Due to fact that cross-sectional section dependence is affected by the asymptotic properties of the first-generation unit root tests, it is required to examine the variables with second-generation unit root tests that take into account the correlation of the panel data series. The results of second-generation unit root test are given in Table 2.

The second-generation panel unit root test (PESCADF) results in Table 2 indicate variables have unit root (Pesaran, 2007). This situation demonstrates that relationship between European countries and Turkey as actors in the market are influenced mutually. (Giannetti, 2015: 551). After the unit root test, there will be co-integration analyses in order to whether find out long-term relationship among the variables.

Table 1. Cross-sectional dependence test

Variables	CD Test	Test Statistics	Prob.
ln(EXP)	LM	2740.774	0.000
	CD_{LM}	51.518	0.000
ln(LSCI)	LM	1158.443	0.000
	CD_{LM}	21.454	0.000
ln(GDP)	LM	1994.628	0.000
	CD_{LM}	40.529	0.000

Table 2. Second generation panel unit root test (PESCADF)

Variables	Series in Level		Series in First Differences	
	T-Bar Stat.		T-Bar Stat.	
	C	C+T	C	C+T
ln(EXP)	-1.210	2.061	-3.621***	-3.532***
ln(LSCI)	-2.363***	1.083	-2.492***	-2.553*
ln(GDP)	1.777	0.957	-2.597***	-2.564*

Note: "C" stands for constant term, "I + T" represents constant and trend. One lag lengths are chosen. ***, **, and * indicate significance at 1%, 5% and 10% respectively.

Westerlund Panel Co-Integration Test

Westerlund [26] co-integration analysis states whether a long-term relationship between variables is present. The Westerlund [26] co-integration test ensures four panel co-integration tests based on the error correction model to test the co-integration relationship between panel data. At the basis of these four tests is to examine the presence of the co-integration relationship by testing whether each unit has its own error correction [27, p. 239]. Westerlund [26] results of panel co-integration analysis are given in Table 3.

Table 3. Westerlund (2007) panel co-integration results

Error Correction Tests	Statistics	
	Constant Model	Constant and Trend Model
G_τ	-2.059***	-2.578
G_α	-3.719	-2.636**
P_τ	-6.152*	-6.484**
P_α	-1.707**	-2.157**

Note: ***, **, and * indicate significance at 1%, 5% and 10% respectively.

According to results of Westerlund (2007) panel co-integration analysis, H_0 hypothesis is rejected in constant and constant-trend models and cointegration relation is determined between panel series. Accordingly, the long-term relationship among the panel series is validated. When the results of the panel cointegration analysis are considered, there are long-term relationship between liner shipping connectivity index, gross domestic product and exports of European countries and Turkey.

Estimation of Long-Term Coefficients (PDOLS)

After applying co-integration tests, DOLS (Dynamic Ordinary Least Square) method which is developed by Pedroni (2000 and 2001) is used to test the consistency and to estimate coefficients of this relationship. DOLS is a method that can eliminate the deviations in static regression (especially due to endogeneity problems) by including dynamic elements to the model.

Table 4 shows the results of Panel DOLS. When the panel DOLS test results are evaluated, the sign of liner shipping connectivity index and gross domestic product are positive as expected and statistically significant at 1% level. In other words, the increase in liner shipping connectivity index and gross domestic product in the long run positively affect the exports of European countries and Turkey.

The elasticity of liner shipping connectivity index and gross domestic product were calculated as 0.21% and 1.05% in European countries and Turkey, respectively. In other words, a 1% increase in liner shipping connectivity index in European countries and Turkey makes an increment approximately 0.21% in exports in the long run. Furthermore, a 1% increment in gross domestic product in European countries and Turkey makes an increase approximately 1.05% in exports in the long run. These results show that it must be more investment in port infrastructure in order to increase the exports in European countries and Turkey.

Dumitrescu-Hurlin Panel Causality Test

Panel causality test revealed by Dumitrescu and Hurlin (2012) is used to test whether there is a causal relationship among the variables. Dumitrescu and Hurlin (2012) panel causality tests hypothesis does not reject the existence of causality in at least one cross-section against the absence of the homogeneity of Granger causality relationship. In this regard, Dumitrescu and Hurlin (2012) also consider the cross-sectional dependence among the countries in the panel causality test. In addition to this, Dumitrescu and Hurlin [29] panel causality tests are not sensitive to the differences between the time series and cross-section in panel data. Namely, panel causality test ensures effective results when the size of time series and cross-section is larger or smaller than other [Dumitrescu & Hurlin, 2012: 1450; Kılıç et al., 2014: 125; Bozoklu & Yılancı, 2013: 174–175). Dumitrescu and Hurlin (2012) results of panel causality test are located in Table 5.

Table 4. Panel DOLS results

Panel DOLS		
Variables	**Coefficient**	**Prob.**
ln(LSCI)	0.214	0.000
ln(GDP)	1.045	0.000

Table 5. Dumitrescu-Hurlin panel causality test results

Causality Relationship	$Z^{HNC}_{N,T}$	Z^{HNC}_{N}
ln(EXP) ln(LSCI)	*4.139****	*2.149***
ln(LSCI) ln(EXP)	*-0.105*	*-0.622*
ln(EXP) ln(GDP)	*-0.749*	*-1.043*
ln(GDP) ln(EXP)	*0.378*	*-0.307*
ln(LSCI) ln(GDP)	*-0.861*	*-1.116*
ln(GDP) ln(LSCI)	*0.696*	*-0.099*

Note: One lag lengths are chosen. ***, **, and * indicate significance at 1%, 5% and 10% respectively.

According to the panel causality test results, there is a uni-directional causality relationship from exports to liner shipping connectivity index of European countries and Turkey. When the Dumitrescu and Hurlin [29] panel causality test results are analyzed, it is seen that the increase in maritime transports of European countries and Turkey is caused by the increment in export volume. In this respect, it is revealed that raising the volume of export has a positive effect on maritime transportation.

SOLUTIONS AND RECOMMENDATIONS

One of the most important factors in international trade is the efficient and less costly transportation of the goods subject to trade. Exporters and importers due to its cost-effectiveness and cargo transportations in high volume frequently use maritime transportation in international trade. In this respect, the ports that support international trade and transportation provide important opportunities for the economic development of the city and the region in which they are located and establish a strong connection between various trade centers.

There is great competition on a global scale to ensure that ports are ready to meet increasing needs. As European countries and Turkey have an important transit route for maritime transport and ports, they have competitive advantages in international trade. According to results of the paper, it is found that the increment in liner shipping connectivity of European countries and Turkey leads to increase in exports volume. Accordingly, both increasing the liner shipping connectivity and developing ports infrastructures are vital for increasing the international trade volume.

Economic growth of countries has significant effects on both increasing exports and developing infrastructure investments. In line with the research findings, it is seen that increment in economic growth of European countries and Turkey affects in a positive way to exports of these countries. As a result of the causality analyzes within the study, it is determined that there is a causality relationship from export to liner shipping connectivity index. This situation proves that export and economic growth have substantial effects on maritime transport. Therefore, both increasing the economic growth levels and enhancing the exports volume of the countries positively affect the maritime transportation performance.

CONCLUSION

In this paper, the influence of maritime transportation and economic development of countries that have important ports of Europe and Turkey on exports of these countries have been analyzed. The paper also investigates the effect of shipping connectivity of European countries and Turkey in terms of export performance. As long as countries have effective shipping connectivity with each other, it is seen that they are going to have substantial export volume. Therefore, the study contributes to theoretical and empirical literature of international trade and logistics because having good maritime transportation and liner shipping connectivity contains export advantages.

In the study, long-term relations among exports, liner shipping connectivity index and gross domestic product of European countries and Turkey is examined by using Westerlund panel co-integration method. Westerlund panel co-integration method allows estimating long-term relationship among the variables. In addition to this, causality relationship among the variables by Dumitrescu-Hurlin panel causality methods in the study is analyzed. These empirical approaches give new perspectives to analysis relationships among the exports, liner shipping connectivity index, and gross domestic product.

Firstly, panel co-integration analysis is performed in order to indicate the long-term relations among the variables. According to the results of the analysis, it has been determined that there is a long-term relationship among exports, liner shipping connectivity index and gross domestic product. According to panel dynamic OLS results, 1% increase in liner shipping connectivity index lead to raising 0.21% of exports of European countries and Turkey. Similar to such relation, 1% increment in gross domestic product lead to increasing 1.05% of exports of these countries. Thus, it has been reached the conclusion that positive effects on the exports of European countries and Turkey will be higher if the infrastructure quality and connectivity of ports of these countries were more intensified. Thereby, these results support the hypothesis that increasing connectivity of maritime transportation contributes positively to enhances exports of European countries and Turkey.

According to results of causality analysis, there is a unidirectional causality relationship from exports to liner shipping connectivity index of European countries and Turkey. In this context, increasing export volume of these countries will be positively affected by the liner shipping connectivity. In addition, further exports of these countries will contribute to the development of more liner shipping connectivity. As a result of the analysis performed in keeping with the research hypothesis, when development of connectivity and quality of maritime transportation raises, exports of European countries and Turkey also follows an increasing trend. According to the empirical evidences within the coverage of this paper, mutually supporting the increase of the volume of exports suggests that increment of liner shipping connectivity will be beneficial for European countries and Turkey.

REFERENCES

Bartholdi, J. J., Jarumaneeroj, P., & Ramudhin, A. (2016). A new connectivity index for container ports. *Maritime Economics & Logistics*, *18*(3), 231–249.

Bozoklu, Ş., & Yılancı, V. (2013). The causality relation between financial development and economic growth: an analysis for emerging economies. *Dokuz Eylül University Journal of Economics and Administrative Sciences Faculty*, *28*(2), 161–187.

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies*, *47*(1), 239–253. doi:10.2307/2297111

Dumitrecsu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, *29*(4), 1450–1460. doi:10.1016/j.econmod.2012.02.014

Fugazza, M. & Hoffmann, J. (2017). Liner shipping connectivity as determinant of trade. *Journal of Shipping and Trade*, 1–18.

Giannetti, C. (2015). Unit roots and the dynamics of market shares: An analysis using an Italian banking micro-panel. *Empirical Economics*, *48*(2), 537–555. doi:10.100700181-013-0795-1

Kang, D., & Woo, S. (2017). Liner shipping networks, port characteristics and the impact on port performance. *Maritime Economics & Logistics*, *19*(2), 274–295. doi:10.105741278-016-0056-2

Kılıç, C., Bayar, Y., & Özekicioğlu, H. (2014). Effect of research and development expenditures on high technology export: a panel data analysis for G8 countries. *Erciyes University Journal of Economic and Administrative Sciences*, *44*, 115–130.

Korkmaz, O. (2012). Türkiye'de Gemi Taşımacılığının Bazı Ekonomik Göstergelere Etkisi. *Business and Economics Research Journal*, *3*(2), 97–109.

Lun, Y. H. V., & Hoffmann, J. (2016). Connectivity and trade relativity: The case of ASEAN. *Journal of Shipping and Trade*, 1–11.

Pedroni, P. (2000). Fully modified OLS for heterogeneous co-integrated panels. *Advances in Econometrics*, *15*, 93–130. doi:10.1016/S0731-9053(00)15004-2

Pedroni, P. (2001). Purchasing power parity tests in co-integrated panels. *The Review of Economics and Statistics*, *83*(4), 727–731. doi:10.1162/003465301753237803

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. IZA Discussion Paper No. 1240.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross section dependence. *Journal of Applied Econometrics*, *22*(2), 265–312. doi:10.1002/jae.951

Reza, M., Suthiwartnarueput, K., & Pornchaiwiseskul, P. (2015). Liner shipping connectivity and international trade in maritime southeast Asian countries. *Journal of International Logistics and Trade*, *13*(3), 43–74. doi:10.24006/jilt.2015.13.3.003

Saban, M., & Güğercin, G. (2009). Deniz Taşımacılığı İşletmelerinde Maliyetleri Etkileyen Faktörler ve Sefer Maliyetleri. *Dokuz Eylül Üniversitesi Denizcilik Dergisi*, *1*(1), 1–16.

Tunalı, H., & Akarçay, N. (2018). Deniz Taşımacılığı ile Sanayi Üretimi İlişkisinin Analizi Türkiye Örneği. *İktisadi, İdari ve Siyasal Araştırmalar Dergisi, 3*(6), 111–122.

Ünver, M. (2016). Ülkelerin Denizyolu Taşımacılığı Bağlantılılık Düzeyinin Gelişmekte Olan Doğu Asya ve Pasifik Ekonomilerine Yapılan İhracata Etkisi. *Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *7*(15), 265–287.

Varbanova, A. (2017). Liner shipping networks and ports connectivity in the Black Sea region. *International Scientific Journal*. *Trans Motauto World*, *2*(5), 192–195.

Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*, *69*(6), 709–748. doi:10.1111/j.1468-0084.2007.00477.x

Yenal, S. (2011). *Dünyada ve Türkiye'de Uluslararası Deniz Yolu Taşımacılığının Gelişiminin Değerlendirilmesi.* Retrieved from http://www.tmo.gov.tr/upload/document/tmodanhaberler/denizyolu.pdf

APPENDIX 1

Table 6.

Belgium	Holland	Portugal
Bulgaria	Iceland	Romania
Denmark	Italy	Slovenia
Estonia	Ireland	Spain
Finland	Latvia	Sweden
France	Lithuania	Turkey
Germany	Norway	United Kingdom
Greece	Poland	

Chapter 9
Incoterms and New Transport Types:
The Importance of Drones

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ABSTRACT

In this research, Drones, which are between incoterms and new forms of transport, are examined. International logistics applications behave in line with the development objectives responsive to changing environmental conditions of business, delivery forms, which are part of the deployment tools and will influence the choice of delivery method with drones were examined. In this context, the purpose of the study is to examine the concepts of logistics and international logistics and the factors that both the buyer and the seller are affected when selecting one of these terms of INCOTERMS. The paper sheds light on the factors when choosing, unmanned vehicles of the future drones and discusses the importance of transportation, delivery market, in terms of the cost of delivery and related rules and regulations drones. Paper concludes with the future trends about the logistics and Incoterms by scanning the available literature.

DOI: 10.4018/978-1-7998-1397-2.ch009

INTRODUCTION

Today, logistics management is becoming more and more important due to the increase in competition, rapid change of consumer preferences, advantages of cost reduction, changes in consumer profile, etc. Companies are also dealing with more and foreign trade; both import and export-oriented transactions are increasing every day. According to the researches and calculations, companies who can manage their logistics processes well can reduce their costs between 15% and 50%. These indicators prove how important and effective logistics is today.

Logistics, which has been understood and remembered as a military concept in the past, has become an invariable force of competition for enterprises rather than storage or transportation for today's businesses. One of the most important issues in the import and export transactions, which is one of the logistic parts, is delivery terms. Which known as INCOTERMS. INCOTERMS, which updated periodically, regulates where, by whom and which make cost and risk allocation in international trade. The selection of the delivery method resulting from these regulations is one of the most important issues that should be considered consciously for both the buyer and the seller.

Whether the buyer or the seller determines the type of delivery and the risks that the enterprises hold in the foreground when choosing the type of delivery is important for the elimination of potential future disputes from today. In addition to thid, the wrong and unconsciously chosen delivery method can cause harm to a company that wants to make a profit. That's why it is very important that the choice of right delivery type.

With the industrial revolution in the 19th century, trade between the countries began to increase. This increase in foreign trade has brought many unique problems besides increasing the welfare level of the countries. One of the main problems experienced in foreign trade transactions is that the technical terms used in the purchase and sale of goods have different meanings from country to country. For example, the incoterms, which first used FOB and CIF, in the interpretation throughout the world, was not standard. In order to prevent this disorder, ICC (International Chamber of Commerce) launched a research in 1920 covering 13 countries. At the end of this research, in 1923, ICC was published a study that compiled the six most used delivery forms. These forms of submission can be regarded as the ancestors of the incoterms used today. The first six delivery forms ICC issued in 1923 are FOB, FAS, FOT, FOR, FREE Delivered CIF and C&F. The second study in 1928 aimed to compile commercial terms used in 30 countries. At the end of this preliminary study, the first incoterms rules were published in 1936. Since then, the period of incoterms has started.

In this study, international logistic practices, delivery types, factors affecting the choice of delivery type and drones that are the means of distribution of the future are included. In the first part of the study logistics and international logistics concepts are examined and researches are made on basic logistics terms. However transportation modes, storage, packaging and transport containers, handling and other logistics applications are examined in the first section. In the second part of the study the concept of INCOTERMS and its development up to the present day and its current state are examined. In addition, after the last revision made in 2010, researches were carried out on the commercial properties of INCOTERMS 2010 terms. Then the factors that affected both the buyer and the seller when selecting one of these terms were examined in detail. In the third part, the drones of the future unmanned vehicles were examined, the importance of transportation, delivery market, delivery cost and related DRONES in terms of rules and regulations; contribution and changes in logistics and incoterms were examined.

BACKGROUND

The International Chamber of Commerce (ICC) has established delivery forms to ensure that the same language is used in export and import transactions. Thanks to these definitions, both the importer and the exporter can know exactly where their responsibilities and expenses will end. The scope of Incoterms is limited to the rights and obligations of the parties to the rights and obligations of the goods sold. Incoterms include delivering goods to the buyer, distribution of costs, passage of damage, issuing documents and, customs clearance. Incoterms is an abbreviation of International Commercial Terms. We can define this as international business conditions of logistics and risks. The International Chamber of Commerce (ICC), headquartered in Paris, publishes Incoterms. Incoterms were first created in 1936 and revised seven times. Latest Incoterms rules, which were last revised as of 2010, came into force as of 1 January 2011. The definitions of incoterms include 11 delivery forms which came into force on 1 January 2011. These 11 delivery methods covers the delivery type that can be used with all transportation methods and the delivery type that can only be used by sea.

INCOTERMS has become a global descriptor for companies in the field of foreign trade and has united commercially in common language. Thus, commercial development was achieved. As a result of this, companies are constantly trying to redefine themselves by reaching a higher level of productivity in order to maintain or increase their market share in the developing world conditions. Technology and technological developments have always been the primary source of achieving higher competitiveness. The first applications of new technologies are often groundbreaking and innovative, although they will not always be successful. One of them is unmanned aerial vehicles. From a logistic point of view, unmanned aerial vehicles the use of drones, ie new transport products, to the final stages of the supply chain or to end customers increases direct customer satisfaction by developing and upgrading the existing business model. In this context, it is monitored how the post-parcel industries have started to use UAVs, how they have changed and developed, and how the relevant companies have been prepared for their competitors and become advantageous.

LOGISTICS CONCEPT AND INTERNATIONAL LOGISTICS APPLICATIONS

Wide ranges of definitions are available in different sources related to logistics management. Generally, logistics managemenet is classified in four main areas as follows (Genç, 2009):

- Business Logistics Management
- Military Logistics Management
- Service Logistics Management
- Event Logistics Management

Logistics applications used in international trade are the subject of Business Logistics Management as a concept. There are various definitions in the literature. Some of these definitions; were made by the Council of Supply Chain Management Professionals (CSCMP). According to this definition, Logistics Management is the supply chain process that covers the efficient planning, implementation and control of the forward and backward flows and storage of goods, services and related information between the point of production and consumption points in order to meet customer requirements (Tanyaş & Hazır, 2011). According to the definition of Society of Logistics Engineers (SOLE, 2014) "Logistics; from design engineering to production, from packaging to marketing, from distribution to use, is the management support area used throughout the life of the material.

Based on these definitions, it is possible to say that Logistics Management is one of the most important and indispensable links of Supply Chain Management. It will be more appropriate to consider Logistics Management in two different applications as Business Logistics and Logistics Enterprises. In this context, Business Logistics i the whole of logistics activities in an enterprise and can be examined in four different groups in a production enterprise as "incoming material", material in production ","outgoing material "and recycled material (Tanyaş & Hazır, 2011).

Logistics Enterprises are the companies that provide logistics services to companies with their own competence. (Tanyaş & Hazır, 2011). These companies, domestic and international transport and storage, packaging, customs clearance, handling and so on, manages all logistics processes on behalf of the trade companies. Logistics enterprises can create a serious competitive advantage for their customers due to their experience, national and international relationships, vehicles and machinery lines.

Logistics Management and International Logistics Concepts

The concept of logistics has gained great importance for businesses today. The word logistics comes from French in origin and is essentially a military concept. The main purpose of logistics as a military concept is to prepare the armies for war and provide them with all the service support that will win the war (Magge and others, 1985). The concept of logistics management has become very popular especially in Europe and North America since the 1980s. The cost advantage and competitive advantage of this concept are the most important benefits of Logistics Management to businesses (Brewer and others, 2001).

Development of current logistics activities stems from the effort to meet military needs in World War II. In the civil field, after World War II, technological and economic requirements have changed rapidly. To put this change in chronological order;

- In the 1950s, the concept of integrated logistics emerged. In the 1960s, there have been improvements in the concepts of physical distribution and purchasing.
- In the 1970s, the logistics function entered into the organization chart both in private and public institutions.
- In the 1980s, important developments in the field of information processing provided ease of application to integrated logistics activities.
- With the global competition and cost factors in the 1990s, logistics activities began to make itself felt better in business management.

Today, businesses in terms of supply chain logistics management turned into an indispensable element of management, create the benefit has assumed a function of enhancing competitiveness. The concept of international logistics can be explained by the planned and correct organization of the flow of goods, money and information between the buyer and the seller outside the country's borders (Küçük, 2012). An international logistics application in which planning and applications are done accurately and completely will provide significant benefits to the enterprise in terms of gaining reputation, money and new customers. The development of international logistics and the development of international trade show serious parallel with each other. Today, due to the speed of information flow, the development of roads and means of transport, the cross-border of trade, the increase of central storage facilities, the proliferation and modernization of handling machinery and equipment, international logistics is now making significant contributions to the acceleration and development of international trade.

Basic International Logistics Terms and Concepts

Transportation, loading, storage, packaging, stacking, documentation etc. in international trade are very common when making services or applications. The basic international logistics terms and concepts can be listed as follows:

- ADR; international standards for the transport of dangerous goods by road (Genç, 2009). According to these standards, hazardous materials are evaluated in nine different classes and each of them is connected to an international standard by means of transport method and precautions.
- Warehouse; warehouses where goods which have not entered into free circulation and whose customs procedures have not been completed are stacked during the period until nationalization enters into free circulation.
- Anti-Dumping Tax; This is the tax applied to the goods of countries or companies that cause unfair competition by dumping in international trade, except customs duty (Alkan & Erdal, 2004). The main purpose here is to contribute to the development of the industry by protecting the domestic producer. ATR is Movement Certificate, between Turkey and the European Union countries of goods in free circulation in the exporting country benefiting from the preferential regime regulated and authorized institutions which are exempt from customs duty again from the customs authorities of the exporting country is to receive approval document circulation (Alkan & Erdal, 2004).
- AWB; Air Waybill is the abbreviation of the initials of the words, airway bill of lading.
- B / L is the abbreviation of Bill of Lading with the initials, the document indicating that the goods are loaded.
- CMR; International road transport contract, truck bill of lading.
- Charter Party is the Charter of the Ship and the rental of all or part of the ship (Küçük, 2012).
- Dumping; price reduction in international markets.
- Demurrage; Compensation resulting from exceeding the pre-agreed loading or unloading time of the goods (Küçük, 2012).
- Storage; it is the place where something is put up for a certain period of time to be protected, stored and used when necessary (Koban and Keser Yıldırır, 2010).
- ETA; is the abbreviation of Estimated Time of Arrival. Specifies the estimated time of arrival.
- ETD; is the abbreviation of Estimated Time of Departure. It shows the estimated time of ascent.
- EUR.1; The European Union and EFTA countries (Switzerland, Norway, Iceland and Liechtenstein) movement certificates for certain products are showing free trade can be done (EU Turkey Business Development Center, 2014).
- FCL is the abbreviation of Full Container Load by taking the initials of the container. The container is fully filled by the exporter and it means only the goods of that exporter.
- Forwarder; all types of transport shipment, storage, distribution, interim transport, customs clearance, insurance, etc. are the logistics enterprises that can provide services to international trade enterprises (Alkan and Erdal, 2004).

- Fumigation; is the medical application of the goods in a certain container or storage provide for certain conditions.
- Groupage; transport of loads in small containers, combined with other loads in large containers.
- In bond; international goods that are transported from one place to another within the country without customs duty paid.
- Intermodal Transportation; In international trade, more than one mode of transport is used jointly for the same business transaction (Genç, 2009).
- Certificate of Origin is a document that shows the country within which an article is produced.
- Freight; the transportation fee of the goods carried by international means of transport regardless of the mode of transport.
- Ro / ro; Roll on / roll of vessel is the abbreviation of the words, wheeled vehicles can board the ship and at the port of arrival the vehicles can continue with their international loads (Küçük, 2012).
- Free zone; it is a restricted area where goods can enter customs free (Alkan & Erdal, 2004).
- Surveyor; in the international trade appraisaling the amount of goods, quality, etc. This appraisal can be carried out by an independent organization other than the buyer and seller, loading, unloading or both.

International Logistics Applications

International logistics applications can be divided into application areas such as transportation, storage, packaging and handling according to their service areas. All these fields of application constitute the concept of international logistics. Most fundamental problem in international logistics applications is how and by which transport vehicle can be used for goods of trade. This shipment can be carried out in a single mode of transport or as a multi-mode transport with multiple modes of transport (Küçük, 2012).

The geographical and political locations of the departure and destination points, the type of material to be transported, the form of packaging and the location, the delivery time agreed between the parties and so on. The reasons are the basis for determining the mode or modes of transport to be selected.

Transportation Modes

Because a product is consumed rather than where it is produced, it is an important part of the supply chain elements of transport (Chopra and Meindl, 2007). Also in the international logistics practices when considering the total cost, the largest share goes to transportation. Transportation by road, rail, airway and maritime directly affects the speed, cost and quality of international logistics activities. Whether domestic or international logistics applications, transportation needs a much larger operational planning and organizational structure than anticipated. However, when a cross-border practice enters, different cultures and operations occur in the environment, which may lead to some application differences, constraints and unnecessary costs (Brewer and others. 2001). For these reasons, choosing the right transportation mode makes a great contribution to the transportation of the desired goods at the right time, in the right place and in the right way. It is possible to examine the modes of transport in six sections according to the mode of transport highway, railway, airline, sea, road, pipeline and multi-mode.

Packaging and Transport Containers

Packaging is an important issue in international trade. Because, considering the lengths of distances and transport time, the goods sold during these processes should be preserved as they were loaded first, but should be packaged in a light enough not to increase transport costs (Akat, 2003). Correct packaging will allows and prevents the delivery against; physical accidents, transportation accidents, climatic and biological causes of product spoilage, successfully (Genç, 2009). Therefore, packaging and transport containers can be examined in more detail under four general headings; sacks and bigbags, pallets, flexible tanks and IBC tanks and containers.

Handling

Handling is one of the most important topics in international logistics applications. Because a proper handling application saves time, space and cost as well as prevents material loss (The Material Handling Institute of America). Handling is defined as the relocation, protection, preservation and control of material or product during production, distribution, consumption and use (The Material Handling Institute, 2014). Considering this definition, handling in general can be considered as correct loading, transportation and unloading of the material. Handling can be examined under different headings as bulk cargo, container and partial cargo handling in international logistics applications.

CONCEPT OF INCOTERMS

In essence, international trade is largely full of obscurity. Even though world feel the effects of globalization more and more powerful every day, this situation is not enough to completely eliminate our commercial risks and concerns. Especially if we try to interpret the trade not by looking at the day humans are in, but by looking at past time periods with much less communication and information, it can be seen that the concerns in that period are more and the rules in trade life are mostly unwritten practices. In this sense, it can be said that international trade started with the formation of political borders separating countries (Taşkın, 2012). After the end of the Second World War, the commercial mobility that started with the acceleration of globalization was followed by the 1980s. As a result of this increasing competition, international trade gained momentum, but various commercial and financial risks emerged (Büyükkalkan, 2013). At the end of the efforts to eliminate these financial and commercial risks, the concept of Incoterms has emerged. Incoterms is a set of standard rules that clearly define the rights and obligations of both the seller and the buyer and make certain rules and regulations (Utkulu and others, 2009).

Headquartered in Paris, the International Chamber of Commerce (ICC), which includes 63 national committees, more than 7,000 member firms and 130 countries, eliminates disputes, and legal disputes between the buyer and seller in international trade transactions. In order to prevent loss of money and time, it has introduced some standard rules for trading transactions (Brodie, 1999). Incoterms, which can be referred to as International Commercial Terms, first started in 1924 under the leadership of the Association of Inter-National Law, and carried out in 1928. The first International Rules on CIF contracts emerged in Poland was called "Warsaw Rules" (Özkan, 2012).

International commercial life of the arrangement according to business needs and work continued as if the first term in 1936 by International Chamber of Commerce "Incoterms 1936" was published. This first study carried out to eliminate the difficulties in commercial life for a long time a major part of the problem as a solution. Differences and new needs arising because of commercial developments were solved in 1953, 1967, 1976, 1980, 1990, 2000 and 2010 by various revisions on the terms of Incoterms (Özkan, 2012). Today, the latest version of Incoterms 2010, which came into force as of 01.01.2011, is being used.

The concept of incoterms covers a number of standard terms used in international trade and clarifies the obligations of the parties in terms of importers and exporters, the place and manner of delivery of goods subject to trade, the sharing of costs to be generated during trade relations, the passage of insurance and damage, and the order of documents (Bağrıaçık &Yıldırım, 2008).

Development of Incoterms Concept and Applications of Incoterms

The introduction of the concept of international trade terms and the first application of Incoterms 1936 has eliminated many commercial disputes. The first result of these concepts, which were designed by the International Chamber of Commerce for the first time in 1921 and started to work, was finalized in 1923. The Commercial Terms Committee of the International Chamber of Commerce completed its work in 1923 and put forward the concepts of six commercial terms. These 6 terms are seen as the beginning of a long journey that continues today. In this study, the terms FOB, FAS, FOT, FOR, Free Delivered CIF and C&F have emerged. These terms are heralded the commercial practice which was later called Incoterms (International Chamber of Commerce, 2014).

In 1936, Incoterms 1936 was developed to create universal rules for the most used trade terms in international trade. Since then, qualified lawyers and commercial consultants of the International Chamber of Commerce made several revisions on the terms Incoterms in 1953, 1967, 1976, 1980, 1990, 2000 and 2010 to keep pace with the development of international trade. The change of commercial practices, differentiation of materials and transportation types, and the development of international law made it compulsory to carry out these revisions at regular intervals by international experts (Gürsoy, 2010).

The concept of incoterms has been revised 7 times since 1936 when it was actually used. The first revision after 1936 corresponds to 1953. Entering World War II have a negative impact on commercial activities and new revision has come 17 years after the first revision. In this revision, the terms FOR-FOT (Free On Raid-Free On Truck) and DCP (Delivered Costs Paid) are added for the transports other than maritime transport which are not included in the first application. These additional terms include rail transport rather than road transport and do not refer to a truck transport (Ramberg, 2011). In 1967, DAF (Delivery At Frontier) and DDP (Delivery in Country of Destination) were added to the need. Thus, the number of terms increased from 6 to 10 with the new revision (Ramberg, 2011). The revision in 1967 was followed by the revisions of 1976 and 1980. The term FOB Airport was added in 1976 for air transport. Although this term contradicts the FOB term for the maritime route in terms of the passage of damage, it remained in the revision of 1980. In the 1980 revision, the term FRC (Free Carrier) was added in order to express the damage passage of sea transportations more clearly (Ramberg, 2011).

In fact, all the changes made in the 1953 revision consists of an addition. In the late 1980s, the International Chamber of Commerce concluded that changes that are more radical because of developing commercial and logistical activities. Therefore, it was decided to revise with a completely new logic.

At the end of the studies carried out for Incoterms 1990 version, the revision draft with serious changes was adopted and entered into force. The abbreviation FCR has been changed to FCA and is still in use today. This change made the terms FOR, FOT and FOB Airport abolished (August, 2004). In the 1990 revision, 13 terms came into force with the addition of new ones.

1990 revision and Incoterms terms; Delivered from the seller's door, customs taxes paid in up to deliver to the seller, brought to a suitable form by the time of the commercial and logistic conditions in all probability deliveries. In the 2000 revision, there was not much change. Only the term FCA has been simplified to regulate damage and property transfer. However, the 2000 version; the development of communication and the spread of the Internet, the use of electronic data, the proliferation of free zones, Incoterms applications in domestic sales began to be used in some of the requirements (August, 2004). Table 1 shows the terms of Incoterms 2000 before the revision in 2010. Due to the needs of the said amendment, studies on the 2010 revision, which is planned to come into force on 01 January 2011, have been carried out in order to eliminate the deficiencies mentioned.

The most fundamental change of the 2010 revision was in the grouping. In the revisions from 1936 to 2000, including the year 2000, the terms were defined by classifying letters. The grouping is not in accordance with the mode of transport or mode, but in the order of delivery from the delivery to the seller, with customs tax paid to the delivery. The 2010 revision and Incoterms 2010 have altered this application; covering all types of transport and sea / inland waters are classified into two main groups, namely covering transport types. Another revision made with the 2010 revision includes DAF (Delivered at Frontier), DES (Delivered Ex-Ship), DEQ (Delivered Ex-Quay), DDU (Delivered Duty Unpaid) and DAT (Delivered at Terminal). Delivered at Place) terms have been added. As a result of these studies,

Table 1. Incoterms 2000

Incoterms 2000		
E	**EXW**	Ex- works
F	**FCA**	Free Carrier
	FAS	Free Alongside Ship
	FOB	Free On Board
C	**CFR**	Carriage and Freight
	CIF	Cost Insurance and Fright
	CPT	Carriage paid to
	CIP	Carriage and Insurance paid to
D	**DAF**	Delivered at Frontier
	DES	Delivered Ex-Ship
	DEQ	Delivered Ex-Quay
	DDU	Delivered Duty Unpaid
	DDP	Delivered Duty Paid

Source: Güven, 2002

Incoterms 2010 entered into force with a total of 11 terms (Ezel, 2013). The classification and ordering of these terms are listed as follows:

- Applications covering all types of transport:
- EXW - Delivery in the Workplace
- FCA - Free Delivery to the Carrier
- CPT - Carriage Delivered Paid
- CIP - Transport and Insurance Delivery Paid
- DAT - Terminal Delivery
- DAP - Delivery at designated place
- DDP – Customs Paid-in
- Delivery Sea and Inland Water Transport Applications;
- FAS - Cost-Free Delivery
- FOB - Cost-Free Delivery on Board
- CFR - Charges and Freight Delivered
- CIF - Charges, Insurance and Freight Delivered

The main purpose of these arrangements made by the International Chamber of Commerce is to facilitate commercial life and to increase the commercial activities between countries. Even with the revision made in 2010, the terms Incoterms were used in the same way in national trade and facilitated domestic commercial activities. As a result of the effects of rapidly developing trade, communication and technological opportunities, it is inevitable to eliminate the negative effects by making incoterms revisions for certain periods (Ezel, 2013).

Incoterms 2010 Applications

Incoterms 2010 version came into force as of 01.01.2011. Both importers and exporters due to the convenience it has brought since its entry into force have rapidly adopted it. In addition; Incoterms 2010 applications are being used in national trade in unions that cooperate in a wide geographical area by providing customs union with the countries such as Russia, China and the United States and with the countries which are spread over wide geographical areas. The ease and comprehensiveness of the implementation has been an example for other countries.

The main difference of the Incoterms 2010 version from the previous versions is that it was classified into two main groups as sea / inland water transport and other types of transport, as previously mentioned, from the factory delivery to the delivery of customs duties to the consignee. In addition, four terms have been removed from 13 terms in the previous version and two new terms have been added and the number of terms has been reduced to 11 (Ezel, 2013).

EXW – Ex-Works (Delivery in the Workplace)

Ex-Works; derived from the word delivery in the workplace. This form of delivery, which is abbreviated with letters E.X.W, is actually one of the commonly used delivery forms. Receiver; the seller is obliged to carry out the necessary logistics organization in front of the previously agreed factory, including loading to the transportation vehicle. In this case; intermediate transportation, intermediate handling, transportation and other handling, intermediate storage applications, insurance procedures, customs procedures on both sides, loading documents to be prepared, handling and intermediate transportation organization at the destination are planned and implemented by the buyer. In general, it is possible to list the seller's obligations as follows (Güven, 2002):

- The production or supply of the goods subject to the contract in the content, packaging, quantity and quality specified in the terms of the contract,
- If requested in the contract, license, permission, certificate, etc. for the goods seller helps the buyer to take formalities,
- By giving the buyer an enough time to receive the goods in accordance with the contract, informs the date and place where the goods will be ready,
- When the goods in contract are ready, it performs the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods in the place and time specified in the contract and delivers them to the transportation vehicle organized by the buyer,
- The seller undertakes the risks, damages, costs incurred until the buyer receives the goods,
- Helps to provide other information and documents that the buyer may request.

The buyer's obligations are at the highest level in this form of delivery. The buyer must use all his commercial skills to make a logistics plan for the contracted goods that will provide the lowest cost but fastest and high quality delivery. When making this logistics plan, the laws and conditions in the country of trade should be well researched, taking into account the possible situations, and taking into consideration all the possibilities and costs that may be encountered during loading and transportation. Generally, it is possible to list the buyer's obligations as follows (Güven, 2002):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,
- Providing the necessary permits, licenses, certificates, etc. for the goods in contract, provided that they cover the risks and expenses. plans formalities, asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- Provides the logistics organization in order to receive the goods prepared by the seller on time and takes delivery of the goods,
- Prepares the necessary origin and circulation documents by carrying out the customs procedures regarding the goods in contract and receives the approval of the relevant authorities,
- To arrange the necessary insurance policy for all loss and damage that may be incurred upon receipt of the goods,
- From the moment the wares offered whether the order is ready to bear all the expenses will occur,
- Upon receipt of the goods, the seller shall provide the necessary documents indicating that he has received the goods in full,
- Provides goods to the place of arrival complete, fast and at minimum cost.

When using this term, the most important feature to be considered is the differences that customs procedures will show from country to country. EXW delivery method does not comply with customs regulations of some countries. In such a case, the importer may not be able to carry out any customs transactions in the country of origin under the legislation. In this case, the FCA delivery method should be preferred by the parties (Brodie, 1999).

FCA - Free Delivery to Carrier

The term free delivery to the carrier is derived from the F.C.A. It is expressed with the abbreviation (Calis, 2007). The city, port or place to be brought to the end of this abbreviation refers to where the goods will be delivered to the buyer's carrier by the seller. This term has been added to Incoterms applications in 1990 revision by replacing FOR, FOT and FOB Airport terms (Özkan, 2012).

After the seller prepares the goods, he performs the exit customs procedures and prepares the goods at the place specified in the contract to the carrier determined and assigned by the buyer. This term can be used regardless of the mode of transport, including combined transport (Güven, 2002). If the seller wants to summarize the term FCA; the seller prepares the goods in the contracted quantity, quality and packaging, and delivers them to the consignee's carrier at the agreed date on the contract. At the place specified in the contract, the seller terminates his responsibility as soon as he delivers the goods undamaged and completely. This place of delivery may be the seller's workplace, the carrier's warehouse, the terminal or another location (International Chamber of Commerce, 2014: History of Incoterms Rules). In the form of this delivery, all risks, costs and responsibilities, including freight fees, insurance, interim transport, handling, intermediate storage and other transactions, pass at the carrier and completely to the buyer from the moment of delivery (Çalış, 2007).

In general, it is possible to list the seller's obligations as follows (Güven, 2002):

- Produce or supply the goods subject to the contract in the content, packaging, quantity and quality specified in the terms of the contract,
- If requested in the contract, license, permission, certificate, etc. for the goods in question. helps the buyer to take formalities,
- By giving the buyer a enough time to receive the goods in accordance with the contract, informs the date and place where the goods will be ready,
- When the goods in contract are ready, it performs the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods in the place and time specified in the contract and delivers them to the transportation vehicle organized by the buyer,
- Prepares the necessary origin and circulation documents by carrying out the customs procedures regarding the goods in question and receives the approval of the relevant authorities
- Seller undertakes the risks, damages, costs incurred until the buyer receives the goods,
- Supports and assists in providing other information and documents that the recipient may request.

Generally, it is possible to list the buyer's obligations as follows (Güven, 2002):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,

- Providing necessary permissions, licenses, certificates, etc. for the goods in contract, provided that they cover the risks and expenses. plans formalities, asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- Provides the necessary logistics organization in order to receive the goods prepared by the seller in accordance with the contract on time, and receives the goods,
- After taking responsibility of the goods, will arrange the necessary insurance policy for all losses and damages that may be incurred,
- It shall bear all expenses arising from the moment the goods are ready and presented to the order,
- Provides the necessary documents to the seller after receiving the goods,
- Brings the goods to the destination, complete, fast and at minimum cost.

This mode of delivery may be used for any mode of transport, including those for multiple means. Although it is similar to the term FOB in general, the main difference between them is the FOB, while the point of delivery is only a ship, while the FCA has a means of any type of transport vehicle. In the case of multiple transportation, the first delivery vehicle is the decisive one (Çalış, 2007).

CPT - Carriage Paid To

This form of transport, unlike the previous form of transport, includes delivery to the agreed destination, with freight paid by the agreed transport means (International Chamber of Commerce, 2014). This term is valid for all types of transport and is mostly used in multi-vehicle transport types (Calis, 2007). The difference of this mode of transport from the previous terms is that all costs up to the destination and all risks up to the first vehicle of transport are borne by the seller (Ozkan, 2012).

In general, it is possible to list the seller's obligations as follows (Güven, 2002):

- The production or supply of the goods subject to the contract in the content, packaging, quantity and quality specified in the terms of the contract,
- License, permission, certificate, etc. for the goods in question if requested and helps the buyer to take formalities,
- Determines the appropriate, safe, fast and least costly transporter who will deliver the goods to the buyer in accordance with the contract at the arrival customs. He informs the buyer and the carrier of the date and place where the goods will be ready, by making the most appropriate logistics plan,
- When the goods subject to the contract are ready, it performs the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods at the place and time specified in the contract and delivers them to the transport vehicle organized by him and undertakes all expenses,
- Prepares the necessary origin and circulation documents by carrying out the customs procedures regarding the goods in question and receives the approval of the relevant authorities.

Generally, it is possible to list the buyer's obligations as follows (Güven, 2002):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,

- Providing necessary permissions, licenses, certificates, etc. for the goods in question, provided that they cover the risks and expenses. He plans formalities, asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- Following the goods prepared by the seller in accordance with the contract and logistics organization, the goods are delivered to the destination customs
- Following the delivery of the goods to the first carrier, shall arrange the necessary insurance policy on behalf of all losses and damages that may be incurred,
- Bearing all expenses arising from the moment the goods arrive at the customs of arrival,
- Providing the necessary documents to the seller after receiving the goods,
- When the goods arrive at the destination, it performs customs and logistic procedures complete, fast and with minimum cost.

CIP - Transport and Insurance Delivery Paid

In this mode of transport, unlike the previous mode of transport, the seller makes the insurance policy and the insurance policy is sent to the buyer together with other loading documents. This term also applies to all types of transport and is often used in multi-vehicle transport types (Calis, 2007).

In general it is possible to list the seller's obligations as follows (Güven, 2002):

- The production or supply of the goods subject to the contract in the content, packaging, quantity and quality specified in the terms of the contract
- If requested in the contract, license, permission, certificate, etc. for the goods in question. helps the buyer to take formalities,
- Determines the appropriate, safe, fast and least costly transporter who will deliver the goods to the buyer in accordance with the contract at the arrival customs. He informs the buyer and the carrier of the date and place where the goods will be ready, by making the most appropriate logistics plan,
- When the goods subject to the contract are ready, it performs the necessary quality controls, packaging and brand processes before delivery,
- Prepares the goods in the place and time specified in the contract and delivers the goods to the transport vehicle organized by him and undertakes all expenses,
- To arrange the necessary insurance policy for all loss and damage that may be incurred following the delivery of the goods to the first carrier,
- Prepares the necessary origin and circulation documents by carrying out the customs procedures regarding the goods in question and receives the approval of the relevant authorities,
- Undertakes the risks, damages and expenses that occur until the delivery of the goods to the first carrier who will perform the agreed transportation method as per the contract,
- Supports and assists in providing other information and documents that the recipient may request.

Generally, it is possible to list the buyer's obligations as follows (Güven, 2002):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,

- Providing the necessary permits, licenses, certificates, etc. for the goods in question, provided that they cover the risks and expenses. He plans formalities, asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- Following the goods prepared by the seller in accordance with the contract and logistics organization, the goods are delivered to the destination customs,
- Bearing all expenses arising from the moment the goods arrive at the customs of arrival,
- After receipt of the goods, the seller is required to provide the necessary documents,
- When the goods arrive at the destination, it performs customs and logistic procedures complete, fast and with minimum cost.

DAT – Deliver at Terminal

This form of delivery is a new term that was incorporated with the 2010 revision of Incoterms. With the term DAT, a concept has been created where the costs and risks belong to the seller including the unloading of goods from the transportation vehicle at the destination point and it can be used since 01.01.2011 regardless of the mode of transportation (Caner, 2012).

This term actually emerged with the revision of Incoterms 2000, replacing the term DEQ, which was abolished by the Incoterms 2010 revision. (Ezel, 2013).

In general, it is possible to list the seller's obligations as follows (Ezel, 2013):

- The goods subject to the contract; produce or supply in the content, packaging, quantity and quality specified in the contract conditions,
- If requested in the contract, license, permission, certificate, etc. for the goods in question. He helps the buyer to take formalities,
- Determines the appropriate, safe, fast and least costly transporter who will deliver the goods to the buyer in accordance with the contract at the arrival customs. He informs the buyer and the carrier of the date and place where the goods will be ready, by making the most appropriate logistics plan,
- When the goods in question are ready, it performs the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods in the place and time specified in the contract and delivers them to the transport vehicle organized by him and undertakes all expenses,
- To arrange the necessary insurance policy for all loss and damage that may be incurred following the delivery of the goods to the first carrier,
- Prepares the necessary origin and circulation documents by making customs procedures regarding the goods subject to the contract and obtains the approval of the relevant authorities,
- Undertakes the risks, damages and expenses that occur until the unloading and delivery of the goods at the designated terminal at the designated place by carrying out the transportation business that is agreed as per the contract,
- Supports and assists in providing other information and documents that the recipient may request.
  In general, it is possible to list the buyer's obligations as follows (Bağrıaçık and Yıldırım, 2008):
- The seller pays the price of the goods in full and on time with the payment method specified in the contract,

- Providing necessary permissions, licenses, certificates, etc. for the goods in question, provided that they cover the risks and expenses. plans formalities, asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- Following the goods prepared by the seller in accordance with the contract and the logistics organization, takes delivery at the designated terminal,
- Shall bear all expenses incurred from the moment the goods arrive at the designated terminal and are discharged,
- Upon receipt of the goods, the seller presents the necessary documents indicating that the goods are fully delivered,
- When the goods come to the designated terminal and evacuated, they perform customs and logistic procedures in a complete, fast and with minimum cost.

DAP – Delivered at Place

This term, which can be used in all forms of transport, is based on the principle that the seller delivers the goods to the buyer at the designated place of delivery but on the vehicle, ie without evacuation. This term is the form of which can be used in all types of transportation by combining the terms of DAF, DES and DDU which were included in the previous revision Incoterms 2000 but removed in the next revision Incoterms 2010 (Ezel, 2013).

In general, it is possible to list the seller's obligations as follows (Ezel, 2013):

- The goods subject to the contract; produce or supply in the content, packaging, quantity and quality specified in the contract conditions,
- If requested in the contract, license, permission, certificate, etc. for the goods in contract. helps the buyer to take formalities,
- Determines the appropriate, safe, fast and least costly transporter who will deliver the goods to the buyer in accordance with the contract at the arrival customs. He informs the buyer and the carrier of the date and place where the goods will be ready, by making the most appropriate logistics plan,
- When the goods in question are ready, it performs the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods in contract at the place and time specified in the contract and delivers them to the transport vehicle organized by him;
- To arrange the necessary insurance policy for all loss and damage that may be incurred following the delivery of the goods to the first carrier,
- Prepares the necessary origin and circulation documents by carrying out the customs procedures regarding the goods in question and receives the approval of the relevant authorities,
- Undertakes the risks, damages and expenses that occur until the delivery of the goods on the vehicle in the designated place by carrying out the contracted transportation work as per the agreement,
- Supports and assists in providing other information and documents that the recipient may request.

In general, it is possible to list the buyer's obligations as follows (Ezel, 2013):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,
- Providing necessary permissions, licenses, certificates, etc. for the goods in question, provided that they cover the risks and expenses. plans formalities, asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- Follow the goods prepared by the seller according to the contract and the logistics organization and evacuate at the designated place and take delivery,
- Bearing all expenses arising from the moment the goods arrive at the designated place,
- Providing the necessary documents to the seller after receiving the goods,
- When the goods arrive at the designated place, the necessary evacuation, customs and logistics operations are complete, fast and with minimum cost.

DDP – Delivered Duty Paid

This term, which can be used in all forms of transport, is based on the principle that the seller makes all the transactions related to the goods and delivers them to the buyer as if he were a seller in the buyer's country (Özkan, 2012). The term DDP is the only group D term that is directly transferred to the 2010 revision without being canceled from the Incoterms 2000 revision (Ezel, 2013). This type of delivery is the highest level of responsibility and activities of the seller. According to this; seller is responsible for all shipping, intermediate storage, handling etc. As fulfill logistic activities at the same time both the input output operations by customs, all expenses paid on behalf of the buyer shall deliver the goods free of charge to recipients. In fact, in this term, the buyer receives the goods without having to deal with any customs or import formalities as if he had been trading with a local seller (International Chamber of Commerce, 2014).

In general, it is possible to list the seller's obligations as follows (Ezel, 2013):

- The production or supply of the goods subject to the contract in the content, packaging, quantity and quality specified in the terms of the contract,
- License, permission, certificate, etc. for the goods in question if requested. helps the buyer to take formalities,
- Determines the appropriate, safe, fast and least costly transporter who will deliver the goods to the buyer in accordance with the contract at the arrival customs. He informs the buyer and the carrier of the date and place where the goods will be ready, by making the most appropriate logistics plan,
- When the goods subject to the agreement are ready, it performs the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods at the place and time specified in the contract and delivers the goods to the transport vehicle organized by him,
- Following the delivery of the goods to the first carrier, shall arrange the necessary insurance policy for all loss and damage that may be incurred,
- Prepares the necessary origin and circulation documents by carrying out the customs procedures regarding the goods in question and receives the approval of the relevant authorities,

- Carrying out the contracted transportation business as required by the contract, evacuating the goods from the vehicle at the designated place, performing customs procedures and undertaking the risks, damages, expenses until paying the necessary taxes to the buyer,
- Supports and assists in providing other information and documents that the recipient may request.

In general, it is possible to list the buyer's obligations as follows (Ezel, 2013):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,
- Agree with the seller about the date and place of delivery of the goods,
- Following the goods prepared by the seller according to the contract and the logistics and customs organization, the goods are delivered at the designated place,
- For all the expenses that will occur from the moment the goods arrive at the designated place,
- Providing the necessary documents to the seller after receiving the goods,
- When the goods are delivered to the designated place, all operations are delivered and transported to their own business is complete, fast and at minimum cost.

FAS – Free Alongside Ship

In this form of delivery, the seller is generally responsible for bringing the quality and quantity of goods agreed with the contract to the ship determined by the buyer (Çalış, 2007). This type of delivery can only be used for sea and inland water transport, and the terms of this group are the minimum delivery of the seller (Brodie, 1999).

In general it is possible to list the seller's obligations as follows (Güven, 2002):

- The production or supply of the goods subject to the contract in the content, packaging, quantity and quality specified in the terms of the contract,
- If requested in the contract, license, permission, certificate, etc. for the goods. helps the buyer to take formalities,
- By giving the buyer a enough time to receive the goods in accordance with the contract, informs the date when the goods will be ready,
- When the goods in question are ready, it performs the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods in the place and time specified in the contract and delivers the goods to the port where the buyer organized the ship,
- Carries out the exit customs procedures related to the goods in question, prepares the necessary origin and circulation documents and receives the approval of the relevant authorities,
- The buyer shall bear the risks, damages and expenses incurred until the goods are delivered.
- Support and assist in providing other information and documents that the recipient may request.

Generally, it is possible to list the buyer's obligations as follows (Güven, 2002):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,

- Providing necessary permissions, licenses, certificates, etc. for the goods in question, provided that they cover the risks and expenses. plans formalities and asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- Providing the logistics organization in order to receive the goods prepared by the seller on time and takes delivery of the goods,
- After taking responsibility of the goods, will arrange the necessary insurance policy for all losses and damages that may be incurred,
- For all costs incurred from the moment the goods are ready and presented to the order,
- Providing the necessary documents to the seller after receiving the goods,
- The goods will be brought to your destination as complete and fast with minimum cost.

FOB – Free On Board

In this form of delivery, the seller is generally obliged to load and deliver the goods of the quality and quantity agreed with the contract, with all the exit customs procedures done on the ship organized by the buyer (Çalış, 2007). The main difference of the FOB term from the previous term, FAS, is that the seller must ship the goods himself, except that the seller brings and delivers the goods to the port. In this case, all risks, damages and costs during shipment are the responsibility of the seller and the responsibility is transferred to the buyer after loading the goods (International Chamber of Commerce, 2014).

This term is used only in marine and inland waterways (Brodie, 1999). With the 2010 revision of Incoterms, a small change was made in terms of content in terms of FOB. Prior to the 2010 revision, goods would have been expected to exceed the handrail for the passage of damage. However, with the 2010 revision, the passage of damage was determined not to exceed the handrail, but to be loaded on the ship itself (Özkan, 2012).

In general it is possible to list the seller's obligations as follows (Güven, 2002):

- The production or supply of the goods subject to the contract in the content, packaging, quantity and quality specified in the terms of the contract,
- If requested in the contract, license, permission, certificate, etc. for the goods in question. helps the buyer to take formalities,
- Allows the buyer a suitable period to receive the goods in accordance with the contract and informs the date when the goods will be ready,
- When the goods in question are ready, it performs the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods in the place and time specified in the contract and delivers the goods on the ship organized by the buyer,
- Carries out customs procedures for the goods in question, prepares the necessary origin and circulation documents and gets the approval of the relevant authorities,
- The buyer shall bear the risks, damages and expenses incurred until the goods are delivered.
- Supports and assists in providing other information and documents that the recipient may request.

Generally, it is possible to list the buyer's obligations as follows (Güven, 2002):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,
- Providing necessary permissions, licenses, certificates, etc. for the goods in question, provided that they cover the risks and expenses. plans formalities and asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- The organization of the goods prepared by the seller in accordance with the contract, makes the necessary ship organization to be loaded on time and waits for the seller to load the goods on the ship,
- To arrange the necessary insurance policy for all the losses and damages that may be incurred following the taking of the responsibility of the goods,
- Bearing all expenses arising from the moment the goods are ready and presented to the order,
- Providing the necessary documents to the seller after receiving the goods,
- The goods will be brought to your destination as complete and fast with minimum cost.

CFR – Cost and Freight

In this form of delivery, in general, the seller agrees to the contract with the quality and quantity of goods on the ship organized by all exit customs operations are delivered and loaded (Calis, 2007). This term can only be used in marine and inland water transport (Brodie, 1999).

In general it is possible to list the seller's obligations as follows (Güven, 2002):

- The production or supply of the goods subject to the contract in the content, packaging, quantity and quality specified in the contract conditions,
- License, permission, certificate, etc. for the goods in question if requested. helps the buyer to take formalities,
- By giving the buyer a suitable period to receive the goods at the port of destination in accordance with the contract, informing the date when the goods will be ready,
- When the goods subject to the agreement are ready, carries out the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods in the place and time specified in the contract and delivers the goods on the ship which it organizes,
- Prepares the necessary origin and circulation documents by carrying out the exit customs procedures related to the subject of the agreement and obtains the approval of the relevant authorities,
- The buyer undertakes the costs incurred until he receives the goods at the port of destination and risks and damages until he completely loads the goods to the ship,
- Supports and assists in providing other information and documents that the recipient may request.

Generally, it is possible to list the buyer's obligations as follows (Güven, 2002):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,

- Providing necessary permissions, licenses, certificates, etc. for the goods in question, provided that they cover the risks and expenses. plans formalities and asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- After loading the goods prepared by the seller in accordance with the contract, taking all responsibility for damage and risk, plans the logistics applications from the port of destination to its own business,
- To arrange the necessary insurance policy for all loss and damage that may be incurred upon receipt of the goods,
- Bearing all expenses arising from the moment the goods are ready and presented to the order,
- Provides the necessary documents to the seller after receiving the goods,
- Provides goods to the place of arrival complete, fast and at minimum cost.

CIF – Cost, Insurance and Freight

In this form of delivery, the seller loads the goods of the quality and quantity agreed with the contract on the vessel he has organized. It performs all exit customs procedures and delivers the necessary insurance policy against any damage or risk (Çalış, 2007). This term can only be used in marine and inland water transport (Brodie, 1999). As in the CFR term, the seller undertakes the costs up to the destination port unless it is specified in the contract, ie the cost of evacuation of the goods belongs to the buyer (Özkan, 2012).

In general it is possible to list the seller's obligations as follows (Güven, 2002):

- The production or supply of the goods subject to the contract in the content, packaging, quantity and quality specified in the contract conditions,
- License, permission, certificate, etc. for the goods in question if requested. helps the buyer to take formalities,
- Allows the buyer a enough period to receive the goods at the port of destination in accordance with the contract and informs the date when the goods will be ready,
- When the goods in contract are ready, it performs the necessary quality controls, packaging and brand operations before delivery,
- Prepares the goods in the place and time specified in the contract and delivers the goods on the ship which it organizes,
- Carries out the exit customs procedures related to the goods in question, prepares the necessary origin and circulation documents and receives the approval of the relevant authorities,
- The buyer undertakes the costs incurred until he receives the goods at the port of destination and risks and damages until he completely loads the goods to the ship,
- Provides the necessary insurance policy for all loss and damage that the goods may occur,
- Supports and assists in providing other information and documents that the recipient may request.

Generally, it is possible to list the buyer's obligations as follows (Güven, 2002):

- The seller pays the price of the goods in full and on time with the payment method specified in the contract,

- Providing necessary permissions, licenses, certificates, etc. for the goods in contract, provided that they cover the risks and expenses. plans formalities and asks for help by informing the seller if necessary,
- Agree with the seller about the date and place of delivery of the goods,
- After loading the goods prepared by the seller in accordance with the contract, he takes responsibility for all damages and risks and plans the logistics applications from the port of destination to his own business,
- Bearing all expenses arising from the moment the goods are ready and presented to the order,
- Provides the necessary documents to the seller after receiving the goods,
- Provides goods to the place of arrival complete, fast and at minimum cost.

Drones First Use for Transport (Amazon and DHL)

Drones are the significant part of the logistics area by taking advantage of the recent growth caused by globalization and e-commerce. It is seen that it attaches importance to innovations in order to further develop some work pieces in packaging, shipping and similar fields. One of the most innovative ideas was proposed by Amazon's CEO, Jeff Bezos, and announced on December 1, 2013. Then the world's largest e-commerce company tested drone transport. (www.realclearpolitics.com)

A small aircraft or a drone could not be used for cargo transport until Jeff Bezos' decleration. There was not any information about this subject available before Amazon's CEO Jeff Bezos announcement.

Experts and industry workers say that they are moving towards faster delivery times in the transport industry and lowering courier costs. Drones was clasified by military in 2010 as shown below in Table 2.

In the cargo industry, B2C (company-to-customer) deliveries are mostly preferred over the internet and have resulted in a growth of 14% in the sector. Recently world cargo industry began to attract quite a lot interest on unmanned Spot air vehicles (UAV). As usual the drones was used as military obligations (Andrew Lotz 2015) before Jeff Bezos declaration. In the past years, drones have been used for military and surveillance purposes and have recently entered the consumer market for cargo and civilian trade applications.

Table 2. UAVs classification by the U.S. Department of Defense

Size	Max. Gross Takeoff Weight(kg)	Normal Operating Altitude(km)	Airspeed (kph)
Small	< 9.4	< 544.3 AGL	< 185.2
Medium	9.4–24.9	< 1587.6	< 463
Large	24.9–598.7	< 8164.7 MSL	< 463
Larger	> 598.7	< 8164.7 MSL	Any Airspeed
Largest	> 598.7	> 8164.7	Any Airspeed

Source: Dempsey, 2010

In terms of the cost of small cargo transportation, the drones have a much lower cost than other road transport vehicles. They offer a much faster delivery time than other vehicles as it seen from companies the drones loading capacity will grow faster. Also, it can be seen that the military Cargo capacities of the unmanned air vehicles will be up to 20 tones (www.popsci.com).

The World of logistics saws the ‘Quadrocopter’ since his first flight in December 2013.It was the first made possible by a comprehensive test of technology an, a large, long-term research and innovation project that also received the German Mobility Award in 2016. Quadrocopter was moving with a small parcel, of one kilometer from the east side of the Rhine to the headquarters of DHL on the west coast. Parcelcopter has been modified and optimized to handle demanding conditions in real delivery operations. Considering all these, it can be seen that the drones will be able to move forward to very advanced dimensions. For example, as indicated in the example given above by the various countries in the near future, the 20 tons loading unmanned aircraft made by China into a future tariff, is not very much Utopia conversion . As the carrying capacity and range of the drones are increases, it is possible to predict that a transportation type that can be cheaper and more effective than land transportation, can also make significant contributions to the logistics sector in a very short time and this will be quite fast in terms of service of world trade.

In addition, one of the succesful operator of this new transport type was DHL that was well known as a partial shipper. Numerous drones projects and prototypes have arrived and gone, but one of them has become a real business case: drone delivery services for the logistics industry. Flying postal worker is here and sending parcels by air to distant or hard-to-reach areas - adding a ‘third dimension’ to multimodal distribution networks. Now, this technology as know that has been tried and tested and after all is ready for converting the parcel delivery systems (www.discover.dhl.com).

DHL was known as the first parcel service provider of the world to directly integrate a parcelcopter logistically into their delivery chain in 2016. The company successfully concluded a three-month trial that saw its third-generation Parcelcopter make fully autonomous deliveries through the winds and snow of the Bavarian Alps for customers in two mountain communities. The drones of DHL can be seen in Table 3.

Table 3. The drones of DHL

details	parcelcopter 3.0	parcelcopter 2.0	parcelcopter 1.0
Aircraft	tiltwing aircraft	Quadrocopter	Quadrocopter
Dimension	2,200 mm	1,030 mm	1,030 mm
Payload	up to 2 kg	up to 1.2 kg	up to 1.2 kg
Airspeed	approx.70 km/h	approx.43 km/h	approx.43 km/h
Control system	autonom	autonom	manual
Flying area	mountainous region	open sea	river crossing
location	Reit im Winkl/Winklmoosalm	Norddeich / juist	Bonn
Flight distance	8.3 km	12 km	1 km
Altitude difference	approx.500 m	none	none
Year	2016 1st quarter	2014 4th quarter	2013 4th quarter

Source: www.discover.dhl.com

At the Amazon side, the unmanned aerial vehicles used by Amazon Prime Air are categorized as small vehicles. The standard laws and terms in non-aircraft are not implemented on an international basis. Therefore, unmanned aerial vehicle-like terms are currently unmanned with remote control vehicle model aircraft. Aircraft system is used as an unmanned aircraft system is defined only as a concept UAV also on vehicle equipment and communication equipment as defined in the regulations on this issue has made regulations in the federal aviation administration of USA section 107 unmanned aerial vehicle regulations (FAA, Sumary of Small Unmanned Aircraft Rule, 2017). Moreover, Table 4 shows how many drones does Amazon needs.

The table is a study showing how many unmanned aircraft the amazon needs. Considering the short-term logistics companies, taking into account the companies that carry the delivery and internet delivery angles, it will not be difficult to repair the future of large logistics companies in the global market with larger unmanned aerial vehicles. There are very few definitions written or published in international standards. Nations must now come together and form the infrastructure of the drone transport system under the World Trade Organization and International Chamber of Commerce. In order for unmanned aerial vehicles to take their places in the transport system, International Working Groups should be established to identify which lines to use and to identify the delivery points in these distribution areas, customs zones and potential risks.

SOLUTIONS AND RECOMMENDATIONS

For all the reasons explained above, new incoterms has to be used and the new revision have to come soon. The solution for this process can be summarized as follows:

- F.A.D (Free Alongside Drone): This term should only be used in drone transport. At the terminals of the drones, the seller shall deliver the goods in the direction of the transport package selected by the buyer at the designated loading point. Damage and expenses related to the goods, when the goods are left in the direction of the transport package of the drone passes to the buyer and from this moment all expenses are belongs to the buyer. It is recommended that the parties specify the

Table 4. How many drones does Amazon need

		2013	2014	2015	2016	2017	2018	2019	2020	2021
Without Amazon	Net Shipping Cost as of Cost of Goods Sold(%)	6,.5	6.7	7.0	7.8	8.8	10.1	11.7	13.7	15.9
Prime Air	Net Shipping Cost($M)	3,500	4,200	5,000	6,400	8,025	10,025	12,375	15,075	18,125
With Amazon Prime Air ($500 valued UAV)	Amazon Prime Air Operating cost ($M)	x	x	x	44.3	51.2	65.6	79.5	100.4	110.4
	UAV Shipment as of Total Shipment(%)	x	x	x	17	34	52	69	86	92
	Number of UAV Shipment(M Unit)	x	x	x	248	504	768	1,040	1,312	1,574
	Total Amazon Shipment (M Unit)	x	x	x	1,459	1,482	1,477	1,507	1,526	1,538
	Net Shipping Cost as of Cost of Goods Sold(%)	6.5	6.7	7.0	6.5	5.9	4.9	3.7	2.0	1.4
	Net Shipping Cost ($M)	3,500	4,200	5,000	5,356	5,348	4,878	3,916	2,211	1,560
	Net Shipping Cost Per Unit($/Shipment)	x	x	x	3.7	3.6	3.3	2.6	1.4	1.0
	Saving Cost ($M)	x	x	x	1,044	2,677	5,147	8,459	12,864	16,565

Source: www.amazon.com

designated loading point as clearly as possible. All costs incurred up to this point shall be covered by the seller and the handling charges for such costs may change due to the rules at the drone terminals. The seller has to deliver the goods in the direction of the drone or to supply the goods already delivered in this way. Reference to the supply procurement refers to the multiple sales of which are chained, in series, as is known in commodity sales. Where the goods are in the transport container, it is usual for the seller to deliver the goods to the carrier in a terminal rather than in the direction of the drone. In such cases the FAD rule is not appropriate and the implementation of the FCA rule is required. The FAD rule requires the seller to clear the goods for export. However, the seller does not have any liability for the customs clearance of the goods for import, payment of import duties and follow-up of the customs formalities required for importation.

- F.O.D (Free On Drone): This term should only be used in Drone transportation. The Free On Drone, means that the seller delivers the goods at the designated loading point by supplying the goods selected or delivered by the buyer. Damage and expenses for goods shall be transferred to the buyer when the goods are in the loading package and in the loading position under the drone. After this situation the buyer is responsible from all the expense and all costs. The seller must deliver the goods in the loading pacs of the drone or to supply the goods already delivered in this way. Reference to the supply procurement refers to the multiple sales of which are chained, in series, as is known in commodity sales. The FOD rule may not be suitable for situations where the seller delivers the goods to the carrier in a terminal before being loaded under the drone. For example, when goods are in the container, it is usual to deliver them in this way. In such cases, the FCA rule must be used. The FOD rule requires the seller to clear the goods for export. However, the seller does not have any liability for the customs clearance of the goods for import, payment of import duties and follow-up of the customs formalities required for importation.
- CDFR (Cost Drone and Fright): This term should only be used in drone transportation. The CDFR rule refers to the seller delivering the goods to the drone or supplying the goods already delivered in this way. Damage and costs for the goods shall be transferred to the buyer when the goods are on board. The seller must make a contract of carriage to bring the goods to the designated destination and pay the costs and freight, when CPT, CDFR, CIP or CDIF rules are used. The seller fulfills his obligation to deliver when the goods are delivered to the carrier according to the relevant rule, not when the goods arrive at the destination. There are two critical points for this rule, because the transfer of damage takes place in different places. Although the sale contract always specifies a destination drone port, it may not indicate the drone port of loading, where the goods are related to the goods and where the damage passes to the buyer. If the drone port of loading is particularly important to the buyer, it is recommended that the parties arrange it as clearly as possible in the contract. It is recommended that the parties identify the relevant point in the agreed destination drone port as clearly as possible. Because up to this point, the expenses will be covered by the seller. It is advisable for the seller to carry out a contract of carriage that specifically matches this choice. If the seller is obliged to bear the costs of unloading the goods at the drone port of destination in relation to the contract of carriage, the purchaser cannot ask for compensation for these costs unless agreed by the parties. The seller must either deliver the goods on board, or supply the goods delivered in this way to be sent instead of already present. In addition, the seller must either make a contract of contract or supply such a contract. The seller must deliver the goods on board of the drone or to supply the goods already delivered in this way. Reference to the supply procurement refers to the multiple sales of which are chained, in series, as is known in commodity

sales. The CDFR rule may not be suitable for situations where the seller delivers the goods to a carrier in a terminal before loading it on board. For example, when goods are in the container, it is usual to deliver them in this way. In such cases, the CDPT rule should be used. The CDFR rule requires the seller to clear the goods for export. However, the seller does not have any liability for the customs clearance of the goods for import, payment of import duties and follow-up of the customs formalities required for importation.

- C.D.I.F.(Drone Cost Insurance and Fright): This term should only be used in drone transportation. The CDIF rule refers to the seller delivering the goods on board or supplying goods already delivered in this way. Damage and costs for the goods shall be transferred to the buyer when the goods are on board. The seller must make a carriage contract to pay the goods to the designated port of destination and pay the costs and freight. The seller also makes an insurance contract against the buyer's risk of loss and damage to the goods during the journey. The buyer should note that in the CDIF rule the seller must provide an insurance that provides only the minimum guarantee. If the buyer wishes to be protected with a wider guarantee, he or she must have a clear agreement with the seller as far as possible or should have additional insurance. When CPT, CDFR, CDIP or CDIF rules are used, the seller fulfills his obligation to deliver when the goods are delivered to the carrier according to the relevant rule, not when the goods arrive at the destination. There are two critical points for this rule because the transfer of damage and the transfer of costs takes place in different places. Although the sale contract always specifies a destination of drone port, it may not indicate the drone port of loading, where the goods are related to the goods and where the damage passes to the buyer. If the drone port of loading is particularly important to the buyer, it is recommended that the parties arrange it as clearly as possible in the contract. It is recommended that the parties identify the relevant point in the agreed destination port as clearly as possible. Because up to this point, the expenses will be covered by the seller. It is advisable for the seller to carry out a contract of carriage that specifically matches this choice. If the seller must bear the costs of unloading goods at the port of destination in relation to the contract of carriage, he cannot demand the compensation of these costs by the buyer . The seller must either deliver the goods on board, or supply the goods delivered in this way to be sent instead of already present. In addition, the seller must either make a contract or supply such a contract. The reference to the term procurement relates to more than one sale, which is chained (in series), as is customary in commodity sales.

One of the important factors that can be seen in drone transportation is the specific loading and unloading areas that drones can use. Security vulnerabilities that may occur in these areas and the drones' own lines are a separate study topic. In international drone transport, countries are required to carry out various studies to determine alternative routes for drones.

FUTURE RESEARCH DIRECTIONS

There are a number of limitations on what they can be done in cargo transport in unmanned aerial vehicles. Like other Technologies. Unmanned Aerial Vehicles essentially are in their new ages. It can be seen as the biggest challenge for small businesses and the biggest risk. The fact that these aircrafts are extremely unstable and external interventions may cause disruptions in delivery of UAV. (Paul, Fredrick, 2015). They cannot escape obstacles on their own. The use of Artificial Intelligence needs to be studied more detailly in future studies (Insinna, 2014).

There are still many problems that the insurance companies have to study and solve. In international transportation, system can made special air lines just for drones which also has special security zones against the ecological or conventional attacks. There have to be base for drone landings with their loads but what will be the incoterms? the main question is this. What will be the responsibilities of both parties.

FIATA-International Federation of Freight Forwarders Associations and other transport contracts issued by transporters have the following names:

- FCR: Forwarders Certificate of Receipt
- FCT: Forwarders Certificate of Transport
- FBL: FIATA Negotiable Combined Transport Bill of Lading
- FWR: FIATA Warehouse Receipt
- TBL: Trough Bill of Lading

Further, new transport contracts for drones need to be developed The loading capacity of aircraft varies according to the type of aircraft and the size of the cargo door of the aircraft. Air cargo is usually transported in airline containers and pallets. They facilitate the transfer of goods at the airport during loading and unloading.

The loading sizes and capacities of commonly used airline pallets and containers are as follows:

- LD3 Airline Container:

The length is 1.46 / 1.96 mt. Width 2.14 mt. Height 1.58 mt. Capacity 1.508 kg / 3.8 m3

- LD7 Airline Container:

The length is 3.07 / 1.98 mt. Width 2.14 mt. Height 1.58 mt. Capacity 5,808 kg / 10.5 m3

- Airline Pallets:

The length is 3.18 mt. Width 2.44 mt. 5,918 kg capacity
New container standards need to be established in drone transport.

CONCLUSION

In this study, international logistic practices, delivery types, factors affecting the choice of delivery type and drones which are the means of distribution of the future are included. In the first part of the study; logistics and international logistics concepts are examined and researches are made on basic logistics terms. However; transportation modes, storage, packaging and transport containers, handling and other logistics applications are examined in the first section. In the second part of the study; the concept of INCOTERMS and its development up to the present day and its current state are examined. In addition, after the last revision made in 2010, researches were carried out on the commercial properties of INCO-

TERMS 2010. Terms and the factors that affected both the buyer and the seller when selecting one of these terms were examined in detail. In the third part, the drones of the future unmanned vehicles were examined, the importance of transportation, delivery market, delivery cost and related DRONES in terms of rules and regulations; Contribution and changes in logistics and İncoterms were examined. Also new incoterms have to be on soon because of new logistic systems will be on as the system understand that there have to be many things have to change like new air bases for drones or ner air lines, which have been protected against hacks.

ACKNOWLEDGMENT

1. Ex-Works (EXW)
2. Free Carrier (FCA)
3. Free Alongside Ship (FAS)
4. Free On Board (FOB)
5. Carriage and Freight (CFR)
6. Carriage Insurance and Freight (CIF)
7. Carriage paid to (CPT)
8. Carriage and Insurance paid to (CIP)
9. Delivered at Frontier (DAF)
10. Delivered Ex-Ship (DES)
11. Delivered Ex-Quay (DEQ)
12. Delivered Duty Unpaid (DDU)
13. Delivery Duty Paid (DDP)

REFERENCES

goo.gl. (2019). Retrieved from https://goo.gl/J6a6WK

Akat, Ö. (2003). *Uluslararası Pazarlama Karması ve Yönetimi (4. baskı)*. Bursa, Turkey: Ekin Kitabevi.

Alkan, M. ve Erdal, M. (2004). Lojistik ve Dış Ticaret Sözlüğü (1. baskı). İstanbul, Turkey: UTİKAD Yayınları.

August, R. (2004). *International Business Law* (4th ed.). New Jersey: Pearson.

Avrupa Birliği Türkiye İş Geliştirme Merkezi. (2014). *Dış Ticarette Kullanılan Belgeler*.28.04.2019. Retrieved from http://www.abigem.org/appmanager/tr/portal?_nfpb=true&_pageLabel=pag eKobiUluslararasi&nodeName=KobiUluslararasi_02.

Bağrıaçık, A. ve Yıldırım, M. (2008). Dış Ticaret Mevzuatı ve Muhasebe Uygulamaları (1. baskı). Ankara, Turkey: Yaklaşım Yayıcılık.

Brewer, A. M., & Button, K. J. ve Henser, D. A. (2001). Logistics and supply chain management (1st ed.). Oxford, UK: Pergamon.

Brodie, P. (1999). *Commercial shipping handbook* (1st ed.). London, UK: LLP.

Büyükkalkan, B. (2013). Gümrük İdarelerinde Ticaretin Kolaylaştırılması Çalışmaları ile Risk Analizi Çalışmaları Arasındaki Korelasyon. *Gümrük ve Ticaret Uzmanları Derneği Gümrük ve Ticaret Dergisi*, *35*, 15–20.

Çalış, A. (2007). *İhracatta Teslim Şekilleri ve Nakliyat (1. baskı)*. Ankara, Turkey: İhracatı Geliştirme Etüd Merkezi Yayınları.

Caner, O. (2012). Incoterms 2010. *İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi*, 22(11), 223-262.

Chopra, S., ve Meindl, P. (2007). Supply chain management: strategy, planning, and organization (3rd ed.). New Jersey: Pearson.

Dempsey, M. E. (2010). *Eyes of the army–U.S. army roadmap for unmanned aircraft systems roadmap 2010-2035*. *U.S. Army UAS Center of Excellence*, *9*, 1–140.

discover. (2019). Retrieved from https://discover.dhl.com/business/business-ethics/parcelcopter-drone-technology)

Ezel, H. (2013). *Uluslararası Ticarette Teslim Şekilleri (Incoterms)*. Yayınlanmamış Yüksek Lisans Tezi, Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü.

FAA, Summary of Small Unmanned Aircraft Rule (Part 107). (2017). Retrieved from https://goo.gl/vLMToL

Genç, R. (2009). *Çağımızın Mesleği Lojistik ve Tedarik Zinciri Yönetiminin Yöntem ve Kavramları (1. baskı)*. Ankara, Turkey: Detay Yayıncılık.

goo.gl. (2019). Retrieved from https://goo.gl/i9AKGh

Gürsoy, Y. (2010). *Dış Ticaret İşlemleri Yönetimi (6. baskı)*. Bursa, Turkey: Ekin Yayınevi.

Güven, Ö. (2002). *İhracat ve İthalatçının El Kitabı (4. baskı)*. İzmir, Turkey: Kardeşler Basımevi.

INSINNA, V. (2014). Start-up debuts sense-and-avoid system for quadcopters. *National Defense*, *99*(728), 14–15.

International Chamber of Commerce. (2014). *History of Incoterms.* Retrieved from http://iccwbo.org/products-and-services/trade-facilitation/incoterms- 2010/history-of-the-incoterms-rules/

Koban, E. ve Yıldırır Keser, E. (2010). Dış Ticarette Lojistik (3. baskı). Bursa, Turkey: Ekin Basın Yayın Dağıtım.

Küçük, O. (2012). *Uluslararası Lojistik (1. baskı)*. Ankara, Turkey: Detay Yayımcılık.

Lotz, A. (2015). Drones in logistics: A feasible future or a waste of effort.

Magge, J. F., Copacino, W. C., & Rosenfield, D. B. (1985). Modern logistics management: Integrating marketing, manufacturing, and physical distribution (1st ed.). Canada: John Wiley & Sons.

Özkan, Ö. (2012). Incoterms 2010 ile Getirilen Yenilikler. *Akademik Bakış Uluslararası Hakemli Sosyal Bilimler E-Dergisi*, 31, 01-15.

Paul, F. (2015). 10 reasons Amazon's drone delivery plan still won't fly. *Techwatch.* Retrieved from http://www.networkworld.com/article/2900317/wireless/10-reasons-amazons-drone-delivery-plan-still-wont-fly

popsci. (2019). Retrieved from https://www.popsci.com/chinas-new-drone-company-has-big-plans)

Ramberg, J. (2011). *ICC Guide to Incoterms 2010: Understanding and Practical Use* (1st ed.). Paris, France: ICC Services.

realclearpolitics. (2019). Retrieved from https://www.realclearpolitics.com/video/2013/12/01/amazons_jeff_bezos_unveils_plan_to_deliver_packages_using_drones_on_60_minutes.html

Tanyaş, R. ve Hazır, M. (2011). Lojistik Temel Kavramlar (1. baskı). Mersin: Çağ Üniversitesi Yayınları.

Taşkın, E. (2012). *Uluslararası Pazarlama: Güncel Örnek Uygulamalar Yaklaşımlar (1. baskı)*. İstanbul, Turkey: Türkmen Kitabevi.

The International Society of Logistics. (2014). *Your window into logistics*. Retrieved from http://www.sole.org/info.asp

The Material Handling Institute. (2014). *History of material handling.* Retrieved from http://www.mhi.org/about

Utkulu, U., Aydemir, İ., & Özken, A. ve Yılmaz, M. (2009). Türkiye'de Dış Ticaret İşlemleri ve Uygulaması (2. baskı). Ankara, Turkey: Gazi Kitabevi.

ADDITIONAL READING

Olegario Llamazares,Dictionary Of International Trade. (2015). *International Trade Logistics Ram Singh (Author) Export Import Procedures - Documentation and Logistics C. Rama Gopal (Author) Logistics Management by S.L.Ganapathi (Author),S.K. Nandi (Author) Yeni Isimiz Dis Ticaret, Hakan Akın (Author) The Rotterdam Rules and International Trade Law, Ioanna Magklasi(Author) International Logistics, Ilker Cingillioglu.* Author.

KEY TERMS AND DEFINITIONS

Air Transport: is a type of transportation that takes place much faster than other means of transportation between the two airports.

Cargo: merchandise given to a commercial or non-commercial ship, aircraft or other means of transport.

Drones: Unmanned air vehicles that also can carry loadings for trade like cargo planes.

I.C.C.: International Chamber of Commerce, who can rule the international trade with International trade life of the arrangement according to business needs.

Incoterms: Delivery rules for international trade that shows the responsibilities for buyer and seller.

Terminal: Is the place where can the operations of loadings and dischargings done for unmanned air vehicles.

Chapter 10
Resource-Based Logistics (RBL) and Competitive Advantage:
Logistics 4.0Ps Model

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ABSTRACT

Logistics service is more complex and knowledge-based in the fourth industrial revolution era. Given this significance, this chapter emphasizes the logistics industry and its specific dynamic capabilities, and measures generating the Industry 4.0 by extending the resource-based logistics (RBL) of Noorliza (2011). The chapter has three parts: Logistics in the fourth industrial revolution, RBL theory, and its impacts and Logistics 4.0 models in the fast-moving environment. This explains how logisticians or logistics firms obtain competitive advantages in the fourth industrial revolution era.

INTRODUCTION

Industry/Logistics 4.0 changes completely the way a logistics service provider (LSP) operates which involves many technologies such as Internet of Things (IoT), Internet of service (IoS), cloud-based logistics, radio frequency (RFID) and enterprise resource planning (ERP). It means digitization of all operations within the entire supply chain and integration of physical systems with cyber worlds (Asdecker and Felch, 2018). Industry 4.0 incorporates real-time big data monitoring of material flows, data intensive and dynamic structural organization between various elements in the supply chain, transport management, flexible and intelligent logistics system for better optimize costs, time and resources.

DOI: 10.4018/978-1-7998-1397-2.ch010

The economic environments and ever-changing customer needs also have brought logistics in the current trend of the digitization of organization within and external to organization's supply chain. Transforming an organization to digitization means require dynamic and rapid change. An organization digitization requires strategic decision-making for successfully implementing Logistics 4.0. Industry 4.0 within logistics includes developments in resource efficiency and sustainability of logistics system, a LSP and people/community and environment. In addition, the information and communication enabled technologies facilitate the delivery system, information exchange and decentralized decision-making and control without much human interaction. For instance automated data management will lead to a better-automated decisions making.

Given this fast-moving environment, there is a lack of attention to how logistics service providers build in their dynamic capabilities or new resources and capabilities (Asdecker and Felch, 2018). In the fast-moving global trade, there has been rapid and complex demands from consumers. In order to compete, firms have to face with the dynamic customer expectations through their dynamic capabilities to facilitate the demands of global market (products and/or services) across the world. Some existing studies empirically tested the impact of dynamic capabilities on firm performance but not comprehensively (Noorliza and Wong, 2013). However, previous study does not provide for managers with what and which dynamic capabilities a firm needs to deal with the demands of the rapidly shifting environment.

Logistics services with agility can help the firm to serve the customers with speed and surprise. Advanced or innovative logistics service has become the proactive approach for empowering service innovation capability and competitiveness. The fast-growing global economy is indeed enormous; hence, leads to increase the significant demand on advanced logistics services dramatically and dynamic. The future trend of logistics service providers (LSPs) should add values to logistics users and improves customer satisfaction; and provides a firm's competitive advantage. This dynamic business environment/market has completely changed the nature of logistics industry through the diverse requirements of new logistics services. These requirements of new logistics services are different from conventional logistics. Hence, managers need to understand how firms build their dynamic capabilities into delivering successful services that has a greater impact on business performance.

In the effort to expedite these dynamic and complex services, we argue that LSPs need to provide the total digitization logistics service/business for handling materials movement right from the sources of raw materials flowed into manufacturing until the finished products distributed to end user. Based on a dynamic capabilities perspective, we hold that logistics firms require new constructs and measurements of more complex and ambiguous resources and capabilities for delivering successful logistics services. We define these complex and ambiguous resources and capabilities as boosters of dynamic capability that lead to the Logistics 4.0 and competitive advantages.

In the rapidly shifting environment, the dynamic capabilities are the most essential sources to achieve sustainable competitive advantage in the long run. According to the dynamic capabilities perspective, firms build new resources and capabilities in the dynamic environment. Firms that are in the dynamic and complex environments invest in their dynamic capabilities in order to adapt with their environments. We argue that LSPs exploit and build new competencies and position themselves for competitive advantage as the Logistics 4.0 evolve. Hence, LSPs within the competitive environments proactively build their dynamic capabilities for delivering successful services.

BACKGROUND

The word Industry 4.0, representing the fourth industrial revolution, has drawn the significant attention of the researchers since 2011; aims to introduce the interconnected collaborative smart factories having the capabilities of satisfying global demand of mass-customized product in sustainable manner (Hofmann and Rüsch 2017). Nevertheless, to become competitive and sustain in the global market, the smart factories have to ensure the smooth material flow and on time delivery. This urges the capabilities of existing logistics system in satisfying the need of more complex system like Industry 4.0 without enhancing the cost and quality (Windt, Böse, and Philipp 2008, and Winkelhaus and Grosse, 2019). In this regard, to contend and sustain, the smart factories have no option other than adopting a real-time responsive logistics system, which in other words termed as Logistics 4.0 (Kache and Seuring 2017 and Winkelhaus and Grosse, 2019).

The term "Logistics 4.0" is defined as an advanced interconnected collaborative logistics system that is capable to satisfy the smart factory's consumer demand in smart and sustainable manner. For such kind of smart logistics system or Logistics 4.0, Winkelhaus and Grosse (2019) propose a conceptual framework for the technology adoption. In this framework, the researchers subdivided the domain of the Logistics into four classes i.e. Supply Chain Logistics, Intra and production logistics, Distribution Logistics and Reverse Logistics. The logistics tasks are mainly reflected through various management activities like transportation management, warehousing management, inventory management, packaging and utilization management, material handling.

However, to date, only a small number of research work highlights about the operational mechanism of Logistics 4.0. For example, Barreto, Amaral, Pereiraa (2017) framed some suggestion for incorporating advanced technologies in the contemporary logistics system by means of resource planning, warehousing and intelligent transportation management, and ensuring information security. The researchers believe that for the proper utilization of resources and integration with the paradigm of Industry 4.0, the logistics information system must be transparent, visible and secured. In this regard, the RFID technology is highly recommended to be incorporated for ensuring the real-time management of warehouse and distribution. Besides, the incorporation of intelligent transportation system along with GPS technology is essential in monitoring the freight movement, negotiating with carriers, consolidating the shipments and thereby, the advent and execution of Logistic 4.0.

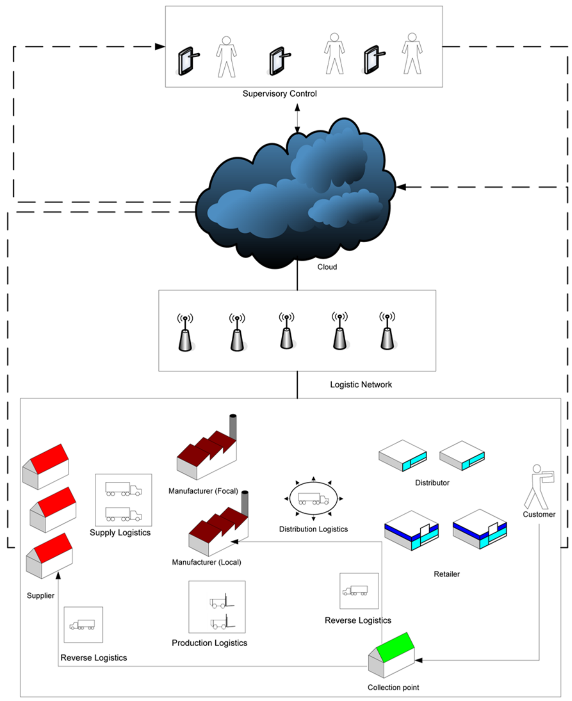
The aim of successful adoption of Logistics 4.0 is to provoke the robots within all the dimensions of conventional logistics system (Wen, He and Zhu, 2018). For example, the unmanned trucks as efficient transport, swarm robot in warehouse, automatic vehicle or drone in smart delivery, real time system in route tracking, big data analytics and artificial intelligence in supply chain. However, to portray the application of robotics in Logistic 4.0, the researchers presented a three-layer robotics control system (i.e. centralized control system, navigation system and surveillance system) for an exemplary warehouse. In which the swarm intelligence is used for the optimization in path planning for the robots. Further, an Autonomous Cooperating Production Logistic Processes proposed by Windt, Böse, and Philipp in 2008. In their proposed system of logistics, every element is considered to have the capacity to formulate the decentralize decision-making. For example, each of the machines have the capabilities to generate the autonomous decentralized decision for assembly or transformation by means of priority rules. However, this kind of autonomy and/or decentralization may divert the solution form the global optima.

By incorporating the wireless Holon network, Pujo et al. (2016) creates a cyber-physical production and logistic system in the lab of Aix Marseille University. In their developed cyber-physical system, each of the Holon are provided with the decision capacity. This autonomous Holon, by the introduction of internet of things, transforms it to a collective intelligence for controlling the system optimally. Zhang, Guo, Lv and Liu (2018) also proposed a framework for three-layer Smart Production-Logistics System architecture and operational mechanism. In the first layer of this system, named intelligent system, the physical resources are coupled with the IoT and sensors to communicate in between, to react subject to change and to integrate in own selves in the cyber physical system. The smart production-logistics systems layer, defined as the second, creates a real time knowledge domain in cloud by incorporating the information extracted from the layer 1. The physical resources of layer 1 also communicate with this layer 2 for receiving the jobs subject to the capacity. With recipient of production order, the Layer 3 and/or self-organizing configuration layer segregate the production task from Logistics. With the incorporation of analytical target cascading (ATC) method, both of the production and logistics tasks are optimized in terms of cost, time, and energy. Final, this system wide solution is cascade down to the all self-organizing lower level system component and thereby, attempted to make Smart Production-Logistics System runs optimally.

Accordingly, Langer et al. (2006) proposed a knowledge base multi agent system for decentralize logistics process management. Each of the elements of logistic system as an agent which not only cooperate with each other, but also make the decision autonomously. Even though, traditionally in agent-based system the local interaction among the agents lead to global optimization, but the authors found this kind of assumption as unrealistic in nature especially for the case of logistic system management. Consequently, for reliable decision-making and improving quality of local solution, the researchers proposed a distributed knowledge management system for autonomous multi-agent logistics process. Besides, Wasesa, Stam and van Heck (2017) investigate the influence of agent based inter-organizational system on business performance. In their model, the coordination structure and the IOS (inter-organizational systems) architecture have considered as independent construct while the Coordination, Agility and Informational performance have taken as dependent construct. The obtained result from two case studies show positive influence of the coordination structure and IOS architecture on business network performance.

A conceptual multi-agent logistics system structure derived from these research works and the architecture proposed (Wang, Wan, Zhang, Li, and Zhang, 2016). Figure 1 displays a conceptual multi-agent logistic system structure and the operational mechanism is proposed for attaining the globally optimal solution in Logistic 4.0. In the multi-agent logistic system, the smart products, machines and elements of different logistics dimensions i.e. the supply logistics (e.g. truck), the production logistics (e.g. AGV), distribution logistics (e.g. truck) and the reverse logistics (e.g. truck), are considered as autonomous social agents. These agents are attributed as autonomous because they have the capabilities to formulate the local decision without the cooperation of any neighbouring agents. Whereas, the possession of the common set of knowledge and negotiating behaviour in formulating the autonomous decision, make the agents also social. Since the aim of the multi-agent system is to deliver a system architecture for Logistics 4.0 having the capabilities of offering logistical solution for the fourth Industrial revolution, it should be capable and/or flexible to respond to the demand for mass customized product in real time basis. It is the agents of society that can aid the Logistic 4.0 to react flexibly by reconfiguring and self-organizing own self.

Figure 1. Multi-agent logistic system architecture of Logistic 4.0



However, in operations i.e. transportation route management, setting the delivery schedule, material handling, warehouse, inventory and packaging management, these agents communicate with each other by means of the logistic network and thereby, cooperate themselves in reshaping one's behaviour in line with the system goal. In these reshaping processes, the agents on need basis incorporate several priority roles. Nevertheless, as these agents try to solve the problems locally in autonomous manner, perhaps only with this form it is difficult to achieve the global optima for the considered system goal. Hence, to ease this issue, in this proposed system architecture the agents are allowed to communicate with the big data analytic block at cloud. This analytic block by means of internet of things, gather system wide real-time data and process it to coordinate the agent's behaviour as well as their self-configuration process. Therefore, it is expected that with the incorporation of big data analytics, the proposed multi agent logistic system can secure the global optimum. It is also noteworthy that, the reward mechanism incorporates in the multi agent system in securing the globally optimized solution. In addition to this, the cloud system also provides the necessary data to the supervisory control unit to bring any necessary changes into the considered multi-agent Logistic system configuration.

RESOURCE-BASED LOGISTICS (RBL) THEORY

The resource-based logistics (RBL) theory of Noorliza (2011) compliments the resource-based view (RBV) and dynamic capability theory of competitive strategy by suggesting that LSPs develop dynamic capabilities (competences) to respond to new business environment for successful performance in long run. The firm dynamic capabilities enable organizations to generate, realign, reconfigure and renew existing resources-capabilities, which evolve heterogeneously, distributed among LSPs and imperfectly mobile through innovation and change that can meet the customer's request quickly and efficiently.

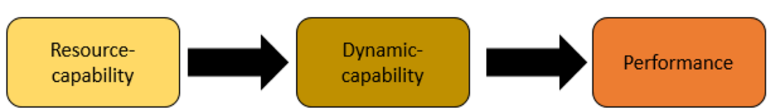
Dynamic capabilities are a firm's ability to develop resources to respond to new changing environment. The dynamic capability is an extension of RBV used to answer for a firm's growth and competitive advantage. The firm's success is enhanced when the strategic resource-capability is increase. A firm's tangible and intangible resource-capability is essential for a firm to attain and sustain competitive advantage; resources and capabilities must be valuable, rare, inimitable and non-substitutable; which are most significant for a sustained competitive advantage. However, in fast moving and dynamic environment, these existing resources-capabilities evolve; dynamic and more complex hence, some are not sustained and sufficient for sustaining competitive advantage; therefore serve as temporary competitive advantage.

RBL theory works in the highly competitive context globally. The RBL indicates that LSPs continuously gain access to and combine certain resources-capabilities in order to provide agile logistics service and remain competitive advantage in a complex and changing environment as indicated in Figure 2 (Noorliza et al., 2015; Noorliza, 2018a and 2018b). These distinctive resources-capabilities act as a booster of dynamic capability to facilitate innovative and agile logistics service. The RBL acknowledges that different dynamic capabilities affect different performance. To sustain, LSPs or logisticians need to realign, reconfigure or renew their existing resource-capabilities to dynamic capabilities with ever changing technology and environment. Instead of merely developing organizational resources-capabilities, LPSs simultaneously develop and realign the existing ones into dynamic capability.

In the contemporary environment, the RBL supports the importance of resources-capabilities as a determinant of sustained competitive advantage and claims that in order to gain competitive advantage; LSPs' resources-capabilities should be unique and idiosyncratic. The scarce, valuable, rare and difficult to imitate resources are the emergence and innovation of RBL, later defined as enabled dynamic capability creating and leading to the firm performance and competitive advantages (Figure 2). LSPs with the highest levels of RBL can obtain the greatest growth. For example, the combination of physical resources and human collaboration is considered the repositories of a firm's knowledge – both tacit and explicit leading to performance. The RBL has a positive impact on the performance and competitive advantage of firms. However, it can affect performance directly or indirectly. Those can affect directly are LSP's dynamic capability to influence performance and those affect indirectly are fundamental resources-capabilities. However, not many logistics firms are able to realize the superior performance through competitive advantages and yet to discover the characteristics of dynamic capabilities.

The characteristics of dynamic capabilities, either its attributes or degrees needs to be identified and measured within a specific industry context, instead of ownership views; will determine a firm performance and sustained competitive advantage. Consequently, the chapter distinguishes among five

Figure 2. Resource-based logistics theory



dimensions of RBL including tangible and physical capability such as logistics and IT equipment, and facilities and technology capability; and intangible capability such as knowledge, relational and organizational capability that differentially influence the competitive advantage of logistics firms significantly. Such dynamic capabilities are discussed in the following sections.

RBL Capability and Performance

Knowledge Capability

The complexity of knowledge capability is defined as the emergence of intangible elements of human intelligence manifested and evolved interactively over time within employees and accumulated within an organization in information/knowledge, skills, abilities, innovativeness, experience and education. The knowledge capability built in through retaining talent people or developing people with skills, knowledge and experience (Noorliza, 2018a). An LSP with dynamic capability can realign and built in people with specific expertise, skills and experience or bring in new people with talent from the same or different industry with multiple and concrete work experiences. Dynamic knowledge capability enables to capitalize tangible and intangibles resource-capability, deliver innovative ideas, inspire trust and confident, leading to performance outcome e.g. economic value and competitive advantage by enhancing cost efficiency and service effectiveness.

The dynamic knowledge capability is the most essential for Logistics 4.0 implementation. The successful of Logistics 4.0 heavily depends upon the IT knowledge of logisticians, the business knowledge of logisticians and IT talent. Talent is significant for LSPs to accomplish outstanding service and customer satisfaction. If the right talent is assigned to support logistics operations with appropriate allocation, these people are able to transform their knowledge and skills into a better performance. Proper training provided to employees will also increase their knowledge and skills in order to perform better. These attributes of knowledge capabilities are employees who are capable of demonstrating the skills necessary to accomplish the LSP's objectives and achieve performance. Such specific skills, knowledge, experience and abilities are difficult to transfer to another firm. Noorliza (2018a) provides evidence of positive relationship between dynamic knowledge capability and performance.

Technology Capability

Technology capability is the key enabler of successful Logistics 4.0. The technology capability is defined as technology-enabled competencies for logistics system, communication, processing of information, transmission, tracking and delivery without much human interaction built in dynamic environment (Noorliza, 2018b). The dynamic technology capability built in through the investment in advanced equipment and facilities as well as logistics information technologies e.g. data acquisition technologies, information technologies, automated material handling, warehousing, transportation and cargo tacking system evolving over time. It evolves through technology development for supporting business, effective communication and leading to innovative service and customer satisfaction. LSPs and logisticians constantly upgrade and improve their systems and technologies, invest in new systems and adopt new process.

Nevertheless, Noorliza (2018b) indicates that the technology capability are imitable, transferable, and substitutable or easy purchased over time, hence not sufficient to guarantee sustained competitive advantages. LSPs need to reconfigure different kinds and levels of technology applications and integrate with talents and bundle of resources-capabilities to fit into the new changing environment. LSPs' technology capability enables innovation and adds economic value by reducing cost or differentiating its services. Noorliza et al (2015) provides evidence of positive relationship between dynamic technology capability and service and innovation advantages.

Physical Capability

Physical capability availability is the fundamental requirement of Logistics 4.0. The physical capability is regarded as competencies for supporting the entire logistics operations to offer agile logistics services and place. The dynamic physical capability built in through the investment in logistics infrastructure, facilities and equipment, facilities and equipment improvement and maintenance, IT infrastructure, IT facilities and physical IT assets.

Equipment, facilities such as warehouses, transportation, packaging or physical tools, and machines for assembling, repackaging and warehousing are important for effective delivery and logistics performance. Investment in physical capability requires improvement and maintenance for logistics and IT infrastructure. Physical IT assets such as communication tools, hardware and software, technical platform and database are important input for logistics to provide service, place as well as to grow by facilitating the movement of information for logistics operations or business. Noorliza and Wong (2013) provides evidence of positive relationship between dynamic physical capability and competitive advantages.

Relational Capability

Relational capability is an important determinant of business performance. The relational capability is defined as competencies in supply chain integration for significant interaction and information process through coordination and collaboration, sharing information and communication (Noorliza, 2011; Noorliza and Wong, 2013). The dynamic relational capability built in over time through winning a new contract, extension of contract or secure a long-term contract. The relational capability development is socially complex and takes some time to develop mutual understanding and long-term relationship. LSPs with dynamic relational capability can develop new or synergistic ways to do business together that require good communication skills for co-ordinating, networking, information sharing, negotiation and bargaining.

The relational capability requires communication for having superb rapport with customers and suppliers, and understanding external and internal customers accurately and successfully which lead to an effective agreement on management of contract. The information exchange and sharing between customers and suppliers help LSPs to eliminate unnecessary error and cost. Such relational capability allows LSPs to better understand customers, effectively participate and manage contracts. Relationships with customers and suppliers allow LSPs to communicate, collaborate and coordinate customer needs and requirements, which enable LSPs to provide continuously the best service at the lowest cost. Logisticians interact with customers or suppliers, when customers make requests for information, changes for delivery, policy or cost charge. The relational capability provides value and sustainable competitive advantage for LSPs. Noorliza and Wong (2013) provides evidence of positive relationship between dynamic relational capability and competitive advantages.

Organizational Capability

Organizational capability is the most essential aspect for LSPs to implement Logistics 4.0. The complexity of organizational capability is defined as competencies in systems, routines, policies, business process, strategies, culture or ways of doing things for fostering and enhancing performance. The organizational capability built in through top management commitment and support are intangible, socially complex process and over long periods. A LSP with dynamic organizational capability can realign its vision, mission, and reconfigure strategies and objectives by responding to new environment. The dynamic organizational capability enable to conceive and implement strategies and objectives of LSPs to its service effectiveness and cost efficiency.

The dynamic organizational capability is significant for a LSP to respond to its new environment and creates sustained competitive advantage by generating agile logistics services and solutions and continual improvement for sustainable service. The management systems, routines and practices through top management commitment and support are important to execute firm's strategic planning and objectives to reach customers and deliver quality services. These processes involve total participation, interaction, commitment and trust with business collaborates e.g. customers and suppliers. Noorliza et al., (2015) provides evidence of positive relationship between dynamic organizational capability and performance.

Performance

Competitive advantage is essential element of firm's performance. The firm's performance anticipates the benefits derived from the implementation of Logistics 4.0 through firm's dynamic capability to achieve agile logistics services as compared to competitors. The concept of competitive advantage is measured by operational efficiency and effectiveness of RBL comprising cost advantage, service advantage and innovation advantage

Cost advantage is conceptualized as a results of operational efficiency and effectiveness of operations at low cost for distribution/transportation (e.g. improved utilization, planning process, reduced delivery of incorrect delivery), equipment, warehouse/inventory (i.e. improved utilization, processing cost, reduced cycle times) and labor.

Service advantage is a result of operational efficiency and effectiveness of customer service for delivery, quality and flexibility (delivery, quality and flexibility). Delivery performance is referred to as the speed of operation (on time and accurate). Service quality is referred to as the satisfaction of the logistics service level. Service flexibility is referred to as the ability to provide variable responses to meet changing needs of customers.

Innovation advantage is a result of operational efficiency and effectiveness of service innovation for the aggressiveness or ability in the reduction of order cycle time, increase of value-added content of logistics services and the ability to provide new and better logistics services.

In general, performance can be measures by multiple performance aspects of a business operation. The performance effects of RBL are vary. Not all RBL can directly affect all performance outcomes, some may affect both, some may affect one advantage only or some may indirectly affect.

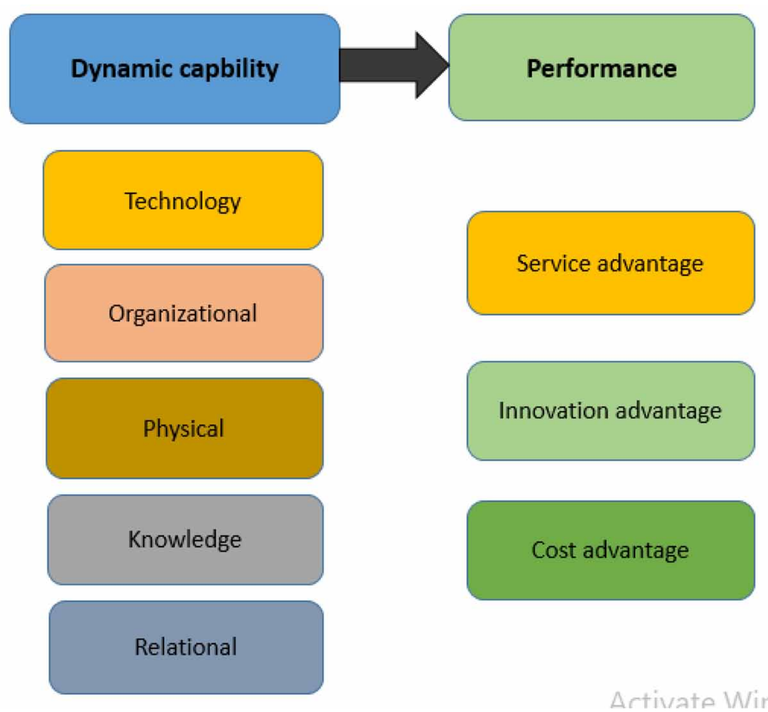
LOGISTICS 4.0 MODELS

Technology, Organizational, Physical, Knowledge and Relational (TOPKR) – Service, Innovation and Cost (SIC) Model

The RBL theory reveals the important of a TOPKR-SIC model in understanding the mechanisms in which different bundles of capabilities can affect different performance metrics. The mechanisms, which affect S-service, I-innovation and C-cost (SIC) are evolved and changed, and require complex and different capabilities. Figure 3 shows this process. For instance, due to less human interaction, LSPs employ less talent staff to cut cost but this may not lead to lower operations cost and increased productivity. Instead, knowledge and organizational capabilities are essential to realign with changing environment and technologies for the effective and efficient utilization of IT, physical and relational capabilities. The benefits of relational capability can be experienced by realigning and developing dynamic organizational and knowledge capabilities in order to respond to ever-demanding customer requests and problems.

T-technology Logistics 4.0 requires diverse logistics information technologies and systems. These technology capabilities enable LPSs to handle the greater volumes of freight, to speed the time taken to deliver and to lower the cost of delivery. Such capability can have significant impact on logistics performance. Despite enabling cost and service, the reality is that not all LSPs can capitalize financial performance. LSPs might obtain service and innovation advantages but due to the high cost of advanced IT, the high cost of developing complicated IT system and the lack of IT talents, LSPs have failed to

Figure 3. A TOPKR-SIC model



achieve competitive advantage when adopting IT. LSPs need to understand how they can develop and realign their technology capability for the benefits of cost advantages.

O-organizational While LSPs moving towards Logistics 4.0, logisticians realign organizational capability with changing environment. This means that when bundling, other capabilities are negligible if organizational capabilities are not develop simultaneously. Such attributes embedded in dynamic organizational capabilities are the significant mediator for the relationship between fundamental capabilities and organizations' competitive advantages. The organizational capabilities hence, are the most prominent indicators for successful Industry 4.0 implementation since they are ambiguous and complex capability, too costly to imitate.

P-physical The dynamic physical capability is necessary infrastructure, equipment and facility for digitization operations and agile logistics service. It might lead to performance but temporarily, as physical capability is easy to be purchased by competitors. LSPs need to renew existing resources-capabilities for enhancing the dynamic physical capability.

K-knowledge The skilful, knowledgeable and experienced staff are necessary for digitization organization. LSPs should highly synergise and accumulate knowledge capability to an appropriate level when investing in advanced technologies and system because its value transforms and evolves over time. This knowledge capability acts as a mediator for the relationship between firm capabilities and performance. It is the most durable and robust capability, hence, promise the ultimate source of sustained competitive advantage.

R-relational The performance implication of relational capability is dependent on firm capabilities for an effective management and interactive participation. The relational capability is important to increase strategic information exchange. Good rapport embedded in dynamic relational capability leads to win or secure continuity of contract, which is extremely hard to imitate.

In brief, different performance metric may depend on different set of capabilities suggesting a different strategic development and operations for different attributes and levels of capabilities. This is perhaps enhance the knowledge about how resource-capability evolved into dynamic capabilities in the long run or new environment. Such dynamic capability is causally ambiguous and therefore, hard to imitate and substitute by competitors. This uncovers the direct, indirect, mediate or moderate effects of dynamic capability.

Logistics 4.0Ps Model

Logistics 4.0Ps model fosters technologies for more agile, flexible and responsive to new and rapid changing environment. The logistics 4.0Ps model for new digital industrial is focusing on optimization of resource-capability, automated operations and smart asset management, which empowers the 4P benefits of process, profit, people and planet. The logistics 4.0Ps model is essential and powerful for promoting Industry/Logistics 4.0 effectively. Figure 4 shows the logistics 4.0Ps model.

The model consists of IoT, RFID and AVG for the optimization of resource-capability, automated operations and smart asset management by profit maximization and cost minimization as indicated in Table 1.

The emergence of the industry IoT evolves the Logistics 4.0 and most technological evolvement used by most of the logistics business is Enterprise Resource Planning (ERP), Warehouse Management Systems (WMS), Transportation Management Systems (TMS), Intelligent Transportation Systems (ITS). The RFID technologies can manage logistics firm's big data and provide accurate, timely and

Figure 4. Logistics 4.0Ps model

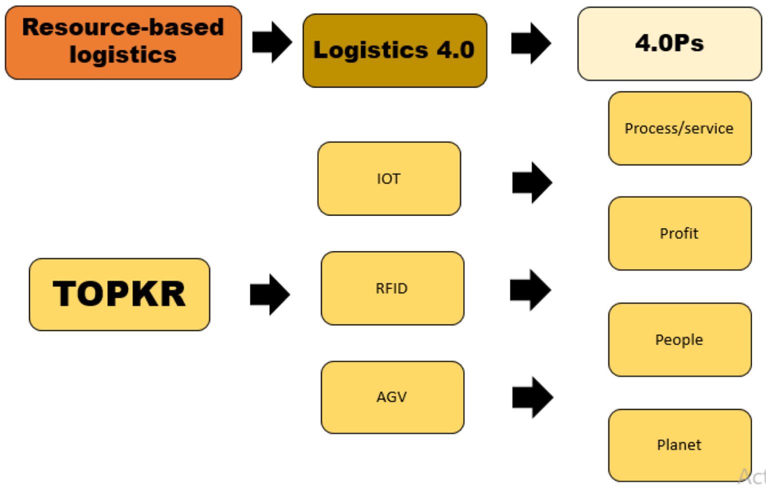


Table 1. Logistics 4.0Ps model description

Technology	Process	Profit	People	Planet
Internet of Things (IoT)	Enable dynamic in re-engineering process and deliver the ability to respond flexibly to disruption and failures	Increase productivity Foster growth	High impact on various aspects of everyday life and the behaviour of users and employees Focus on analysing	Environmental concerns Using water and steam
Radio frequency identification (RFID)	Accurate, timely and reliable information to manage operations and co-ordinate material flows	Inventory cost reduction and error	Facilitate customer value creation	Reduce error and save energy
Automated guided vehicle (AGV)	Increase efficiency and accuracy	Increase productivity and reduce cost	Increase workplace safety	Environmental and sustainability issues

reliable information about material flows. It allows any tagged item to be mobile and intelligent and to communicate with a firm's overall information infrastructure. This RFID tracking and tracing capability can increase the visibility and enhance efficiency throughout the supply chain. AGV system provides higher flexibility to change routes, real-time optimization of internal logistics routes, automatic loading and unloading materials.

The Logistics 4.0Ps model is the best end-to-end solution for financial, inventories, distribution and logistics that empowers more sustainable industrial value formation that caters for the 4.0Ps of values. It is leading to change the entire logistics system and operations from the organizational architecture and structure to process/service offered, and business model. In addition, this intelligent model creates intelligent reports serving decision support for predictive planning and process, decision making, automated processes and providing more efficient and effective use of assets or RBL leading to process optimization, better management, saving energy and profit. Furthermore, this new business model is more attractive to prospective staff that provides more flexible work arrangement, gives more freedom for staff to fulfil the obligations of the task regardless of positions. It is essential for staff to balance their family obligations and their work duties that can increase labour efficiency.

CONCLUSION

The chapter upholds that RBL is essential for fostering Logistics 4.0. However, the knowledge about its dynamic capabilities and attributes has yet to be explored. The chapter emphasizes on logistics in the fourth industrial revolution, the RBL and its dynamic capabilities and impacts and the Logistics 4.0 models for achieving LSPs' competitive advantages in the Industry 4.0. The extent of RBL will differentiate between the high-and-low firm performances. It also provides the construct and measure of TOPKR-SIC and Logistics 4.0Ps models for successful implementing Logistics 4.0. Logistics 4.0Ps model empowers sustainable performance antecedents by maximizing profits, excellence process/services, ensuring the well-being of humankind and the planet as well as minimizing cost and hardship. Future research should propose and investigate the successful and effectiveness of the above work model and systems.

REFERENCES

Asdecker, B., & Felch, V. (2018). Development of an Industry 4.0 maturity model for the delivery process in supply chains. *Journal of Modelling in Management*, *13*(4), 840–883. doi:10.1108/JM2-03-2018-0042

Barreto, L., Amaral, A., & Pereira, T. (2017). Industry 4.0 implications in logistics: An overview. *Procedia Manufacturing*, *13*, 1245–1252. doi:10.1016/j.promfg.2017.09.045

Hofmann, E., & Rüsch, M. (2017). Industry 4.0 and the current status as well as future prospects on logistics. *Computers in Industry*, *89*, 23–34. doi:10.1016/j.compind.2017.04.002

Kache, F., & Seuring, S. (2017). Challenges and opportunities of digital information at the intersection of Big Data analytics and supply chain management. *International Journal of Operations & Production Management*, *37*(1), 10–36. doi:10.1108/IJOPM-02-2015-0078

Langer, H., Gehrke, J. D., Hammer, J., Lorenz, M., Timm, I. J., & Herzog, O. (2006). A framework for distributed knowledge management in autonomous logistic processes. *International Journal of Knowledge-Based and Intelligent Engineering Systems*, *10*(4), 277–290. doi:10.3233/KES-2006-10404

Noorliza, K. (2011). Resource-based logistics and logistics performance (Thesis), Business School, The University of Hull. Retrieved from https://hydra.hull.ac.uk/resource/hull:5299

Noorliza, K., Wong, C. Y., Mhah, A., & Lai, K.-H. (2015). The effects of resource bundling on third-party logistics providers' performance. *International Journal of Engineering Business Management*, *7*(9), 1–14.

Noorliza, K. (2018a). Knowledge resources, technology resources and competitive advantage of logistics service providers. *Knowledge Management Research and Practice*, *16*(4), 451–463. doi:10.1080/14778238.2018.1521541

Noorliza, K. (2018b). How knowledge resource does matter in technology and cost advantages of a firm? Evidence from Malaysian logistics sector. *Asian Journal of Technology Innovation*, *26*(3), 346–368. doi:10.1080/19761597.2018.1555002

Noorliza, K., & Wong, C. Y. (2013). The impact of logistics resources on the performance of Malaysian logistics service providers. Production Planning & Control. *The Management of Operations*, *24*(7), 589–606.

Pujo, P., Ounnar, F., Power, D., & Khader, S. (2016). Wireless holon network for job shop isoechoic control. *Computers in Industry*, *83*, 12–27. doi:10.1016/j.compind.2016.08.005

Wang, S., Wan, J., Zhang, D., Li, D., & Zhang, C. (2016). Towards smart factory for industry 4.0: A self-organized multi-agent system with big data-based feedback and coordination. *Computer Networks*, *101*, 158–168. doi:10.1016/j.comnet.2015.12.017

Wasesa, M., Stam, A., & van Heck, E. (2017). Investigating agent-based inter-organizational systems and business network performance: Lessons learned from the logistics sector. *Journal of Enterprise Information Management*, *30*(2), 226–243. doi:10.1108/JEIM-07-2015-0069

Wen, J., He, L., & Zhu, F. (2018). Swarm robotics control and communications: Imminent challenges for next generation smart logistics. *IEEE Communications Magazine*, *56*(7), 102–107. doi:10.1109/MCOM.2018.1700544

Windt, K., Böse, F., & Philipp, T. (2008). Autonomy in production logistics: Identification, characterisation and application. *Robotics and Computer-integrated Manufacturing*, *24*(4), 572–578. doi:10.1016/j.rcim.2007.07.008

Windt, K., Böse, F., & Philipp, T. (2008). Autonomy in production logistics: Identification, characterisation and application. *Robotics and Computer-integrated Manufacturing*, *24*(4), 572–578. doi:10.1016/j.rcim.2007.07.008

Winkelhaus, S., & Grosse, E. H. (2019). Logistics 4.0: A systematic review towards a new logistics system. *International Journal of Production Research*, 1–26. doi:10.1080/00207543.2019.1612964

Zhang, Y., Guo, Z., Lv, J., & Liu, Y. (2018). A framework for smart production-logistics systems based on CPS and industrial IoT. *IEEE Transactions on Industrial Informatics*, *14*(9), 4019–4032. doi:10.1109/TII.2018.2845683

Chapter 11
A Resource-Based Theory Perspective of Logistics

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ABSTRACT

The Resource Based Theory (RBT), where specific sets of resources are bundled into precious, scarce, and hard-to-imitate capabilities, has been demonstrated to be helpful for explaining why some companies have been better than others over time. Accordingly, this chapter, drawing on the related literature, proposes that the RBT has the potential to be applied to important areas of logistics research. Since no clear exposition of the resource-based approach has been provided in the logistics literature, this study helps to understand the critical effects of logistics capabilities in creating competitive advantage. RBT is described with relations and interactions among resource and capability. Authors illustrate how the RBT represents the underlying theoretical support for one of the central propositions of distinctive logistics capability. The chapter examines past researches and illustrates how RBV theory is an appropriate theoretical lens to advance the much-needed understanding of the logistics capabilities.

INTRODUCTION

When the literature concerning competitive or sustainable advantage is examined, the dominance of the two distinct approaches is apparent. The first approach, the industrial organization view (outside-in), also known as Porter's theory, links superior performance as an industry structure function and the position of the company in the industry. According to Porter, five forces namely power of suppliers, competitive rivalry, threat of substitutes, threat of potential entrants, and power of buyers are determined to create sustainable advantages in such a destructive competitive business world. The industrial organization (I/O) model focuses an external perspective and claims that forces outside of the organization shapes a firm's

DOI: 10.4018/978-1-7998-1397-2.ch011

strategic actions and thus the industries and markets in which firms operate have a higher influence on firms' economic performance than strategic actions relating resources, capabilities, and core competencies.

The second approach, Resource Based View (inside-out) suggests choosing a strategy which privilegedly uses firm's resources and capabilities rather than external opportunities (Grant, 1991; 115). Researchers have argued that internal resources such as employees, knowledge, skills, information, patents, trademarks, copyrights, and so forth are more significant for a firm in accomplishing and maintaining competitive advantage relative to external factors (Grant, 1991; Barney, 1991). This proposition is shared by several related concepts: "strategic resources" (Barney, 1986; Dierickx & Cool, 1989), strategic assets (Amit & Schoemaker, 1993), "distinctive competence"(Snow & Hrenibiniak, 1980; Selznick, 1957), "core competence" (Prahalad & Hamel; 1990), absorptive capacity (Cohen & Levinthal, 1990), "invisible assets" (Itami & Numagani; 1992), "dynamic capabilities" (Teece, Pisano & Shuen,1997; Helfat & Peteraf, 2003). As new theories and concepts are brought into the field, old ones begin to lose popularity and usage. However, it should be noted resource-based view (RBV) does not replace the I/O approach although it has been one of the most efficacious and much-cited theories recently. Therefore, the competitive advantage may likely be achieved by complementary and integrated use of both views (Mahoney & Pandian, 1992; Peteraf, 1993; Peteraf & Barney, 2003) and recognizing reciprocatory interplay between the market environment and company capabilities. A careful look at how capabilities and the market environment affect each other may be one of the next great opportunities for strategy research. (Henderson & Mitchel, 1997; 5).

After confirming that an integrative approach is beneficial and both approaches have unique contributions to strategic management literature, this study intends to focus on RBV because recently, there has been prevalent recognition among scholars and practitioners that resources is so crucial in sustaining competitive advantage. RBV scholars claim that organizations are mixed-bag with regards to the resources and capabilities they possess and thus these miscellaneous resource positions express reasons of different performances of firms .(Penrose, 1959; Wernerfelt, 1984; Barney, 1991; Grant, 1991; Peteraf, 1993; Henderson & Cockburn, 1994). This heterogeneity of resources results from idiosyncratic situations that lead to path-creating. Hence, intra-industry heterogeneity resulted from creative sources employment prevents their diffusion throughout the industry (Popadiuk, Rivera & Bataglia; 2014). Accordingly, this study explores firm heterogeneous resources in the context of logistics that represent sufficient conditions for producing sustainable advantage. The remainder of this study is regulated as follows:

The first part reveals an evaluation of past researches on RBV. The second section proceeds from RBV literature to how RBV stands for a theoretical background for one of the central proposals of distinctive logistics capability. Then, the author develops some ideas of how RBV theory is a valid theoretical perspective to progress the much-required understanding of the logistics capabilities. Finally, the paper draws conclusions and discusses how logistics researchers and operators can implement them professionally and also a suggestion for further researches is taken into consideration.

BACKGROUND

1. Resource Based View

According to Grant (1991) resources are inputs used in the company's value creation process. Likewise, Thompson & Strickland (1999; 91) confirm that "resources are inputs into a firm's production process such as capital equipment, the skills of individual employees, patents, finance and talented managers". Grant (1991) defines six groups of resources; namely, fiscal, human, physical, reputation, technological and organizational. According to Barney (1991) organizational resources may be grouped into three categories; (1) physical resources including equipment and plant, geographic location and accessibility of raw materials, (2) human resources including training, experience,, intelligence, judgmental capacity, relationships and understanding of all organisational participants, (3) organizational resources containing organization's administrative framework (management, planning and control systems), unofficial relationships among colleagues, teams not only in but also between the organisation and its environment, a firm's reputation, and its work climate.

On the other hand, according to Hafeez & collegues (2007) resources may be sub-classified as physical assets, intellectual assets and cultural assets. Furthermore, Collins & Montgomery (2008; 142) classify resources into tangible resources, i.e. human, physical, financial and intangible resources, i.e. reputation, organization, patents. A consensus come to light on classifying the resources into 2 groups as tangible and intangible assets (Table 1).

RBV scholars states that intangible resources are more probable to become a source of sustainable competitive edge because global competitiveness necessitates abilities combined with knowledge. Intangible assets that are precious, scarce among the companies existent and prospective rivals, utterly imitable and non-substitutable provide a useful way to measure the strategic power of the organization

Table 1. Types of resources

TANGIBLE RESOURCES	
Financial	●capability to create internal cash flow to invest ●borrowing capacity of the company
Physical	● exhaustiveness and position of a company's facility and tools/equipments ●Accessibility of raw materials
Organisational	● The company's official reporting structure and its official planning, monitoring, and regulating systems
Technological	● Technological asset capacity like patents, copyrights, trademarks and trade secrets
INTANGIBLE RESOURCES	
Human capital	● Know-how, talents and experience ●Trustworthiness and loyalty ● Management skills ● Organisational culture
Innovation	● R & D abilities ● Creativity and innovativeness
Reputational	●Products are perceived as good quality, durable, and reliable ●Firm's Reputation ●Dedication to corporate social responsibility concept and acting accordingly

Source: (Adapted from Hitt, Ireland and Hoskisson, 2005).

(Barney, 1991; Amit & Schoemaker, 1993; Hitt et al., 2001; Itami & Roehl 1987; Srivistava et al. 1998). A resource can be imperfectly imitable if accumulating this resource is bound up with unprecedented circumstances (path dependency); there exists an unclear causal relation among firm's resources and its superior performance (causal ambiguity); profound processing insight is often needed to achieve coding (social complexity) (Barney, 1991; Teese & Pisano; 1994).

According to Grant (1991), theorists should make a distinction between internal assets and abilities in order to grip a company's capability to gain competitive advantage. Helfat and Peteraf affirm that "An organizational capability refers to the ability of an organization to perform a coordinated set of tasks, utilizing organizational resources, for the purpose of achieving a particular end result" (2003; 999). Capabilities are tools that are used for deployment of the sources to achieve desirable outputs (Grant, 1991; Amit & Schoemaker; 1993). Sources are self-generated assets whereas capabilities are embeded within organisational routines, implementations and procedures regarding operations of an enterprise (Nanda, 1996; Hafeez et al; 2002). Many scholars accept that capabilities may be formed via utilizing tangible and intangible value driver sources together (Amit & Schoemaker, 1993; Dierickx & Cool, 1989; Grant, 1991; Teece, Pisano & Shuen; 1997; Miller, Eisenstat & Foote, 2002). Parallel to the most of the above explanations, capability (ability) can be described as entire routines while achieving a firm's target with interactive coordination of sources comprising collective learning and experience. It can be thought that the capabilities of the firm derive from a distinct combining of sources with experiential intelligence of the company's human capital.

Meanwhile, Henderson & Cockburn (1994) distinguish between capabilities that are able to transform firms' resources named as component capabilities and integrative capabilities. Component capabilities are described as local capabilities like know-how and qualifications implanted in the company or special organisational rutins that are systematic patterns of interactions via individuals within a firm as the time went by (inter-organizational learning) (Nelson & Winter, 1982; Henderson & Cockburn, 1994; Teese & Pisano; 1994). Replication and transfer of these capabilities are often impossible since they are resident in the ordinary course of business and resulted via history patterns of interactive relations which present beneficial resolutions to specific problems (Teese & Pisano; 1994; Teece, Pisano & Schuen; 1997). Integrative capabilities are dynamic in nature and created by the integration of external knowledge and domestic sources and component capabilities in emergent or flexible lines to facilitate organisational modernization (Henderson & Cockburn, 1994; Teese & Pisano; 1994; Iansiti & Clark; 994). Many authors have referred to knowledge acquiring activities and learning processes in integrative capabilities which enables resource deployment, innovation and better environment adaptation (Hayes, Wheelwright & Clark, 1988; Leonard-Barton, 1992; Teece, Pisano & Shuen, 1997).

Some authors separated capabilities into a hierarchy such as zero-level (operational), first-order (dynamic) and second order (learning) capabilities (Collis, 1994; Winter; 2003; Zahra et al., 2006; Wang & Ahmed; 2007; Wu et al., 2010). Operational capabilities involve those routines along a company's value chain and thus considered significant for any firm mechanism. Dynamic capabilities generate value via modification of operational praxis to alterations in environmental conditions and needs. As Helfat & Peteraf explain, "Dynamic -capabilities do not directly affect output for the firm in which they reside, but indirectly contribute to the output of the firm through an impact on operational capabilities" (2003, p. 999). Dynamic capabilities reform company's information sources, rutins also eventually, alter the way of doing business made by corporate insiders via upgrading and reconstructing capabilities. The renewal of operational capabilities in return for the changing environment inhibits obsolescence of outmoded information and prevents well-functioning operating routines from turning into core rigidities

(Leonard & Barton, 1992; Teece, Pisano & Shuen, 1997). Finally, second order (learning) capabilities stands at higher level in hierarchy which are also sometimes referred as meta-capabilities (Collis, 1994) or higher-order capabilities (Winter, 2003) and regenerative dynamic capabilities (Ambrosini, Bowman & Collier 2009). Learning-to-learn capabilities (Collis, 1994) have potential to specify the passage of the firm's advancement by transmitting experience aggregation, knowledge transfuse and generation (Zollo & Winter 2002). There exists numerous studies in the literature relating to higher order abilities but the author only intends to acknowledge that capabilities are complementary fields of RBV and they are not distinct from resources. Both of them have a distinctive mission and when they are handled in an complementary approach, the effectiveness of the firm in reaching its strategic goals would enhance (O'Cass and Sok, 2012; p. 346).

Consequently, capabilities are not solely the assets of the firm but they are outcome of bales of assets working together. Although sources exist independently, abilities are imbedded in business rutins, practices and organisation's operation- related procedures (Nanda 1996; Hafeez et al; 2002) including process and product design, product development, logistics operations, value chain integration, all aspects of marketing and customer service, and organization design (Miller, Eisenstat and Foote, 2002: 44). In this study, in line with the literature, firm capabilities could be practically defined as various assets combining with collective learning, empirical know-how and personnel's experiences so as to achieve a desired outcome (Amit & Schoemaker, 1993; Dierickx & Cool, 1989; Grant, 1991; Teece, Pisano & Shuen; 1997; Miller, Eisenstat & Foote, 2002).

2. Logistics Capabilities

Logistics capabilities could be described as complexed cluster of personal abilities, assets and cumulative knowledge obtained during business operations which allow companies to coordinate logistics activities and utilize their assets (Day, 1994; Huang & Huang; 2012). Logistics service capability refers logistics companies' competence of resource creation and deployment to make their clients satisfied in search of preferable service performance (Lai, 2004; Lai et al., 2010). Organizational resources and capabilities and their impact on superior company performance have been comprehensively examined in the literature and the findings of these studies influenced logistics research. Logistics capability has been investigated like a functional area of the firm which might ensure competitive advantage and higher-level firm performance (Global Logistics Research Team at Michigan State University 1995; Bowersox et al. 1995; Daugherty & Pittman, 1995; Morash et al. 1996; Eckert & Fawcett 1996; Clinton & Closs, 1997; Fawcett, Stanley & Smith, 1997; Lynch, 1998; Lynch, Keller & Ozment, 2000; Ellinger et al., 2000; Zhao et al., 2001; Lai 2004; Shang & Marlow, 2005; Joong-Kun Cho, 2008; Lai et al., 2008; Yang, 2012). According to these studies, logistics capability is the backbone of the firm as it positively affects performance in terms of revenue growth, cost cutting, customer satisfaction and innovation.

One of the most earlier investigations of logistics capabilities was carried out by the Global Logistics Research Team at Michigan State University (1995) by using 17 worldwide logistics abilities that were later on grouped into four abilities namely integration, positioning, measurement and agility. Shang & Marlow (2007) expressed the relationships between logistics competence, logistics performance, and financial performance and confirmed the results of Michigan State University by identifying four critical logistics competencies including knowledge and integration competency, client focused logistics capability, measurement competency, and agility competency. Daugherty & Pittman (1995) investigated use of time-based strategies with distribution and manufacturing executives from ten Fortune 500 firms and concluded that fast cycle capabilities can utilise time-based strategies along with information technology and flexibility to achieve competitive advantage. Fawcett et al. (1997) also conducted a research to better understand the role of logistics processes in the development of universal customer service strategies and concluded that delivery speed, service quality, flexibility, cost and innovation are key logistics abilities that aids companies boost their performance and administrate worldwide resources and markets.

Morover, Morash, Droge & Vickery (1996) investigates relationships between strategic logistics capabilities and firm performance. They classified logistics capabilities into two as demand-oriented logistics capabilities (delivery reliability, post-sale customer service, responsiveness to target markets, delivery speed, and pre-sale customer service) and supply-oriented capabilities (widespread distribution coverage, selective distribution coverage, low total cost distribution). The findings of the study indicate that delivery speed, reliability, responsiveness, and low cost distribution are four critical logistics capabilities that were significantly associated with performance. Meanwhile, Daugherty and Pittman (1995) investigated Fortune 500 firms and concluded that time-based capabilities with information technology and flexibility contributes competitive edge of the firms. Eckert and Fawcett (1996) found that people, quality, and time are the key capabilities for logistic function.

Furthermore, Zhao, Droge & Stank (2001) classify logistics capabilities into customer-focused and information-focused capabilities and investigated its impact on firm performance. Customer-focused capabilities include focus on the market segment, relationships, responsiveness and flexibility while information-focused capabilities include information sharing, information technology and integration. The results of the study revealed that customer-focused capabilities directly influence firm performance whereas information-focused capabilities indirectly influence firm performance. Although information-focused capabilities do not affect firm performance alone, managers should focus both of them because information-focus capabilities affect firm performance indirectly by affecting customer- focused capabilities. In addition, Mentzer, Min & Bobbitt (2004) identified four logistic capabilities that contribute to firm competitive advantage i.e. demand-management interface capabilities, supply-management interface capabilities, information management capabilities. On the other hand, Stank, Davis & Fugate (2005) classified logistics capabilities as time management, information exchange, customer focus, evaluation, and integration.

Cho, Ozmet & Sink (2008) presented the relation between firm's logistics capability, logistics outsourcing and its performance in the e-commerce market. They determined logistics capabilities, some of which were adapted from previous research (Morash et al.,1996) including presale customer service, postsale customer service, delivery speed, responsiveness to target, widespread distribution coverage, global distribution coverage, selective distribution coverage, and low total cost distribution. They also added three logistics capabilities consisting of delivery reliability, delivery information communication, and web-based order handling in order to take up the particular e-commerce logistics challenge. The results of the study led to conclusion that companies ought to better prevent logistics outsourcing if their performance is based upon competitive edge owing to internally powerful logistics capabilities and competencies.

Yang and colleagues (2009) went through the connection between resource, logistics service capability, innovation capability and the performance of Taiwanese container shipping service companies depending on the resource-based view. They classified logistics service capability as service reliability capability, value-added service capability, relationship building capability, information integration and flexibility capability. The findings indicated that resources such as network resource, information equipment resource and corporation image positively influence both logistics service capability and innovation. In addition, it is emphasized in the study that logistics service capability both affects container liner shipping companies' performance and acts like a intermediary between resource and company performance as well as innovation capability and company performance.

Furthermore, Lu & Yang (2010) investigated the critical logistics service capabilities and company performance of international distribution center operators in Taiwan. They identified 3 crucial logistics service capabilities, namely, customer response capability, innovation capability and flexible operation capability. They separated firms into three groups via cluster analysis as (1)customer response and flexible operation capabilities-oriented firms, (2)customer response and innovation capabilities-oriented firms, and (3)customer response capability-oriented firms. The results of the study revealed that customer response and innovation capabilities-oriented firms gave top company performance, pursued by customer response and flexible operation capabilities-oriented firms and customer response capability-oriented firms.

Reviewing the literature led to conclusion there are some factors that affect logistics capabilities of organizations. Table 2 summarizes basic logistics capabilites that is determined by the author from the literature.

FUTURE RESEARCH DIRECTIONS

This paper inspires several prospective research areas. For instance, the author notices that reputation management capability of logistics, combined with a resource-based view is not much investigated and thus the effects of reputation management capability of logistic firms can be deeply investigated in future studies. Due to the fact that the present study concentrates just upon the literature review of logistics capabilities, future studies could further contribute to the literature via empirical studies. Moreover, comparative studies that compare two or more different countries would be beneficial to understand if cultural differences influence the capabilities of logistic firms. Subsequent research is also required to investigate other types of capabilities related to logistic performance.

CONCLUSION AND SUGGESTIONS

RBV explains how organisational assets which are precious, rare and hard to imitate, create operational capabilities resulting in sustainable competitive advantage. This article, through the perspective of RBV of the firm tries to explore a broader view of logistics capabilities. In parallel with some of empirical samples, logistic capabilities are identified as; flexibility, quality, cost, response time and reliability, customer relationships, organizational learning, innovation and integration capability. It is apparent from the past studies that tangible (financial, physical, organizational, technological) and intangible assets (human, innovation, reputational) of the organization could be bunched together in order to augment company's logistic capabilities and performance.

The new economy which has become more knowledge and innovation intensive reveals the fact that logistic management should shift from the classic approach that principally concentrates on tangible assets. Creative ideas and innovative solutions, agility, intellectual property, brand name and reputation becomes superior to all tangible assets, such as buildings, land, equipment and cash, as they are valuable, scarce, harder to copy and transfer. Since knowledge, innovation, customer satisfaction, agility, firm reputation is all created via human resources' expertise, talent, skills, competence, attitude and motiva-

Table 2. Logistic capabilities

Flexibility	Daugherty & Pittman, 1995; Morash & Lynch, 2002; Min & Bobbitt, 2004; Shang & Marlow, 2005; Zhang, Qingyu, Vonderembse & Lim, 2005; Lu & Yang, 2006; Lu & Yang, 2010; Hartmann & Grahl, 2011; Yang, 2012; Huang & Huang, 2012
Quality	Hayes, Wheelwright & Clark, 1988; Eckert & Fawcett, 1996; Fawcett, Stanley & Smith, 1997; Mentzer, Flint, & Hult; 2001; Mentzer & Bobbitt, 2004; Richey, Genchev & Daugherty, 2005; Wen, 2012; Kilibarda, Zečević & Vidović (2012); Staudt et al. (2015)
Cost	Morash, Droge & Vickery, 1996; Fawcett, Stanley & Smith, 1997; Mentzer & Bobbitt, 2004; Cho, Ozment & Sink, 2008; Jack, Powers & Skinner, 2009; Wen, 2012
Response time and reliability	Daugherty & Pittman, 1995; Eckert & Fawcett, 1996; Morash, Droge & Vickery, 1996; Fawcett, Stanley & Smith, 1997; Morash & Lynch, 2002; Stank, Davis & Fugate, 2005; Schramm-Klein & Morschett, 2006; Cho, Ozment & Sink, 2008; Yang, Marlow & Lu, 2009; Yang, 2012
Customer relationships	Morash, Droge & Vickery, 1996; Stank & Lackey, 1997; Zhao, Dröge & Stank 2001; Mentzer, Min, & Bobbitt, 2004; Stank, Davis & Fugate, 2005; Flint, Gammelgaard & Mentzer, 2005; Esper, Fugate & Davis-Sramek, 2007; Cho, Ozment & Sink, 2008; Wen, 2012
Organizational learning	Daugherty & Pittman, 1995; Bowersox & Daugherty, 1995; Stank, Daugherty & Ellinger, 1996; Closs, Goldsby & Clinton, 1997; Zhao, Dröge & Stank, 2001; Ellinger, Ellinger & Keller, 2002; Chapman, Soosay & Kandampully, 2003; Mentzer & Bobbitt, 2004; Lai, 2004; Stank, Davis & Fugate, 2005; Shang & Marlow, 2005; Lu & Yang, 2006; Esper, Fugate & Sramek, 2007; Autry & Griffis, 2008; Wagner, 2008; Flint, Larsson & Gammelgaard, 2008; Yang, Marlow & Lu, 2009; Li & Dingti, 2010; Yang, 2012; Xue, 2013; Golrizgashti, 2014; Alkhatib, Darlington, Yang & Nguyen, 2015
Innovation	Hayes, Wheelwright & Clark, 1988; Persson, 1991; Fawcett, Stanley & Smith, 1997; Hakansson & Persson, 2004; Funt, Larsson, Gammelgaard & Mentzer, 2005; Richey, Genchev & Daugherty, 2005; Panayides & So, 2005; Lu & Yang, 2006; Flint, Larsson & Gammelgaard, 2008; Wagner, 2008; Li & Dingti, 2010; Lu & Yang, 2010; Huang & Huang, 2013; Shafiee, Lotfi & Saleh, 2014; Bai & Sarkis, 2014; Anand & Grover; 2015; Vlachos, 2016
Integration capability	Kahn and Mentzer, 1996; Closs, Goldsby & Clinton 1997; Daugherty, Stank & Ellingeret, 1998; Zhao et al. 2001; Bowersox, Closs & Stank, 2003; Mentzer & Bobbitt 2004; Stank, Davis & Fugate, 2005; Esper, Fugate & Davis-Sramek, 2007

tion logistics firms should recognize the importance of human resource management. Supportive and encouraging HRM built on trust and open communication is a useful instrument to acquire, share and disseminate knowledge which is also the necessary ingredient for innovation works in organizations.

Since employees are the primary interface with customers, suppliers, and other important partners, quality relationships that organizations have with their employees contribute to logistics firm performance and accomplishment of organizational goals. When organizational structures and practices encourage autonomous actions of employees, delegate the locus of decision-making to the teams and encourage participative decision-making among team members, the quality of services, the quality of communications with customers and other stakeholders is likely to increase.

REFERENCES

Alkhatib, S. F. R., Darlington, Z. Y., & Nguyen, T. T. (2015). A novel technique for evaluating and selecting logistics service providers based on the logistics resource view. *Expert Systems with Applications*, *42*(20), 6976–6989. doi:10.1016/j.eswa.2015.05.010

Ambrosini, V., Bowman, C., & Collier, N. (2009). Dynamic capabilities: An exploration of how firms renew their resource base. *British Journal of Management*, *20*(1), 9–24. doi:10.1111/j.1467-8551.2008.00610.x

Amit, R., & Schoemaker, J. P. (1993). Strategic assets and organizational rent. *Strategic Management Journal*, *14*(1), 33–46. doi:10.1002mj.4250140105

Anand, N., & Grover, N. (2015). Measuring retail supply chain performance: Theoretical model using key performance indicators (KPIs). *Benchmarking: An International Journal*, *22*(1), 135–166. doi:10.1108/BIJ-05-2012-0034

Autry, C. W., & Griffis, S. E. (2008). Supply chain capital: The impact of structural and relational linkages on firm execution and innovation. *Journal of Business Logistics*, *29*(1), 157–174. doi:10.1002/j.2158-1592.2008.tb00073.x

Bai, C., & Sarkis, J. (2014). Determining and applying sustainable supplier key performance indicators. *Supply Chain Management*, *19*(3), 275–291. doi:10.1108/SCM-12-2013-0441

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *7*(1), 99–120. doi:10.1177/014920639101700108

Barney, J. B. (1986). Types of competetion and the theory of strategy: Toward an integrative framework. *Academy of Management Review*, 11.

Bowersox, D. J., & Daugherty, P. J. (1995). Logistics paradigms: The impact of information technology. *Journal of Business Logistics*, *16*(1), 65–80.

Chapman, R., Soosay, C., & Kandampully, J. (2003). Innovation in logistic services and the new business model: A conceptual framework. *International Journal of Physical Distribution & Logistics Management*, *33*(7), 630–650. doi:10.1108/09600030310499295

Clinton, S. R., & Closs, D. J. (1997). Logistics strategy: Does it exist? *Journal of Business Logistics*, *18*(1), 19–44.

Closs, D. J., Thomas, J. G., & Steven, R. C. (1997). Information technology influences on world class capability. *International Journal of Physical Distribution & Logistics Management*, *27*(1), 4–17. doi:10.1108/09600039710162259

Cohen, M. W., & Levinthal, A. D. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1).

Collins, D. J., & Montgomery, C. A. (2008). *A corporate strategy: A resource-based approach* (2nd ed.). New York, NY: McGraw-Hill.

Collis, D. J. (1994). Research note: How valuable are organizational capabilities? *Strategic Management Journal*, *15*, 143–152.

Daugherty, P., & Pittman, P. H. (1995). Utilization of time-based strategies: Creating distribution flexibility/responsiveness. *International Journal of Operations & Production Management*, *4*, 60.

Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of Marketing*, *58*(4), 37–52. doi:10.1177/002224299405800404

Diericks, I., Cool, K., & Barney, J. B. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management Science*, *35*(12).

Eckert, J. A., & Fawcett, S. J. (1996). Critical capability for logistics excellence: People, quality, and time. *Proceedings of the Council of Logistics Management*, 183-197.

Ellinger, A., Ellinger, D., & Keller, S. B. (2002). Logistics managers' learning environments and firm performance. *Journal of Business Logistics*, *23*(1), 19–37. doi:10.1002/j.2158-1592.2002.tb00014.x

Esper, F., Fugate, B. S., & Davis-Sramek, B. (2007). Logistics learning capability: Sustaining the competitive advantage through logistics leverage. *Journal of Business Logistics*, *28*(2), 57–81. doi:10.1002/j.2158-1592.2007.tb00058.x

Fawcett, S., Stanley, S., & Smith, S. (1997). Developing logistics capabilities to improve the performance of international operations. *Journal of Business Logistics*, *18*(2), 101–127.

Flint, D., Larsson, E., Gammelgaard, B., & Mentzer, J. T. (2005). Logistics innovation: A customer value-oriented social process. *Journal of Business Logistics*, *26*(1), 113–147. doi:10.1002/j.2158-1592.2005.tb00196.x

Golrizgashti, S. (2014). Supply chain value creation methodology under BSC approach. *Journal of Industrial Engineering International*, 10, 67(1)–67(15).

Grant, M. R. (1991). *The resource-based theory of competitive advantage: Implication for strategy formulation*, California Management Review, Spring.

Hafeez, K., & Essmail, E. A. (2007). evaluating organization core competences and associated personal competences using analytical hierarchy process. *Management Research News*, *8*(30), 530–547. doi:10.1108/01409170710773689

Hafeez, K., Zhang, Y., & Malak, N. (2002). Core competence for sustainable competitive advantage: A structured methodology for identifying core competence. *IEEE Transactions on Engineering Management*, *49*(1), 28–35. doi:10.1109/17.985745

Håkansson, H., & Persson, G. (2004). Supply chain management: The logic of supply chains and networks. *International Journal of Logistics Management*, *15*(1), 11–26. doi:10.1108/09574090410700202

Hartmann, E., & De Grahl, A. (2011). The flexibility of logistics service providers and its impact on customer loyalty: An empirical study. *The Journal of Supply Chain Management*, *47*(3), 63–85. doi:10.1111/j.1745-493X.2011.03228.x

Hayes, R. H., Wheelwright, S., & Clark, K. (1988). *Dynamic manufacturing: Creating the learning organization*. New York: Free Press.

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal*, *24*(10), 889–1068. doi:10.1002mj.332

Henderson, R., & Cockburn, I. (1994). Measuring competence: exploring firm-effects in pharmaceutical research. *Strategic Management Journal*, Winter Special Issue 15, 63–84.

Henderson, R., & Mitchell, W. (1997). The interactions of organizational and competitive influences on strategy and performance. *Strategic Management Journal*, Summer Special Issue 18, 5–15.

Hitt, M. A., Bierman, L., Shimizu, K., & Kochhar, R. (2001). Direct and moderating effects of human capital on strategy and performance in professional service firms: A resource-based perspective. *Academy of Management Journal*, *44*(1), 13–28.

Hitt, M. A., Duane, I. R., & Robert, E. H. (2005). *Strategic management competitiveness and globalization: Concepts* (6th ed.). Ohio: Thomson South Western Publishing.

Huang, C. J., & Huang, K. P. (2012). The logistics capabilities scale for logistics service providers. *Journal of Information and Optimization Sciences*, *33*(1), 135–148. doi:10.1080/02522667.2012.10700139

Iansiti, M., & Clark, K. (1994). Integration and dynamic capability: Evidence from product development in automo-biles and mainframe computers. *Industrial and Corporate Change*, *3*(3), 557–605. doi:10.1093/icc/3.3.557

Itami, H., & Numagami, T. (1992). Dynamic interaction between strategy and technology. *Strategic Management Journal*, *13*(Special Issue), 119–135. doi:10.1002mj.4250130909

Itami, H., & Roehl, T. (1987). *Mobilizing invisible assets*. Cambridge, MA: Harvard University Press.

Jack, E., Thomas, L. P., & Beitelspacher, L. (2010). Reverse logistics capabilities: Antecedents and cost savings. *International Journal of Physical Distribution & Logistics Management*, *40*(3), 228–246. doi:10.1108/09600031011035100

Kahn, K. B., & Mentzer, J. T. (1996). Logistics and interdepartmental integration. *International Journal of Physical Distribution & Logistics Management*, *26*(8), 6–14. doi:10.1108/09600039610182753

Kilibarda, M., Zečević, S., & Vidović, M. (2012). Measuring the quality of logistic service as an element of the logistics provider offering. *Total Quality Management & Business Excellence*, *23*(11-12), 1345–1361. doi:10.1080/14783363.2012.704279

Lai, C.-S., Chiu, C.-J., Yang, C.-F., & Pai, D.-C. (2010). The effects of corporate social responsibility on brand performance: The mediating effect of industrial brand equity and corporate reputation. *Journal of Business Ethics*, *95*(3), 457–469. doi:10.100710551-010-0433-1

Lai, F., Li, D., Wang, Q., & Zhao, X. (2008). The information technology capability of third-party logistics providers: A resource-based view and empirical evidence from China. *The Journal of Supply Chain Management*, *44*(3), 22–38. doi:10.1111/j.1745-493X.2008.00064.x

Lai, K. H. (2004). Service capability and performance of logistics service providers. *Transportation Research Part E, Logistics and Transportation Review*, *40*(5), 385–399. doi:10.1016/j.tre.2004.01.002

Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, *13*(S1), 111–125. doi:10.1002mj.4250131009

Li, L., & Dingti, L. (2019). Effects of logistics capabilities on performance in manufacturing firms. *Proceedings of The 3rd International Conference on Logistics and Supply Chain Management*, 50-58.

Lu, C. S., & Yang, C. C. (2006). Evaluating key logistics capabilities for international distribution center in Taiwan. *Transportation Journal*, *45*(4), 9–27.

Lu, C. S., & Yang, C. C. (2010). Logistics service capabilities and firm performance of international distribution center operators. *Service Industries Journal*, *30*(2), 281–298. doi:10.1080/02642060802123392

Lynch, D., Keller, S., & Ozment, J. (2000). The effects of logistics capabilities and strategy on firm performance. *Journal of Business Logistics*, *21*(2), 47–67.

Mahoney, J. T., & Pandian, J. R. (1992). The resource-based view within the conversation of strategic management. *Strategic Management Journal*, *13*(5), 363–380. doi:10.1002mj.4250130505

Mentzer, J. T., Daniel, J. E., & Tomas, M. H. (2001). Logistics service quality as a segment- customized process. *Journal of Marketing*, *65*(4), 82–104. doi:10.1509/jmkg.65.4.82.18390

Mentzer, J. T., Min, S., & Bobbitt, L. M. (2004). Toward a unified theory of logistics. *International Journal of Physical Distribution & Logistics Management*, *34*(8), 606–627. doi:10.1108/09600030410557758

Miller, D., Eisenstat, R., & Foote, N. (2002). Strategy from the inside out. *California Management Review*, *44*(3), 37–54. doi:10.2307/41166131

Morash, E. A., Droge, C. M., & Shawnee, K. V. (1996). Strategic logistics capabilities for competitive advantage and firm success. *Journal of Business Logistics*, *17*(1), 1–22.

Morash, E. A., & Lynch, D. F. (2002). Public policy and global supply chain capabilities and performance: A resource-based view. *Journal of International Marketing*, *10*(1), 25–51. doi:10.1509/jimk.10.1.25.19529

Nelson, R. R., & Sidney, G. W. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Belknap Press/Harvard University Press.

O'Cass, A., & Sok, P. (2012). Examining the role of within functional area resource-capability complementarity in achieving customer and product-based performance outcomes. *Journal of Strategic Marketing*, *20*(4), 345–363. doi:10.1080/0965254X.2011.643918

Penrose, E. G. (1959). *The theory of the growth of the firm*. New York: Wiley.

Persson, G. (1991). Achieving competitiveness through logistics. *International Journal of Logistics Management*, *2*(1), 1–11. doi:10.1108/09574099110804625

Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal*, *14*(3), 179–192. doi:10.1002mj.4250140303

Peteraf, M. A., & Barney, J. B. (2003). Unraveling the resource-based tangle. *Managerial and Decision Economics*, *24*(4), 309–323. doi:10.1002/mde.1126

Popadiuk, S., Rivera, E., & Bataglia, W. (2014). Heterogeneity of isomorphic pressures: Intertwining the resource-based view and the neoinstitutional approach. *Brazilian Administration Review*, *11*(4), 456–475. doi:10.1590/1807-7692bar2014130003

Prahalad, C. K., & Hamel, G. (1990). *The core competence of the corporation. Harvard Business Review*. May-June.

Qingyu, Z., Vonderembse, M. A., & Lim, J. (2005). Logistics flexibility and its impact on customer satisfaction. *International Journal of Logistics Management*, *16*(1), 71–95. doi:10.1108/09574090510617367

Resources, capabilities and competencies. (1996). InNanda, A. (Ed.), *B. Boingeon, & A. Edmondson, Organisational Learning and Competitive Advantage*. London, UK: Sage.

Richey, R. G., Chen, H., Genchev, S. E., & Daugherty, P. J. (2005). Developing effective reverse logistics programs. *Industrial Marketing Management*, *34*(8), 830–840. doi:10.1016/j.indmarman.2005.01.003

Schramm-Klein, H., & Morschett, D. (2006). The relationship between marketing performance, logistics performance and company performance for retail companies. *International Review of Retail, Distribution and Consumer Research*, *16*(2), 277–296. doi:10.1080/09593960600572399

Selznick, P. (1957). *Leadership and administration*. New York: Harper and Row.

Shafiee, M., Lotfi, F. H., & Saleh, H. (2014). Supply chain performance evaluation with data envelopment analysis and balanced scorecard approach. *Applied Mathematical Modelling*, *38*(21-22), 5092–5112. doi:10.1016/j.apm.2014.03.023

Shang, K., & Marlow, P. (2005). Logistics capabilities and performance in Taiwan's major manufacturing firms. *Transportation Research Part E, Logistics and Transportation Review*, *41*(3), 217–234. doi:10.1016/j.tre.2004.03.002

Shang, K. C., & Marlow, P. (2008). The effects of logistics competency on performance. *Journal of International Logistics and Trade*, *5*(2), 45–66. doi:10.24006/jilt.2007.5.2.003

Shang, K. C., & Marlow, P. (2008). The effects of logistics competency on performance. *Journal of International Logistics and Trade*, *5*(2), 45–66. doi:10.24006/jilt.2007.5.2.003

Snow, C. C., & Hrebiniak, L. G. (1980). Strategy, distinctive competence and organizational performance. *Administrative Science Quarterly*, 25.

Srivastava, R. K., Fahey, L., & Christensen, H. K. (2001). The resource-based view and marketing: The role of market-based assets in gaining competitive advantage. *Journal of Management*, *27*(6), 777–802. doi:10.1177/014920630102700610

Srivastava, R. K., Fahey, L., & Christensen, H. K. (2001). The resource-based view and marketing: The role of market-based assets in gaining competitive advantage. *Journal of Management*, *27*(6), 777–802. doi:10.1177/014920630102700610

Stank, T. J., Daugherty, P., & Ellinger, A. (1999). Marketing/Logistics integration and firm performance. *International Journal of Logistics Management*, *10*(1), 11–24. doi:10.1108/09574099910805905

Stank, T. P., Davis, B. R., & Fugate, B. S. (2005). A strategic framework for supply chain-oriented logistics. *Journal of Business Logistics*, *26*(2), 27–46.

Staudt, F. H., Alpan, G., Di Mascolo, M., & Rodriguez, C. M. T. (2015). warehouse performance measurement: A literature review. *International Journal of Production Research*, *53*(18), 5524–5544. doi:10.1080/00207543.2015.1030466

Teece, D., & Pisano, G. (1994). The dynamic capabilities of firms: An introduction. *Industrial and Corporate Change*, *3*(3), 537–556. doi:10.1093/icc/3.3.537-a

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533. doi:10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Thompson A. A., & Strickland, A. A. (1999). *Strategic management: concepts and cases*. (11th Ed.) Singapore: McGraw-Hill Comp.

Vlachos, I. P. (2016). Reverse logistics capabilities and firm performance: The mediating role of business strategy. *International Journal of Logistics Research and Applications*, *19*(5), 424–442. doi:10.1080/13675567.2015.1115471

Wagner, S. M. (2008). Innovation management in the German transportation industry. *Journal of Business Logistics*, *29*(2), 215–231. doi:10.1002/j.2158-1592.2008.tb00093.x

Wang, C., & Ahmed, P. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews*, *9*(1), 31–51. doi:10.1111/j.1468-2370.2007.00201.x

Wen, Y.-H. (2012). Impact of collaborative transport management on logistics capability and competitive advantage for the carrier. *Transportation Journal*, *51*(4), 452–473. doi:10.5325/transportationj.51.4.0452

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171–180. doi:10.1002mj.4250050207

Winter, S. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, *24*(10), 991–995. doi:10.1002mj.318

Wu, S. J., Melnyk, S. A., & Flynn, B. B. (2010). Operational capabilities: The secret ingredient. *Decision Sciences*, *41*(4), 721–754. doi:10.1111/j.1540-5915.2010.00294.x

Xue, C. (2013). Service capability evaluation of third party logistics enterprise in a cluster environment. *Journal of Applied Sciences (Faisalabad)*, 2625–2631.

Yang, C. C. (2012). Assessing the moderating effect of innovation capability on the relationship between logistics service capability and firm performance for Ocean freight forwarders. *International Journal of Logistics Research and Applications*, *15*(1), 53–69. doi:10.1080/13675567.2012.669469

Yang, C. C., Marlow, P. B., & Lu, C. S. (2009). Assessing resources, logistics service capabilities, innovation capabilities and the performance of container shipping services in Taiwan. *International Journal of Production Economics*, *122*(1), 4–20. doi:10.1016/j.ijpe.2009.03.016

Zahra, S., Sapienza, H., & Davidsson, P. (2006). Entrepreneurship and dynamic capabilities: A review, model and research agenda. *Journal of Management Studies*, *43*(4), 917–955. doi:10.1111/j.1467-6486.2006.00616.x

Zhao, M., Dröge, C., & Stank, T. (2001). The effects of logistics capabilities on firm performance: Customer-focused versus information-focused capabilities. *Journal of Business Logistics*, *22*(2), 91–107. doi:10.1002/j.2158-1592.2001.tb00005.x

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, *13*(3), 339–351. doi:10.1287/orsc.13.3.339.2780

Chapter 12
Sustainability in Liner Shipping

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ABSTRACT

The concept of sustainability has become increasingly significant and has forced companies to take sustainable measures because of the reduction of energy resources and operational efficiency, the increase in emission release, and environmental pollution. In addition, technological developments and globalization have also affected the maritime industry and coerced shipping companies to struggle to survive in a highly competitive environment. Sustainability is addressed by environmental, social, and economic aspects under the GRI. It should be noticed that many important elements based on economy, environment, social aspects, technology, and information determine sustainability. Sustainability also benefits from KPI indicators that determine ship performance criteria. This chapter examines the concept of sustainability in various dimensions and establishes a general framework by searching the literature of sustainability of liner shipping and also sustainability reports of the international maritime transport companies.

INTRODUCTION

The problems created by our consumption habits are one of the common problems of the whole world. Global warming, environmental pollution, destroyed living spaces and unhealthy societies are at the forefront of today's problems. The most important reason for these problems is human activities.

In this study, generally accepted reports such as the Global Reporting Initiatives (GRI) and sustainability reports of the international liner shipping companies were examined. Also according to KPI (Key Performance Indicators), indications of the sustainability concept was determined for liner shipping companies.

DOI: 10.4018/978-1-7998-1397-2.ch012

The following chapters of the study are as follows. In the first part, the concept of sustainability and the importance of this concept for businesses corporate sustainability are evaluated. The multi-dimensional structure of sustainability has been revealed. In the next section, global reporting initiative (GRI), shipping key performance indicators (KPI) and the sustainability reports of liner shipping companies are examined. The conclusion part represents that evaluations related to the sustainability indicators for liner shipping are given.

BACKGROUND

Sustainability

Etymologically, sustainability term is originated from the Latin word "sustenere". It was initially appeared in forestry, where it means never harvesting more than what the forest yields in new growth (Wiersum,1995). The concern with protection of natural resources for the future is perennial, of course, our paleolithic ancestors are worried about the extinction of their prey, and the first farmers must be concerned about maintaining soil fertility. The report of the Roman Club was a milestone predicting that many natural resources critical to our survival would be depleted in one or two generations. After all, such unbecoming negativity in public policy was supposed to be about improving things. Therefore, Brundtland Report was welcomed for showing a way out of impending doom. (Kuhlman & Farrington, 2010).

Sustainability is a multidimensional and multilevel approach to create future-oriented ways of living that balance human activity and wildlife processes over long-term time frames. sustainability is often related to the health of the world, the provider of living systems for humanity, and the establishment of knowledgeable and empowered societies (Chauhan & Chaddah, 2017). Definition of sustainability adopted by the United Nations in its Agenda for Development: *Development is a multidimensional undertaking to achieve a higher quality of life for all people. Economic development, social development and environmental protection are interdependent and mutually reinforcing components of sustainable development (*Agenda for Development 1997).

Today, the concept of sustainability has achieved become widespread, even mainstream. It has drawn attention and come in sight as application in public discourse thanks to a 1987 report by United Nations' Brundtland Commission (World Commission on Environment and Development) entitled Our Common Future. This was for the first time in recorded international policy recognized sustainable development (the sister term to sustainability) as an agenda item for cities and nations worldwide (WCED, 1987). This report was concerned with the stress between humanity's desire for a better life on the one hand and the limitations imposed by nature on the other. This report stated that the economic aspects of sustainability by defining sustainable development as "*economic development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.*" The concept of sustainability started to be spoken and implemented in all areas of the world agenda today; economic, environmental and social dimensions. The critical objectives of environmental and development policies in sustainable development are as follows (Report of World Commission on Environmental and Development, 1987):

- Reviving growth;
- Changing the quality of growth;

- Meeting essential needs for jobs, food, energy, water, and sanitation;
- Ensuring a sustainable level of population;
- Conserving and enhancing the resource base:
- Reorienting technology and managing risk; and
- Merging environment and economics in decision making.

Achieving the above conditions and in parallel with accomplishment of the sustainable development described by Brundtland is only possible with the restructuring of national policies, economy, bureaucracy, social systems, production systems and technology and the development of a new international trade and financial system (Talay, 1997).

The Importance of Sustainability for Businesses and Corporate Sustainability

Sustainability in terms of businesses; refers to a balanced evaluation of economic expectations with social and environmental sensitivity (Aksoy, 2013). In addition to economic responsibilities, businesses have also brought social and environmental responsibilities. However, businesses have become responsible not only to their shareholders or potential investors but also to all of their stakeholders. The sensitivity of consumers in environmental and social issues has led businesses to behave more responsibly in the supply of products and services. The global environmental catastrophes have caused businesses to be more sensitive in their activities. Furthermore, the sustainability "criterion has started to come forward in the international trade agreements. In the long term, the continuity of the businesses has become dependent on the efficient use of social, environmental and economic resources.

All these factors necessitated the adoption of corporate sustainability in management policies by considering the sustainability criteria. To create long-term value in businesses, corporate sustainability requires a combination of economic factors as well as environmental and social factors in all decision-making mechanisms and risk management. If this definition is dealing with in terms of enterprises, an enterprise should provide corporate sustainability. In other words, the needs of the parties, which are related directly or indirectly to the business, are covered by ensuring that their future needs are met. In this context, the aim of corporate sustainability is the efficient use of environmental, social and economic resources (Dyllick & Hockerts, 2002).

GLOBAL REPORTING INITIATIVE (GRI)

The Global Reporting Initiative was founded in 1997. It was improved by Coalition for Environmentally Responsible Economies, United Nations Environment Programme and the Tellus Institute. A sustainability report is a report published by an organization or a company on the environmental, economic and social impacts resulting from its daily activities. The reporting is designed to serve as a generally accepted framework for reporting the economic, environmental and social performance of an organization. It is designed to be used by organizations of all sizes and sectors. The GRI Reporting Framework contains general and industry-specific content that is generally accepted by a large number of stakeholders around the globe to report on an organization's sustainability performance (GRI, 2011). The sustainability performance indicators are regulated by environmental, economic and social categories. Each category includes set of key and additional performance indicators (Sustainability Reporting Guidelines GRI Version 3.1). The GRI provides criteria in order to measure performances of businesses for each sub criteria:

- **Economic dimension:** The economic dimension of sustainability relates to the economic conditions of the organization's stakeholders and their impact on local, national and global economic systems. The GRI economic standards consist of economic performance, procurement practices, indirect economic effects, anti corruption.
- **Environmental dimension:** The environmental dimension of sustainability relates to an organization's impact on natural systems, including ecosystems, air, water and land. The GRI Environmental Standards consist of energy, effluents, biodiversity, emissions, waste, environmental compliance.
- **Social dimension:** The social dimension of sustainability relates to its impact on the social systems. The Social Performance Indicators define key performance aspects surrounding human rights, society, labor practices, product responsibility, labor-management relations, occupational health and safety, training, education, diversity and equal opportunity, non-discriminations, child labor, forced or compulsory labor, security practices, public policy, customer health and safety, socioeconomic compliance.

THE SHIPPING KPI (KEY PERFORMANCE INDICATORS) STANDARTS

The Shipping Key Performance Indicators proposes a global shipping industry system for describing, measuring and reporting information on operational performance in order to increase performance improvements internally in companies engaged in the vessel operation activities as well as provide an efficient communication platform of vessel operation performance to internal and external stakeholders. While addressing the sustainability indicators of shipping companies, note that shipping Shipping Key Performance Indicators has a role in improving the efficiency of ship operations. The Shipping KPI Standard is hierarchically constructed with 8 Shipping Performance Index (SPI), 33 Key Performance Indicators and 64 Performance Indicators (PI). Shipping Performance Indexes (SPI) are aggregated statements of performance in a given area (BIMCO the Shipping KPI Standard V3.0, 2018):

- **Environmental Performance:** Environmental Performance refers a shipping company's capability to avoid spills and decrease emissions that influence the environment, caused by the ship operations.
- **Health and Safety Performance:** Health and Safety Management Performance is described as a statement of the shipping company's competence to effectively manage the health and safety of the personnel onboard.
- **Security Performance:** Shipping company's capability to manage ship security is stated as Security Performance.
- **HR Performance:** Human Resources Management Performance is a statement of the shipping company's ability to employ, retain, develop and manage personnel with the required competences in order to provide safe and influential operations of the vessel.

- **Technical Performance:** Technical Performance describes a statement based on company's capability to maintain the ship, minimize the number of condition of class and decrease failures of crucial equipment and system.
- **Navigational Performance:** Navigational Safety Performance means a statement of safe navigation and absence of navigational deficit.
- **Operational Performance:** Operational Performance is a statement of the operational effectiveness of the ship including safe and efficient cargo handling, ship availability and budget management.
- **Port State Control Performance:** This Ship Performance Indicator expresses the shipping company's capability to handle ships Port State Control inspections and the associated corrective actions.

LINER SHIPPING

The liner shipping industry has long been recognized as the economic engine of the world because of its direct economic participation. Liner shipping is the service of carrying goods with high capacity by ocean-going ships that provides regular services between specified ports on fixed schedules and tariffs. Liner ships primarily are container ships and Ro-Ro ships, carries about 60 percent of the goods by sea each year (www.worldshipping.org). There are approximately four hundred liner services in operation today, most providing weekly departures from all the ports. Container ships can carry large quantities of high value-added goods in single voyage.

Since 2000, the real demand of container transportation has been lower than the expected value, and the competition among liner shipping companies has become increasingly harsh. The maritime industry, which draws attention with freight rate imbalance, unbalanced cargo flow and a high degree of required financial commitment, is a variable and risky sector in strong competition among carriers. Maersk, MSC, CMA-CGM, Evergreen Line and APL are five large ocean liners operates that account for app. 50% of the world's container fleet (Caschili at al 2014).

Morever, with the structural change of liner vessels' transportation routes and rising prices of input factors, cost control become significant for liner shipping companies. In other words, the efficiency of transportation service will be very important indicators for liner shipping companies in the future. Indicate that the optimized shipping liner network with sustainable collaborative shipping can be solved efficiently, so it can also be led to improve the service performance, decrease the cost, and develop the service level of liner shipping companies. The issue of sustainable optimization of container liner shipping in collaborative transportation has been put forward to decrease shipping costs and rise profits of shipping companies (Chuanwang & Jinxian Weng 2016). The maritime industry will remain a sustainable mode of transportation thanks to the technological developments that have been invented to boost the engine efficiency of the ships, and in particular the increasing international regulations on the environment.

The Importance of Sustainability for Liner Shipping

Vessel management, which raises its importance day by day, requires more control due to its development and its present dimensions. In order to provide the sustainability of shipping, it is expected that shipowners meet internationally recognized criteria such as economic, social and environmental aspects. In particular, from an environmental point of view, the entry into force of contracts for the reduction of the Ballast Water Treatment system or the reduction of ship-induced emissions is of paramount importance for the sustainability of liner transport. Therefore, organizations and governments have been focused their attention on sustainability and have been set standards in many areas. In the next years, stakeholders, market, customers, and regulatory pressures on sustainability will lead to significant changes in the operation of international container shipping lines. Especially, environmentally regulations are likely to become the most important cost-driver factors in the coming years, as governments and companies raise the bars on emissions, ballast water discharge, ship recycling and ship design. At the same time, regulatory changes to safety, health and safety, business ethics and labor standards will apply additional pressure to international container lines to improve sustainability performance (Pruzan at al. 2010). In order for an existing liner shipping companies to exist in the future, a sustainable (long life) policy must be implemented. In retrospect, it is seen that out of the top 25 container shipping companies that were present in 2000, just 15 remain in 2017 with 10 container shipping lines having either disappeared like Cho Yang and Hanjin (Barrios, 2017).

SUSTAINABILITY REPORTS OF LINER SHIPPING COMPANIES

As a key factor in the international transportation, the effect of shipping on the societies and global economy should not be underestimated. Sustainability is an indispensable part of shipping corporate philosophy and for liner shipping. It means reconciling economic efficiency, environmental protection, and social responsibility based on stable economic development. All of container shipping lines can be more sustainable (long life) considering future regulations and legal requirements and, wherever possible, participating in the development of global solutions.

The current three-carrier alliance collectively account for 79% of the container trade in the world and also, these 3 alliances cover 11 lines include all 10 of the Top 10 container liners in the world (Barrios, 2017):

- **2M Alliance (MSC, Maersk, Hyundai):** 2M Alliance is a vessel-sharing agreement on the Trans-Pacific-Asia-Europe and Trans-Atlantic trade routes. The Alliance was put together in a struggle to challenge the 2M Alliance led by mighty Maersk with MSC. Maersk and MSC have taken over a number of charters and operations of ships chartered to Hyundai Merchant Marine (HMM). This Alliance has 223 ships with a capacity of about 2.4 million TEUs operating 25 weekly services globally covering 1327 port pairs. MSC and Maersk have a combined capacity of about 6 million TEUs, and that is about 29.5% of the overall global market share in container capacity (flexiport).
- **Ocean Alliance (CMA CGM, COSCO, OOCL, Evergreen):** The Ocean Alliance, led by CMA-CGM is made up of Cosco Shipping, Orient Overseas Container Line and Evergreen Line, offers 40 services on the east-west trades with 498 port calls. These ocean alliances has 323 ships with a capacity of about 3.5 million TEUs operating 40 weekly services globally covering 1571 port pairs.
- **The Alliance (NYK Group, "K" Line, MOL, Yang Ming, Hapag-Lloyd):** This alliance has 241 ships with a capacity of about 3.3 million TEUs operating 32 weekly services globally covering 1152 port pairs. This distribution is as follows; 2M is 34%, Ocean Alliance is 28%, The Alliance is 17% and the others is 21% (www.xeneta.com).

Since these three alliances have a share of 79% in total liner container shipping, the sustainability reports of the container shipping companies within these alliances have been examined. A framework about the sustainability indicators have been presented by examining the sustainability reports published by liner ship operators. The sustainability reports of Maersk, MSC and CMA CGM companies, which have a particularly large share in these alliances, are reviewed below.

When examined Maersk Line's 2018 sustainability report; it is seen that it helps multiply the benefits of trade, decarbonise logistics, cut in half food loss; leads change in the ship recycling industry, health, safety & environment, human & labour rights, responsible tax practices and procurement, ocean health, diversity & inclusion has been identified as a sustainability strategy. Accordingly, sustainability performance indicators are as follows:

Social performance; Number of employees, women in leadership, gender – female/total, target nationalities in leadership, target nationalities/total, fatalities, lost-time injury frequency etc.

Environmental performance; includes energy consumption, greenhouse gas emissions, SOx and NOx, other air emissions, waste ve water resources consumption, spills.

Economic performance; is composed of revenue, profit/loss before depreciation, Capex (Capital Expense), tax for the year.

In the MSC Line's 2018 sustainability report; social inclusion, environment, health and safety, business ethics and protection of human rights has been identified as a sustainability strategy.

The sustainability goals of the MSC are listed in the report as no poorness, reduced inequalities, good health, quality education, gender equality, clean energy, economic growth, innovation and infrastructure, responsible production, life below water, partnerships for the aims. Sustainability strategies are shown below:

- **Environmental Protection;** MSC's main topic is to preserving the environment and biodiversity, clean energy, responsible consumption and production, climate action, life below water, life on land. In addition, energy efficiency practices, low-carbon technologies and operational efficiency systems are regularly assessed to ensure that they meet current and future international regulations.
- **Wildlife Conservation and Marine Biodiversity;** MSC efforts to minimise to environmental impact and it is promoting the protection of wildlife and marine biodiversity.
- **Health And Safety;** In this regard, it is promoted personal, environmental and navigational safety in line with good health and well-being, decent work and economic growth and life below water applicable international quality shipping regulations and other relevant international instruments.

To develop training programs and technical skills to further promote a safety culture among crew members and to provide the ability to react quickly in the event of emergencies and unexpected events, especially natural disasters.

Business Ethics and Protection of Human Rights; In this area, human rights, labor, environment and anti-corruption indicators are included together with promoting a culture of integrity throughout the organisation and also, employees with a safe working environment, stable financial revenues through long-term career paths. MSC also focuses on women's empowerment by promoting the elimination of gender disparities in employment, both on board and offshore, and by investing in technical and managerial training for women. In addition, the MSC included indicators that promote local employment.

Considering the Social Inclusive approach of MSC; Adapting business strategies to global social trends, creating jobs for a fast-growing population, global business with a local approach, facilitating maritime trade to tackle food insecurity. Investing in infrastructure to improve connections is engaging stakeholders to overcome common challenges, creating new opportunities for small farmers, fostering responsible consumption and food safety, caring for the environment with sustainable cold chain technology are seen as key points.

Environment approach of MSC emphasizes; strategy requirements for climate change and environmental sustainability as below:

- Decrease emissions of sulphur oxides and other pollutants.
- Sets standards for proper management of ballast water and sediments to prevent the spread of harmful marine species.
- Specifies a minimum efficiency level per capacity mile according to ship type and size.
- Supporting low-carbon shipping at an international level.

In terms of investments in innovative technologies; Eco-containers (to build containers using sustainable materials and almost all of the new productions are made from bamboo flooring, which is environmentally friendly and economical and also as well as use of Water Based Paint on containers for minimise Volatile Organic Compounds emissions), preparing for the IMO 2020 sulphur limit (such as reduce emissions from vessel by using Exhaust Gas Cleaning Systems), antifouling coating(vessel's propeller blades coated with silicon paints). advocatıng for shore power supply (By using the onshore electricity grid, ships can reduce emissions at the port by around 80%.), ballast water treatment systems (design new ships for the minimum amount of ballast water possible), MSC Cruises' investment in LNG technology.

Occupational health and safety approach of MSC necessitates;

- promoting a culture of safety on board,
- fostering environmental protection and human safety at sea,
- technical skills training model,

MSC's technical skills training model as below;

- Personal safety: Focus on behavioural safety, Mindset, Task to responsibility, Value-added training, Positive atmosphere
- Cargo safety: Cargo care, weather, maintenance,
- Navigational safety: Navigational briefings, pilots training
    - working conditions and crew retention rates;
- Internet on board: The most important benefit for the crew is to get daily news and be informed about global events, to be closer to their families and to take advantage of online services such as internet banking, research and education.

- Cyber security: This helps significantly reduce maritime, navigational safety and operational risks, and provides better performance. A connected vessel can transfer data to the shore in real time and provide remote access to the system and equipment for diagnostics, troubleshooting, updates and maintenance. Thus, it contributes to better provision of real-time information about potential critical situations such as piracy attacks, voyage planning, map corrections, weather and medical assistance.

According to CMA CGM's 2018 corporate social responsibility report, it is based on 6 pillars ethics and compliance, value chain, social, safety & security, environment, societal.

Ethics and compliance program is formed in 4 main areas. These are;

- Ethics and anti-corruption
- Competition law
- Economic sanctions
- Data protection

Strategic Objectives related to Value Chain are:

- Innovation & Digital Transformation
- Customer Satisfaction
- Responsible procurement

Social

- Diversity; means gender equality, interculturality and intergenerationality since; it is a source of inspiration and innovation.
- Mobility; employees have the opportunity to advance and involve in different departments at headquarters, subsidiaries and agencies across the world. Three different mobility options are offered. These are;
    - Cross-functional mobility to help expand their skill sets.
    - Vertical mobility which allows them to take on new responsibilities.
    - Geographical mobility to enrich their skills
- Interculturality
- Intergenerationality
    - Expert conferences and mentoring initiatives have been introduced to support young talent and facilitate the transfer of expertise.
- Gender equality; it possible to assess the gender pay gap through five indicators: "the closing of the pay gap between women and men, the gap in pay increase and promotions rates, the salary increase of female employees upon their return from maternity leave, the number of women among the ten highest salaries"
- Disability; tailor-made solutions adapted to their needs like changing the layout of workstations (footrests, special IT equipment, ergonomic chairs, special IT equipment, etc.)

- Work-life balance; employees have a decent quality of life at work, flexible working hours for pregnant women, paternity leave, personalized working hours for full-time staff
- An attractive employer;
    - talent management
    - succession plans
    - talent-spotting
    - the lead program
    - junior employer mobility program

Safety and Security

- Security at sea and ashore
    - especially measures to protection of the vessels against piracy
    - to reduce the risk of personnel being exposed to major outbreaks such as Ebola and natural and technological disasters such as earthquakes and tsunamis.
- navigation center of fleet
- Crisis management
- Occupational health & safety
- Maritime safety
- Cargo safety & security

The Environmental Policy

Environmental policy consists of 3 strategic points as climate change and air quality, conservation of oceans and marine biodiversity, and innovative ecological solutions. These important three points highlight the following issues;

- Energy, emissions and air pollutants
    - reducing CO2 emissions per TEU-km by 50%
- Energy consumption

Reducing fuel consumption by constantly renewing fleet, reducing speed, optimizing shipping routes, overseeing and monitoring consumption and implementing technical improvements related to propulsion and hydro-dynamism. Eco-technologies aim at reducing fuel consumption: New bulbous bows development hydrodynamics, twisted leading edge rudder with bulb, new propellers. Recovery boilers for auxiliary, using large capacity ships.

- Waste, pollution and biodiversity
- Environmental innovations and technologies
- Employee training and information on the environment
- Environmental initiatives and awards

Modern Fleet

- Eco-containers
- Low sulfur compliance
- Optimized hull
- Tin-free antifouling
- Limited air polluants
- Navigation Center
- Hold bilge water
- Alternative maritime power / shore power connection
- Water ballast treatment system chemical free
- Optimized bulbous bow
- Fast Oil Recovery System
- Electronically controlled engine
- Additional bilge tank
- Water ballast treatment system
- Optimized propellers

Societal

- The CMA CGM Foundation
  - Race for children with trisomy
  - Race for an association that Works for children in need
  - Participation in a cleanup program of the port
  - Toys and clothes collection for children in need
  - Participation of a desert cleaning day etc.
- Emergency relief – natural disasters
- Launch of the humanitarian services office indicators appear.

FUTURE RESEARCH DIRECTIONS

Increasing efforts in the field of sustainability-oriented ship operations applications increase our hopes that more sustainable companies will come into being in the future. Successful organizations in these applications are expected to be more long lasting in addition to achieving sustainable ship management. In addition to these studies, a comparison can be made between liner shipping companies that provide sustainability reports and those that do not. Besides most of the sustainability, indicators are given on a common ground, comparative studies can be carried out considering that different sub-indicators may stand out especially in terms of shareholders and customers in the shipping companies that serving as liquid-bulk, general cargo or RO-RO carrier.

CONCLUSION

In this study, sustainability reports of liner shipping companies that have a significant share in liner maritime transportation were examined and the indicators of liner transportation were presented. When the indicators presented in the reports are examined in order to maintain the existence of the liner companies that exist today, common indicators appear in all three dimensions of sustainability.

When the economic dimension of sustainability is analyzed, indicators such as, economic performance, revenue, profit/loss before depreciation, capital expense, economic conditions of its stakeholders, market presence, tax for the year, indirect economic impacts, procurement practices, anti-corruption, anti-competitive behaviors are seen.

On the other hand, analysis of environmental dimension of sustainability sets forth indicators like environmental innovations and technologies, energy consumption, decreasing emissions of sulphur oxides, waste, pollution and biodiversity, management of ballast water, employee training and information on the environment. Moreover it effects low-carbon technologies, supporting low-carbon shipping at an international level, environmental initiatives and awards, specifies a minimum efficiency level per capacity mile according to ship type and size, climate action, life below water, energy efficiency practices, protection of wildlife and marine biodiversity, responsible consumption and production, materials, environmental compliance, supply environmental assessment.

Indicators of social dimension are presented as diversity, gender equality, work-life balance, interculturality, intergenerationality, foundation, emergency relief – natural disasters, launch of the humanitarian, succession plans, talent-spotting, talent management, the lead program, junior employer mobility program, number of employees, women in leadership, target nationalities in leadership, fatalities. Moreover, lost-time injury frequency, labor practices, human rights, adapting business strategies to global social trends are creating new opportunities for small farmers, fostering responsible consumption and food safety, creating jobs for a fast-growing population, engaging stakeholders to overcome common challenges. Besides sustainability ais related with labor/management relations, occupational health and safety, training and education, non-discriminations, child labor, forced or compulsory labor, security practices, right and indigenous peoples, human rights assessment, customer health and safety, marketing and labeling, customer privacy, socioeconomic compliance, internet on board and cyber security.

In addition, it is seen that liner companies have invested in new technologies both to increase efficiency in ship operations and to operate ships more environmentally. innovative technologies are optimized propellers, eco-containers, water based paint on containers for minimise volatile organic compounds emissions, exhaust gas cleaning systems, antifouling coating, advocating for shore power supply, optimized bulbous bow, ballast water treatment systems, lng technology, optimized hull lines double hull protection, fleet navigation center, fast oil recovery system, grey waters tank, autotuning engine, additional bilge water tank.

REFERENCES

Agenda for Development. (1997). New York, NY: United Nations.

Aksoy, Ç. (2013). *A scale proposal for sustainability performance assessment and its implementation*. (Doctoral Thesis), Turkey.

Barrios, K. (2017). *Global container shipping alliances.* Retrieved from https://www.xeneta.com/blog/shipping-alliances

Çağlar, V. (2016). Sustainable container terminal operations: challenges and enhancements, *Journal Of The Black Sea Studies*, (49), 141-156.

Chauhan, P., & Chaddah, J. K. (2017). Role of social media in influencing sustainability practices among Indian Organizations. *Sansmaran Research Journal*; Mumbai, 7, 1: 12-18.

CMA CGM Corporate Social Responsibility Report. (2018). Retrieved from https://www.cmacgm-group.com/en/csr/social

Dyllick, T., & Hockerts, K. (2002). Beyond the business case for corporate sustainability. *Business Strategy and the Environment*, (11): 131–132.

Gang, D., Chuanwang, S., & Jinxian, W. (2016). Liner shipping fleet deployment with sustainable collaborative transportation. *Sustainability*, *8*(2), 165. doi:10.3390u8020165

Global Reporting Initiative (GRI). (2018). Retrieved from https://www.globalreporting.org/information/about-gri/what-is-GRI/Pages/

GRI Standards Download Center. (n.d.). Retrieved from https://www.globalreporting.org/standards/gri-standards-download-center/

Guide to Ocean Alliances. (n.d.). Retrieved from https://www.flexport.com/blog/what-are-ocean-alliances

KPI Association Ltd. (n.d.). Retrieved from https://www.shipping-kpi.org/book/pages/introduction#?kpiProfileId=1

Kuhlman, T., & Farrington, J. (2010). What is sustainability? *Sustainability, 2*. Retrieved from www.mdpi.com/journal/sustainability

Peder, M., & Pruzan-Jorgensen, A. F. (2010). *Sustainability trends in the container shipping industry*. Retrieved from https://www.bsr.org/en/our-insights/report-view/sustainability-trends-in-the-container-shipping-industry

ReportM. S. (2018). Retrieved from https://www.maersk.com/sustainability

Simone, C., Francesca, M., Francesco, P., & Claudio, F. (2014). An analysis of shipping agreements: the cooperative container network [Springer Science+Business Media New York.]. *Networks and Spatial Economics*, *14*(3-4), 357–377. doi:10.100711067-014-9230-1

Sustainability ReportM. S. C. (2017). Retrieved from https://www.msc.com/sustainability

Sustainability Reporting Guidelines, G. R. I. (2011). Version 3.1. Retrieved from https://www.globalreporting.org/resourcelibrary/G3.1-Guideline.pdf

Sustainable Shipping Initiative Vision 2040. (2011). Retrieved from https://www.ssi2040.org/about-the-ssi/the-case-for-action

Talay, İ. (1997). A research on the concept and application of sustainability: Şanlıurfa example. (Doctoral Thesis), University of Ankara, Turkey.

Wiersum, K. F. (1995). 200 years of sustainability in forestry: Lessons from history. *Environmental Management*, *19*(3), 321–329. doi:10.1007/BF02471975

World Commission on Environment and Development-WCED. (1987). *Our common future*. New York, NY: Oxford University Press.

World Shipping Council - Partners in Trade. (n.d.). Retrieved from http://www.worldshipping.org/about-the-industry/how-liner-shipping-works

Chapter 13
Management and Organization in Transportation and Logistics

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ABSTRACT

In today's business environment, in which organizations try to outpace their rivals, the power of management and organization come into prominence. Management, as an art and science, constitutes great importance in terms of creating sustainability in the organizations, and sustainability acts as an important agent for being successful in the competition. Especially supply chain management is evaluated to be among the most crucial organizational activities, which needs to be heavily focused on, in order to create customer satisfaction in the process of product and/or service delivery. Furthermore, as it is known, supply chain management is the key element of transportation and logistics. This chapter scrutinizes the importance of management and organization in transportation and logistics. With this purpose, a literature review presents the study both in a historical and contemporary point of view.

INTRODUCTION

From 1880's on, the industrial revolution in Western countries gained power via various inventions and thus, the businesses gained pace in terms of growth. Especially in the beginning of the 20th century, with the masterpieces of Taylor (1911), Fayol (1916) and Weber, the developments related to business management have gained pace.

Management is defined both as an *art*, which is as old as the communal living and as a *developing science*. Therefore, management as a process, expresses applying the functions and activities as an *art* and gathering the scientific and systematic information as a *science*. The main qualification of management is the application of integrated information, which is developed by various disciplines and analytical methods (Koçel, 2005).

DOI: 10.4018/978-1-7998-1397-2.ch013

Management is also defined in various concepts. According to the some of these definitions management is "the process of creating an environment in which groups of people can colloborate and achieve the aims productively". Another definition of management is "planning, organizing, managing and controlling the organizational sources" (Eren, 2012).

As for Transportation and Logistics, they constitute great importance in the overall development countries and they are important in the process of production as well, which is not accepted as complete until the service/products are delivered to the consumers. Therefore, their roles are very crucial (Adefolalu, 1977; Ajiboye and Afolayan, 2009; Ajiboye and Ayantoyinbo, 2009).

Transportation and Logistics Management, on the other hand, is defined by Chartered Institute of Logistics and Transport (CILT) International (2003), as any activity consistent with the general targets of the institute as pointed out in the charter including prejudice to the generality there of: (a) the administration, planning and organizing, operating any forms of transport, transit, traffic, locomotive, physical distribution, logistics or any activity related there to (b), the research and development (R&D), education related to the art and science of logistics and transport and to all its branches (Ajiboye and Afolayan, 2009).

BACKGROUND

Effective management is evaluated as the main key to achieve sustainability and success, mainly in supply chain management, which stands for transportation and logistics. There are a number of crucial factors in logistics management in terms of effectiveness. Automation and perfect coordination are among these factors. But, it should be taken into consideration that there is always an extent for the improvision the process. As the businesses grow, new strategies to regulate logistics planning processes for ameliorating the output, are needed. In order to manage logistics more effectively; proper planning, adopting automation and giving value to relations have to be taken into consideration (Kiraga, 2014). In this sense, the purpose of this study is to reveal the importance of management and organization in transportation and logistics. With this purpose, the literature has tried to be scrutinized in a historical approach and it has been revealed that logistics and transportation cannot be performed without effective management and organization.

MANAGEMENT AND ORGANIZATION

The meaning of "management", have been defined by various branches of science. For example, according to economy science, management is the production factor together with natural sources, human force and capital. According to the sociologists, on the other hand, management is the system of class and respect. According to the branches of science such as psychology and law, management can only be performed via people who have definite aims. The common point of all these definitions of management, is achieving definite aims via efforts of people. However, in management there is not only achieving the aims via efforts of people but there is also assuring that all sources are used efficiently by people. Therefore, management is the sum of decision making and decision applying processes that will use people, materials, hardware, assets, raw materials and time in a harmonious, productive and effective way (Palamutçuoğlu, 2015).

Organization as a term, comes from the word “oreganon” in Greek, which means limb/organ. Limb, as it is known, is the part of a whole that performs in order to keep the whole alive. As for organizations, limb is the part of the system that is structured to reach the aims via definite activities. Therefore, organization is structuring the units, which are built by the system to perform in harmony in order to achieve the aims. As for businesses, organization is performed by both supplying production elements like inventory, machinery, raw material and people, and by distributing these production elements to the related units in order to provide productive performance (Eren, 2012). To sum up, organization is to equip the business with tangible means and human means that are needed to achieve the organizational aims and distributing these means to the related units.

As for the process of organization (Eren, 2012):

-defining the duties that are needed for achieving the aims
-grouping the similar duties via job analysis
-defining the qualifications and numbers of people that are needed for performing these duties
-defining the required competencies, abilities and knowledge of the prospective employees
-defining the jobs and duties before recruitment
-defining the responsibility extent of the employees in managerial positions in terms of using the organizational resources and representing the business.

The Purpose of Management and Organization

The main purpose of management is to achieve organizational aims. The organizational aims that need to be achieved can be categorised under three headings (Genç, 2007):

Aim of order is to display necessary behaviour in order to achieve required aims. In addition, each organization has a culture. Therefore, each organization has *cultural aims* and it is crucial that this culture both represents the employees and it is appropriate for them. The foundation reason of an organization is financial benefits. In other words, making profit. Thus, *economical aims* are again among the core aims of an organization.

The Qualifications of Management and Organization

Organizations have definite qualifications, which can be evaluated as the foundation base. In order to assure sustainability and competitive advantage, these qualifications need to be adopted by managers and applied in management and organization as well.

These qualifications can be categorised as follows (Genç, 2007):

- *Aims:* Organizations have to adopt a core aim in order to live. However, this aim needs to be defined and adopted by all members of the organization.
- *Corporation:* Upon defining the core aim of the organization, the most appropriate candidates are selected among the employees in order to make them perform towards achieving the aim.
- *Creativity:* Management is directing the employees. Therefore, the manager should motivate the employees as well, in order to make them creative and thus, productive and effective.
- *Hierachy:* Managers are always superior to the employees. Therefore in management there is the hiearchy of superior-inferior, which needs to be obeyed.

- *Democracy:* An important qualification of management is to achieve the aims without equipment, via employees. In this sense, it is necessary to involve the employees in the process of decision making, decision applying and controlling.
- *Group:* Management consists the activities of two or more people. Therefore management is a group activity.
- *Communication:* In organizations communication among the manager(s), employees and top management and communication among employees themselves, is very important. When there is efficient communication in an organization, all employees get to know each other well, solve their problems effectively and their commitment to the organization increases.

The Process of Management and Organization

The activity groups that constitute the management process, are sub functions of management function. Management process approach, which is the product of Henri Fayol's researches, focuses on managerial activities that need to be fulfilled in order to achieve organizational aims. These functions are defined as *planning, organizing, directing, coordination* and *control*. *Planning* is predicting the developments related to the future and defining how to reach the organizational aims. *Organizing* is structuring the organization, defining the duties and employees and structuring an environment that is suitable to achieve the aims. *Directing* is to encourage, direct and activate the employees in order to achieve the organizational aims. *Coordination* is integrating the activities and employees in order to ease working conditions and provide success. *Control* is determining if the aims are reached or not/or to what extent the aims are achieved and taking the necessary precautions (Bengi, 2013).

TRANSPORTATION AND LOGISTICS

Transportation, is the transfer of humanbeings, animals and products from a definite location to another definite location. Air, rail, road, water, cable, pipeline and space, are among the means of transportation. The importance of transportation is because of the fact that it renders trade between people possible and thus, civilization is established. It is also accepted as the trigger of logistics. While planning is required in logistics, transportation is the instrument to perform the planning. This is to say that, delivering the products or services from point A to point B. In short, transportation is an important part of logistics and therefore the managers need to make further decisions beyond transportation (Robinson, 2013):

- Packaging
- Containerization
- Documentation
- Insurance
- Storage
- Importing and Exporting Regulations
- Delivery Damage Claims
- Managing vendors and partners

As for logistics, it is evaluated and applied in different ways by each profession. For example, Helsinki (1996) evaluates logistics from the business perspective and defines it as a frame of business planning for managing all resources such as materials and capital; and service and information. On the other hand, the military, according to JCS (undated), evaluates logistics as the science of planning and practising the movement of forces. According to the definition of The Council of Logistics Management (CILM) of the United States of America (USA) (1998), logistics is the process of planning, organizing, applying and controlling the course of storage of goods, services and related information from location of origin to the location of consumption with the purpose of satisfying customer needs and requirements in an effective way. The Canadian Association of Logistics Management (1998) evaluates logistics as the process of planning, implementing, and controlling the efficient, cost effective flow and storage of raw materials, in-process inventory, finished goods and related information from point of origin to point of consumption for the purpose of meeting customer requirements (Tilanus, 1997). To sum up, logistics is related to as supply chain management, which focuses on the management and control of products/services between people and organizations. It is the process of trying to satisfy the needs and requirements of the customers in a timely way via the resources such as capital, materials, technologies and people, spending effort for optimising the products and/or service and producing and utilizing the network.

History and Advancement of Transportation and Logistics

Mustafa Kemal Atatürk, the founder of Turkish Republic has some valuable expressions about transportation and logistics, as follows:

-"The activity and vitality of economical life is related to the condition and extent of transportation means, ways, trains and ports (1922)".

-"Ways, railways, ports and all transport vehicles are the material and political blood vessels of national entity. They are means of peace and power (1930)".

Logistics, in fact, was a military term and activity that was related with getting soldiers and munitions to the battleground. The main background of its development as a combinatorial part of the modern production process, is the fact that the recession of the USA in the 1950's caused industries to pay extreme attention and give importance on goods circulations. Logistics in business was not considered as an academic affair until the period of 1960's. The trade-off between transport and inventory costs, which is a key element of logistics, was formally accepted as an academic subject in economics in the mid 1880's. Nowadays, a number of researches are made on logistics and thus, logistics has been started to be a part of business activities (BTRE, 2001).

The development of business logistics is generally evaluated four seperate periods (Chang, 1998):

Before the 1950's, logistics was in a passive situation. Production was the main concern of the administration and business logistics was believed to be a "necessary evil" in that period. During the 1950's and 1960's, there was the tendency of applying new ideas on business that are related to administration. Drucker (2001), evaluated Logistics as the "Economy's Dark Continent". He also mentioned that the process of physical distribution after producing products, is both the most possible development area in American businesses and the most neglected area at the same time. From the 1970's onwards, applica-

tions and researches related to logistics started to appear. Due to the fact that petroleum prices increased in 1973, the effect of logistics activities on businesses increased as well. Market growth remained slow, high stagflation put pressure and third world countries competed on products and services. Therefore, these factors caused an increase in terms of the importance of logistics system on businesses (Tseng, Yue and Taylor, 2005).

Transportation activities gain importance because of the main principle of logistic activities, which is responding to the needs and requirements of the customers in the right time and in the right place. Using appropriate transportation means and performing the activities via those means in a coordinated, planned and programmed way, constitute great importance.

The Purpose of Transportation and Logistics

Logistic activities, consist managerial activities such as planning, organizing, coordinating, directing and controlling. The aim of these logistics activities is to perform by taking into consideration the important indicators for the organization to stay strong such as quality, cost, time and service. Thus, the general aims of logistics activities can be evaluated as follows (Orhan, 2003):

- Choosing the most appropriate transportation way and thus, decreasing the time of the delivery.
- Defining stock control systems that base on performing the activities such as “Just In Time” (JIT), when there is a demand.
- Keeping the costs minimum.
- Sustaining productivity
- Providing quality service in order not to make customers dissatisfied.
- Using systems such as GPRS in order to provide both the organization and the customers with the chance of following the loads and vehicles 7/24.

MANAGEMENT AND ORGANIZATION IN TRANSPORTATION AND LOGISTICS

Transportation and logistics management is the technique, practice or science of controlling, planning, developing and maintaining adequate transport services that meet the individual and corporate needs and requirements. The Council of Logistics Management in the USA (2003), defines Transportation and Logistics Management as the art of managing the inventory in the process of delivery products and services to the appropriate location, at the appropriate time and in the appropriate condition and choosing the appropriate equipment and in the appropriate direction. It also consists of fields such as shipment scheduling, freight cost managing, shipment tracking and parcel managing in the optimum extent. However, Ajiboye (2007) observed that the main objective of Transportation and Logistics Management is to provide a functional and sustainable transport services for the nation and this has to be done by providing a consistent general approach and realistic guide for the operation of transport sector, which is described as the engine of the nation’s economic growth and development.

Transportation and Logistics Management decisions are classified traditionally as *strategic, tactic* and *operational* (Ghiani, Laporte and Musmanno, 2004). *Strategic decisions* are the decisions that have long term effects. These kinds of decisions consist logistics system design and providing costly sources (location of the facilities, size of the capacity, plans of the factories and warehouses). Strategic decisions are usually made for future predictions because of the fact that the data is not definite. *Tactical decisions*, on the other hand, are based on middle term period (monthly or quarterly periods) and consist subjects such as planning of promotion and distributing the resources (allocation of storage, strategy of gathering demands, choosing transportation model). Finally, *operational decisions* are based on daily activities and have a narrow scale. These kind of decisions consist loading and vehicle shipment and gathering warehouse demand (Duman, 2012).

In 1990's, the importance of logistics function in organizations have been realised thoroughly. The reasons of this can be defined as follows (Birdoğan, 2004):

- A great number of organizations have experienced that customer service and satisfaction, which have an important place in marketing strategy, can be provided by a better logistics system that will provide lower costs and higher customer satisfaction.
- With the rapid rise of transportation costs, logistics have become one of the most important cost elements and thus, managements have realised that by controlling these costs effectively cost saving can be provided for both the organizations and the customers.
- Logistics have started to be evaluated as a solution for cost saving.
- The marketing approach that focuses on responding the needs of every single customer, has caused an expansion in product line and the need for inventory control, because of the fact that production has brought about the necessity of a good logistics management.
- Organizations, have faced with various concepts about logistics such as packaging and developing the recycling channels. The customers have demanded that organizations take into consideration the subject of recycling and thus, the organizations have developed a great number of recycling systems in this process, which are cost effective.
- The fact that the increase in the need of the international organizations in terms of transporting the products from one place to another, which has been caused by the globalization, have resulted in the distribution lines to extend. Therefore, the concepts of location and time, which are among the advantages of logistics, have started to gain more importance.
- The growth of organizations that make international production or sales and the growth of scales, are among the other important factors that affect logistics function in terms of importance.

Important Factors for Effective Transportation and Logistics Management and Practical Advantages in Application

According to Kiraga (2014), there are some important factors that can enable transportation and logistics management to be run effectively. The first factor is accepted as Proper Planning. As it is widely known, the first step for accomplishing a task is planning and in terms of transportation and logistics, planning process involves obtaining the products, developing the facilities of storage and delivering the products to the right location. The main aim of planning, as it is widely known and accepted, is to perform maximum work in the minimum time and thus, maximizing the profits.

Another important factor is adopting automation. As today's era is the era of technology, automation plays the most crucial role in terms of boosting the organizational efficiency. Therefore, its role is vital in the business process optimization. The use of an appropriate software can ease the process of transportation and logistics. Giving value to relations is again an important factor. Human resources is the fundamental aspect of an organization that provides growth and each employee has to be perfect in field of work. Thus, it is crucial to train the human resources regularly. Regular trainings make the human resources stay updated with the latest information trends in the industry and relatedly an increase in organizational efficiency and satisfaction of the customers is provided.

Warehouse management is also a very important factor because of the fact that without effective warehouse management, logistics management cannot be completed. Operations related to warehouses are mainly dependent on the type of products. For example perishable goods such as dairy products, need refrigeration facilities. Grains, on the other hand, have be stored in an environment that is moisture free. In short, businesses should focus on developing the inventory of warehouses in order to keep the wastage of goods in minimum extent. Measuring and improvising is also accepted as an important factor. The main reason of this is the fact that logistics network optimization cannot be accepted as complete without integration of measurement, analysis, and feedbacks. When new strategies are applied in the system, the output is needed to be measured accordingly. This is crucial as it implies the situation of the strategy as success or failure. Feedbacks also help in improvising. The ideas and suggestions of the employees should be recorded periodically. This ensures a pool of ideas is generated and at the same time any flaws in the system are revealed.

In addition, the importance of management and organization in terms of gaining competitive advantage should not be disregarded. Competitive advantage, defines the opportunities for an organization in order to adapt different market conditions. In today's global market area, the market is characterized by stiff competition, and logistics plays a major role in the consumer service (Kurochkin, 2012). The conditions that are needed for defining the quantitative characteristics of the effects of logistics solutions can be presented as follows:

- The presence of well-functioning accounting and information system
- Conduct comprehensive analysis of costs and revenues structural divisions of the company and all the participants, based on the application of the principle of "mission" of the supply chain and a single methodology for calculating costs
- Definition of the share of profits from the logistics activities of the company (Prokhoroval, Kolomyts, Nenasheva, Sholukha and Vashchenko, 2016).

Block Quotes

The activity and vitality of economical life is related to the condition and extent of transportation means, ways, trains and ports (Mustafa Kemal Atatürk, 1922)

Ways, railways, ports and all transport vehicles are the material and political blood vessels of national entity. They are means of peace and power (Mustafa Kemal Atatürk, 1930)

SOLUTIONS AND RECOMMENDATIONS

Logistics has its sources from Greek “logistikos” (computation ability) and French “logistique” (demanding) words. Mainly the word logistics is composed of the words logic and statistics. These words refer to “statistical logic”. The concept of logistics is mainly used for defining the transportation of equipment and the army forces in the military field. In this sense logistics, is the organizing and applying a plan or an operation. The main aim of logistics is to reach a high level in customer services and creating competitive advantage by using resources and investments optimum (Erdal & Çancı, 2009).

Since logistics have started to advance from 1950s on, a great number of researches have started to be conducted on the field. In addition, because of the fact that nationalisation and globalisation trends have emerged in recent decades, the importance of logistics management has started to draw attention in a fast-increasing pace. For businesses, logistics is a must, in terms of optimising the current production and distribution processes, which are based on the similar resources, via management techniques. The main element in logistics chain is the transportation system that integrates the different separated activities. Transportation, occupies one-third of the total amount in the logistics costs and systems of transportation affect the logistics system performance to a great extent. Transporting is required in the whole production procedures, from manufacturing to delivery to the final consumers. Therefore, only a good coordination between each component would increase the benefits to a maximum.

Logistics consists prediction, planning, organizing, coordination and control, which are among management functions It directs and manages all activities that are related to production and distribution of a product and/or service. Therefore, logistics is the sum of activities that consist various fields and requires an integration and collaboration. In short, logistics strategies have to be integrated with organizational management strategies such as purchasing, production and marketing in order to gain competitive advantage and increase the value-added activities of the organization. (Duman, 2012).

FUTURE RESEARCH DIRECTIONS

Management and organization in transportation and logistics can be considered as critical success factors, in terms of their being crucial in order to sustain the supply chain in a successful and flawless way. Therefore, transportation and logistics cannot be run without effective management and organization. Thus, the importance of management and organization in transportation and logistics needs to be scrutinized and explained in detail in future researches. In addition, logistics organizations can be observed and analyzed statistically in order to make comparisons and draw a general frame of the sector. Thus, the importance of management and organization can be comprehended thoroughly, certain problems can be detected and concrete solutions can be defined and applied.

CONCLUSION

Transportation and Logistics, is the most important activity of an organization that is performed out of the organization. These activities have a considerable impact on organizational performance. Organizations have to make long term profits in order to gain sustainability and this can only be assured by decreasing logistics costs on the condition that they provide customer service that is required by the market. Therefore, an effective and productive logistics function and management is crucial.

ACKNOWLEDGMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

Adefolalu, A. A. (1977). Significance of transportation in rural development in environmental and spatial factors. *In Proceedings of the 20th Annual Conference of Nigeria Geographical Association, University of Ife*, Ile Ife.

Ajiboye, A. O. (2007). Opportunities and challenges in the field of transport and logistics management in Nigeria. In K. U. Nnadi, & I. C. Ogwude (Eds.), *Transport in Nigeria - Economics, management policy* (pp. 49–73). Owerri: Reliable Publishers.

Ajiboye, A. O., & Afolayan, O. (2009). The impact of transportation on agricultural production in a developing country: A case study kolanut production in Nigeria. *International Journal of Agricultural Economics and Rural Development*, *2*(2), 49–57.

Ajiboye, A. O., & Afolayan, O. (2009). A study of the transportation factors militating against agricultural production in a developing country: The case of Nigeria. *Africa Journal of Technology Policy*, *5*(1), 263–271.

Ajiboye, A. O., & Ayantoyinbo, B. B. (2009). Analysis of transportation and distribution problems of agricultural products marketing in Sub-Saharan region: An application to kolanut. *Journal of Technology*. *Entrpreneurship and Rural Development*, *4*(1), 188–200.

Bengi, B.S. (2013). *Lojistik merkezlerde yönetim ve organizasyon: Trakya master plan örneği.* T.C. Namık Kemal Üniversitesi Fen Bilimleri Enstitüsü Yüksek Lisans Tezi Birdoğan Baki, (2004). *Lojistik Yönetimi Ve Lojistik Sektör Analizi,* Lega Kitabevi, Trabzon, 2004, 9-11, 10.

BTRE. (2001). Logistics in Australia: A preliminary analysis. *Bureau of Transport and Regional Economics, Canberra*. Retrieved from http://www.btre.gov.au/docs/wp49_contents.htm

Canadian Association of Logistics Management. (1998). Retrieved from http://www.calm.org/calm/AboutCALM/AboutCALM.html

Chang, Y. H. (1998). *Logistical management*. Taiwan: Hwa-Tai Bookstore Ltd.

CILM. (1998). Opportunities in logistics management: A publication of the council of logistics management of United States of America. Retrieved from http://www.clm1.org/mission.html

CILT. (2003). *The chartered institute of logistics and transport, international royal charters and bye laws*. London, UK.

Erdal, M., & Çancı, M. (2009). Lojistik Yönetimi, 3. Baskı, İstanbul: UTİKAD Yayınları.

Eren, E. (2012). *Örgütsel davranış ve yönetim psikolojisi*. İstanbul, Turkey: Beta Yayıncılık.

Fayol, H. (1916). *General and Industrial Management*. Paris, France: Institute of Electrical and Electronics Engineering.

Fiske, S. T., & Taylor, S. E. (1991). *Social cognition*. New York: McGraw-Hill.

Genç, N. (2007). *Yönetim ve Organizasyon*. Ankara, Turkey: Seçkin Yayıncılık.

Ghiani, G., Laporte, R., & Musmanno, R. (2004). *Introduction to logistics systems planning and control*. Wiley.

Helsinki, F. I. (1996). *What is logistics?* Logistics Partners Oyo. JSC.

Kiraga, R. (2014). *Transport management practices and logistics performance of humanitarian organizations in Kenya*. (Unpublished Thesis), University of Nairobi.

Koçel, T. (2005). *İşletme Yöneticiliği: Yönetim ve Organizasyon, Organizasyonlarda Davranış, Klasik Modern-Çağdaş ve Güncel Yaklaşımlar, Genişletilmiş 10. Baskı*. İstanbul, Turkey: Beta Yayınları.

Kurochkin, D. (2012). *Logistics: (Transport, procurement, manufacturing, distribution, warehousing, info): Lectures* (p. 268). Minsk: FUA Inform.

Orhan, O. Z. (2003). Dünyada ve Türkiye'de Lojistik Sektörünün Gelişimi, Marmara Üniversitesi İktisadi ve İdari Bilimler Fakültesi, *İstanbul Ticaret Odası Yayınları*, İstanbul, 2003, 26.

Prokhoroval, V. V., Kolomyts, O. N., Nenasheva, A. I., Sholukha, N. A., & Vashchenko, P. G. (2016). Logistics management as a tool to achieve competitive advantages of the enterprise trade. [Special Issue on "Management of Systems of Socio-Economic and Legal Relations in Modern Conditions of Development of Education and Society".]. *International Review of Management and Marketing*, *6*(6), 32–37.

RobinsonA. (2013). Retrieved from https://cerasis.com/2013/08/13/transportation-and-logistics-management/

Tilanus, B. (1997). *Information systems in logistics and transportation*. London, UK: Elsevier Science Ltd.

Tseng, Y., Yue, W. L., & Taylor, M. A. P. (2005). The role of transportation in logistics chain. *Proceedings of the Eastern Asia Society for Transportation Studies*, *5*, 1657–1672.

ADDITIONAL READING

CILT. (2003). *The chartered institute of logistics and transport, international royal charters and bye laws*. London.

Koçel, T. (2005). *İşletme Yöneticiliği: Yönetim ve Organizasyon, Organizasyonlarda Davranış, Klasik Modern-Çağdaş ve Güncel Yaklaşımlar, Genişletilmiş 10. Baskı*. İstanbul: Beta Yayınları.

Orhan, O. Z. (2003). Dünyada ve Türkiye'de Lojistik Sektörünün Gelişimi, Marmara Üniversitesi İktisadi ve İdari Bilimler Fakültesi, *İstanbul Ticaret Odası Yayınları*, İstanbul, 2003, s: 26.

KEY TERMS AND DEFINITIONS

Asset: Any component, model, process or framework of value that can be leveraged or reused.

CILM: The Council of Logistics Management of the United States of America (USA).

CILT: Chartered Institute of Logistics and Transport International.

Hardware: Fixtures, equipment, tools and devices used for general purpose construction and repair of a structure or object. Also such equipment as sold as stock by a store of the same name.

Raw Material: Materials purchased for manufacture, not yet altered by the production process.

Supply Chain: A network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers.

Tangible: Possible to be treated as fact; real or concrete.

Warehouse: A place for storing large amounts of products (wares). In logistics, a place where products go to from the manufacturer before going to the retailer.

Chapter 14
An Analysis for Coal Transportation and Demand in US and International Markets

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ABSTRACT

Since coal resources are located around the world and often far away from where the coal is consumed, transportation is important. The industries that use coal such as power plants, industrial plants, coke plants, and commercial institutions usually prefer different transportation methods. The demand in these industries and the transportation methods they use differ over time. This chapter analyzes the international coal transportation and demand. An analysis for the US coal market and the transportation to industries along with the methods that are used between 2001-2015 are presented. A trend analysis was performed to show the long-term demand for each transportation method in each industry. Such analysis is also useful as it allows observing the coal demand from each industry. Analysis results reveal the change in coal amounts that are transported to each industry using the railroad, truck, and other methods.

INTRODUCTION

The energy commodity chains are important for the energy supply of residential and industrial demand. Both the international and domestic chains are interconnected and multimode transportation is common. The distance between the sources and the final consumption locations require a well-established material handling and commodity distribution system. An effective logistics management system is the most important part of this process.

Coal, an important energy commodity, is the most abundant and largest energy resource that is widely used in many industries. The coal is considered as a reliable source due its availability in nature, flexibility to use and its distribution around the world. The coal reserves are not evenly distributed as the consumption location is far away from the mine. The distance between the reserves and consumption

DOI: 10.4018/978-1-7998-1397-2.ch014

points require the transportation of this bulk commodity that becomes a problem for secure and economic coal supply. The transportation cost that depends on the distance between the source and destination becomes a significant part of the total cost (Wallin et al, 2007).

The researches those analyze the supply and demand relations of the coal and the relationship between the transportation and logistics do not exist in the literature. In this paper first, the coal reserves and its production are analyzed. Section 2 provides the method and the data processing. In section 3, the countries with the largest reserves and production capacities are presented using historical data. The relationships such as the total coal production and consumption, the total export and import are presented to show the general situation in international markets. Then we focus on the transportation methods at the national level and we present a detailed analysis for the USA coal transportation in section 4. In this section, we focus both on the historical demand change from different industries and transportation methods used to transport coal. We present the discussion and conclusion in section 5 and 6 respectively.

BACKGROUND

The transportation and logistics issues of the coal have to be carefully analyzed in terms of production and shipment to decrease the total cost. The deregulated markets put cost pressure on the fossil fuels especially on the coal, however, the coal-fired power plants are still the major coal consuming entities as the energy demand grows. On the other hand, the power plants need to be cost competitive to be dispatched in the power markets (Whittington and Bellhouse, 2009). The emission costs bring extra costs for coal plants that also affect their competitiveness. They need to select the right coal resource to generate power with a lower cost (EU, 2008), (Golombek et al., 2005). Other industries that use coal include industrial plants, commercial institutions, and coke plants. It is observed that the demand for coal is decreasing due to emissions and pressure against fossil fuels. The major transportation method that is used for international coal transportation is the sea. However, for the domestic coal transportation-railroad, truck, river, tramway, conveyor, slurry pipeline, great lakes, and tidewaters are used.

The average increase in energy demand is 7% per annum around the world (EIA, 2017). On the other hand, fuel prices have experienced turmoil and fluctuation over the years. An analysis of the coal demand and transportation is needed to see the change in sectoral demand and transportation methods. A long-term trend can be expected for the sectoral coal demand, as the coal is one of the oldest energy sources. The researches on the transportation and production of coal are mainly in the reports. There are limited researches on the transportation and logistics of the coal both in the international and national level.

The researches on the optimum operation of the coal logistics network usually propose methods to solve the optimization problems and increase operation efficiency. A mixed integer programming method is proposed for the planning of fuel-coal imports for power plants in (Shih, 1997). The diversity of supply sources for power companies that has more than one plant makes the coal logistics problem challenging. The main objective is the minimization of total inventory and holding costs and the constraints are harbor unloading capacity, demand balance, and inventory balance constraints. The model is developed for the central coal logistics system of Taiwan power company to show its validity. Sherali and Puri (1993) present a model for coal blending and cleaning silos in which the coal is supplied from different resources and the objective is to efficiently deliver the coal to customers to meet the demand. They proposed three different linear programming models based on the problem complexity and computational burden. The main objective is the minimization of total operational cost and they develop a decision tool to make cost-effective decisions under multiple products, ores, and demand over time. A model for a coal loading port in China is developed (Zhao et al., 2010). The coal is first transported to the port via trains and then the river vessels are used to deliver the coal to the subsidiaries. They develop a Markov decision model that minimizes holding cost, shortage, and transportation cost by integrating ordering and delivery decisions. The problem considers the product and route diversities which are usually the decision variables that makes the problem challenging. Ash and Waters (1991) provide a simulation methodology for the coal shipment from the mines in west Canada to power stations in the east. The transportation cost for such distances become more important as it will be the major part of the final coal price. They simulate the alternative routes across Canada and present the possible outcomes of each scenario for strategic route planning. Liu (2008) presents a model for coal blending and transportation where intermodal transportation network for coal import exists. The coal supply, quality, price, demand at the power plant are included in the model. The main objective of the model which is a mix-integer zero-one programming problem is the overall cost minimization. Kozan and Liu (2012) present a decision support system by integrating the operations of coal shipment, coal stockpiles and coal railing within a system. A scheduling optimization methodology is developed to model, solve and analyze the coal transport problem and hence improve the overall efficiency of the system. Chang (1980) develops a multimodal approach for a regional railroad distribution network. The author uses a two-stage model to allocate resources among demands and then assigns flows to the network according to efficiency criteria. Bascetin and Kesimal (1999) propose a fuzzy-based approach to determine the best coal transportation system for short distance coal transportation such as a pit to the power plant. They evaluate truck, conveyor and crusher alternatives and use the multi-attribute decision making method to determine the best alternative.

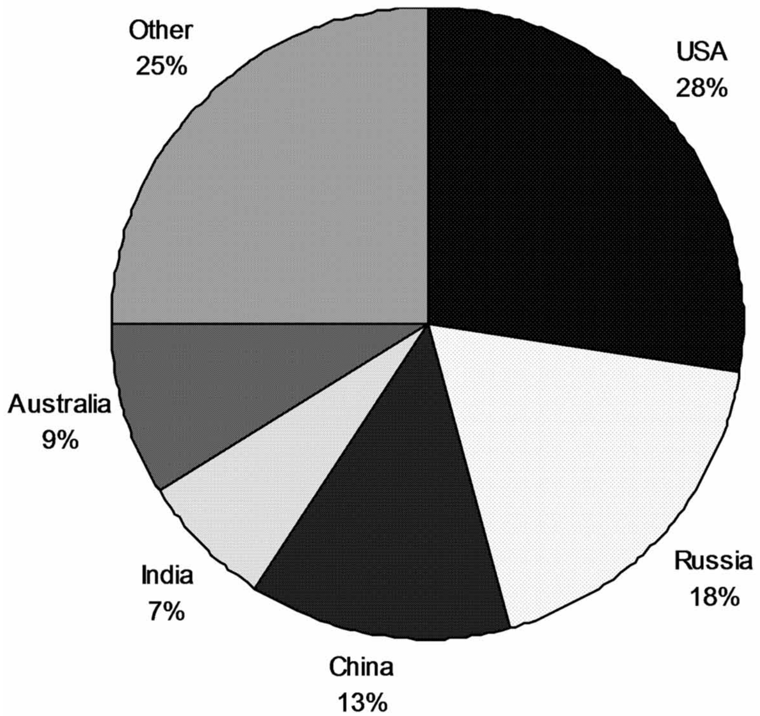
There are also some researches to evaluate the capacity and locations of the ports and transportation network (Osleeb and Ratick, 1983, Osleeb et al., 1986). They propose mixed integer programming models to evaluate the logistic operations and its results. A research on the existing coal distribution infrastructure is presented (McCollum, 2007). The author develops four demand scenarios to analyze the coal consumption and the possible problems on meeting the demand of coal until 2050. He mentions that the researches on coal distribution date back 80's and are still required for a reliable coal supply. He first presents the coal transportation routes and maps in the US and then coal demand analysis based on the power consumptions to determine the possible bottlenecks and congestions on the transportation routes. Tu and Guldman (2001), develop a model and a tool called Geographic Information System to identify the coal transportation routes considering coal production sites, power plants, and costs of transportation. They visualize the transportation process and validate the model in a case study developed for Ohio. A wide research on coal transportation to power plants and its reliability in US is presented in (Kaplan, 2007). He explores the major coal resources and discusses transportation reliability issues while he expresses the importance of coal for the energy supply.

ANALYSIS FOR COAL RESOURCES IN THE WORLD

Coal Reserves

Although the coal can be found in many countries, the reserves are concentrated in some regions. The countries with the largest proved reserves are given in Figure 1 (EIA, 2017).

Figure 1. Largest coal reserves by country



The total coal reserves in the world are estimated to be 860 Btones. The reserves that include sub-bituminous, antrasic bituminous and lignite are located in more than 100 countries and coal is produced in more than 50 countries and almost half of it is antrasic bituminous coal. However, 75% of all coal is located in four countries. USA (28%), Russia (18%), China (13%), Australia (9%) and India (7%) have the largest proved reserves respectively. The demand for sub-bituminous, antrasic bituminous and lignite are different as well as their consumption purpose. It is expected that the international coal trade takes place between these major countries and other demanding countries. Now we will analyse the coal production and trade.

Coal Production and Trade

The coal production and consumption values vary based on factors such as price, demand, and economic growth. Figure 2 shows the World annual coal production and consumption values between 2008-2015. The figure shows that the long-term trend of production and consumption is up even if the production and the consumption decreased in the last three years. Asia-Pacific region (30.9%), North America (28.5%), Russia (18.2%) and Africa (3.8%) have the largest coal reserves (BP, 2015).

The coal can be consumed locally or can be transported to the customers in other regions. It is observed that the development of international transportation capabilities and logistics affected the international coal export and import. Figure 3 shows the total amount of coal exported and imported in the world between 2008 and 2015. The trend raised until 2013 and declined in 2014 and 2015. This is because the share of coal-fired electricity generation raised rapidly until 2013. The pressure on the coal-fired power

Figure 2. Production-consumption of world total coal

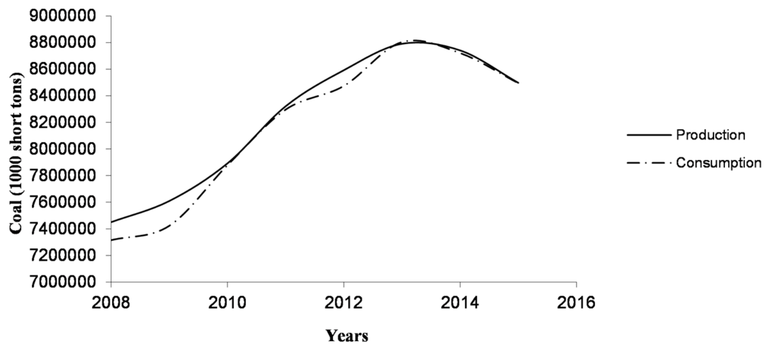
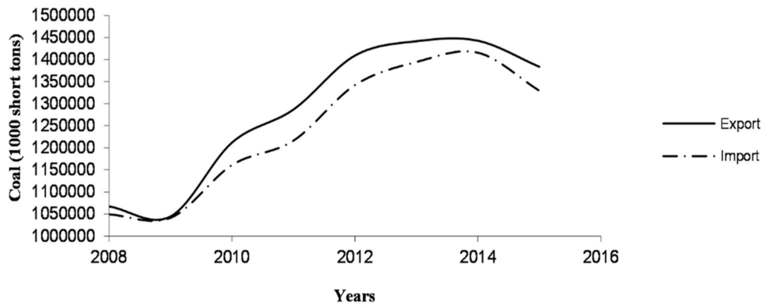


Figure 3. Export-import change in world coal



plants and incentives for renewable energy sources made the trend to downward (EIA, 2017). However, the analysis shows that there are positive trend values in the long term for both coal import and export.

Another important parameter to consider is the rate of exported coal per produced coal and the rate of imported coal per consumption. In other words, it is useful to estimate the percentage of exported coal which is produced and the percentage of imported coal which is consumed. Figure 4 shows the percentages of export/production and import/consumption rates between 2008-2015. It is shown in the figure that around 16% of the produced coal is exported while around 15% of the consumed coal is imported. Despite difficulties, both of them have increasing trend values in long term.

The Coal Consumption and International Transportation

Coal is a major energy source and dominant electricity generation fuel as it can be widely available. It is estimated that coal provides approximately 43% of the annual electricity demand and 29% of total world energy supply. Coal is second only to oil, which is at 31%. Figure 5 shows the sectors where the coal is widely used (Coal information, 2016).

Although the share of renewables is growing in electricity generation, it is estimated that coal will continue to be major source for the electricity generation in the future. The coal is widely used in the production of steel and the steel industry is another important coal consumer.

Figure 4. Export-import change in world coal

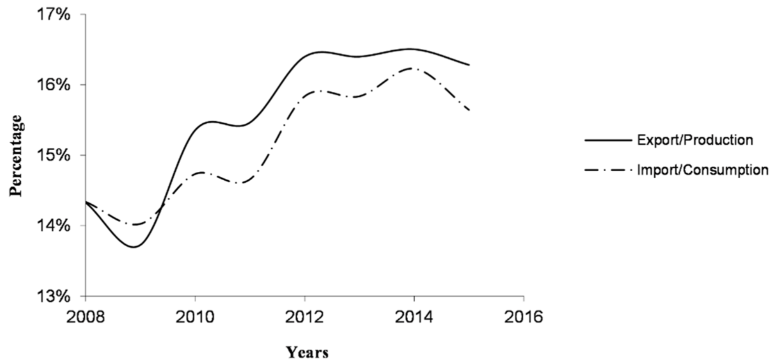
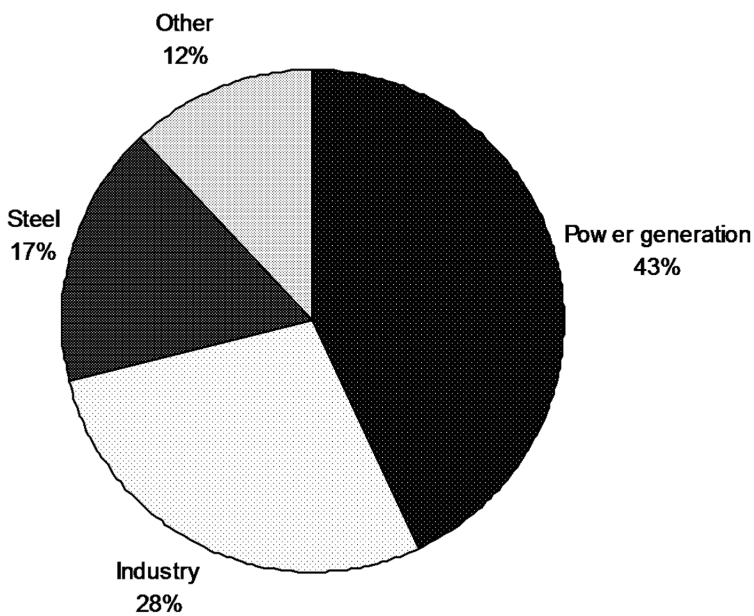


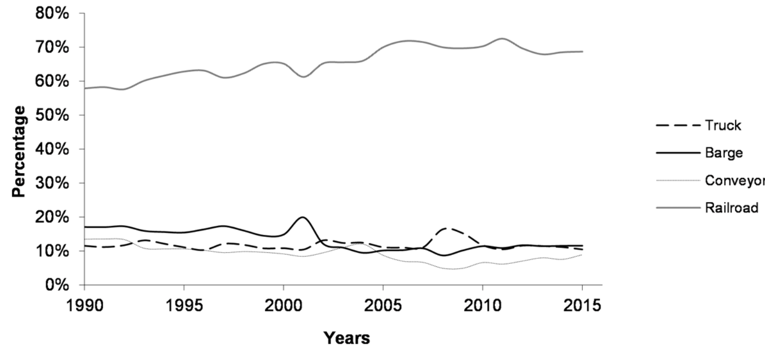
Figure 5. The shares for the coal usage



Selection of coal transportation method for coal logistics depends on the distance that coal will be transported. If the distance is long and the road that the transportation will be made is hard ground, then the truck is a good option. The railway is a viable option as its mass transportation capacity and relatively less cost. The barges can also be a preferred option if the river or navigable water allows. They are able to carry a huge amount of coal at once and the commodity can be transferred by river safely with a low cost. Loading and unloading should be carried out where proper handling equipment exist such as ports. Figure 6 shows the ratio of each transportation method for total coal transportation in US Coal market between 1990 and 2015.

The railroad transportation has been the preferred method for coal transportation in the past. The transportation with barge, conveyor, and truck are close to each other. The railroad infrastructure is not well established in many countries however, it provides reliable, fast and cost effective transportation option.

Figure 6. Historical change of ratios of transportation methods for USA



The international transportation for coal becomes possible because of the development in sea transportation. Figure 7 shows the shares of seaborne trade by country in 2015. Indonesia and Australia have the largest share in exports and they export 62% of all the coal. The total amount of coal that is exported is estimated as 780,000 M short tons (Coal information, 2016).

It is also worth mentioning that numbers given in Figure 7 include both steam coal and coking coals. Lignite is less preferred for international trade and has a negligible share in this total. Figure 8 shows the total amount of steam and coking coals transported by sea. Because of increasing demand for coal in international markets, coal transportation by sea shows a raising trend for both steam and coking coal.

Figure 7. Global seaborne steam coal trade, 2015

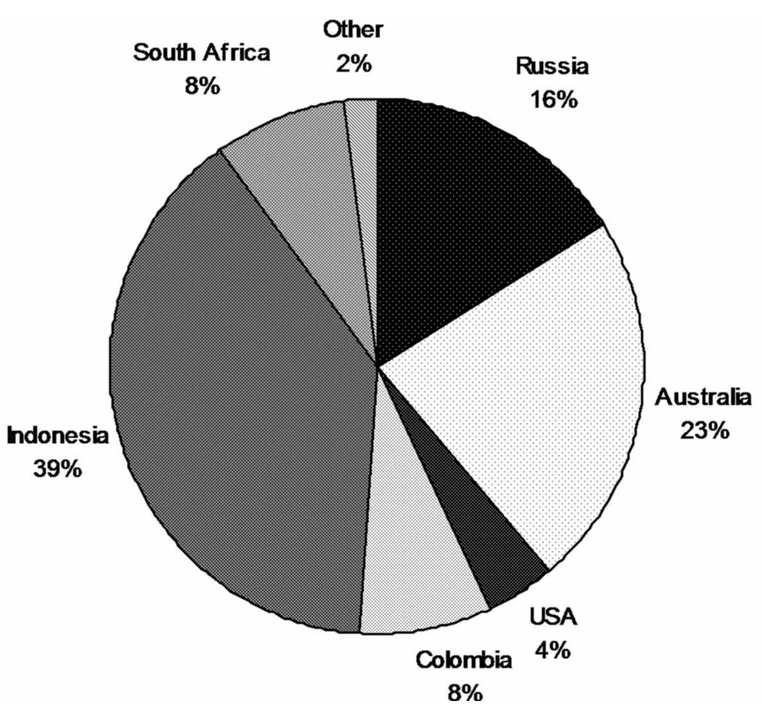
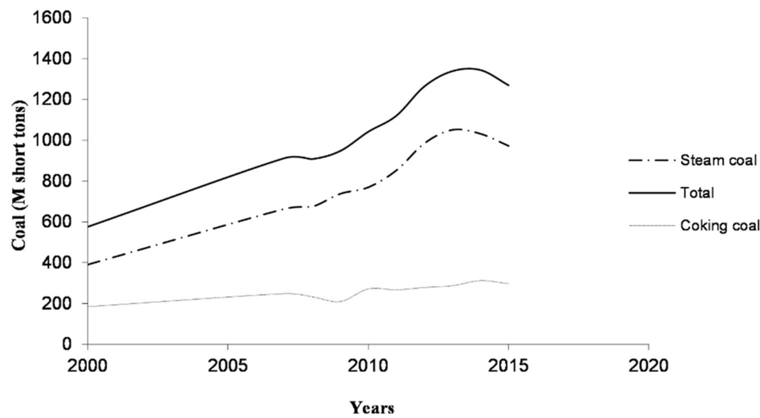


Figure 8. Coal transportation by sea, years 2000-2015



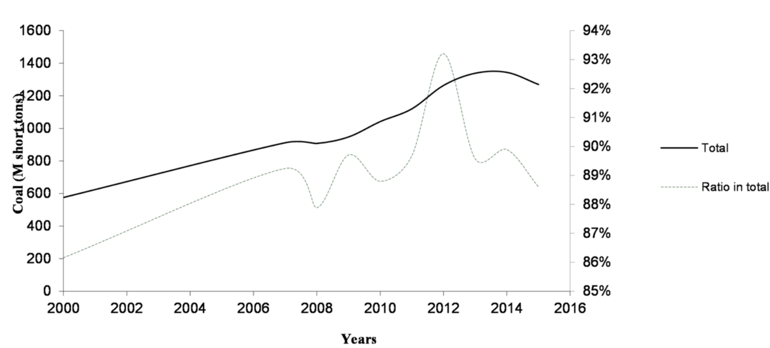
Coking coal is widely preferred by international customers and used by the industry. The major transportation method for international delivery is the sea. In average, 89% of the exported coal is transported by a sea of which average of 21% is coking coal and 68% of it is steam coal. Figure 9 shows the total amount of coal transported by sea and its respective ratio in total coal transportation between 2000 and 2015. The data shows that coal logistics using sea increased a lot in the last two decades. The demand for coal decreased in the last two years and a similar pattern is observed in total sea transportation. Despite difficulties, there is an increasing trend for the sea-based transportation of the coal.

AN ANALYSIS FOR COAL DEMAND AND TRANSPORTATION IN US COAL MARKET

The Method and the Data

It is important for the coal consuming companies to find the optimum coal resource along with its type, transportation method, heat content and emission content. Once the coal is mined, the process starts

Figure 9. Coking coal and steam coal transportation in sea by years



with the washing of coal followed by crushing, blending and transportation to the customer. We analyze the recent coal data to observe the changes in supply and demand as well as transportation and logistics. The data for the coal logistics is limited and many the reports that are published are not open to public. However, the analyzed data brought useful results and recommendations. The data for the international reserves, production, consumption, export, import of the coal is used from the annual reports and agencies. The data formatted and cleansed to have reliable figures and tables.

In order to analyze the transportation methods and demand changes in different industries, we use USA coal data provided by EIA. One reason we use the USA coal data is that the data is reliable and neatly classified over the years. Such data is not available for all countries. The data include important parameters such as the amounts of transportation, transportation methods, the costs and demand from different industries. Table 1 provides the notation used for the analysis.

The analysis was carried out to focus on the transportation methods and the final destinations in USA. We do the calculations for each year for all destinations and transportation methods in an effort to find the long-term trend. See below pseudo-code for the method.

Once the analysis is completed, the detailed figures for each industry along with the long-term trend results were used to show the relationship between demand and the transportation methods over the years. A trend analysis is presented using the data to further investigate the situation in the coal market.

Total Coal Transportation

An analysis for coal demand and transportation in US coal market USA is the country with the largest coal reserves and is the largest coal exporting country. The US energy market used to be coal dominated however the share of the coal decreased due to pressure from the environmental regulations and the increasing share of the renewable energy resource (EIA,2017). Figure 11 shows the relationship between transportation, production and consumption in USA between 2001 and 2015.

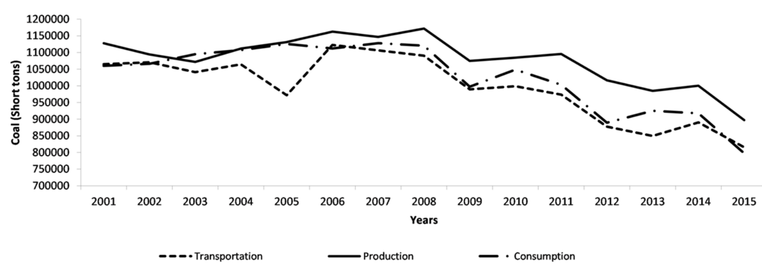
Table 1. Notations used for the analysis

i :	Destination index
t :	Year index
j :	Index for the transportation method
I :	Total number of destinations
J :	Total number of transportation methods
$C_{i,j,t}$:	Amount of coal transported to the destination i using method j in year t
$P_{i,j,t}$:	Percentage of coal transported to the destination i using method j in year t
$C_{j,t}$:	Amount of coal transported using method j in year t
$P_{j,t}$:	Percentage of coal transported using method j in year t
$C_{i,t}$:	Amount of coal transported to the destination i in year t
$P_{i,t}$:	Percentage of coal transported to the destination i in year t
C_t :	Amount of coal transported in year t
Pt :	Percentage of coal transported in year t
R :	Trend analysis value or slope

Figure 10. Pseudo code for the USA coal market analysis

```
Start
Set t=2001, i=1, j=1
For t=2001 to 2015 do
    For i=1 to I do
        For j=1 to J do
            Calculate C_{i,j,t} , P_{i,j,t}
        End for
    Calculate C_{j,t} , P_{j,t}, C_{i,t} , P_{i,t}
    End for
    Calculate C_t , P_t
End for
Compute R
End
```

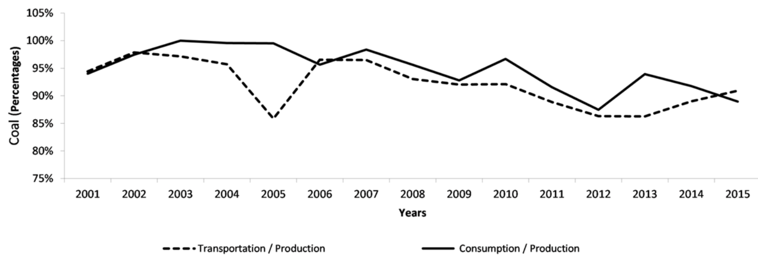
Figure 11. Total coal production, consumption, and transportation in USA



The amounts shown in the figure are total amounts and it is seen that there is a decreasing trend in long term. The location of the coal mine and the final destination that the coal is demanded might be different which is usually the case in USA. The coal mines are located heavily in states like Wyoming, Montana, Illinois, and Pennsylvania whereas the demand is from other states which include coal-fired power plants and steel industry. It is shown that the trend is downward in the long run, which indicates that coal production, transportation, and consumption are falling. The relationship between transportation vs. production and consumption vs. production might provide an idea about the ratio of local and country-based consumption. Figure 12 shows the ratios of transportation vs. production and consumption vs. production.

Based on the data provided, a downward trend is observed in transportation/production and consumption/production rates with a slope of -0.0077 and -0.0058 respectively. It can be argued that in the long term the local or country-based coal consumption also decreases whereas transportation rate decreases more. In other words, the ratio of coal that is consumed in the local market increases. The destinations where the coal is transported to are classified as electric power plants, commercial institutions, industrial

Figure 12. The relationship between transportation, consumption and production in usa



plants excluding coal and coke plants. On the other hand, main transportation methods are classified as the railroad, truck, river, great lakes, tidewater piers, ocean vessel, tramway, conveyor and slurry pipeline. The railroad is the dominant coal transportation method in USA. Now we analyze the coal transportation modes in details in the following sections.

Transportation Modes for Total Coal Logistics

Figure 13 present the details of the transportation methods for total coal transportation. The figures show the total transportation between 2001-2015 both in short tons and their percentages.

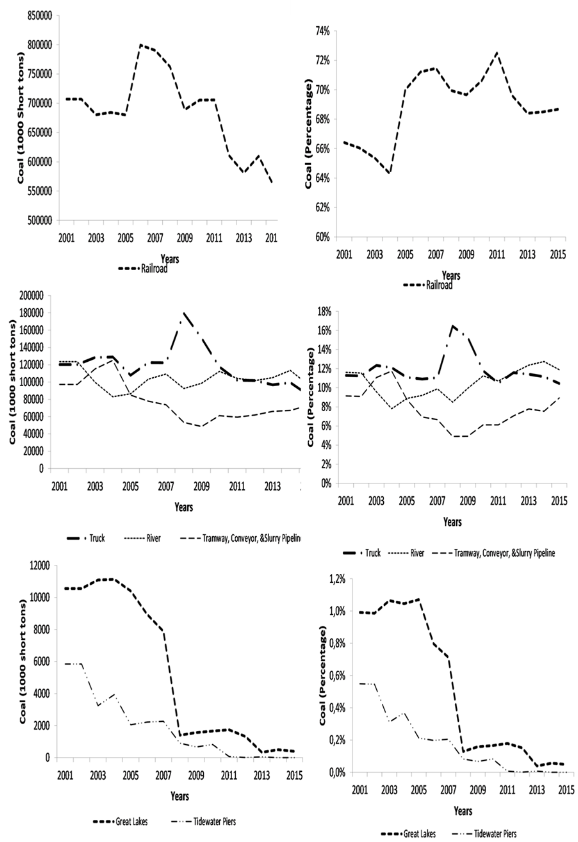
Figures show that truck and river follow the railroad in total coal transportation ratio. The total coal transportation for all transportation methods shows a decreasing trend. The ratio of coal transportation with the railroad has an increasing trend. Even if the amount of coal decreasing in coal transportation, the ratio of coal transported with the railroad is increasing. The railroad is a cost-effective, fast and preferred method for transportation with an average of 69% of total coal transportation. Trucks are usually used to transport the coal from the mine to load point and from port to the main destination. The multimode transportation is possible in coal transportation. Given that total coal production and transportation are decreasing, the increasing ratio of railroad, truck, river and other methods are expected as they are preferred and cost-effective methods.

Transportation by tramway, conveyor & slurry pipeline, great lakes and tidewater piers have an average ratio of 8% in total coal transportation in 15 years. When the figures are analyzed a decreasing trend is observed for tramway, conveyor & slurry pipeline, great lakes, and tidewater piers. The decrease in these transportation methods might be related to the coal types, the location of the coal source, the location of the final destination and the transportation cost. However, it can be claimed that by tramway, conveyor & slurry pipeline, great lakes and tidewater piers are not preferred as much as railroad, truck, and river and it will continue in this way in the short run. It is also important to see the share of the coal that is transported to each sector and the transportation methods that are used. We now focus on industry based coal analysis and transportation methods.

Transportation to Electric Power Plants

Electric power plants are the main coal consuming industry in the USA. There are 968 coal-fired generator with 279,719 MW capacity that corresponds to 26.8% of total capacity as of 2015 (EIA, 2017). However, environmental regulations and climate act imposed an extra cost on the coal-fired power plants

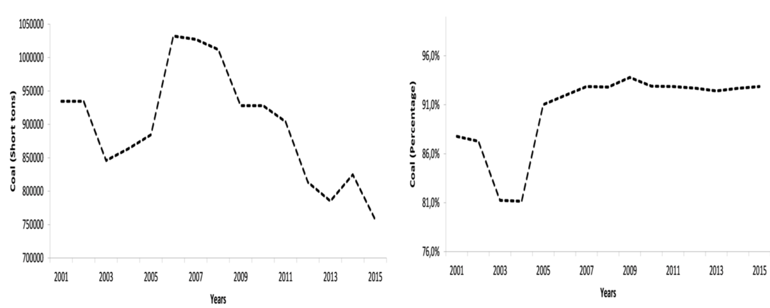
Figure 13. Total coal transportation for each method and their respective ratio to total (short tones and percentages)



and total investment on coal-fired plants decreased. The increasing share of renewables also played an important role. Figure 14 shows the total coal transported to electric power plants between 2001-2015 both in short tons and their percentages.

Figure 14 shows that total coal transported to electric power plants decreases with a slope of -9477 whereas the ratio of total coal transported to electric power plants increases with a slope of 0.0064 as shown

Figure 14. Total coal transportation to electric power plants (a. short tons) (b. percentage)

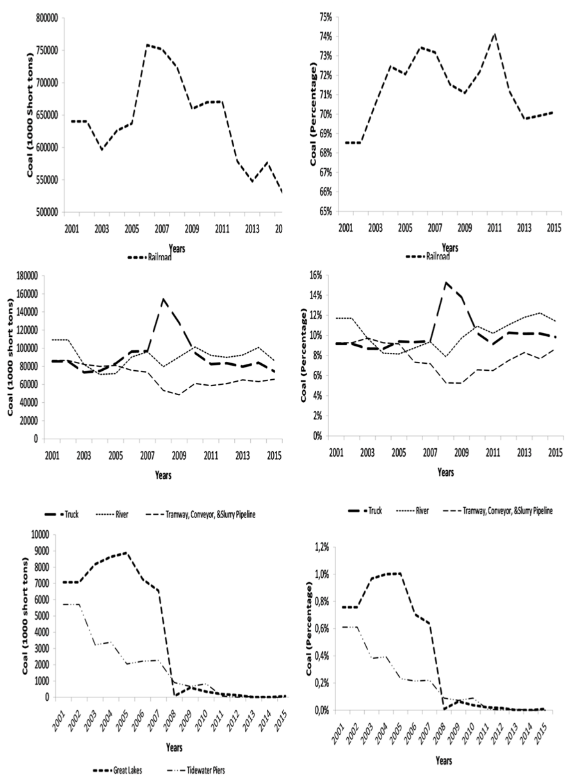


in Figure 14 at the left. It is obvious that there is a sharp decrease starting from 2008 due to increasing coal prices and new regulations imposed on coal-fired power plants for greenhouse gas emissions. The cap and trade program and the number of allowances can be used also play an important role. Figure 15 presents the transportation methods used to transport coal to electric power plants.

The railroad, truck, and river have an average transportation ratio of 71.24%, 10.17% and 10.18% respectively in total transportation to electric power plants. Figures show that truck and river follow the railroad in total coal transportation ratio. The total coal transportation ratio of the railroad, truck, and river to electric power plants has an increasing trend with a slope of 0.00043, 0.001 and 0.0012 respectively. On the other hand, the truck has a slightly increasing trend in terms of tones transported whereas all other methods have decreasing trends. The coal-fired power plants are usually located to destinations where they have access to railways. Some power plants prefer rivers and they use barges to transport coal. The decreasing demand for coal from power plants also affects the utilization of railroads and river transportation.

The average share of transportation by tramway, conveyor & slurry pipeline, great lakes and tidewater piers are 7.8%, 0.4%, and 0.2% respectively. When the figures are analyzed a decreasing trend is observed with a slope of -0.0014, -0.0008, and -0.0004 for tramway, conveyor & slurry pipeline, great lakes and tidewater piers respectively. Electric power plants can operate using limited number of coal types. The

Figure 15. Total coal transportation for each method and their respective ratio (short tones and percentages)



location of the power plant and coal resource, the type of coal and cost has to be analyzed for a better explanation. It is observed that tramway, conveyor & slurry pipeline, great lakes and tidewater piers are not preferred as much as railroad, truck, and river and in it will continue in this way in the long run.

Transportation to Industrial Plants Excluding Coal-Fired Power Plants

Industrial plants excluding coal power plants are the second largest coal consuming industry in the USA. However, the consumption in industrial plants also effected from the environmental regulations and extra cost imposed from the greenhouse gas emissions. Figure 16 show the total coal transported to industrial plants between 2001-2015 both in short tons and their percentages.

There is a decreasing trend both for the total transportation and for the percentage with a trend value of -7056 and -0.00589 respectively. The industrial plants excluding coal plants impacted from the technological advancement and pressure for coal consumption. Hence the total coal transported to industrial plants is decreasing in long run. Figure 17 presents the transportation methods used to transport coal to industrial plants.

The average transportation ratio of railroad, truck and river are %69, %12 and %11 respectively in total transportation to industrial plants. The total coal transportation ratio of railroad and river to industrial plants has an increasing trend with a slope of 0.0025 and 0.0017 respectively whereas the river has a decreasing trend of -0.0003. All the transportation modes have a decreasing trend in terms of total tones transported. It is obvious that industrial plants heavily prefer railroad for coal transportation and other methods have smaller shares.

Transportation by tramway, conveyor & slurry pipeline has an average ratio of 8% whereas great lakes and tidewater piers have an average close to 0%. When the figures are analyzed decreasing trends are observed for tramway, conveyor & slurry pipeline, great lakes and tidewater piers respectively. The locations of the industrial plants are more diverse than the Electric power plants and it is more difficult to comment on the change. However, it is also true that tramway, conveyor & slurry pipeline, great lakes and tidewater piers are not preferred as much as railroad, truck, and river and it will continue in this way in the short run.

Figure 16. Total coal transportation to industrial plants (a.short tons) (b. percentage)

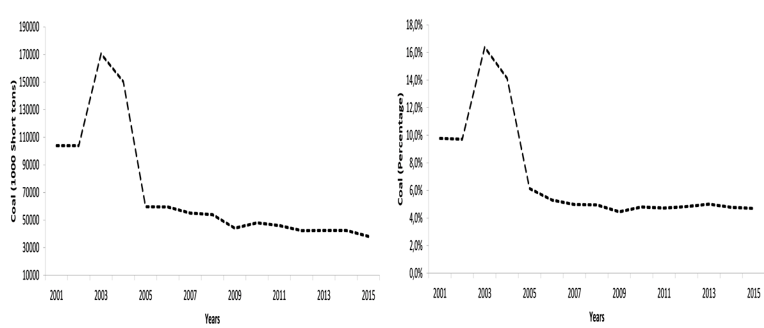
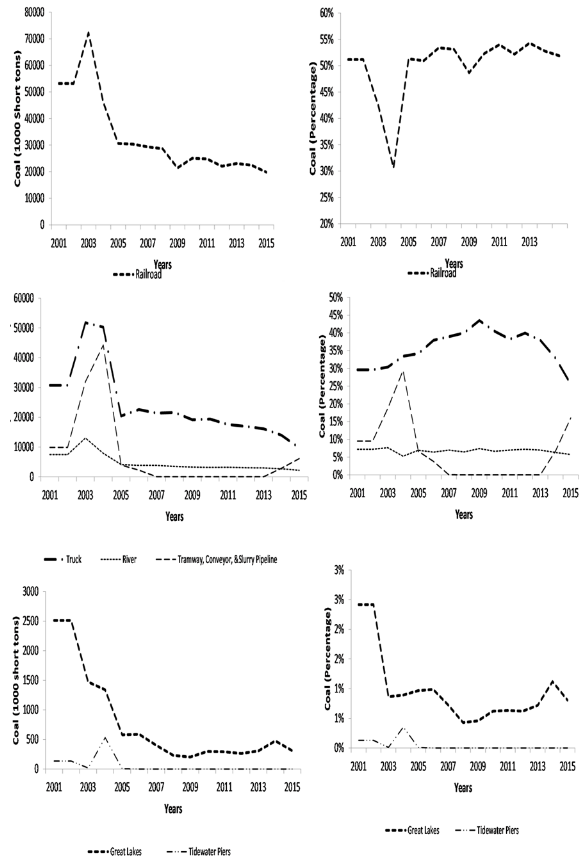


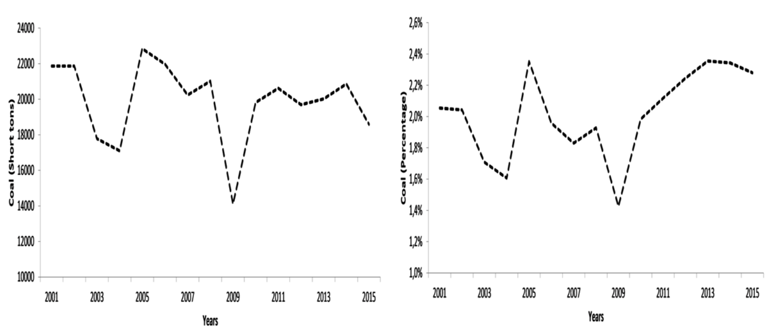
Figure 17. Total coal transportation for each method and their respective ratio (short tones and percentages)



Transportation to Coke Plants

Coke plants are the third largest coal consuming industry in the USA with an average share of 2%. Figure 18 shows the total coal transported to coke plants between 2001-2015 both in short tons and their percentages in total transportation.

Figure 18. Total coal transportation to coke plants (a.short tons) (b.percentage)



The total coal transportation to coke plants has a decreasing trend value whereas an increasing trend is observed in its percentage with -88 and 0.0003 respectively. It is true that the total transportation is decreasing and its ratio to total is slightly increasing in the long run. It is obvious that the decrease in transportation to coke plants is less than that of total coal transportation and as a result, an increasing but misleading ratio is observed. Figure 19 presents the transportation methods used to transport coal to coke plants.

The railroad, truck, and river have an average transportation ratio of %44.4, %6.26 and %35.7 respectively in total transportation to coke plants. The total coal transportation ratio of the river to coke plants has an increasing trend with a slope of 0.013. On the other hand, the railroad, truck and Great lakes have decreasing trends with slopes of -0.00952, -0.0012 and -0.0036 respectively. Great lakes have an average of 3.90% and tramway, conveyor & slurry pipeline has an average of 2.44% with a negative slope. The railroad and river are the main transportation methods and the demand for river-based transportation is increasing.

Transportation to Commercial Institutions

Commercial institutions are the fourth largest coal consuming industry in the USA. Figure 20 shows the total coal transported to commercial institutions between 2001-2015 both in short tons and their percentages in total transportation.

Figure 20 shows that transportation to commercial institutions has decreasing trends with -277 and -0.0023 respectively at the right and left. The data shows that like industrial plants, the total coal transported to commercial institutions is decreasing in the long run both in short tones and in percentage. Figure 21 presents the transportation methods used to transport coal to commercial institutions.

Figure 19. Total coal transportation for each method and their respective ratio (short tones and percentages)

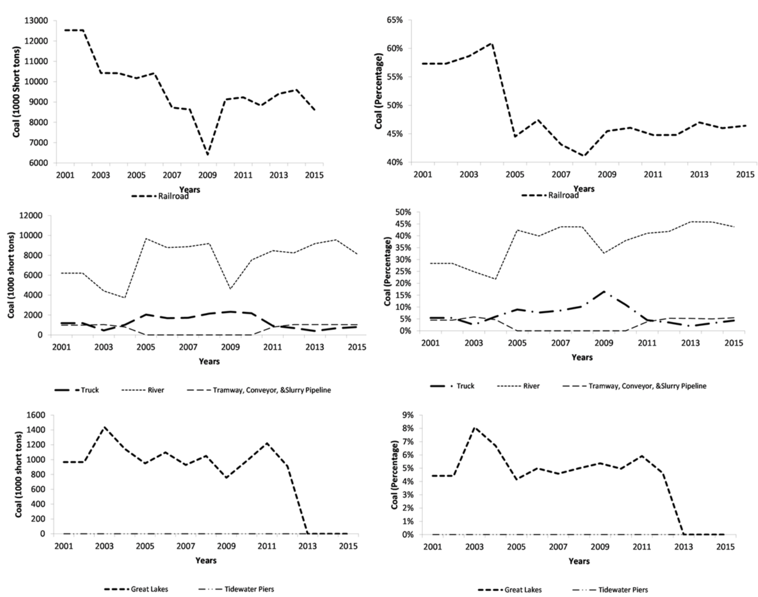


Figure 20. Total coal transportation to commercial institutions (a.short tons) (b.percentage)

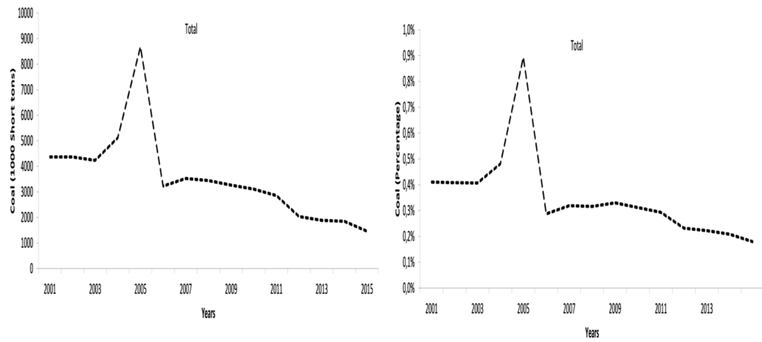
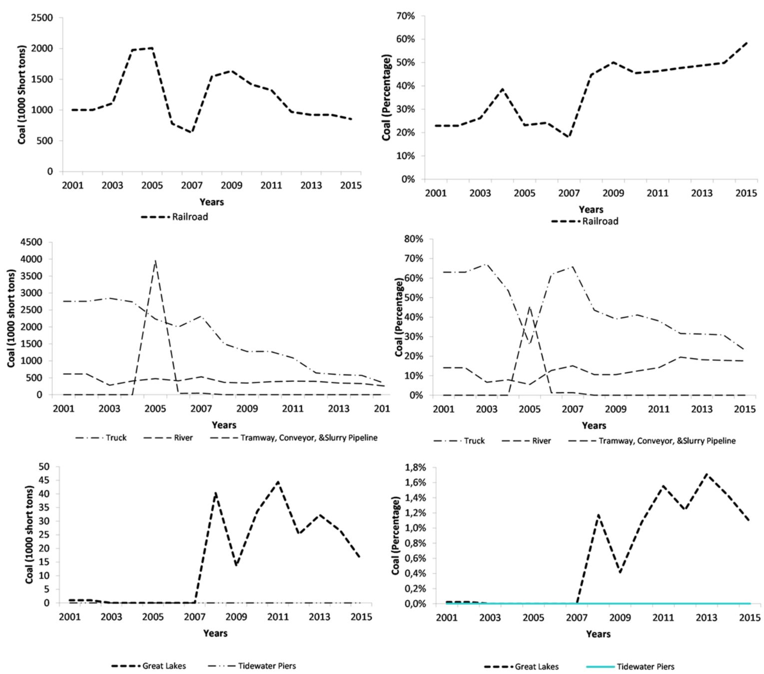


Figure 21. Total coal transportation for each method and their respective ratio (short tones and percentages)



The railroad, truck, and river have an average transportation ratio of 38%, 45% and 13% respectively in total transportation to commercial institutions. The total coal transportation ratio of railroad and river has an increasing trend with a slope of 0.025 and 0.006 respectively where the truck has a decreasing trend with a slope of -0.027. All the transportation modes have a decreasing trend in terms of tones transported whereas Great lakes has a slightly increasing trend.

The amount of total coal transported to the commercial institutions is low with an average of 0.37% in total. Tramway, conveyor & slurry pipeline, great lakes and tidewater piers have values close 0%. The situation of the commercial plants is similar to that of the industrial plants in which many determining factors might come into play. The railroad, truck, and river have the largest share respectively comparing to other methods.

DISCUSSION

It is obvious that the total coal production, consumption, and transportation decrease over time as can be observed in Figure 11. It is shown that production, consumption, and transportation have trend values of -11907, -18131 and -17477 respectively. Figure 12 provides transportation/production and consumption/production ratios. The ratios show the change for coal transported to local or international destinations over the years. Both of them also have decreasing trend values of around -0.62%. It is shown that the transportation and consumption for produced coal are decreasing and hence an increasing ratio of coal is consumed within a country. It is shown that the transportation and consumption for produced coal are decreasing that indicates that the ratio of coal, which is consumed in the country, is increasing.

The change in the total coal production, consumption and transportation are affecting the transportation methods and the final destinations. We have shown each final destination and the transportation method used for total coal transportation. Table 2 shows the trend values for total coal transported to each final destination and the transportation method. It is shown that trend values for total coal transportation to electric power plants, industrial plants, commercial plants, and coke plants are decreasing. The largest decrease is observed in electric power plants followed by industrial plants. There are some small positive trend values in river transportation to coke plants, truck transportation to electric power plants, tramway transportation to coke plants, ocean vessel transportation to industrial plants and great lakes to commercial institutions. However, they represent small amounts compared to total coal transportation

All of the values except in truck transportation to electric power plants, tramway transportation to coke plants, ocean vessel transportation to industrial plants and great lakes to commercial institutions are statistically significant with 5% confidence level. It is also interesting to analyze the percentages as they show the change in demand in each destination. Table 3 shows the trend values for percentages. It is shown that trend values for percentage of total coal transported to electric power plants is 0.64%. Even if the total transportation is decreasing, the decrease amounts to other sectors are more than that of electric power plants. The same can be told for the total railroad transportation to electric power plants and hence the trend values are positive.

Table 2. Trend values for the coal transportation methods and destinations (s.tones)

Transportation method	Final Destination				
	Total	Electric Power Sector	Industrial Plants	Coke Plants	Commercial institutions
Railroad	-9349	-6256	-2841	-229	-22
Truck	-2274	15	-2058	-33	-198
River	-307	-23	-501	233	-16
Great Lakes	-969	-758	-141	-72	3
Tidewater Piers	-421	-407	-14	0	0
Tramway, Conveyor,SP	-3521	-2030	-1505	14	-43
Ocean vessel	4	0	4	0	0
Unknown	-795	-18	0	0	0
Total		-9477	-7056	-88	-277

Table 3. Trend values for the coal percentages of the transportation methods and destinations (%)

Transportation method	Final Destination				
	Total	Electric Power Sector	Industrial Plants	Coke Plants	Commercial institutions
Railroad	0,26	0,04	0,59	-0,95	2,51
Truck	-0,03	0,11	0,28	-0,12	-2,75
River	0,17	0,12	-0,04	1,35	0,62
Great Lakes	-0,09	-0,08	-0,08	-0,36	0,13
Tidewater Piers	-0,04	-0,04	-0,01	0,00	0,00
Tramway, Conveyor, &Sl.P.	-0,20	-0,14	-0,75	0,07	-0,50
Ocean vessel	0,00	0,00	0,01	0,00	0,00
Unknown	-0,08	0,00	0,00	0,00	0,00
Total		0,64	-0,59	0,03	-0,02

The truck transportation to electric power plants and industrial plants, river transportation to electric power plants, commercial institutions and coke plants also have increasing trend values. Although they do not have high amounts, the trend values of great lakes to commercial institutions, tramway to coke plants and ocean vessel to industrial plants have rising trend values. The difference for the trend values of total coal transportation and their percentages can be explained with the demand change in each industry. If the change in total coal transportation to final destinations is more or less than the change in total coal transportation, conflicting values are observed.

One can observe that the demand for total coal is decreasing. The share of the renewables in total electricity generation increases and the coal fired power plants are under the pressure of emission regulations. As a result, the cost of generation for electricity is increasing for coal fired power plants. They are not dispatched in the power market as they used to be. Some coal fired power plants are retired and new investment for coal plants do not appeal investor. The decrease in coal demand by electric power plants both in total demand and percentage reflect this demand change. Same is true for industrial plants, coke plants, and commercial institutions. The coal consumption brings liabilities for the emission outputs and extra cost. It is shown that total coal transportation to industrial plants, coke plants, and commercial institutions are decreasing. The differences in the percentages are due to the fact that the decrease rate to each sector is different resulting some positive and negative percentage values. Railroad is the most preferred transportation method followed by tramway, conveyor, SP and truck. It is shown that railroad increases its share comparing to other methods in terms of percentage because it has the capacity to transport large amount of coal to longer distances.

CONCLUSION

The coal has been an important primary energy source throughout the centuries. The mining, handling, logistics, and transportation of the coal were challenging activities that require extensive analysis. In this paper, we first focused on the total coal supply and demand in international markets. The countries with the largest coal reserves USA, Russia, China, India, and Australia, which are sorted based on their reserve size, have around 75% of all reserve. On the other hand, Indonesia, Australia, Russia, Colombia, and South Africa, which are sorted, based on their trade size, make 98% of all the seaborne trade. We have shown that the share of coal transportation in international trade, the exported and imported coal do increase. The share of each coal type transported by sea also presented and it is shown that almost 89% of the international coal transportation is sea-based. In terms of logistics, international vessels and ships are widely used and there is a growing trend to use ships for coal transportation. It is interesting to analyze the export ratio per produced coal and import ratio per consumed coal. We have shown that although these ratios span within the range of 14-17%, the export per production has a higher ratio. We have also analyzed the ratio of coal that is produced and transported to another location and the ratio of coal that is produced and consumed over the years. We have shown that in average 92% of coal is produced and transported to another location or consumed.

Then the coal transportation in US Coal market was analyzed in details. A trend analysis was applied to total coal logistics by each method such as truck, railroad, river, great lakes, tramway, conveyor and ocean vessel. The same method was applied for the coal transported to electric power plants, industrial plants, coke plants, and commercial institutions. It is shown that despite the increasing trend in international markets for coal, the trend for coal demand and transportation is usually decreasing in USA. This decreasing trend can be observed in terms of total transportation and the percentage of transportation to each sector. In terms of transportation methods, the railroad has been and is the most preferred way of transportation however, the amount of coal that is transported with railroad is decreasing as the total demand for coal is decreasing.

REFERENCES

Ash, L., & Waters, C. D. J. (1991). Simulating the transport of coal across Canada - Strategic route planning. *The Journal of the Operational Research Society*, *42*(3), 195–203.

Bascetin, A., & Kesimal, A. (1999). The study of a fuzzy set theory for the selection of an optimum coal transportation system from pit to the power plant. *International Journal of Surface Mining*, *Reclamation, and Environment*, *13*(3), 97–101.

Berlin Forum COAL Working Group Meeting. (2006). Brussels.

Bistline, J., & Rai, V. (2010). The role of carbon capture technologies in greenhouse gas emissions-reduction models: A parametric study for the U.S. power sector. *Energy Policy*, *38*(2), 1177–1191. doi:10.1016/j.enpol.2009.11.008

BP statistical review of world energy. (2013). Retrieved from http://www.bp.com/content/dam/bp/pdf/statisticalreview/statistical_review_of_world_energy_2013.pdf

Chang, C.-H., Miles, R. D., & Sinha, K. C. (1981). A regional network optimization model for coal transportation. *Transportation Research Part B: Methodological*, *15*(4), 227–238. doi:10.1016/0191-2615(81)90009-6

Coal sector report, Turkish coal institute. (2014). Retrieved from http://www.taskomuru.gov.tr/file//duyuru/TTKGM_Sektor_Raporu_2016.PDF

Directive 2001/81/EC of the European Parliament and of the Council. Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:309:0022:0030:EN:PDF

EIA. International Energy Outlook, Energy Information Administration report, USA. (2009). Available at http://www.eia.doe.gov/oiaf/ieo/electricity.html

EIA. (2017). Retrieved from https://www.eia.gov/outlooks/ieo/table4-3.php

EU climate action. Retrieved from http://ec.europa.eu/climateaction/eu_action/index_en.htm

EU Emission Trading Scheme website. Retrieved from http://ec.europa.eu/environment/climat/emission/index_en.htm

EU. The market for solid fuels in the community in 2007 and the Outlook for 2008, Commission of the European Communities Working Document, 2009. Retrieved from http://ec.europa.eu/energy/observatory/coal/report_solid_fuels_market_eu_en.htm

Golombek, R., Kittelsen, S. A., & Maestad, O. 2005. Coal transport demand in Western Europe and Japan: Imports of energy market liberalisation and climate policy. Working paper, Center of International Economics and Shipping, Bergen, Norway.

Kaplan, S. M. (2007). Rail transportation of coal to power plants: Reliability issues, CRS Report for Congress RL34186, Retrieved from http://ncseonline.org/nle/crs/abstract.cfm?NLEid=1916

Kozan, E., & Liu, S. Q. (2012). A demand-responsive decision support system for coal transportation. *Decision Support Systems*, *54*(1), 665–680. doi:10.1016/j.dss.2012.08.012

Lindner, E. (1997). *Chemie für Ingenieure*. Lindner Verlag Karlsruhe.

Liu, C. M. (2008). A Blending and Inter-Modal Transportation Model for the Coal Distribution Problem. *International Journal of Operations Research*, *5*(2), 107–116.

McCollum, D. L. (2007). Future Impacts of Coal Distribution Constraints on Coal Cost, Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-07-26, 2007.

Osleeb, J. P., & Ratick, S. J. (1983). A mixed integer and multiple objective programming model to analyze coal handling in New England. *European Journal of Operational Research*, *12*(3), 302–313. doi:10.1016/0377-2217(83)90200-X

Osleeb, J. P., Ratick, S. J., Buckley, P., Lee, K., & Kuby, M. (1986). Evaluating dredging and offshore loading locations for U.S. coal exports using the local logistics system. *Annals of Operations Research*, *6*(6), 161–180. doi:10.1007/BF02026823

Schneider, T.H., (2006). The future of coal-fired power generation in Europe,

Sherali, H. D., & Puri, R. (1993). Models for a coal blending and distribution problem. *Omega*, *21*(2), 235–243. doi:10.1016/0305-0483(93)90056-Q

Shih, L. H. (1997). Planning of fuel coal imports using a mixed integer programming method. *International Journal of Production Economics*, *51*(3), 243–249. doi:10.1016/S0925-5273(97)00078-9

Statistics, C. World Coal Association. (2014). Available at http://www.worldcoal.org/resources/coal-statistics/

Tu, H., & Guldmann, J. M. (2001). GIS in Coal Transportation Modeling: Case Study of Ohio, *Geographic*. *Information Sciences*, *7*(1), 24–34.

UNCTAD, Review of Maritime Transport, United Nations Publications, 2015, Ref: UNCTAD/RMT/2015 Retrieved from http://unctad.org/en/PublicationsLibrary/rmt2015_en.pdf

Wallin, T. O., Mills, J. C. Jr, & Kidder, A. (1988). Transport barriers to the expansion of United States exports of bulk commodities: A ten-year perspective with focus on coal foreign summaries. *Transport Reviews*, *8*(4), 301–315. doi:10.1080/01441648808716695

Whittington, H. W., & Bellhouse, G. M. (2000). Coal-fired generation in a privatized electricity supply industry. *International Journal of Electrical Power & Energy Systems*, *22*(3), 205–212. doi:10.1016/S0142-0615(99)00047-2

Whyatt, J. D., & Metcafle, S. E. (2004). Optimising the environmental benefits of emission reductions from UK coal- and oil-fired power stations: A critical loads approach. *Environmental Science & Policy*, *7*(6), 451–463. doi:10.1016/j.envsci.2004.08.001

Zhao, G. Z., Wang, F., & Zhang, Z. Y. (2008). The Complexity of Coal Logistics Network Analysis and Optimization Method Research. *Techniques and Approaches*, *27*, 117–119.

KEY TERMS AND DEFINITIONS

Coal Production and Consumption: The coal is produced and processed before it is delivered to the final destination. However, not all of the coal is consumed within a country and it is common to export to coal to other countries. Hence, it is required to analyze the production and consumption separately.

Coal Transportation: The coal is mined, processed and blended before it is carried to its final destination. As it is a bulk commodity, the transportation requires a huge effort and coal transportation refers to steps that are followed to deliver the coal to the desired location.

Slope: A gradient of a line, which is obtained using regression analysis to determine the direction and level of change in long run, based on the past data.

Steam Coal: Sometımes called thermal coal. The coal that ıs used ın power plants and other energy needıng plants.

Trend Analysis: Trend analysis aims to determine the direction of movement of a time series data using past and current data.

US Coal Market: refers to production, transportation, and consumption of coal in the US where the price, demand, and tariffs are determined.

World Coal Market: The coal reserves are distributed around the world and it is exported from the countries with high reserves to buyers. The price, transportation, and distribution are determined based on the international rules and regulations in the world coal market.

Chapter 15
The Place of High Speed Crafts (HSCs) in Maritime Transportation

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ABSTRACT

Transportation involves all concepts of distance, speed, and time. Maritime transportation is one of the oldest methods of transportation. Continuous demand for high speed in shipping has led to the emergence of High Speed Craft (HSC). The growing number of HSCs has necessitated the development of new safety concepts for such vessels and waters where they navigate. The navigation on HSC requires great/high attention. Safety of navigation is very important for preventing accidents and marine pollutions. The main causes of accidents in HSCs are related to bridge personnel and bridge operations. It is observed that human factor and safety of navigation are prominent.

INTRODUCTION

Transportation systems have been evolving for centuries in accordance with the technology. Speed is very important and affects distance-time values of transportation. The revolutionary means that technology provides to transportation is *speed*. Continuous demand for high speed in shipping has led to the emergence of HSC.

This chapter aims to reveal the place and the importance of HSCs in the maritime transportation. For this purpose, the authors will describe maritime transportation, speed, types of HSC, international regulations about HSC, navigation on HSC and HSC accidents in order.

DOI: 10.4018/978-1-7998-1397-2.ch015

BACKGROUND

HSC with new technologies and advantages has started to be seen more and more in maritime transport. The common features of HSCs are comfort, safety, loading-unloading-cruising speed, lightweight construction, peculiar design, and advanced technology (Garbatov, Rudan, & Guedes Soares, 2010; Okasha, Frangopol, Saydam, & Salvino, 2011). It is considered that the number of such vessels will increase (Yousefi, Shafaghat, & Shakeri, 2013).

MARITIME TRANSPORTATION

Transportation involves the activities for cargo and passengers to reach the destination at the possible lowest cost both in time and when they are needed (Bullock, Haddow, & Coppola, 2018; Gudehus & Kotzab, 2012, p. 623). Transportation is one of economic, social, cultural, political, military, geographical, psychological, and environmental fundamental blocks that affects the society continuously (García-Olivares, Solé, & Osychenko, 2018). It has a central role in healthy and sustainable community (Watkins, 2018). Transport activities are as old as the history of mankind and have always been a part of life (Grazia Speranza, 2018). Societies that carry out these activities well have always been one step ahead of others. The use of wheel in pictures about the development of civilization and the fact that locomotive is one of symbols of the Industrial Revolution show how important transportation is for humanity (Kılcı, 2017).

Transportation is a strategic sector consisting of demand and supply components (Teodorović & Janić, 2017). It shapes the economy with its role in the production of goods and services (Çancı & Güngören, 2013). Transportation plays critical and key role in logistics management. Improvements in transportation make a big difference in country trade volume by providing competitive advantage (Kherbash & Mocan, 2015); disruptions damage the economy (Kara & Ciğerlioğlu, 2018). Therefore transportation field is one of important and decisive dynamics in economic development and improvement (Vickerman, 2018). From another point of view, transportation is vital in accessing catastrophe areas after natural disasters for providing assistance and evacuating people (Edrissi, Nourinejad, & Roorda, 2015). The need for transportation is indispensable and escalates every year (Sumalee & Ho, 2018). Types of transportation system according to the environment and the technology used are (Baykal, 2012, p. 1); roadway, railway, waterway (maritime), airline, and pipeline (Çancı & Erdal, 2003, p. 25).

About 71% of the world is covered with water (Rodrigue, 2017). People have been inspired by floating tree pieces on the water (Baykal, 2011, p. 2; Rossi & Russo, 2017, p. 217). They have used the lifting force of water since the Stone Age for various purposes, such as going somewhere to find food and gaining advantage in war (Drobetz & Johns, 2018).

Sea is a kind of water mass. Sea and sea related activities have always been in the forefront of the development of humanity and the increase in the level of prosperity (Cleveland & Morris, 2014; Fernández-Macho, González, & Virto, 2016). Great civilizations were generally established and developed on the coasts where maritime trade and transportation were intense (Arı, 2014). Therefore marine civilizations have a special place in the history of world (Gürdeniz, 2015, p. 427). Today, approximately 40% of the world's population lives within 100 km of the coasts (United Nations, 2017). Sea areas, called "Blue Homeland" (Ertürk, 2018; Gürdeniz, 2015, p. 13), have provided economic, political, military benefits and continue to provide them (Gürdeniz, 2013, p. 31). Maritime trading activities are increasing rapidly and dynamically (Chintoan-Uta & Silva, 2017).

Maritime transportation is one of the oldest methods of transportation (Mandal, 2017, p. 2) which may be considered as the backbone of globalizing world trade (Ernstsen & Nazir, 2018) with influential and dominant role (Fan, Zhang, & Yin, 2018). It is very important for the economy of many countries (Veneti, Makrygiorgos, Konstantopoulos, Pantziou, & Vetsikas, 2017) and a key element for various activities in sustainable economy for the future (Brouer, Karsten, & Pisinger, 2017). It has different features from other industries in terms of the environment and the tools used (Alexandridis, Kavussanos, Kim, Tsouknidis, & Visvikis, 2018). Maritime transportation system is efficient (Deligiannis, 2017), cost effective (Baykal, 2012, p. 4; Çancı & Erdal, 2003, p. 26), wide handling voluminous (Köseoğlu, 2015), easy customs procedures-border crossings (Kutluk, 2018), widespread (Chi, Pedrielli, Ng, Kister, & Bressan, 2018), environmentally friendly (Fagerholt, Gausel, Rakke, & Psaraftis, 2015), safe, and secure (Jercea, 2012).

Remarkable progress has been observed in the maritime transportation which is the backbone of the transportation sector. By means of maritime transportation more than 80% as tonnage and 70% as value of freight in global trade is transported 24 hours a day and 365 days a year (UNCTAD, 2017, p. x, 2018, p. 4). In 2017, the amount of maritime transportation in world transport activities was 11.6 billion tons with a share of 85% (İMEAK Chamber of Shipping, 2018a, p. 10). This amount is expected to reach 15 billion tons in 2035 (Shipyards' & Maritime Equipment Association, 2017, p. 15).

SPEED

The concept of speed is often associated with negative cases such as increasing the probability of accidents in traffic, aggravating the consequences of these accidents, bringing death, and impacts on energy consumption-environment (Cetin, Yilmaz, & Erkan, 2018; Köksal, 2013). Other examples supporting this attitude are fast thinking action bringing risks and going fast in human relations causing frustration.

Nevertheless, speed has become one of the most needed and demanded requirements in today's societies. Speed is progressively essential in social, cultural, economic relations (A. Nas, 2017) and has shaped the human interactions (Czarniawska, 2013). Speed is the passion of people. It is a decisive force that has penetrated every aspect of life. It has been studied many times (Choudhary, Imprialou, Velaga, & Choudhary, 2018). It is the perpetual property of the human mobility, and functionality of it in the life has developed day after day (Berry, Johnson, & Porter, 2011). Today, it has become one of the concepts that are highlighted and the necessity is emphasized at every opportunity.

A simple but crucial indication of speed is that surviving in wild life and in ancient times depends on it. Examples about importance of speed are necessity of quick answering in exams, effect of transport platforms' increasing speeds on humanity's age jump, and improving the quality of life by fast technology that makes living easier. Globalization of technology, companies that may respond to customers' needs immediately to be successful, and spread of "time is money" sense may be other examples (A. Nas, 2017; Sarıer, 2016). It is a time when systems and services are changing very fast (Witolla, Sames, & Greig, 2016).

In maritime, the unit of speed is "knot (kn)". 1 knot is the distance traveled in nautical miles in 1 hour. 1 nautical mile is 1.852 m. Therefore 1 kn equals 1.852 m/h (Küçükşahin, 2003, p. 592). Log and Global Navigation Satellite System (GNSS) are used in speed measurement on ships (Hobbs, 1981, p. 115).

Speed affects distance and time values. Transportation sector which is distinct in understanding the importance of speed includes all concepts of distance, speed, and time. Common purpose of whole maritime stakeholders is to be able to get more distance in less time by more speed.

HIGH SPEED CRAFT (HSC)

Transportation systems have been evolving for centuries in accordance with the technology (Pagliara, Mauriello, & Garofalo, 2017). One of the transportation aims is to minimize the total transport time (Rani & Gulati, 2017). In order to achieve this goal, the revolutionary means that technology provides to individuals is speed. Speed is the most critical factor taken into consideration in the selection of transport routes and systems in order to reduce the cost factor due to time and to increase the competitiveness. Thanks to high speed, rapid delivery of goods and services to the demanders provides the development of many industrial branches and the increase of employment (Nævestad, Hesjevoll, & Phillips, 2018). Shorter travel times bring social and economic benefits to individuals (Giuffrida, Ignaccolo, Inturri, Rofè, & Calabrò, 2017). Therefore faster transportation system is preferred as a priority (Çancı & Güngören, 2013). High speed in transportation has become beneficial and desirable feature ((Ato) Xu, Zhou, Yang, & Li, 2018). Delays due to speed may adversely affect a wide area depending on the transport network.

From the seafaring times of the 1700s to the present day, labor and money need in order to make transportation as fast as possible shows how important the speed increment is in the shipping (Yun & Bliault, 2012, p. 1). In recent years, the need for higher speed in all aspects of maritime which have great evolutions in every field (Jurdzinski, 2018) has come to the forefront with the growth of world trade. Speed is a major key variable in expressing maritime service quality (Cullinane, 2012). It may directly or indirectly affect the number-size of ships and transportation costs.

High speed is one of the important factors for reaching the port and completing the transport contract as soon as possible (Aydin, Lee, & Mansouri, 2017). The benefits of high speed are more noticeable in long-range navigation. These benefits include reducing costs and increasing trade volume per unit time. Ship's port and cruising time periods have been shortened thanks to the boosted speed with new technologies used both in loading-unloading operations and deck-machine departments. In this way, high quality and timely transportation is done from door to door (Wen, Pacino, Kontovas, & Psaraftis, 2017). Perishable loads are delivered to the consignees at the earliest (Dulebenets & Ozguven, 2017). Ports serve ship firstly which arrives firstly. In this context, high speed navigation offers advantages (Alvarez, Longva, & Engebrethsen, 2010).

Continuous demand for high speed in shipping, in particular to ensure increment short-distance sea transportation's competitiveness and proportion to other types of transport, has led to the emergence of HSC (Baykal, 2011, p. 23; Papanikolaou, 2005). HSC is a vessel capable of maximum speed equal to or exceeding $3{,}7x\nabla^{0{,}1667}$ m/s ($7{,}19x\nabla^{0{,}1667}$ kn) where ∇ is volume of displacement corresponding to the design waterline in unit of m^3 (International Maritime Organization, 2014; The Maritime and Coastguard Agency, 2008). This value is approximately 20 kn and above (de Melo Rodriguez, Echevarrieta, & Serra, 2015).

THE DEVELOPMENT OF HSC

Passengers and cargo transport between ports with all possible dispatch is a supply-demand (Bendall & Stent, 2001) and critical competition factor (Fang & Chan, 2007). For this reason, HSC is a type of ship that has heightened attention and growing number in shipping (Mousaviraad, Wang, & Stern, 2015), also is rapidly developing in maritime domain (Varyani, Gatiganti, & Gerigk, 2000). HSC is an important component of intermodal transport due to flexibility, cost, time efficiency, and high speed (Antão & Soares, 2003). HSC with new technologies and advantages has started to be seen more and more in maritime transport, search and rescue operations, military ship types, and sports-leisure boats (Magoga, Aksus, Cannon, Ojeda, & Thomas, 2017). Although today's economic-environmental conditions demand reduction in fuel consumption and harmful gas emission, the development of hull-propulsion systems and the need for alternative modern means of transport will enable HSCs to continue their existence in the coming years (Garme, Rosén, Stenius, & Kuttenkeuler, 2014; Yun & Bliault, 2012, p. v).

The common features of HSCs are comfort, safety, loading-unloading-cruising speed, lightweight construction, peculiar design, and advanced technology (Garbatov et al., 2010; Okasha et al., 2011). HSCs' cruise distances are variable and transport time intervals are short. In this way, high cost end products are transported faster and more frequently (Tupper, 2013a). HSCs' size, speed, maneuverability, durability, and performance increase as time progresses (American Bureau of Shipping, 2003, p. 1). They may provide the comfort of passengers and the safety of cargo even in adverse weather and sea conditions (Tezdogan, Incecik, & Turan, 2014).

HSCs have emerged as a result of efforts to build a stable, strong, safe, reliable, comfortable, economical, environmentally friendly, and fast marine vessel (Ghassemi, 2009). First researches on HSCs were conducted on the aircrafts that may also be used at sea nearly a century ago (Stout, 1950; Tavakoli Dakhrabadi & Seif, 2018). In the following years, studies focused on boats that slide on water (S. Wang, Su, Zhang, & Yang, 2012). Studies on HSCs are carried out in a wide range of subjects ranging from sport boats to warships (Talaat, Hafez, & Banawan, 2017).

The first hydrofoil was built in 1905 (Moraes, Vasconcellos, & Latorre, 2004). However cargo and passenger transportation with HSC was made for the first time with the hydrofoil named "Freccia del Sole (Arrow of the Sun)" in Italy in 1957 (Antão & Soares, 2008). Thus, HSCs were used for commercial and military purposes (Payne, 1997). After this date, great efforts have been made to improve hydrofoil and Air Cushion Vehicle (ACV) in particular. In the 1960s, ACV that could carry 254 passengers and 30 vehicles from Dover to Calais in the English Channel at a speed of 65 kn and hydrofoil that could carry 260 passengers from Hong Kong to Macau in the South China Sea at a speed of 42 kn were seen (AIMU Technical Services Committee, n.d.). In the 1980s and 1990s, dimensions, carrying capacities, and operational areas of HSCs increased significantly (Eyres & Bruce, 2012); monohull and catamaran HSCs have started voyages (Hareide, Mjelde, Glomsvoll, & Ostnes, 2017). Catamaran which carries 1024 passengers and 150 vehicles from Buenos Aires to Montevideo in the Argentine Sea at a speed of 58 kn (Daily Mail Online, 2013) or catamaran which carries 1192 passengers and 213 vehicles from Istanbul to Bursa in the Sea of Marmara at a speed of 35 kn (Istanbul Fast Ferries Co.Inc., 2018) can be cited as examples of today's HSCs. The fact that HSCs can be built in Europe and Australia in a short period of time (Pustoshnyi, 2013) in line with the growing demand diversifies these examples (Tiao, 2010). HSCs which can carry more passengers and cargo more rapidly will be seen in the coming years (Khedmati & Keivanfar, 2010).

In 2018, the number of ships was 283.209 worldwide and the number of HSCs was 4.049 with rate of 1,4% (MarineTraffic, 2018). For the same period, there were 1.132 ships in the Turkish Merchant Fleet. Among these, the number of HSCs was 42 with rate of 3.7% (İMEAK Chamber of Shipping, 2018b; MarineTraffic, 2018). It is considered that the number of such boats will increase (Yousefi et al., 2013) as a result of the continuous interest in the HSCs (Torsvik, 2009). According to number of HSC, top five countries are America, China, Russia, Italy, and Norway. In this list, Turkey ranks tenth (Fast Ferry International, 2018).

TYPES OF HSC

Two most important goals taken into account during the design of the vessels are to boost the speed and the amount of cargo with limited engine power. In this context, growing concern in HSC has enabled the development of various hull forms (Seo et al., 2016). HSCs are supported by force of buoyancy at low speeds. They utilize aerodynamic forces and hydrodynamic structures to increase speed and to reduce water resistance at high speeds (Bari & Matveev, 2016). They are in various designs and sizes (Reza Kohansal & Ghassemi, 2010). Their drafts are less than their width (Tuck, 1990). They are used for many different purposes from sport activities to military areas (Tavakoli, Najafi, Amini, & Dashtimanesh, 2018). HSCs are divided into two categories: air supported and displacement (AIMU Technical Services Committee, n.d.).

Air Supported HSC

Types of air supported HSC are; ACV, Surface Effect Ship (SES), and Foil Supported Craft (FSC) (Papanikolaou, 2002).

ACV

ACV is also known as hovercraft. She is fully supported by air buffer and slides close to the surface. Construction and operation characteristics are different compared to other vessels (Zhou, Tang, & Zhang, 2009). The air buffer reduces surface resistance. Hence she may navigate on water and also snowy, icy, muddy, swampy, soft lands, etc. ACV is amphibious (Baykal, 2011, p. 24). Because of this feature, she is used in military areas extensively (Zhao, Shi, Shi, & Bian, 2003). The load and the sea conditions which she may navigate are limited (Papanikolaou, 2002). Her resistance to the wind is low (Rawson & Tupper, 2001).

SES

SES has both an air buffer and a catamaran (twin) body (Esmailian, Farzanegan, Menhaj, & Ghassemi, 2018). Bow-stern air buffers are flexible and twin side bodies are rigid (Savaresi, Bertin, & Bittanti, 2000). SES is not amphibious. Water propellers or jets are used as propulsion system. Machine space requirement is smaller than ACV (García-Espinosa, Di Capua, Serván-Camas, Ubach, & Oñate, 2015). There are two operating modes: catamaran and air cushion catamaran (Basturk & Krstic, 2013). In the air cushion catamaran mode, air buffer lifts approximately 80% of the boat weight (Auestad, Gravdahl, Sørensen, & Espeland, 2013). Thus her draft is less than conventional catamaran (Baykal, 2011, p. 24). Advantages of less draft are that she is able to navigate well stable in various sea-wind conditions and the speed-propulsion power ratio is high (Vamråk, Bua, Hassani, & Auestad, 2016).

FSC

FSC has less transport capacity but is more stable than ACV and SES. She has boat legs in the form of aircraft wings. These legs show more of the wing effect that allows airplanes to take off (Liang & Zong, 2011; Yun & Bliault, 2012, p. 14) and make vessel body to cut off contact with water (Babicz, 2015, p. 302). Therefore performance, speed, stability, and maneuverability of the ship are increased (Djavareshkian & Esmaeili, 2013). FSCs are frequently used for rapid transportation at seas or in shallow waters such as rivers (Xu & Meng, 2016).

One type of FSC is hydrofoil (surface piercing foil). Water resistance decreases (Tupper, 2013b) as the boat rises above her legs in water while she accelerates (Baykal, 2011, p. 23). She has stable hull structure and low fuel consumption (Sequenzia, Rizzuti, Martorelli, & Ingrassia, 2018; Yun & Bliault, 2012, p. 179). The development of design and production materials with the advancement of technology has made it possible for passengers on such boats to travel more comfortably (Ruggiero & Morace, 2018).

The other type of FSC is jetfoil (submerged foil). As she accelerates, the hull loses contact with water (S. H. Kim & Yamato, 2004). Her legs are submerged in all navigation conditions (Marine Insight, 2017). Thence she has good speed, power, and sea endurance (Yun & Bliault, 2012, p. 202).

Displacement HSC

Types of displacement HSC are; monohull, catamaran, trimaran, Small Waterplane Area Twin Hull (SWATH), and Air Lubricated Hull (ALH) (AIMU Technical Services Committee, n.d.).

Monohull

Examples of monohull HSCs may be seen on yachts, ferries, and frigate-style warships (Wei, Li, Yu, & Yi, 2016). She has the ability to work with high speed in different weather conditions thanks to its slim body (F. M. Santos, Temarel, & Guedes Soares, 2009). Their drafts are more than catamarans and trimarans (J. Wang & McOwan, 2000).

Catamaran

Multihull vessels are frequently used (Hajiabadi, Shafaghat, & Kazemi Moghadam, 2018) in various fields (Poundra, Utama, Hardianto, & Suwasono, 2017) and seen as the future of maritime transportation (Bulian & Francescutto, 2008). The development of multihull vessels which have advantages of stability, load, speed, and resistance has started with catamaran (Yanuar, Gunawan, Muhyi, & Jamaluddin, 2016). The demand for catamaran has increased dramatically (Najafi, Aliakbari, & Hashemi, 2018). The catamaran has two symmetrical thin bodies. These bodies reduce water resistance (Babicz, 2015, p. 97). Twin body design with small water surface area creates stable, maneuverable, and large platform at high speeds for passengers-loads (Bari & Matveev, 2017; Tupper, 2013b) and provides superiority over monohull (Farkas, Degiuli, & Martić, 2017). She is effectively and widely used for military and commercial purposes as a result of her high performance (del Águila Ferrandis, Brizzolara, & Chryssostomidis, 2018).

Trimaran

The trimaran has two short bodies one on each side and a long central body connected to them (Kihara, Dobashi, Hibi, & Uemura, 2018). Side bodies increase the stability and reduce the water resistance (Jiang, Sun, Zou, Hu, & Yang, 2017). She is more stable and durable than monohull and catamaran under heavy sea conditions. Her performance is also high (Bennett, 2018). Trimaran offers comfortable, safe, fuel efficient, high speed cruising, and large deck space. Thanks to her unique structure, she has been used frequently in recent years, especially in the transportation of passengers and vehicles (Zong, Sun, & Jiang, 2018). She has also been seen in the design of manned or unmanned military ships widely (Silva et al., 2018).

SWATH

SWATH is a modified form of catamaran design (Liu, Wu, & Guedes Soares, 2018). There are two torpedo-shaped structures connected to the upper body under the waterline (Vernengo & Brizzolara, 2017). The purposes of these structures are to increase buoyancy of the ship and to maintain good stability even in heavy seas (Babicz, 2015, p. 569). SWATH's vibration, noise, and fuel consumption levels are low (Zaghi, Dubbioso, Broglia, & Muscari, 2016). She is comfortable thanks to her special geometric boat shapes (Beena & Subramanian, 2003). She has a wide deck area and remarkable maritime features. SWATH is being built in different varieties and increasing sizes such as passenger, oceanographic research, diving support, military ship types (Guo, Ji, Wen, & Cui, 2017).

ALH

ALH is a planning type water boat, resulting from the efforts (Kumagai, Takahashi, & Murai, 2015) to reduce water friction resistance (Hao & Yongpeng, 2018) and to increase cruise speed, fuel economy, energy efficiency (H. J. Park, Tasaka, & Murai, 2018). In such vessel, methods are to give air bubbles from hull bottom into water, to form a continuous air layer between hull bottom and water or to leave partial cavities filled with air on hull bottom (Butterworth, Atlar, & Shi, 2015; Cucinotta, Nigrelli, & Sfravara, 2017; S. H. Park & Lee, 2018). By cause of air running under the bottom like lubrication (Li, Wu, Ma, & Wang, 2008), amount of water friction is reduced (Yanuar, Waskito, Pratama, Candra, & Rahmat, 2018).

INTERNATIONAL REGULATIONS ABOUT HSC

From the first day of maritime transportation to our time, various ships were involved in accidents by cause of various reasons and casualties-environmental pollutions occurred (Nilsson, Gärling, & Lützhöft, 2009). International Maritime Organization (IMO), with its history dating back to 1948, has adopted the concept of "safe, secure, efficient, good quality, and sustainable shipping on clean seas" as aim and mission in order to prevent marine accidents (International Maritime Organization, 2018e, 2018f, 2018d). In this respect, IMO has implemented a number of reactive and proactive measures such as regulations, training programs, rules, technologies, audits, etc. (Zheng, Talley, Jin, & Ng, 2016).

As speed increases at sea, risks in terms of navigation increase (Antão & Soares, 2003). Growing number of HSCs has necessitated the development of new safety concepts for such vessels and waters where they navigate (Antão & Soares, 2008). It is obvious that miserable results will occur in any accident due to the fact that their displacements are less and their speeds are more than conventional ships. In order to reduce these results, IMO implemented the Code of Safety for Dynamically Supported Craft (DSC Code) in 1977 as a recommendation. The 1977 DSC Code superseded the previous IMO recommendations for such vessels (Hoppe, 2005).

With the development of many HSCs in the 1980s and 1990s, IMO has introduced new international regulations to catch the relevant needs (Gehling, 2007). The International Code of Safety for High Speed Craft (HSC Code) which was developed by the revision of the 1977 DSC Code and a new chapter in International Convention for the Safety of Life at Sea (SOLAS), "Chapter 10-Safety measures for high speed craft", were adopted in 1994. The 1994 HSC Code contains comprehensive, detailed, and mandatory rules including design, construction, stability, training, operation, navigation, safety, security, and repair-maintenance (International Maritime Organization, 2018b).

Due to rapid developments in the HSC sector, IMO has made amendments to SOLAS Chapter 10 and has adopted the 2000 HSC Code in 2000. The 2000 HSC Code has updated the 1994 HSC Code (International Maritime Organization, 2018b).

NAVIGATION ON HSC

The problem of controlling any vessel on water dates back to ancient times (Thomas & Sclavounos, 2007). Navigation is an important concept to overcome this problem. The fundamental elements of navigation are; position, direction, distance, time, and speed (Ertuğrul, 2014, p. 1; Hobbs, 1981, p. 1; Logsdon, 1992, p. 3). The main purpose of navigation is to transport the watercraft safely from one position to another under current circumstances (Haşimoğlu, 2015, p. 1). It includes voyage planning, monitoring, screening, controlling, evaluating, maneuvering, avoiding from hazards, and recording of all voyage data (da Conceição, Dahlman, & Navarro, 2017).

The main control place of navigation on HSC is the bridge at top of the ship. The bridge is equipped with advanced technical systems and devices (Krystosik-Gromadzińska, 2018). Navigating with HSC is dynamic (Olsson & Jansson, 2006), complex (Gould et al., 2009), risky (Bailey, Housley, & Belcher, 2006), high concentration-attention demanding (Leung, Chan, Ng, & Wong, 2006), and high level operation (Hareide et al., 2017). It has its own unique challenges. The primary reason for these difficulties is navigation with high speed (Antão & Soares, 2008; Xue, Clelland, Lee, & Han, 2011) in coastal or restricted waters where sea traffic is increasing every day (H. Wang, Liu, Liu, Zhang, & Wang, 2018) and accidents are seen widely (Uğurlu, Yildirim, & Yuksekyildiz, 2013). Other reasons are the necessity for good maneuverability (Faltinsen, 2006) and the alteration of HSC maneuverability with speed, sea, and weather conditions (D. J. Kim & Kim, 2017; M. Santos, 2014). The navigation on HSC requires great attention also at open sea (Bulian, Francescutto, & Zotti, 2008). Course legs distances, arrival times to wheel over points, limits of cross track errors, determination of navigation hazards, areas that should not be entered, safety depths-contours-heights, navigational aids, tides, decision points for critical maneuvers, emergency situation plans, and ship maneuver characteristics are important in terms of safe and efficient implementation of HSC navigation (International Chamber of Shipping, 2016).

A combination of coastal plotting and electronic navigation is applied in high speed navigation (Pike, 1993). Coastal plotting is a type of navigation which is made by using known land marks, navigational aids or depths (Sügen, 1996, p. 318). Electronic navigation is a type of navigation which is made by using electronic navigational aids (Sügen, 1996, p. 538). Echo Sounder, Log, Auto Pilot, Radio Detection and Ranging (RADAR), Automatic Radar Plotting Aid (ARPA), GNSS, Electronic Chart Display and Information System (ECDIS), Integrated Navigation System (INS), and Integrated Bridge System (IBS) are used.

HSC ACCIDENTS

Seafaring is a distinct type of profession from other professional groups in a number of ways. It has closed loop and hierarchical structure. Works on board are on 24 hours basis 7 days. Ship is the place of both living and working for mariners. The ship is far from the nearest land facility while on sail. The structural dimensions of ships are limited and subject to meteorological conditions. In case of any emergency, the ship's personnel interfere. The crew can be multinational (Håvold, 2005). With the measures taken in the 20th century, the death rate of marine accidents has decreased. However seafaring is still one of the most dangerous and risky professions compared to others (Lu & Tsai, 2010).

Safety is the state of being away from hazards caused by natural forces or human errors randomly (S. Nas, 2015). Safety at sea aims to protect human life and property in addition to prevent injury and environmental pollution. It has been a leading issue for everyone since the Titanic disaster (Luo & Shin, 2016; Yılmaz & Ece, 2017). One of the things to be done to ensure safety at sea is safe navigation (Cho, Han, & Kim, 2018; Yoon, Nguyen, & Nguyen, 2018). Safe navigation means that the ship is not exposed to any hazards and can always be controlled within acceptable limits. Safe navigation requires compliance with rules and procedures as well as good training, well maintained system-equipment, familiarity with used equipment, effective-correct command, movement, control, communication, and management (Sun, Zhang, Liu, & Chen, 2018).

Shipping is a risky sector. Maritime traffic is increasing day by day. Therefore, accidents may occur at sea (Gledić, Parunov, Prebeg, & Ćorak, 2019; G. Zhang, Thai, Yuen, Loh, & Zhou, 2018). Marine accidents affect not only the ships and the employees on those ships, but also the regions where accident occurred and people living in severe and wide range of economic, political, and environmental aspects (Uğurlu, Kum, & Aydoğdu, 2017; L. Wang & Yang, 2018). Today safety of navigation has become more important than ever in terms of preventing marine accidents (Khan, Khan, Veitch, & Yang, 2018). In order to increase the safety of navigation, IMO has introduced several regulations since 1959 (International Maritime Organization, 2018c). The Concentrated Inspection Campaigns (CICs) of 2008 and 2017 applied in Port State Controls (PSCs) were carried out on safety of navigation (Abuja MoU, 2018; Black Sea MoU, 2009, 2018b; Paris MoU, 2018b, 2018c; Tokyo MoU, 2017). In spite of all these measures, safety of navigation category in PSCs is at the top of the deficiency lists (Abuja MoU, 2018; Black Sea MoU, 2018a; Caribbean MoU, 2018; Indian Ocean MoU, 2018; Mediterranean MoU, 2017; Paris MoU, 2018a; Riyadh MoU, 2018; Tokyo MoU, 2018; Vina Del Mar MoU, 2017).

HSCs navigate in coastal or restricted waters where marine traffic is intense. With regard to safety of navigation, the negative conditions for such vessels are decrease of visibility, darkening of air, and wavy seas (Pike, 1993). Navigation safety is often adversely affected as speed increases (Hamzeie, Savolainen, & Gates, 2017). This is because high speed reduces the time required to evaluate the information from environment, to decide, and to maneuver for preventing accident (Tanishita & van Wee, 2017). Navigating on the same line and performing the same maneuvers in the same berths continuously may cause the navigator to feel self-confidence extremely and may be another accident factor in HSC (Louro, Vazquez, & de la Campa, 2012).

4.730 ship accidents occurred between 2004 and 2018. In the same period the number of accidents in HSCs was 23 with rate of 0,4% (International Maritime Organization, 2018a). On vessels, collision and grounding accidents are experienced repeatedly (Gang, Wang, Sun, Zhou, & Zhang, 2016; Hsu, 2015; Marine Accident Investigation Branch, 2018; S. Zhang, Villavicencio, Zhu, & Pedersen, 2017). For the reasons described in the paragraph above, HSCs are also exposed to collision and grounding accidents frequently (Oh, Park, & Kwon, 2016; Orłowski, Bastien, Razmkhah, & McCartan, 2017; W. Wang, Peng, Song, & Zhou, 2015).

In the last few decades, the main causes of accidents have shifted from technical failures to organization, management, culture or human factors (Håvold, 2005). Despite advances in technology (R. Zhang & Furusho, 2016), the human factor remains dominant consideration in marine accidents (Abuelenin, 2017; Uğurlu, Erol, & Başar, 2016; Zong et al., 2018). The main causes of accidents in HSCs are related to bridge personnel and bridge operations. It is observed that human factor and safety of navigation are prominent (Antão & Soares, 2008; International Maritime Organization, 2018g).

FUTURE RESEARCH DIRECTIONS

Mental Work Load (MWL) is the amount of information processing capacity that is used (Eggemeier, 1988). Situational Awareness (SA) is the perception of instant information, the understanding of this information in the direction of person's goals, and the prediction of future events related to the situation (Endsley, 1995). Safety Culture (SC) is the individual-group-organizational attitudes, norms, values, and practices shared by management and staff to ensure that risks are always minimized (Ek, Runefors, & Borell, 2014).

In complex systems, MWL and SA are closely linked concepts (Lin, Hsieh, & Lin, 2013). The increment of automation in systems with developing technology enhances MWL and reduces SA. This causes delays in responding to events (Yin & Zhang, 2013) and also leads to human errors (Lin et al., 2013). The basis of many proposed system changes and implementations is to reduce MWL that occurs when a person performs dynamic and complicated tasks and to increase SA (Vidulich, 2000). It is necessary to ensure SA for safe navigation (International Chamber of Shipping, 2016). In complex advanced technology systems which HSC's bridge can be exemplified, MWL exceeds one's capacity, reduces SA, and induces errors (DiDomenico & Nussbaum, 2011; Eggemeier, 1988). The appropriate level of MWL and SA is essential for the formation of SC (Rodriguez, Lee, & Makic, 2017). In this way, it is also possible to improve SC and to reduce the accident frequency related to human error (Y. G. Kim, Lee, & Seong, 2017).

NASA Task Load Index (NASA-TLX) is one of the most common methods for measuring MWL. The original NASA-TLX has six factors which do not contain that are related to the target evaluation system. For this reason, Revised version of NASA-TLX (RNASA-TLX) was designed in the previous study of the authors. RNASA-TLX and the questionnaire for electronic navigation equipment were carried out with navigators working on different types of ships in different areas whilst navigating, berthing/unberthing, and anchoring. This study explained the fundamental information for understanding the electronic navigation equipment's effect to MWL on the bridge (Kartoğlu & Kum, 2017).

Despite the latest technology and systems, maritime navigation remains a sophisticated task (Last, Kroker, & Linsen, 2017). It had huge advances in technology in past decade and is still under development. Thanks to the developments that improve the safety of navigation, role of the navigator has changed drastically when electronic systems and automation cover all ships. The navigator has become the center of bridge in order to prevent any undesirable situation, to eliminate uncertainty, and to maintain the safety of navigation. As a result of this, navigator must perform increasing number of tasks in shorter periods on the bridge (International Chamber of Shipping, 2016; Kartoğlu & Kum, 2017). In this context; MWL, SA, and SC relationships affecting the navigator on HSC should be examined in future researches in terms of bridge navigation operation. The authors will study about this subject which increases safety and prevents possibility of any accident.

CONCLUSION

Transportation sector which is distinct in understanding the importance of speed includes all concepts of distance, speed, and time. Speed has become one of the most needed and demanded requirements in today's societies. Speed is the most critical factor taken into consideration in the selection of transport routes and systems. Continuous demand for high speed in maritime has led to the emergence of HSC (Baykal, 2011, p. 23; Papanikolaou, 2005).

HSC has emerged as a result of efforts to build a stable, strong, safe, reliable, comfortable, economical, environmentally friendly, and fast marine vessel (Ghassemi, 2009). HSCs with new technologies and advantages have started to be seen more and more in maritime transport, search and rescue operations, military ship types, and sports-leisure boats (Magoga et al., 2017). Studies on HSCs are carried out in a wide range of subjects.

With the development of many HSCs in the 1970s, 1980s, and 1990s, IMO has introduced new international regulations to catch the relevant needs. These international regulations were the 1977 DSC Code, the 1994 HSC Code, and SOLAS Chapter 10. Due to rapid developments in the HSC sector, IMO has made amendments to SOLAS Chapter 10 and has adopted the 2000 HSC Code in 2000.

Seafaring is a distinct type of profession from other professional groups and is still one of the most dangerous-risky professions compared to others. Safety at sea is a crucial issue. One of the things to be done to ensure safety at sea is safe navigation (Cho et al., 2018; Yoon et al., 2018). Today safety of navigation has become more important than ever in terms of preventing marine accidents (Khan et al., 2018).

On vessels, collision and grounding accidents are experienced repeatedly (Gang et al., 2016; Hsu, 2015; Marine Accident Investigation Branch, 2018; S. Zhang et al., 2017). HSCs are also exposed to collision and grounding accidents frequently (Oh et al., 2016; Orłowski et al., 2017; W. Wang et al., 2015). The main causes of accidents in HSCs are related to bridge personnel and bridge operations. It is observed that human factor and safety of navigation are prominent (Antão & Soares, 2008; International Maritime Organization, 2018g).

REFERENCES

Abuelenin, A. H. M. (2017). The impact of shortage implementation of the international regulations on maritime safety. *Cogent Social Sciences*, *3*(1). doi:10.1080/23311886.2017.1335499

Abuja MoU. (2018). *Annual Report 2017*. Retrieved from http://www.abujamou.org/assets/annual_report_2017.pdf

AIMU Technical Services Committee. (n.d.). *High speed craft. AIMU Technical Services Committee Reports*. Retrieved from http://www.aimuedu.org/aimupapers/hsc.pdf

Alexandridis, G., Kavussanos, M. G., Kim, C. Y., Tsouknidis, D. A., & Visvikis, I. D. (2018). A survey of shipping finance research: Setting the future research agenda. *Transportation Research Part E, Logistics and Transportation Review*, *115*(February), 164–212. doi:10.1016/j.tre.2018.04.001

Alvarez, J. F., Longva, T., & Engebrethsen, E. S. (2010). A methodology to assess vessel berthing and speed optimization policies. *Maritime Economics & Logistics*, *12*(4), 327–346. doi:10.1057/mel.2010.11

American Bureau of Shipping. (2003). *Guidance notes on dynamic load approach and direct analysis for high speed craft. ABS American Bureau for Shipping*. Houston, TX. Retrieved from https://ww2.eagle.org/content/dam/eagle/rules-and-guides/archives/design_and_analysis/113_dlaanddirectanalhigh-speedcraft/pub113_hsc_dla.pdf

Antão, P., & Soares, C. G. (2003). Analysis of high speed craft accidents. In T. Bedford, & P. van Gelder (Eds.), *Safety and reliability: Proceedings of the ESREL 2003 Conference*, *Maastricht, the Netherlands* (Vol. 1, pp. 37–44). Boca Raton, FL: CRC Press.

Antão, P., & Soares, C. G. (2008). Causal factors in accidents of high-speed craft and conventional ocean-going vessels. *Reliability Engineering & System Safety*, *93*(9), 1292–1304. doi:10.1016/j.ress.2007.07.010

Arı, K. (2014). İzmir'de Deniz Ulaşımı ve Ticaretinin Kent Kimliğinin Oluşumu Üzerindeki Etkileri. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, *3*(1), 1–18.

(Ato) Xu, W., Zhou, J., Yang, L., & Li, L. (2018). The implications of high-speed rail for Chinese cities: Connectivity and accessibility. *Transportation Research Part A, Policy and Practice*, *116*(January), 308–326. doi:10.1016/j.tra.2018.06.023

Auestad, Ø. F., Gravdahl, J. T., Sørensen, A. J., & Espeland, T. H. (2013). Simulator and control system design for a free floating surface effect ship at zero vessel speed. *IFAC Proceedings Volumes, 46*(10), 67–72. doi:10.3182/20130626-3-AU-2035.00064

Aydin, N., Lee, H., & Mansouri, S. A. (2017). Speed optimization and bunkering in liner shipping in the presence of uncertain service times and time windows at ports. *European Journal of Operational Research*, *259*(1), 143–154. doi:10.1016/j.ejor.2016.10.002

Babicz, J. (2015). *Wärtsilä Encyclopedia of Ship Technology* (2nd ed.). Helsinki: Wärtsilä Corporation.

Bailey, N., Housley, W., & Belcher, P. (2006). Navigation, interaction, and bridge team work. *The Sociological Review*, *54*(2), 342–362. doi:10.1111/j.1467-954X.2006.00617.x

Bari, G. S., & Matveev, K. I. (2016). Hydrodynamic modeling of planing catamarans with symmetric hulls. *Ocean Engineering*, *115*, 60–66. doi:10.1016/j.oceaneng.2016.01.035

Bari, G. S., & Matveev, K. I. (2017). Hydrodynamics of single-deadrise hulls and their catamaran configurations. *International Journal of Naval Architecture and Ocean Engineering*, *9*(3), 305–314. doi:10.1016/j.ijnaoe.2016.11.001

Basturk, H. I., & Krstic, M. (2013). Adaptive wave cancelation by acceleration feedback for ramp-connected air cushion-actuated surface effect ships. *Automatica*, *49*(9), 2591–2602. doi:10.1016/j.automatica.2013.05.017

Baykal, R. (2011). *Gemiler ve Açık Deniz Yapıları* (1st ed.). İstanbul, Turkey: Birsen Yayınevi Ltd. Şti.

Baykal, R. (2012). *Karma Taşımacılık Yaklaşımıyla Limanlar ve Terminaller* (1st ed.). İstanbul, Turkey: Birsen Yayınevi Ltd. Şti.

Beena, V. I., & Subramanian, V. A. (2003). Parametric studies on seaworthiness of SWATH ships. *Ocean Engineering*, *30*(9), 1077–1106. doi:10.1016/S0029-8018(02)00101-4

Bendall, H. B., & Stent, A. F. (2001). A scheduling model for a high-speed containership service: a hub and spoke short-sea application. *International Journal of Maritime Economics*, *3*(3), 262–277. doi:10.1057/palgrave.ijme.9100018

Bennett, J. (2018). Trimarans make waves in the fast ferry sector. Retrieved from https://www.passenger-ship.info/news/view,trimarans-make-waves-in-the-fast-ferry-sector_50510.htm

Berry, T. D., Johnson, K. L., & Porter, B. E. (2011). Speed(ing). In Handbook of traffic psychology (pp. 249–265). Elsevier. doi:10.1016/B978-0-12-381984-0.10018-9

Black Sea MoU. (2009). Pre-press release CIC on safety of navigation. Retrieved from http://www.bsmou.org/2009/01/pre-press-release-cic-on-safety-of-navigation-2/

Black Sea MoU. (2018a). *Annual report for 2017*. Retrieved from http://www.bsmou.org/downloads/annual-reports/BSMOU-AR-2017.pdf

Black Sea MoU. (2018b). Report of the 2017 CIC on safety of navigation-including ECDIS. Retrieved from http://www.bsmou.org/2018/06/report-of-the-2017-cic-on-the-saferty-of-navigation-including-ecdis/

Brouer, B. D., Karsten, C. V., & Pisinger, D. (2017). Optimization in liner shipping. *4OR, 15*(1), 1–35. doi:10.100710288-017-0342-6

Bulian, G., & Francescutto, A. (2008). Large amplitude rolling and strongly nonlinear behaviour of multihull ships in moderate beam waves. In E. Kreuzer (Ed.), *IUTAM Symposium on Fluid-Structure Interaction in Ocean Engineering* (pp. 25–36). Dordrecht, The Netherlands: Springer Netherlands. 10.1007/978-1-4020-8630-4_3

Bulian, G., Francescutto, A., & Zotti, I. (2008). Stability and roll motion of fast multihull vessels in beam waves. *Ships and Offshore Structures*, *3*(3), 215–228. doi:10.1080/17445300801990913

Bullock, J. A., Haddow, G. D., & Coppola, D. P. (2018). Transportation safety and security. In *Homeland Security* (pp. 169–188). Elsevier; doi:10.1016/B978-0-12-804465-0.00007-8

Butterworth, J., Atlar, M., & Shi, W. (2015). Experimental analysis of an air cavity concept applied on a ship hull to improve the hull resistance. *Ocean Engineering*, *110*, 2–10. doi:10.1016/j.oceaneng.2015.10.022

Çancı, M., & Erdal, M. (2003). *Lojistik Yönetimi: Freight Forwarder El Kitabı 1*. İstanbul, Turkey: UTİKAD.

Çancı, M., & Güngören, M. (2013). İktisadi Yaşamda Taşımacılık Sektörü. *Elektronik Sosyal Bilimler Dergisi*, *12*(45), 198–213.

Caribbean MoU. (2018). *2017 annual report*. Retrieved from http://www.caribbeanmou.org/sites/default/files/annual_report_2017.pdf

Cetin, V. R., Yilmaz, H. H., & Erkan, V. (2018). The impact of increasing speed limit in Turkey: The case of Ankara-Sivrihisar road section. *Case Studies on Transport Policy*, *6*(1), 72–80. doi:10.1016/j.cstp.2017.11.004

Chi, H., Pedrielli, G., Ng, S. H., Kister, T., & Bressan, S. (2018). A framework for real-time monitoring of energy efficiency of marine vessels. *Energy*, *145*, 246–260. doi:10.1016/j.energy.2017.12.088

Chintoan-Uta, M., & Silva, J. R. (2017). Global maritime domain awareness: A sustainable development perspective. *WMU Journal of Maritime Affairs*, *16*(1), 37–52. doi:10.100713437-016-0109-5

Cho, Y., Han, J., & Kim, J. (2018). Intent inference of ship maneuvering for automatic ship collision avoidance. *IFAC-PapersOnLine*, *51*(29), 384–388. doi:10.1016/j.ifacol.2018.09.457

Choudhary, P., Imprialou, M., Velaga, N. R., & Choudhary, A. (2018). Impacts of speed variations on freeway crashes by severity and vehicle type. *Accident; Analysis and Prevention*, *121*, 213–222. doi:10.1016/j.aap.2018.09.015 PMID:30265907

Cleveland, C. J., & Morris, C. (2014). Transportation, Water. In *Handbook of energy* (Vol. II, pp. 623–632). Elsevier; doi:10.1016/B978-0-12-417013-1.00035-2

Cucinotta, F., Nigrelli, V., & Sfravara, F. (2017). A preliminary method for the numerical prediction of the behavior of air bubbles in the design of Air Cavity Ships (pp. 509–516). doi:10.1007/978-3-319-45781-9_51

Cullinane, K. (2012). An international dimension: Shipping. In T. Ryley & L. Chapman (Eds.), *Transport and sustainability* (Vol. 2, pp. 65–104). Emerald Group. doi:10.1108/S2044-9941(2012)0000002007

Czarniawska, B. (2013). Is speed good? *Scandinavian Journal of Management*, *29*(1), 7–12. doi:10.1016/j.scaman.2012.11.007

da Conceição, V. P., Dahlman, J., & Navarro, A. (2017). What is maritime navigation? Unfolding the complexity of a sociotechnical system. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *61*(1), 267–271. doi:10.1177/1541931213601549

Daily Mail Online. (2013). Meet Francisco: The fastest ferry on the planet with jet engines that propel over 1000 passengers and 150 cars at 67 MPH. *Daily Mail Online.* Retrieved from http://www.dailymail.co.uk/news/article-2351454/Meet-Francisco-The-fastest-ferry-planet-jet-engines-propel-1000-passengers-150-cars-67-MPH.html

de Melo Rodriguez, G., Echevarrieta, I., & Serra, J. M. (2015). Improving the efficiency of a high speed catamaran through the replacement of the propulsion system. *TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 9*(4), 531–535. doi:10.12716/1001.09.04.09

del Águila Ferrandis, J., Brizzolara, S., & Chryssostomidis, C. (2018). Influence of large hull deformations on the motion response of a fast catamaran craft with varying stiffness. *Ocean Engineering*, *163*, 207–222. doi:10.1016/j.oceaneng.2018.05.038

Deligiannis, P. (2017). Ship performance indicator. *Marine Policy*, *75*, 204–209. doi:10.1016/j.marpol.2016.02.027

DiDomenico, A., & Nussbaum, M. A. (2011). Effects of different physical workload parameters on mental workload and performance. *International Journal of Industrial Ergonomics*, *41*(3), 255–260. doi:10.1016/j.ergon.2011.01.008

Djavareshkian, M. H., & Esmaeili, A. (2013). Neuro-fuzzy based approach for estimation of Hydrofoil performance. *Ocean Engineering*, *59*, 1–8. doi:10.1016/j.oceaneng.2012.10.015

Drobetz, W., & Johns, M. (2018). The evolution of modern ship finance. In *Finance and risk management for international logistics and the supply chain* (pp. 85–108). Elsevier; doi:10.1016/B978-0-12-813830-4.00004-6

Dulebenets, M. A., & Ozguven, E. E. (2017). Vessel scheduling in liner shipping: Modeling transport of perishable assets. *International Journal of Production Economics, 184*(November, 2016), 141–156. doi:10.1016/j.ijpe.2016.11.011

Edrissi, A., Nourinejad, M., & Roorda, M. J. (2015). Transportation network reliability in emergency response. *Transportation Research Part E, Logistics and Transportation Review*, *80*, 56–73. doi:10.1016/j.tre.2015.05.005

Eggemeier, F. T. (1988). Properties of workload assessment techniques. In Advances in Psychology (Vol. 52, pp. 41–62). doi:10.1016/S0166-4115(08)62382-1

Ek, Å., Runefors, M., & Borell, J. (2014). Relationships between safety culture aspects – A work process to enable interpretation. *Marine Policy*, *44*, 179–186. doi:10.1016/j.marpol.2013.08.024

Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *37*(1), 32–64. doi:10.1518/001872095779049543

Ernstsen, J., & Nazir, S. (2018). Consistency in the development of performance assessment methods in the maritime domain. *WMU Journal of Maritime Affairs*, *17*(1), 71–90. doi:10.100713437-018-0136-5

Ertuğrul, M. U. (2014). *Seyir (1. Baskı)*. İstanbul, Turkey: Akademi Denizcilik.

Ertürk, T. (2018). Türkiye denizlerini kaybetmek üzere. Retrieved from https://odatv.com/turkiye-denizlerini-kaybetmek-uzere-01111813.html

Esmailian, E., Farzanegan, B., Menhaj, M. B., & Ghassemi, H. (2018). A robust neuro-based adaptive control system design for a surface effect ship with uncertain dynamics and input saturation to cargo transfer at sea. *Applied Ocean Research*, *74*, 59–68. doi:10.1016/j.apor.2018.02.010

Eyres, D. J., & Bruce, G. J. (2012). Development of ship types. In *Ship construction* (pp. 17–33). Elsevier; doi:10.1016/B978-0-08-097239-8.00003-9

Fagerholt, K., Gausel, N. T., Rakke, J. G., & Psaraftis, H. N. (2015). Maritime routing and speed optimization with emission control areas. *Transportation Research Part C, Emerging Technologies*, *52*, 57–73. doi:10.1016/j.trc.2014.12.010

Faltinsen, O. M. (2006). Hydrodynamic features of high-speed vessels. *Ships and Offshore Structures*, *1*(1), 13–23. doi:10.1533aos.2005.0010

Fan, L., Zhang, S., & Yin, J. (2018). Structural analysis of shipping fleet capacity. *Journal of Advanced Transportation*, *2018*, 1–11. doi:10.1155/2018/3854090

Fang, C. C., & Chan, H. S. (2007). An investigation on the vertical motion sickness characteristics of a high-speed catamaran ferry. *Ocean Engineering*, *34*(14–15), 1909–1917. doi:10.1016/j.oceaneng.2007.04.001

Farkas, A., Degiuli, N., & Martić, I. (2017). Numerical investigation into the interaction of resistance components for a series 60 catamaran. *Ocean Engineering*, *146*, 151–169. doi:10.1016/j.oceaneng.2017.09.043

Fast Ferry International. (2018). Fast Ferry Vessel Database. Retrieved from http://www.fastferryinfo.com/fastferries/

Fernández-Macho, J., González, P., & Virto, J. (2016). An index to assess maritime importance in the European Atlantic economy. *Marine Policy*, *64*, 72–81. doi:10.1016/j.marpol.2015.11.011

Gang, L., Wang, Y., Sun, Y., Zhou, L., & Zhang, M. (2016). Estimation of vessel collision risk index based on support vector machine. *Advances in Mechanical Engineering*, *8*(11). doi:10.1177/1687814016671250

Garbatov, Y., Rudan, S., & Guedes Soares, C. (2010). Fatigue assessment of welded trapezoidal joints of a very fast ferry subjected to combined load. *Engineering Structures*, *32*(3), 800–807. doi:10.1016/j.engstruct.2009.12.007

García-Espinosa, J., Di Capua, D., Serván-Camas, B., Ubach, P.-A., & Oñate, E. (2015). A FEM fluid–structure interaction algorithm for analysis of the seal dynamics of a surface-effect ship. *Computer Methods in Applied Mechanics and Engineering*, *295*, 290–304. doi:10.1016/j.cma.2015.07.010

García-Olivares, A., Solé, J., & Osychenko, O. (2018). Transportation in a 100% renewable energy system. *Energy Conversion and Management, 158*(August 2017), 266–285. doi:10.1016/j.enconman.2017.12.053

Garme, K., Rosén, A., Stenius, I., & Kuttenkeuler, J. (2014). Rough water performance of lightweight high-speed craft. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, *228*(3), 293–301. doi:10.1177/1475090212460456

Gehling, R. (2007). International safety standards for high-performance marine vehicles–the DSC Code, HSC Codes and the WIG Craft Guidelines. *Australian Journal of Mechanical Engineering*, *4*(2), 101–110. doi:10.1080/14484846.2007.11464519

Ghassemi, H. (2009). Hydrodynamic characteristics of the surface-piercing propellers for the planing craft. *Journal of Marine Science and Application*, *8*(4), 267–274. doi:10.100711804-009-8076-2

Giuffrida, N., Ignaccolo, M., Inturri, G., Rofè, Y., & Calabrò, G. (2017). Investigating the correlation between transportation social need and accessibility: The case of Catania. *Transportation Research Procedia*, *27*, 816–823. doi:10.1016/j.trpro.2017.12.122

Gledić, I., Parunov, J., Prebeg, P., & Ćorak, M. (2019). Low-cycle fatigue of ship hull damaged in collision. *Engineering Failure Analysis*, *96*, 436–454. doi:10.1016/j.engfailanal.2018.11.005

Gould, K. S., Røed, B. K., Saus, E. R., Koefoed, V. F., Bridger, R. S., & Moen, B. E. (2009). Effects of navigation method on workload and performance in simulated high-speed ship navigation. *Applied Ergonomics*, *40*(1), 103–114. doi:10.1016/j.apergo.2008.01.001 PMID:18295184

Grazia Speranza, M. (2018). Trends in transportation and logistics. *European Journal of Operational Research*, *264*(3), 830–836. doi:10.1016/j.ejor.2016.08.032

Gudehus, T., & Kotzab, H. (2012). *Comprehensive logistics*. Berlin, Germany: Springer Berlin Heidelberg; doi:10.1007/978-3-642-24367-7

Guo, J., Ji, X., Wen, Y., & Cui, X. (2017). A new shock factor of SWATH catamaran subjected to underwater explosion. *Ocean Engineering*, *130*, 620–628. doi:10.1016/j.oceaneng.2016.12.017

Gürdeniz, C. (2013). *Hedefteki Donanma* (M. Tanaydın, Ed.). (1st ed.). İstanbul, Turkey: Kırmızı Kedi Yayınevi.

Gürdeniz, C. (2015). *Mavi Uygarlık-Türkiye Denizcileşmelidir* (T. Arslan, Ed.). 1st ed.). İstanbul, Turkey: Kırmızı Kedi Yayınevi.

Hajiabadi, A., Shafaghat, R., & Kazemi Moghadam, H. (2018). A study into the effect of loading conditions on the resistance of asymmetric high-speed catamaran based on experimental tests. *Alexandria Engineering Journal*, *57*(3), 1713–1720. doi:10.1016/j.aej.2017.03.045

Hamzeie, R., Savolainen, P. T., & Gates, T. J. (2017). Driver speed selection and crash risk: Insights from the naturalistic driving study. *Journal of Safety Research*, *63*, 187–194. doi:10.1016/j.jsr.2017.10.007 PMID:29203018

Hao, W. U., & Yongpeng, O. U. (2018). Numerical simulation of air layer morphology on flat bottom plate with air cavity and evaluation of the drag reduction effect. *International Journal of Naval Architecture and Ocean Engineering*. doi:10.1016/j.ijnaoe.2018.09.005

Hareide, O. S., Mjelde, F. V., Glomsvoll, O., & Ostnes, R. (2017). Developing a high-speed craft route monitor window BT - Augmented cognition, enhancing cognition, and behavior in complex human environments. In D. D. Schmorrow, & C. M. Fidopiastis (Eds.), (pp. 461–473). Cham, Switzerland: Springer International Publishing.

Haşimoğlu, Z. (2015). *Seyir*. İstanbul, Turkey: Birsen Yayın Dağıtım Ltd.Şti.

Håvold, J. I. (2005). Safety-culture in a Norwegian shipping company. *Journal of Safety Research*, *36*(5), 441–458. doi:10.1016/j.jsr.2005.08.005 PMID:16310804

Hobbs, R. R. (1981). *Marine navigation 1: Piloting*. Dordrecht, The Netherlands: Springer Netherlands; doi:10.1007/978-94-011-7370-4

Hoppe, H. (2005). International regulations for high-speed craft an overview. In *International Conference on Fast Sea Transportation FAST 2005*. St. Petersburg.

Hsu, W. K. K. (2015). Assessing the safety factors of ship berthing operations. *Journal of Navigation*, *68*(03), 576–588. doi:10.1017/S0373463314000861

İMEAK Chamber of Shipping. (2018a). *Deniz Sektör Raporu 2017*. İstanbul, Turkey. Retrieved from http://www.denizticaretodasi.org.tr/Shared Documents/sektorraporu/2017_sektor_tr.pdf

İMEAK Chamber of Shipping. (2018b). Türk Deniz Ticaret Filosu. Retrieved from http://www.denizticaretodasi.org.tr/Shared Documents/filo-verileri/kasim2018.pdf

Indian Ocean MoU. (2018). *Annual report - 2017*. Retrieved from http://www.iomou.org/php/iomoudoc2/annrep17.pdf

Insight, M. (2017). 4 types of high performance marine vehicles. Retrieved from https://www.marineinsight.com/naval-architecture/types-of-high-performance-marine-vehicles/

International Chamber of Shipping. (2016). *Bridge procedures guide. Release 9.1.3. (Fifth)*. London, UK: Marisec Publications.

International Maritime Organization. (2014). *SOLAS, Consolidated Edition 2014: Consolidated Text of the International Convention for the Safety of Life at Sea, 1974, and Its Protocol of 1988: Articles, Annexes, and Certificates*. International Maritime Organization.

International Maritime Organization. (2018a). GISIS: Marine casualties and incidents. Retrieved from https://gisis.imo.org/Public/MCI/Search.aspx?Mode=Advanced

International Maritime Organization. (2018b). High-speed craft (HSC). Retrieved from http://www.imo.org/en/OurWork/Safety/Regulations/Pages/HSC.aspx

International Maritime Organization. (2018c). IMO and the safety of navigation. Retrieved from http://www.imo.org/en/OurWork/Safety/Navigation/Pages/Default.aspx

International Maritime Organization. (2018d). IMO and the sustainable development goals. Retrieved from http://www.imo.org/en/MediaCentre/HotTopics/Pages/SustainableDevelopmentGoals.aspx

International Maritime Organization. (2018e). Introduction to IMO. Retrieved from http://www.imo.org/About/Pages/Default.aspx

International Maritime Organization. (2018f). Short history of IMO. Retrieved from http://www.imo.org/en/About/HistoryOfIMO/Pages/Default.aspx

International Maritime Organization. (2018g). Vision, principles, and goals. Retrieved from http://www.imo.org/en/OurWork/HumanElement/VisionPrinciplesGoals/Pages/Default.aspx

Istanbul Fast Ferries Co. Inc. (2018). Filomuz. Retrieved from https://www.ido.com.tr/services-new#filomuz

Jercea, A. D. (2012). The importance of international transportation as part of the world economy after the end economic crisis. *Metalurgia International*, *17*(8), 85–89.

Jiang, Y., Sun, H., Zou, J., Hu, A., & Yang, J. (2017). Experimental and numerical investigations on hydrodynamic and aerodynamic characteristics of the tunnel of planing trimaran. *Applied Ocean Research*, *63*, 1–10. doi:10.1016/j.apor.2016.12.009

Jurdzinski, M. (2018). Changing the model of maritime navigation. *TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 12*(1), 35–41. doi:10.12716/1001.12.01.03

Kara, M. A., & Ciğerlioğlu, O. (2018). Türkiye Ekonomisinde Ulaşım Altyapısının Ekonomik Büyümeye Etkisi. *Gaziantep University Journal of Social Sciences*, *17*(2), 577–591. doi:10.21547/jss.382949

Kartoğlu, C., & Kum, S. (2017). Assessment of electronic navigation equipment's effect to mental workload by utilising revised NASA task load index. In A. Weintrit (Ed.), *Marine navigation: Proceedings of the 12th International Conference on Marine Navigation and Safety of Sea Transportation (TransNav 2017)* (pp. 23–28). Gdyinia Maritime University, Gdynia, Poland, June 21-23. Boca Raton, FL: CRC Press. 10.1201/9781315099132-1

Khan, B., Khan, F., Veitch, B., & Yang, M. (2018). An operational risk analysis tool to analyze marine transportation in Arctic waters. *Reliability Engineering & System Safety*, *169*, 485–502. doi:10.1016/j.ress.2017.09.014

Khedmati, M. R., & Keivanfar, I. (2010). Crushing response of bow structure of aluminium high-speed crafts at the event of inclined collisions: Numerical simulation. *International Journal of Crashworthiness*, *15*(5), 469–479. doi:10.1080/13588261003703726

Kherbash, O., & Mocan, M. L. (2015). A review of logistics and transport sector as a factor of globalization. *Procedia Economics and Finance*, *27*(15), 42–47. doi:10.1016/S2212-5671(15)00969-7

Kihara, H., Dobashi, J., Hibi, S., & Uemura, M. (2018). Fundamental studies on the influence of wave loads on a trimaran's cross-deck structure. *Journal of Marine Science and Technology*. doi:10.100700773-018-0548-0

Kılcı, H. (2017). Taşımacılık Faaliyetlerinin Rekabet Üstünlüğü Oluşturmada İşletmecilikte Yeri ve Önemi: Türkiye Örneği ve Türkiye'de Taşımacılığın Gelişimi. *Balkan Sosyal Bilimler Dergisi, ICOMEP*(Özel Sayı), 74–86.

Kim, D. J., & Kim, S. Y. (2017). Turning characteristics of waterjet propelled planing boat at semi-planing speeds. *Ocean Engineering*, *143*, 24–33. doi:10.1016/j.oceaneng.2017.07.034

Kim, S. H., & Yamato, H. (2004). An experimental study of the longitudinal motion control of a fully submerged hydrofoil model in following seas. *Ocean Engineering*, *31*(5–6), 523–537. doi:10.1016/j.oceaneng.2003.10.003

Kim, Y. G., Lee, S. M., & Seong, P. H. (2017). A methodology for a quantitative assessment of safety culture in NPPs based on Bayesian networks. *Annals of Nuclear Energy*, *102*, 23–36. doi:10.1016/j.anucene.2016.08.023

Köksal, Ş. (2013). TRAFİKTE HIZ VE KAZA RİSKİ. Retrieved from http://www.trafik.gov.tr/Sayfalar/AsiriHiz.aspx

Köseoğlu, B. (2015). Limanlarda Tasarım, Planlama ve Modelleme Süreçlerinde Kulanılan Yöntem ve Teknikler Üzerine Bir Literatür Araştırması. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, *7*(1), 1–20.

Krystosik-Gromadzińska, A. (2018). Ergonomic assessment of selected workstations on a merchant ship. *International Journal of Occupational Safety and Ergonomics*, *24*(1), 91–99. doi:10.1080/10803548.2016.1273589 PMID:27997306

Küçükşahin, F. (2003). *Ansiklopedik Bilimsel ve Teknik Denizcilik Sözlüğü: İngilizce-Türkçe* (1st ed.). İstanbul, Turkey: Akademi Denizcilik.

Kumagai, I., Takahashi, Y., & Murai, Y. (2015). Power-saving device for air bubble generation using a hydrofoil to reduce ship drag: Theory, experiments, and application to ships. *Ocean Engineering*, *95*, 183–194. doi:10.1016/j.oceaneng.2014.11.019

Kutluk, E. (2018). İstanbul Boğazı'ndan Geçen Gemilerin Oluşturduğu Trafik Yükünün Çevresel Etkileri: Ro-Ro Gemileri Özelinde Bir İnceleme. *Marmara Üniversitesi Siyasal Bilimler Dergisi*, *6*(1), 285–310.

Last, P., Kroker, M., & Linsen, L. (2017). Generating real-time objects for a bridge ship-handling simulator based on automatic identification system data. *Simulation Modelling Practice and Theory*, *72*, 69–87. doi:10.1016/j.simpat.2016.12.011

Leung, A. W. S., Chan, C. C. H., Ng, J. J. M., & Wong, P. C. C. (2006). Factors contributing to officers' fatigue in high-speed maritime craft operations. *Applied Ergonomics*, *37*(5), 565–576. doi:10.1016/j.apergo.2005.11.003 PMID:16368069

Li, Y., Wu, X., Ma, Y., & Wang, J. (2008). A method based on potential theory for calculating air cavity formation of an air cavity resistance reduction ship. *Journal of Marine Science and Application*, *7*(2), 98–101. doi:10.100711804-008-7077-x

Liang, H., & Zong, Z. (2011). A lifting line theory for a three-dimensional hydrofoil. *Journal of Marine Science and Application*, *10*(2), 199–205. doi:10.100711804-011-1038-5

Lin, C. J., Hsieh, T. L., & Lin, S. F. (2013). Development of staffing evaluation principle for advanced main control room and the effect on situation awareness and mental workload. *Nuclear Engineering and Design*, *265*, 137–144. doi:10.1016/j.nucengdes.2013.08.056

Liu, B., Wu, W., & Guedes Soares, C. (2018). Ultimate strength analysis of a SWATH ship subjected to transverse loads. *Marine Structures*, *57*, 105–120. doi:10.1016/j.marstruc.2017.10.006

Logsdon, T. (1992). *The Navstar global positioning system*. Boston, MA: Springer US; doi:10.1007/978-1-4615-3104-3

Louro, J., Vazquez, P., & de la Campa, R. M. (2012). Accident risk factors in conventional and high speed ferry ships in Spain. *Journal for Maritime Research*, *9*(1), 3–8.

Lu, C. S., & Tsai, C. L. (2010). The effect of safety climate on seafarers' safety behaviors in container shipping. *Accident; Analysis and Prevention*, *42*(6), 1999–2006. doi:10.1016/j.aap.2010.06.008 PMID:20728654

Luo, M., & Shin, S. H. (2016). Half-century research developments in maritime accidents: Future directions. *Accident; Analysis and Prevention*. doi:10.1016/j.aap.2016.04.010 PMID:27106054

Magoga, T., Aksus, S., Cannon, S., Ojeda, R., & Thomas, G. (2017). Identification of slam events experienced by a high-speed craft. *Ocean Engineering*, *140*, 309–321. doi:10.1016/j.oceaneng.2016.07.017

Mandal, N. R. (2017). *Ship construction and welding* (Vol. 2). Singapore: Springer Singapore; doi:10.1007/978-981-10-2955-4

Marine Accident Investigation Branch. (2018). *MAIB ANNUAL REPORT 2017*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/720443/MAIB_Annual_Report_2017.pdf

MarineTraffic. (2018). MarineTraffic Data | Vessels. Retrieved from https://www.marinetraffic.com/en/data/?asset_type=vessels&columns=shipname:asc,flag,photo,recognized_next_port,reported_eta,reported_destination,current_port,imo,ship_type,show_on_live_map,time_of_latest_position,lat_of_latest_position,lon_of_latest_posit

Mediterranean MoU. (2017). *Annual report 2016*. Retrieved from http://www.medmou.org/

Moraes, H. B., Vasconcellos, J. M., & Latorre, R. G. (2004). Wave resistance for high-speed catamarans. *Ocean Engineering*, *31*(17–18), 2253–2282. doi:10.1016/j.oceaneng.2004.03.012

Mousaviraad, S. M., Wang, Z., & Stern, F. (2015). URANS studies of hydrodynamic performance and slamming loads on high-speed planing hulls in calm water and waves for deep and shallow conditions. *Applied Ocean Research*, *51*, 222–240. doi:10.1016/j.apor.2015.04.007

Nævestad, T. O., Hesjevoll, I. S., & Phillips, R. O. (2018). How can we improve safety culture in transport organizations? A review of interventions, effects and influencing factors. *Transportation Research Part F: Traffic Psychology and Behaviour*, *54*, 28–46. doi:10.1016/j.trf.2018.01.002

Najafi, A., Aliakbari, T., & Hashemi, S. A. (2018). Experimental optimization of hydrodynamic performance of catamarans using hydrofoil element. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, 1–14. doi:10.1177/1475090218761415

Nas, A. (2017). Türkiye'de 4.5G Reklamlarında Hızın Kültürel Temsili. İstanbul Üniversitesi İletişim Fakültesi Dergisi | Istanbul University Faculty of Communication Journal, (52), 67–87. doi:10.17064/iuifd.333135

Nas, S. (2015). The definitions of safety and security. *Journal of ETA Maritime Science*, *3*(2), 53–54. doi:10.5505/jems.2015.42713

Nilsson, R., Gärling, T., & Lützhöft, M. (2009). An experimental simulation study of advanced decision support system for ship navigation. *Transportation Research Part F: Traffic Psychology and Behaviour*, *12*(3), 188–197. doi:10.1016/j.trf.2008.12.005

Oh, J., Park, S., & Kwon, O. S. (2016). Advanced navigation aids system based on augmented reality. *International Journal of E-Navigation and Maritime Economy*, *5*, 21–31. doi:10.1016/j.enavi.2016.12.002

Okasha, N. M., Frangopol, D. M., Saydam, D., & Salvino, L. W. (2011). Reliability analysis and damage detection in high-speed naval craft based on structural health monitoring data. *Structural Health Monitoring: An International Journal*, *10*(4), 361–379. doi:10.1177/1475921710379516

Olsson, E., & Jansson, A. (2006). Work on the bridge – studies of officers on high-speed ferries. *Behaviour & Information Technology*, *25*(1), 37–64. doi:10.1080/01449290500066711

Orłowski, M., Bastien, C., Razmkhah, O., & McCartan, S. (2017). Design methodology for crash occupant protection in cabin design of the high speed vessel. *Marine Structures*, *51*, 1–20. doi:10.1016/j.marstruc.2016.10.001

Pagliara, F., Mauriello, F., & Garofalo, A. (2017). Exploring the interdependences between High Speed Rail systems and tourism: Some evidence from Italy. *Transportation Research Part A, Policy and Practice*, *106*, 300–308. doi:10.1016/j.tra.2017.09.022

Papanikolaou, A. (2002). Developments and potential of advanced marine vehicles concepts. *Bulletin of the KANSAI Society of Naval Architects*, *55*, 50–54.

Papanikolaou, A. (2005). Review of advanced marine vehicles concepts. In *Proceedings of the Seventh International Symposium on High speed marine vehicles (HSMV 2005)*, *Naples, Italy* (pp. 21–23).

Paris MoU. (2018a). *2017 Paris MoU Annual Report. Safeguarding responsible and sustainable shipping*. Retrieved from https://www.parismou.org/sites/default/files/2017 Annual ParisMoU_0.pdf

Paris MoU. (2018b). Concentrated inspection campaign. Retrieved from https://www.parismou.org/inspections-risk/inspection-types/concentrated-inspection-campaign

Paris MoU. (2018c). Concentrated inspection campaign (CIC) on safety of navigation, including ECDIS (2017). Retrieved from https://www.parismou.org/concentrated-inspection-campaign-cic-safety-navigation-including-ecdis-2017

Park, H. J., Tasaka, Y., & Murai, Y. (2018). Bubbly drag reduction accompanied by void wave generation inside turbulent boundary layers. *Experiments in fluids*, *59*(11), 166. doi:10.100700348-018-2621-1

Park, S. H., & Lee, I. (2018). Optimization of drag reduction effect of air lubrication for a tanker model. *International Journal of Naval Architecture and Ocean Engineering*, *10*(4), 427–438. doi:10.1016/j.ijnaoe.2017.09.003

Payne, P. R. (1997). The response of a hydrofoil to wave orbital velocity fields. *Ocean Engineering*, *24*(3), 235–263. doi:10.1016/S0029-8018(96)00011-X

Pike, D. (1993). Fast-ferry navigation. *Journal of Navigation*, *46*(02), 282–286. doi:10.1017/S0373463300011632

Poundra, G. A. P., Utama, I. K. A. P., Hardianto, D., & Suwasono, B. (2017). Optimizing trimaran yacht hull configuration based on resistance and seakeeping criteria. *Procedia Engineering*, *194*, 112–119. doi:10.1016/j.proeng.2017.08.124

Pustoshnyi, A. V. (2013). Prospects for high-speed water transport in Russia. *Herald of the Russian Academy of Sciences*, *83*(6), 506–512. doi:10.1134/S1019331614010043

Rani, D., & Gulati, T. R. (2017). Time optimization in totally uncertain transportation problems. *International Journal of Fuzzy Systems*, *19*(3), 739–750. doi:10.100740815-016-0176-y

Rawson, K. J., & Tupper, E. C. (2001). Particular ship types. In *Basic ship theory* (pp. 655–694). Elsevier; doi:10.1016/B978-075065398-5/50019-4

Reza Kohansal, A., & Ghassemi, H. (2010). A numerical modeling of hydrodynamic characteristics of various planing hull forms. *Ocean Engineering*, *37*(5–6), 498–510. doi:10.1016/j.oceaneng.2010.01.008

Riyadh MoU. (2018). *2017 Riyadh MoU annual report*. Retrieved from https://riyadhmou.org/public_html/assets/uploads/images/3b4b3362fb82d3a92acd2fdb2ee02d15.pdf

Rodrigue, J.-P. (2017). Maritime transport. In *International encyclopedia of geography: People, the earth, environment, and technology* (pp. 1–7). Oxford, UK: John Wiley & Sons; doi:10.1002/9781118786352.wbieg0155

Rodriguez, A. C., Lee, D. A. Jr, & Makic, M. B. F. (2017). Situational awareness in critical care: an aviation approach to reduce error. *Journal of Perianesthesia Nursing*, *32*(6), 650–652. doi:10.1016/j.jopan.2017.08.001 PMID:29157771

Rossi, C., & Russo, F. (2017). *Ancient engineers' inventions* (Vol. 33). Cham, Switzerland: Springer International Publishing; doi:10.1007/978-3-319-44476-5

Ruggiero, V., & Morace, F. (2018). Methodology to study the comfort implementation for a new generation of hydrofoils. *International Journal on Interactive Design and Manufacturing (IJIDeM)*. doi:10.100712008-018-0511-7

Santos, F. M., Temarel, P., & Guedes Soares, C. (2009). Modal analysis of a fast patrol boat made of composite material. *Ocean Engineering*, *36*(2), 179–192. doi:10.1016/j.oceaneng.2008.09.013

Santos, M. (2014). Neuro-fuzzy modeling and fuzzy control of a fast ferry. In F. Matía, G. N. Marichal, & E. Jiménez (Eds.), *Fuzzy modeling and control: Theory and applications* (pp. 191–204). Paris, France: Atlantis Press; doi:10.2991/978-94-6239-082-9_10

Sarıer, B. (2016). Günlük hayatta temassız ödemenin yeri | Bankalararası Kart Merkezi. Retrieved from https://bkm.com.tr/gunluk-hayatta-temassiz-odemenin-yeri/

Savaresi, S. M., Bertin, D., & Bittanti, S. (2000). Non-linear design of an IGV-FAN servo system for surface effect ships. *IFAC Proceedings Volumes, 33*(9), 601–606. doi:10.1016/S1474-6670(17)38210-1

Seo, J., Choi, H. K., Jeong, U. C., Lee, D. K., Rhee, S. H., Jung, C. M., & Yoo, J. (2016). Model tests on resistance and seakeeping performance of wave-piercing high-speed vessel with spray rails. *International Journal of Naval Architecture and Ocean Engineering*, *8*(5), 442–455. doi:10.1016/j.ijnaoe.2016.05.010

Sequenzia, G., Rizzuti, S., Martorelli, M., & Ingrassia, T. (2018). Advances on mechanics, design engineering and manufacturing. *International Journal on Interactive Design and Manufacturing*, 575–584. doi:10.100712008-018-0509-1

Shipyards' & Maritime Equipment Association. (2017). *2017 Market forecast report*. Retrieved from https://maritimetechnology.nl/media/2017-Market-Forecast-Report-finaal.pdf

Silva, I. S., Campopiano, F., Lopes, G. S. V., Uenojo, A. K., Silva, H. T., Pellini, E. L., ... Barros, E. A. (2018). Development of a Trimaran ASV. *IFAC-PapersOnLine*, *51*(29), 8–13. doi:10.1016/j.ifacol.2018.09.461

Stout, E. G. (1950). Development of high-speed water-based aircraft. *Journal of the Aeronautical Sciences*, *17*(8), 457–480. doi:10.2514/8.1698

Sügen, Y. (1996). *Kaptanın Kılavuzu* (3rd ed.). İstanbul, Turkey: Beta Basım Yayım Dağıtım A.Ş.

Sumalee, A., & Ho, H. W. (2018). Smarter and more connected: Future intelligent transportation system. *IATSS Research*, *42*(2), 67–71. doi:10.1016/j.iatssr.2018.05.005

Sun, L., Zhang, H., Liu, W., & Chen, F. (2018). Research on risk assessment and control of inland navigation safety. *International Journal of System Assurance Engineering and Management*, *9*(3), 729–738. doi:10.100713198-017-0694-5

Talaat, W. M., Hafez, K. A., & Banawan, A. A. (2017). A CFD presentation and visualization for a new model that uses interceptors to harness hydro-energy at the wash of fast boats. *Ocean Engineering*, *130*, 542–556. doi:10.1016/j.oceaneng.2016.12.014

Tanishita, M., & van Wee, B. (2017). Impact of vehicle speeds and changes in mean speeds on per vehicle-kilometer traffic accident rates in Japan. *IATSS Research*, *41*(3), 107–112. doi:10.1016/j.iatssr.2016.09.003

Tavakoli, S., Najafi, S., Amini, E., & Dashtimanesh, A. (2018). Performance of high-speed planing hulls accelerating from rest under the action of a surface piercing propeller and an outboard engine. *Applied Ocean Research*, *77*, 45–60. doi:10.1016/j.apor.2018.05.004

Tavakoli Dakhrabadi, M., & Seif, M. S. (2018). Hydro-aerodynamic mathematical model and multi-objective optimization of wing-in-ground effect craft in take-off. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, *232*(4), 421–433. doi:10.1177/1475090217708478

Teodorović, D., & Janić, M. (2017). Transport economics. In *Transportation engineering* (pp. 635–717). Elsevier; doi:10.1016/B978-0-12-803818-5.00010-X

Tezdogan, T., Incecik, A., & Turan, O. (2014). Operability assessment of high-speed passenger ships based on human comfort criteria. *Ocean Engineering*, *89*(0), 32–52. doi:10.1016/j.oceaneng.2014.07.009

The Maritime and Coastguard Agency. (2008). International code of safety for high-speed craft (2000-2008 Edition. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282657/msis34_hsc_code_2000_2008_itos_rev1.01-full-2.pdf

Thomas, B. S., & Sclavounos, P. D. (2007). Optimal-control theory applied to ship maneuvering in restricted waters. *Journal of Engineering Mathematics*, *58*(1–4), 301–315. doi:10.100710665-006-9130-6

Tiao, W. C. (2010). Practical approach to investigate the statistics of nonlinear pressure on a high-speed ship by using the Volterra model. *Ocean Engineering*, *37*(8–9), 847–857. doi:10.1016/j.oceaneng.2010.02.019

Tokyo MoU. (2017). Launch of joint concentrated inspection campaign on safety of navigation (Solas Ch. V). Retrieved from http://www.tokyo-mou.org/doc/Press Release on CIC on Safety of Navigation.pdf

Tokyo MoU. (2018). *Annual report on Port State Control in the Asia-Pacific Region*. Retrieved from http://www.tokyo-mou.org/doc/ANN17.pdf

Torsvik, T. (2009). Modelling of ship waves from high-speed vessels. In E. Quak, & T. Soomere (Eds.), *Applied wave mathematics: Selected topics in solids, fluids, and mathematical methods* (pp. 229–263). Berlin, Germany: Springer Berlin Heidelberg; doi:10.1007/978-3-642-00585-5_13

Tuck, E. O. (1990). Planing surfaces. In M. A. Golberg (Ed.), *Numerical solution of integral equations* (pp. 363–372). Boston, MA: Springer US; doi:10.1007/978-1-4899-2593-0_7

Tupper, E. C. (2013a). Ship design. In Introduction to naval architecture (5th Ed., pp. 343–377). Elsevier. doi:10.1016/B978-0-08-098237-3.00014-X

Tupper, E. C. (2013b). Ship types. In Introduction to naval architecture (5th Ed., pp. 379–412). Elsevier. doi:10.1016/B978-0-08-098237-3.00015-1

Uğurlu, Ö., Erol, S., & Başar, E. (2016). The analysis of life safety and economic loss in marine accidents occurring in the Turkish Straits. *Maritime Policy & Management*, *43*(3), 356–370. doi:10.1080/03088839.2014.1000992

Uğurlu, Ö., Kum, S., & Aydoğdu, Y. V. (2017). Analysis of occupational accidents encountered by deck cadets in maritime transportation. *Maritime Policy & Management*, *44*(3), 304–322. doi:10.1080/03088839.2016.1245449

Uğurlu, Ö., Yildirim, U., & Yuksekyildiz, E. (2013). Marine accident analysis with GIS. *Journal of Shipping and Ocean Engineering*, *3*(1–2), 21.

UNCTAD. (2017). *UNCTAD Review of maritime transport 2017*. United Nations Publications. Retrieved from http://unctad.org/en/PublicationsLibrary/rmt2017_en.pdf

UNCTAD. (2018). *UNCTAD 50 years of review of maritime transport, 1968-2018: Reflecting on the past, exploring the future*. Retrieved from https://unctad.org/en/PublicationsLibrary/dtl2018d1_en.pdf

United Nations. (2017). Factsheet: People and oceans. Retrieved from https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact-sheet-package.pdf

Vamråk, V., Bua, N. H., Hassani, V., & Auestad, Ø. F. (2016). Robust lateral control of a surface effect ship using H∞ mixed sensitivity synthesis. *IFAC-PapersOnLine*, *49*(23), 540–545. doi:10.1016/j.ifacol.2016.10.491

Varyani, K. S., Gatiganti, R. M., & Gerigk, M. (2000). Motions and slamming impact on catamaran. *Ocean Engineering*, *27*(7), 729–747. doi:10.1016/S0029-8018(99)00011-6

Veneti, A., Makrygiorgos, A., Konstantopoulos, C., Pantziou, G., & Vetsikas, I. A. (2017). Minimizing the fuel consumption and the risk in maritime transportation: A bi-objective weather routing approach. *Computers & Operations Research*, *88*, 220–236. doi:10.1016/j.cor.2017.07.010

Vernengo, G., & Brizzolara, S. (2017). Numerical investigation on the hydrodynamic performance of fast SWATHs with optimum canted struts arrangements. *Applied Ocean Research*, *63*, 76–89. doi:10.1016/j.apor.2017.01.009

Vickerman, R. (2018). Can high-speed rail have a transformative effect on the economy? *Transport Policy*, *62*, 31–37. doi:10.1016/j.tranpol.2017.03.008

Vidulich, M. A. (2000). The relationship between mental workload and situation awareness. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *44*(21), 3-460-3–463. 10.1177/154193120004402122

Vina Del Mar MoU. (2017). *Annual report on Port State Control Latin American Agreement 2016*. Retrieved from http://www.equasis.org/Fichiers/Statistique/MOA/PSC Annual Reports Vina Del Mar MoU/PSC_ ANNUAL_REPORT_VDMOU_2016.pdf

Wang, H., Liu, J., Liu, K., Zhang, J., & Wang, Z. (2018). Sensitivity analysis of traffic efficiency in restricted channel influenced by the variance of ship speed. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, *232*(2), 212–224. doi:10.1177/1475090217720549

Wang, J., & McOwan, S. (2000). Fast passenger ferries and their future. *Maritime Policy & Management*, *27*(3), 231–251. doi:10.1080/030888300411086

Wang, L., & Yang, Z. (2018). Bayesian network modelling and analysis of accident severity in waterborne transportation: A case study in China. *Reliability Engineering & System Safety*, *180*, 277–289. doi:10.1016/j.ress.2018.07.021

Wang, S., Su, Y., Zhang, X., & Yang, J. (2012). RANSE simulation of high-speed planning craft in regular waves. *Journal of Marine Science and Application*, *11*(4), 447–452. doi:10.100711804-012-1154-x

Wang, W., Peng, Y., Song, X., & Zhou, Y. (2015). Impact of navigational safety level on seaport fairway capacity. *Journal of Navigation*, *68*(06), 1120–1132. doi:10.1017/S0373463315000387

Watkins, K. E. (2018). Using value sensitive design to understand transportation choices and envision a future transportation system. *Ethics and Information Technology*. doi:10.100710676-018-9478-0

Wei, C., Li, Y., Yu, S., & Yi, H. (2016). Experimental study on the high speed mono-wave-piercing boat. *Journal of Shanghai Jiaotong University (Science)*, *21*(5), 524–529. doi:10.100712204-016-1758-4

Wen, M., Pacino, D., Kontovas, C. A., & Psaraftis, H. N. (2017). A multiple ship routing and speed optimization problem under time, cost and environmental objectives. *Transportation Research Part D, Transport and Environment*, *52*, 303–321. doi:10.1016/j.trd.2017.03.009

Witolla, T., Sames, P., & Greig, A. (2016). Vessels for the future. *Transportation Research Procedia*, *14*, 1641–1648. doi:10.1016/j.trpro.2016.05.129

Xu, G. D., & Meng, Q. (2016). Waves induced by a two-dimensional foil advancing in shallow water. *Engineering Analysis with Boundary Elements*, *64*, 150–157. doi:10.1016/j.enganabound.2015.12.005

Xue, Y., Clelland, D., Lee, B. S., & Han, D. (2011). Automatic simulation of ship navigation. *Ocean Engineering*, *38*(17–18), 2290–2305. doi:10.1016/j.oceaneng.2011.10.011

Yanuar, G., Gunawan, Muhyi, A., & Jamaluddin, A. (2016). Ship resistance of quadramaran with various hull position configurations. *Journal of Marine Science and Application*, *15*(1), 28–32. doi:10.100711804-016-1340-3

Yanuar, W., Waskito, K. T., Pratama, S. Y., Candra, B. D., & Rahmat, B. A. (2018). Comparison of microbubble and air layer injection with porous media for drag reduction on a self-propelled barge ship model. *Journal of Marine Science and Application*, *17*(2), 165–172. doi:10.100711804-018-0028-2

Yılmaz, F., & Ece, N. J. (2017). Analysis of the relationship between variables related to Paris Mou - PSC inspections and the results of inspection applied to Turkish flagged ships. *Journal of ETA Maritime Science*, *5*(2), 172–185. doi:10.5505/jems.2017.20592

Yin, Z., & Zhang, J. (2013). Identifying changes in human operator mental workload by locally linear embedding and support vector clustering approaches. *IFAC Proceedings Volumes, 46*(13), 353–358. doi:10.3182/20130708-3-CN-2036.00011

Yoon, H. K., Nguyen, V. M., & Nguyen, T. T. (2018). Development of solution for safe ship considering seakeeping PERformance. *TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 12*(3), 517–525. doi:10.12716/1001.12.03.10

Yousefi, R., Shafaghat, R., & Shakeri, M. (2013). Hydrodynamic analysis techniques for high-speed planing hulls. *Applied Ocean Research*, *42*, 105–113. doi:10.1016/j.apor.2013.05.004

Yun, L., & Bliault, A. (2012). *High performance marine vessels*. Boston, MA: Springer US; doi:10.1007/978-1-4614-0869-7

Zaghi, S., Dubbioso, G., Broglia, R., & Muscari, R. (2016). Hydrodynamic characterization of USV vessels with innovative SWATH configuration for coastal monitoring and low environmental impact. *Transportation Research Procedia*, *14*, 1562–1570. doi:10.1016/j.trpro.2016.05.121

Zhang, G., Thai, V. V., Yuen, K. F., Loh, H. S., & Zhou, Q. (2018). Addressing the epistemic uncertainty in maritime accidents modelling using Bayesian network with interval probabilities. *Safety Science*, *102*, 211–225. doi:10.1016/j.ssci.2017.10.016

Zhang, R., & Furusho, M. (2016). Constructing a decision-support system for safe ship-navigation using a Bayesian network. In V. G. Duffy (Ed.), Vol. 10917, pp. 616–628. Cham, Switzerland: Springer International; doi:10.1007/978-3-319-40247-5_62

Zhang, S., Villavicencio, R., Zhu, L., & Pedersen, P. T. (2017). Impact mechanics of ship collisions and validations with experimental results. *Marine Structures*, *52*, 69–81. doi:10.1016/j.marstruc.2016.12.003

Zhao, S., Shi, X., Shi, Y., & Bian, X. (2003). Simulation study of plane motion of air cushion vehicle. *Journal of Marine Science and Application*, *2*(2), 67–71. doi:10.1007/BF02918666

Zheng, Y., Talley, W. K., Jin, D., & Ng, M. (2016). Crew injuries in container vessel accidents. *Maritime Policy & Management*, *43*(5), 541–551. doi:10.1080/03088839.2016.1150610

Zhou, J., Tang, W., & Zhang, S. (2009). Sea keeping analysis of air cushion vehicle with different wave angles under the operation resistance. *Journal of Shanghai Jiaotong University (Science)*, *14*(4), 471–475. doi:10.100712204-009-0471-y

Zong, Z., Sun, Y., & Jiang, Y. (2018). Experimental study of controlled T-foil for vertical acceleration reduction of a trimaran. *Journal of Marine Science and Technology*. doi:10.100700773-018-0576-9

ADDITIONAL READING

Amyot, J. R. (Ed.). (1989). *Hovercraft Technology, Economics and Applications*. Amsterdam: Elsevier; doi:10.1016/C2009-0-09667-6

Ari, I., Aksakalli, V., Aydogdu, V., & Kum, S. (2013). Optimal ship navigation with safety distance and realistic turn constraints. *European Journal of Operational Research*, *229*(3), 707–717. doi:10.1016/j.ejor.2013.03.022

Bye, R. J., & Aalberg, A. L. (2018). Maritime navigation accidents and risk indicators: An exploratory statistical analysis using AIS data and accident reports. *Reliability Engineering & System Safety*, *176*, 174–186. doi:10.1016/j.ress.2018.03.033

Cariou, P., Mejia, M. Q. Jr, & Wolff, F.-C. (2008). On the effectiveness of port state control inspections. *Transportation Research Part E, Logistics and Transportation Review*, *44*(3), 491–503. doi:10.1016/j.tre.2006.11.005

Faltinsen, O. M. (2006). *Hydrodynamics of High-Speed Marine Vehicles*. Cambridge: Cambridge University Press; doi:10.1017/CBO9780511546068

Mantle, P. J. (2015). *High-Speed Marine Craft*. Cambridge: Cambridge University Press; doi:10.1017/CBO9781316106716

Vorus, W. S. (2017). *Hydrodynamics of Planing Monohull Watercraft*. Cham: Springer International Publishing; doi:10.1007/978-3-319-39219-6

Yun, L., & Bliault, A. (2000). *Theory & Design of Air Cushion Craft*. Oxford: Elsevier Butterworth-Heinemann.

Yun, L., Bliault, A., & Doo, J. (2010). *WIG craft and ekranoplan: Ground effect craft technology. WIG Craft and Ekranoplan: Ground Effect Craft Technology*. Boston, MA: Springer US; doi:10.1007/978-1-4419-0042-5

KEY TERMS AND DEFINITIONS

Air Supported: Supported by aerodynamic forces.

Displacement: The amount of water that submerged part of vessel displaces.

International Maritime Organization: An international organization that is responsible for safe, secure, efficient, and environmental shipping.

Maritime Transportation: A type of transportation in which water masses are used for the shipment of people and cargo by any floating object.

Navigation: The science and the art that deals with methods and rules necessary to take marine craft from one position to another as soon as possible with safety and peacefully.

Navigational Aids: Special purpose signs placed by people on land or at sea according to a certain system.

Navigator: Master or deck officer who is responsible for ship handling.

Speed: Quickness and swiftness.

Chapter 16
Transportation of Chemical Cargoes by Tanker Ships

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ABSTRACT

Chemical and industrial chemical substances are used in every area of industry. Much of these chemicals are transported from one country to another by ships. Most of these ships are container ships and chemical tankers. Chemical tankers are included in international logistics because they carry large amounts of different cargoes. Moving more suitable and larger amounts of cargo from one port to another plays a role in the provision of trade. The transport of chemical loads generally takes place in 4 stages with different ship types. These stages are: tank preparation, loading, transportation, and discharging. This chapter explains these steps.

INTRODUCTION

Transport of chemical cargoes between cities and between countries is carried out by land transport, rail transportation, airway transportation and sea transportation. A large scale of the transport of these chemicals from one country to another is carried out by ships as maritime transport. Most of these ships are container ships and chemical tankers. Container ships carry loads as little as partial. They are

DOI: 10.4018/978-1-7998-1397-2.ch016

transported in special containers in the form of non-large tube sizes. Chemical tankers are included in international logistics by carrying large quantities or large amounts of different cargoes. Sea transport is one of the most important tools that enable the cargoes to reach their places of use as raw materials. Moving more suitable and larger amounts of cargo from one port to other ports or ports plays a role in the provision of trade. Chemical tanker ships are constructed in different sizes and tonnages. The biggest reason for this is that different sizes of cargoes are produced and the carrying capacity of the vessels is determined according to these cargoes. The transport of chemical loads generally takes place in 4 stages with different ship types. These stages are respectively tank preparation, loading, transportation and discharging. All of these steps should be planned according to the characteristics of the cargo to be carried and the dangers it contains. In this chapter, major chemical tanker types, types of loads are mentioned. There are many different operations in chemical tankers. These operations in terms of commercial and safety have unique risks, hazards and dangers. Seafarers can perform these operations in many different methods. This chapter describes the dangers of chemical loads in general and how the operations are performed to guide seafarers.

LITERATURE REVIEW

Since the transportation of chemical cargoes creates more infrastructure, ships, rules and risks than the transportation of other cargoes, a lot of special studies have been done in the literature. Most of these studies emerge as studies involving the risk factor, unlike the ordinary transportation operation service given to any cargo. Some of these are examined for quantitative evaluation of precations on chemical tanker operations. Risk assessments were conducted with Analytic Hierarcy Process. Chemical Tanker operations have been evaluated in terms of accidents and their prevention (Arslan,2019).

In a study conducted by (Çelik,2010), it was investigated the development of the International Safety Management (ISM) code in accordance with the requirements of Occupational Health and Safety Management Systems (OHSAS 18001: 2007) regarding the operational restrictions on Chemical Tankers.

In another study, legal compliance processes are mentioned. In chemical tankers, information is given on the impact of issues related to the management of occupational health and safety requirements. In another study, the implementation of the strengths, weaknesses, opportunities and threats (SWOT) analysis to formulate a strategy for safe transport of bulk liquid chemicals in chemical tankers has been examined (Arslan & Er, SWOT Analysis for Safer Carriage of Bulk Liquid Chemicals in Tankers, 2008).

A study that provides models for efficient transfer of bulk liquid cargoes has been studied. A system has been formulated by modeling the most appropriate sequences for the discharge of various types of liquid impurities (Cheng & Karimi, 2006).

In another study, the details of the static electrical hazard and the points to be considered in chemical cargoes are explained (Britton, 1999). It has been mentioned how to control static electricity. Measures to be taken in sampling and calculation of operations in chemical cargoes have also been mentioned. In addition, informed the flammable and explosion properties of the cargoes should be known.

In another study examined, it was conducted to evaluate human errors in chemical tanker operations. Analytic Hierarchy Process method is used to evaluate the human errors and the possibility of human error(Akyüz & Celik, 2016).

CHEMICAL TANKER TYPES

There are three (3) categories in ship form from the "IBC CODE for the Construction and Equipment of Ship Carrying Dangerous Chemicals in Bulk

Type 1 Ship

Type 1 ships are constructed and equipped to carry the most dangerous or reactive chemicals which require the most extensive precautions to avoid spill if the vessel is involved in a col- lision or grounding. Furthermore the requirements to damage survival capability and buoyancy after a collision or grounding are rather stringent. The maximum load for any tank on type 1 ships is 1,250 m3(IMO-Marpol, 1978).

Type 2 Ship

A type 2 ships are constructed and equipped to carry less dangerous product than type 1, but nevertheless so dangerous that the ves- sel must be capable of surviving minor collisions and grounding without leaking cargo to the environment. Depending on the size of the vessel type 2 ships are sub- ject to almost the same requirements for damage stability as type 1 ships. The maximum load for any tank on type 1 ships is 3000 m3(IMO, 2017).

Type 3 Ship

A type 3 ships are constructed to carry products that represent a greater danger than oil products and consequently requires some protection. A type 3 vessel has no demands to the location of the cargo tanks, but is subject to some requirements as to damage stability.

In the 1960s, ships were changed. The number of tanks and the pumping system on the ships increased. The internal structure of the tanks was started to be protected against the load with special paints. Against special loads, special stainless steel alloy tanks have begun to be constructed. Thanks to the double bottom and double skin cavities, the ventilation between the tanks and tank washing operations have been started to be made easier by providing the space between the tanks in the tankers of chemical substances and by building the tank bases flat. Effective and complete tank cleaning operations are very important for chemical ships.

CHEMICAL CARGO TYPES

Many types of chemical cargo are transported by ships in world seas. Chemical industry in the world is one of the fastest developing and changing sectors. Therefore, new chemical cargoes are continuously produced and transported from one port to another by ships. Chemical cargoes can be classified according to the risks, environmental hazards, chemical structures and human health hazards. Seafarers should carefully plan all stages of the voyage with the awareness of the possible danger and hazards of these cargoes. Generally, chemical loads can be classified as follows.

Flammable Cargoes

Flammable cargoes are defined as “Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (such as paints, varnishes, lacquers, etc, but not including substances which, on account of their other dangerous characteristics, have been included in other classes) which give off a flammable vapour at or below 60°C closed-cup test (corresponding to 65.6°C open-cup test), normally referred to as the “flashpoint” ” at IMDG Code. The loading and discharging and tank cleaning operations should be carried out by taking necessary precautions against the burning hazards of these cargoes. Necessary measures will be discussed in the operations section (IMO-IMDG, 2016).

Toxic Cargoes

These substances can cause serious drugs and deaths on living things. Serious damage to personnel when swallowed, inhaled or contacted skin. It is very important to remove the stacks that can be moved here from the personnel. Personnel cleaning is not contacting directly according to the feature and the use of protective equipment.

Corrosive Cargoes

Three dangerous details should be kept in mind when working with corrosive liquids:

- Danger Of Corrosion Of Ship Or Equipment: Common ship-building materials will be corroded pretty fast and many of the products in this group can only be transported in ships equipped with special tank- materials, special coating and with gaskets used to the purpose (IMO-SOLAS, 1974). It is important to check if the concentration of the product has in influence to the resistance of the materials.
- Danger of Fire: When corrosive liquids metal attack, if mixed with air flammable or explosive fumes that may occur. In particular, the acids develop free hydrogen, are highly explosive when mixed with air, and note that corrosive liquids can be flammable and cause automatic ignition in saw dust, rags or other similar materials.
- Health Hazards: The liquids will when they come in contact with skin or tissue damage or even destroy this. The vvounds, which come, will be painful and heal slowly. Eyes and mucous membranes are very sensitive to corrosive liquids, so therefore do not neglect the use of protection equipment.

Reactive Cargoes

These cargoes are cargoes which lose their own properties by reacting by themselves, water or other cargoes (IMO-SOLAS, 1974). The result of the reaction can occur in other dangerous situations such as burning, explosion and poisoning. The products in this connection can be split into several groups

- Self-Reaction: There will normally be two kind of reactions in question and that is decomposition or polymerization. Both reactions may be destructive to the ship and it is important to monitor the temperature of the load at certain intervals when handling such liquids. The rise in temperature may indicate that a reaction is in progress and that some measures must be taken to control the situation (International Chamber of Shipping (ICS), 2006). Decomposition will also cause heavy rise in pressure. Such liquids are normally added to an inhibitor and may require inerting of the tanks, and the shipper must provide a clear loading and voyage instruction regarding the control and edition of the extra inhibitor..If IBC "O" Column refers IBC chapter 15.13 inhibitor certificate must be required by cargo surveyor, an case of absence LP should be issued.

- Liquids Which React Violently With Water: Many chemicals cannot come in contact water unless it causes violently reactions. The reaction may be de- composition with formation of enormous amounts of dangerous fumes; it may be formation of acids or salts with hydrogen evolution, and there may be an undesirable temperature rise. Other reactions can cause discolouration of the product or may form other materials, which may attack the coating or tank materials. Information about reactions can be found in handbooks (International Chamber of Shipping (ICS), 2006).
- Liquids Which React With Air: As many products may react with air it will often be necessary to inert the tanks. The grade of inerting depends of the product end its purity, it may be assumed that the shipper will give accurate instructions about the inerting and whether traditional inert gas or pure nitrogen may be used.
- Liquids Which React With Other Chemicals: How far some of the products that are to be loaded can react with each other, shall often be considered on board, even if it may be expected that the shipper will give information about this problem. The best guide to this problem is US Coast Guard Compatibility Chart, but the information from this compatibility chart should also be compared with the information from the shipper's data sheet.

Vegetable Cargoes

It is a sad fact that a number of cargoes are contaminated by remnants of the previous cargo carried in a ship's tank, despite thorough and conscientious cleaning prior to loading. This naturally creates a serious problem whatever cargo is contaminated, but becomes even more serious when the cargo is meant for human consumption.

The National Institute of Oilseed Products (NIOP) in the USA, and the Federation of Oils, Seeds and Fats Associa- tion (FOSFA) in the UK have both conducted studies and research in order to eliminate the potential contamination problem. Discussions have taken place with representatives of importers and some shipowners in this connection, and cargo lists have been prepared.

FOSFA gives a list of so called "Banned immediate previous cargoes" with more than 50 products and a list of "Acceptable previous cargoes" giving about 110 different cargoes which can be accepted as previous cargoes (USGC, 1990). Before a ship can be accepted as carrier of edible oils it shall comply with the FOSFA "International Qualifications for all Ships Engaged in the Ocean and Short Sea Carriage and Transhipment of Oils and Fats for Edible and OleoChemicol Use" giving requirements mainly to materials of construction and tank coatings.

A statement, in the form of the FOSFA International Ship's Qualifications Combined Master's Certificate" signed by the ship's captain/chief officer shall be provided for the shipper, certifying that the ship is qualified for the coming voyage with edible oil.

The ship must also comply with the FOSFA "International \Operational Procedures for all Ships Engaged in the Ocean \ and Short Sea Carriage and Transhipment of Oils and Fats for \ Edible and OleoChemical Use" which for example details the requirements to the previous cargoes (USGC, 1990).

It is worth noting that in order to accept a cargo as “Acceptable Previous Cargo” it shall have been not less than 60% by volume of the tank The “Operational Procedures” will also give details such as inspection of tanks, sampling, heating instruction and loading through shore hose directly into ship’s tanks.

Static Electricity Precautions

The most important countermeasure that must be taken to prevent an electrostatic hazard is to bond all metal objects together (Britton, 1999). The vessel must be reduce loading rate and should not used metal sounding for first 30 minutes at beginning of the loading and also the vessel should reduce loading rate when loading low conductivity cargo (IMO, 2007). There should be a delay of 30 minutes after the completion of loading of each tank before commencing dipping, ullaging or sampling operations with metallic equipment; This is to allow the settlement of water or particulate matter in the liquid and the dissipation of any electrical potential.

CARGO PLANNING

When loading orders are received the following should be checked:

Are the products mentioned on the ship’s “Certificate of Fitness” (CoF) or in chapter 18 of the IBC-code or are they oils as defined in Marpol’s Annex I (IMO, 2007).

Figure 1. The control of hazard Associated with the initial of static accumulator cargoes (IMO,2007)

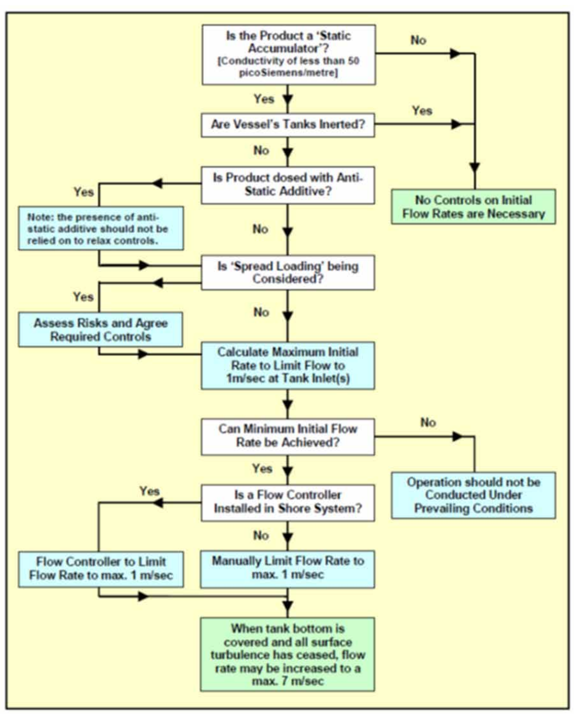


Figure 2. Formula

$$LR < \frac{3600\,u}{t}$$

LR: loading rate

u: ullage volume at the liquid level of 98% (m3)

t: time elapsed after issue of alarm to complete

Are there any restrictions in the IBC-code regarding ship type or tank type (this will also be stated in the CoF)

Are there any coating restrictions.

Are there any restrictions regarding filling of the tanks because of high densities.

Afterwards the cargo can be "laid out" considering trim, heating, and - of course - volumes. In this connection also the filling limits should be taken into account.

IBC Chapter 16.1.3 states that "tanks carrying liquids at ambient temperatures should be so loaded as to avoid the tank becoming liquid full during the voyage, having due regard to the highest temperature which the cargo may reach."

It is normally assumed that a tank may be filled up to 98% but in order to be quite accurate one may use the formula, which was given in the previous edition of Tanker Safety Guide (Chemicals):

Stoppage of cargo inflow into the cargo tank (sec S = Safety margin, usually 2% of capacity). During the loading operation all tanks should be stopped before the last high-level alarm, thus preventing an overflow due to a leaking valve. If necessary the tanks can then be topped off to a higher level at the end of the loading operation. In calm weather the density of the gas Is Important and dangerous gas concentrations should be suspected at low places on deck, along the ship's sides and on the water surface. Regulations for tank vent According to the IBC-code special regulations for vent systems systems has been laid down for chemical tankers. All tanks should be provided with a vent system appropriate to the cargoes the ship is certified to carry. Common gas outlets are only acceptable if the vapours from the carried products cannot react with each other.

General Cargo Planning Procedures

Generally, a detailed planning should be carried out to transport any cargo on chemical vessels. Whether the cargo is suitable for the ship or whether it can be safely transported in the desired quantity should be examined by taking into consideration all of the following criteria. If these criteria are appropriate, other steps are planned separately. Flow-chart for Cargo Loading Planning is expressed as below:

- Vessel should be loaded homogeneously to the ship to avoid hogging and sagging with a positive trim.
- Vessel should be loaded especially in cargo tanks without the ballast and according to the desired evacuation steps.

- It should be ensured that the stability of the ship during loading, transportation and discharging stages is appropriate and safe with international rules.
- Reactive cargoes should not be placed in adjacent tanks. All pipe systems must be separated by double-blind flanges to prevent improper use of valves.
- Toxic cargoes must not be placed in adjacent tanks with eatable products and must be separated by double-blind flanges.
- Vessel must be ensured that cargo can carry by checking with the tank coating manufacturer's list of permissible cargoes for coatings in each tanks. In certain cases the tank coating manufacturer gives a limited acceptance for a product like time or temperature.
- Polymerizable products and drying vegetable oils must not be loaded next to heated cargoes or hot bulkhead.
- Volatile products must not be loaded next to heated cargoes or hot bulkhead due to prevent unnecessary evaporation losses.
- In case of more than one load, the necessary separation should be performed by checking the compabilities of the cargoes via compability chart.
- If heating performed by steam heating coils should be blind flanged towards the engine room when products are carried which do not require heating.
- Cargo tanks should be never loaded over 98,5%.
- Generally, from 10% to 90% filling ratio of half loading is prohibited in order to avoid sloshing, where tank's breadth exceeds 60% ship's one, or tank's length exceeds 10% Lf (ship's length) or 10, whichever is larger.

LOADING OPERATION

The loading operation shall be carried out in accordance with the loading plan, planned by the chief officer and approved by the captain. Responsible officer shall observe the above-mentioned precautions when preparing this plan. The first stage of loading operation is tank inspection. Ship responsible officer and the cargo surveyor which representing shipper perform tank inspection together.

Tank inspection varies according to the current conditions. Sometimes visual control is sufficient, but sometimes it is possible to use the methods up to the test in the laboratory environment. How to do the tank inspection is decided according to the properties of the cargo to be loaded and the characteristics of the cargo previously carried. The main purpose is that the cargo to be transported is not damaged by the old remains in the tank. Tank inspection methods are explained briefly below.

- *Visual Inspection: It is a method applied for relatively non-sensitive cargoes. These cargos are not expected to be damaged by mikro levels cloride, carbon, etc. particles that remain in the tank. Responsible officer and cargo survey checks if any residues, rust or any other material by entering tanks after taking the necessary safety measures are taken. Also check whether the tank is dry or not.*
- *Wall Wash Inspection: It is of outmost importance when making chemical testing of cargo tanks, to keep all glassware and other items for testing in clean condition. All agents such as methanol and deionized water must be ensured of pure laboratory grade prior to use.*

Suggest using a clean plastic bucket to transport material for obtaining wall wash samples. The bucket should contain squeeze bottle, cut-away funnel, bottles for the number of tanks to be tested, flashlight, plastic disposable gloves and marking pen for bottles.

Randomly select two spots on each bulkhead, including blind spots, for methanol rinse in order to get a representation of app. 1 m^2 in total. Rinse all equipment first with pure methanol (funnel, bottles, hands, etc.). While holding the funnel and bottle in one hand pressed against the bulkhead, use the squeeze bottle to pour methanol slowly on the bulkhead app. 1 meter above the funnel, making an app. 10 cm wide path of methanol running down into the funnel. By collecting app. 25 ml of wall wash from each spot, you will have ample for testing. It's of imperative importance that the surface to be methanol washed is dry.

Testing for Hydrocarbons (Water Miscibility)

- Fill a clean stoppered cylinder with 25 ml of wall wash sample. Add 75 ml of deionized water. Invert tube to mix same and allow to stand for about 20 minutes.
- A standard solution, consisting of 25 ml of laboratory methanol and 75 ml of deionized water, should be prepared to compare to the wall wash samples.
- Place the tubes on a black surface. Compare the wall wash sample alongside of standard solution by looking vertically down the tubes in good natural light or artificial white light.
- If a bluish tint is present, there are moderate to heavy hydrocarbons. If a whitish haze is observed, this usually indicates slight hydrocarbons. Factors which could affect this test are, if the graduation numbers on the tube are in blue, or if the column is dirty.

Testing for Chlorides

- In a clean stoppered cylinder, make a standard solution, consisting of 50 ml of laboratory methanol and 1 ml of silver nitrate solution to compare to the wall wash samples. The standard solution should remain transparent.
- Fill a clean stoppered cylinder with 50 ml of wall wash sample and 1 ml of silver nitrate solution. Invert the tube to mix.
- Compare the turbidity of the sample with the standard by looking down through the liquid against a black background. If any turbidity is formed, chlorides are present.

In order to determine the exact amount of chlorides present in a sample, other standards then the above mentioned can be made. One of the ways can be found in Dr. A. Verwey.

Permanganate Time Test

Of all the tests performed on board, this one is most subject to error due to its complexity. Ideally, all the equipment, used for testing, will have been thoroughly cleaned with hydrochloric acid and rinsed 3 times with tap water, twice with deionized water and twice with methanol. The test must not be done in sunlight, but preferably in white fluorescent light.

- A permanganate solution made of 0,1 gram potassium permanganate ($KMnO_4$) powder or crystals mixed with 500 mls of deionized water should be prepared in an amber coloured bottle. The bottle should be stored in a dark place and the solution should be renewed every 3 days.
- Prepare a water bath that must maintain 14,5-15,5 °C during the whole test. E.g. use a beach cool box filled with water. Then adjust with ice cubes in order to maintain the correct temperature.
- Fill one stoppered cylinder with 50 ml standard colour solution (Uranyl Nitrate – Cobaltous Chloride Solution) and place it in the bath. This solution can be used again and again as long it is not contaminated.
- Fill one stoppered cylinder with 50 ml of wall wash sample and in another stoppered cylinder with 50 ml of clean laboratory methanol, and place both in the water bath for 5-10 minutes in order to obtain the same temperature as the bath.
- When the 5-10 minutes has passed, then add 2 ml of potassium permanganate solution to each of the two above mentioned cylinders and invert once to mix, then replace them in the bath, noting the exact time. Determine the intensity of the pink colour at max of 10 minute intervals. Report the minutes elapsed between the time the potassium permanganate solution was added and the time the pink colour matches the standard. If the cylinder with laboratory methanol fades at less time than you are testing for, it is an indication of a problem with either the quality of the laboratory methanol, quality of the potassium permanganate solution, or the cleanliness of testing equipment.
- Requirements for passing the test runs from 45 minutes up to 120 minutes although 60 minutes is about normal.

LOADING PRECAUTIONS

Before loading İt is very important to check the function of the P/V valves and the high level alarms. Loading of chemicals should always start with a slow loading rate in order to assure that the uplining is correct and check for leakage in the cargo piping in use. The maximum loading rate is agreed with the loading master taking note of the construction of the cargo piping, the ship's construction and the danger of the chemical to be loaded.

Topping off should be carried out in accordance to the method of gauging stated in the IMO Code, and always recognizing the character of the cargo. Gauging should be carried out In accordance with the specification in chapter 17 column J of the code. The following gauging methods ere considered.

- Open Device (O): Gauging with ullage tape or stick is allowed through open hatch or ullage port.
- Restricted Device (R):It is allowed to use a gauging system, which permits minor amount of vapour to come into contact with atmospheric air during the gauging, but in the rest of the time is com- pietely dosed. A typical example of such a device is a vertical pipe with a ball valve on top. It is then possible to attach a special instrument to the ball valve, open the valve and make the gauging.
- Closed Device (C): It is allowed to use a system, which penetrates the top of the tank, but moreover is vapour and liquid tight Examples are float systems, electronic or magnetic systems or tank radar.
- Indirect Device (I):This system does not permit penetration of the tank, so the only way to measure the content of the tank is to weigh the cargo (draft survey), use flow meter or similar

The gas venting system requires special attention when loading chemicals. IMO distinguishes in t the product hst between open and controlled vent systems and for systems with safety relief valve The open tank vent is only allowed for products with flash point above 60 ºC and which does not have any health risk. In all other instances special rules should be adhered to, where an important point is that the gas outlet should be placed it least 6 m above deck and walkway or 3 m above if the ship is fitted with hteh velocity valves.

It is important to notice, when transporting health risky products, if there are special requirements concerning handling of the vapour mentioned m column o in the IMO code, for many products it is required that the vapour is returned ashore via a so called vapour return line.

DISCHARGING OPERATION

Mostly the same precautions should be taken during the discharge as during the loading. Again it is important to check the function of P/V valves. At the very start of the discharge emergency stops should be tested. If the tanks have been filled above the level of the highest high- level alarm, all tanks should be discharged to a level below the high-level alarm in the beginning of the discharging operation, thus allowing the alarm to be put into operation, and giving the possibility of a warning if a leaking valve in the system causes a tank to be filled during the discharge of other tanks with the same product. Sometimes it is not allowed that air is drawn into the tank during discharge, so in order to prevent vacuum the tanks must be refilled with inert gas or nitrogen. This is not a problem in ships with their own inert gas generator, but in other ships it will be necessary to connect a vapour return or a nitrogen source from shore.

During the discharge it is necessary to be aware of the conditions in the pump room, if any. Even if the pumps can be run from outside the pump room it is sometimes necessary to enter the pump room to inspect the pumps or valves there. Despite the operation of mechanical ventila- tion, it must be a standing order, that nobody enters the pump room without permission from the responsible officer. This officer is the one to decide whether to use protective equipment and moreover assure that the regulations for entering the pump room are adhered to.

TANK CLEANING

Cleaning of tanks is usually the responsibility of the ship. The Tank Cleaning and the cleanliness involved have different standards depending on the previous cargo and the cargo to be loaded. But the matter can be still more complicated, as cleanliness for one and the same product varies, depending on whom the receiver is and for what the cargo is finally intended.

Tank washing is carried out to:

1. Prevent the buildup of oily residues, sludge and sand.
2. Prevent cargo contamination between incompatible cargoes.
3. Prepare tanks for the carriage of clean ballast or the next cargo.
4. Facilitate gas freeing and tank entry for repairs.
5. Comply with Charter Party requirements, and maximize income.

It is accomplished by means of portable or fixed tank washing machines or sometimes a combination of both. Crude oil ships and some product vessels are fitted with high capacity fixed machines some of whose arc of operation may be controlled in the vertical plane.

Portable machines should be carefully positioned to achieve best results, particularly where residues exist in areas of the tank 'shadowed1 by deep frames, floors etc.

Portable machines must only be used with tank cleaning hoses which have been tested for electrical continuity.

It is essential that any specific tank washing requirements contained within a Charter Party are complied with in full.

The requirements of MARPOL 73/78 are to be complied with at all times.

A deck watch must be on duty at all times during cargo tank cleaning operations, the arrangement of which must ensure that at least one watchkeeper is on duty on deck at all times.

Practical Cleaning Methods

Same Cargo

If the vessel is to carry the same product on the following voyage, the cleaning operation might be omitted. Of course this is not always the case, as there still may be a number of reasons for the shipper to demand clean, gas free tanks before loading. One such reason might be that the final use of the product is quite different.

High Vapour Pressure Cargo

If the vapour pressure of the product exceeds 50 mb at 20 C, tank cleaning may be accomplished simply by ventilation according to MARPOL's Annex II. Whether this is an technique or not depends on the product and the vessel's equipment. For example it is possible and allowable to ventilate pure Benzene, but it might be unwanted because of the toxic properties of Benzene vapour, and because of remaining smell and/or solid residues in the tank. Tank cleaning by ventilation alone requires efficient blowers and MARPOL specifies a minimum blower capacity according to the diameter of the air and the depth of the tanks (TaeChang, Roh, & Park, 2014). Tank cleaning by ventilation is an excellent procedure with many High Vapour Pressure Products, as it eliminates the need to decide what to do with slops. The method is particularly efficient if the vessel features a hot air or dry air system.

Prewash

MARPOL's Annex II specifies a Mandatory Prewash for many substances. If this is relevant for the product to be cleaned, the procedures in the vessel's P&A manual should be strictly adhered to. Mostly the above mentioned considerations will be dealt with quickly, and what is left is the actual tank cleaning where the purpose generally is to get the tanks as clean as possible, as the next cargo might not have been decided upon.

Preliminary Cleaning

For the first and, possibly the only cleaning, it must be decided whether to use water or not. A few cargoes will react with water (for example Toluene Disocyanate Acroriym (TDI)) and form insoluble sedi- ments. For the great majority of cargoes there is, however, no doubt the tanks are washed with water.

The purpose of pre cleaning is to remove the residues after the discharge. The sooner the pre cleaning is carried out after discharge, the easier oil and residues will be removed. Pre cleaning should be done with tank cleaning machines using sea or fresh water. Temperature for pre cleaning depends on the grade of cargo previously discharged, but the wash water temperature should normally not be more than 10 13 higher than the cargo previously discharged. This procedure has to be executed with a view to obtain optimal results in cleanliness and is not set up in respect to MARPOL.

The next question will be whether to use hot or cold water, and this might well be the most important question. With many products a wrong choice of washing temperature will not mean alot, but when cleaning after a “drying oil” (veg. and animal oils with a low content of free fatty acids) it is of utmost importance to start with cold water as the product otherwise will dry into a coat on the tank surfaces which is very difficult to remove. Using hot water will also be a great mistake after many polymerisable products. If in doubt consulting various Tank Cleaning Guides, Survey Companies or the shipper might give a suggestion, and if it is impossible to get enough information the washing procedure should be initiated with cold water. Furthermore it must be decided how long the washing should go on. The time will always depend on the ship’s equipment, and might vary from one cycle to several hours depending on the tank structure, the product and the washing machines. Again reference to a Tank Cleaning Guide might be useful.

Tank Cleaning Guides

Several companies, which manufacture cleaning agents, also publish handbooks or instructions to explain how to use the cleaning agents for various products. Also some independent companies publish such tank-cleaning guides. An example of such a guide is the Tank Cleaning Guide published by Laboratory Or. A. Verwey, Rotterdam.

This guide takes both the discharged cargo and the product to be loaded into consideration. The list advises on the cleaning operation between 415 different products. Below is shown a copy from the first part of the book which provides a cleaning code by entering with the products in question.

Final Cleaning

Chemical Addivities

There are a great many substances, which can be added to chemical cargo residues which work on the detergent principle and facilitate the tank washing procedures. This is especially true for water insoluble cargoes these cleaning compounds consist of a synthetic soap, a detergent and an emulsifier, all dissolved in an aromatic or aliphatic hydrocarbon Solvent the Synthetic soap and detergent activate cleaning while the emulsifier keeps the impurities dissolved in wafer these are carried into the water insoluble residues by the solvent Carrier. This is the most popular method of chemical cleaning and is known as emulsification.

A second method of chemical tank cleaning is called saponification, a process which basically turns the residue Into a soapy solution. This type of cleaning is ideal for animal and vegetable oils since they are esters and are composed of glycerols and fatty acids, which can be broken down by the alkali such as caustic soda. The fatty acids react with the caustic forming a soapy mixture, which is soluble in water

There are productS on the market, which contain a "quick break" emulsifier thereby reducing the amount of tank washing. These emulsifiers ensure a clean break between the emulsified residues and the wash water in the settling tank. The free water may have a residue content as low as 10 ppm and therefore may be removed from the settling tank for reuse This way the amount of washing in the settling tank is kept as a minimum. The use of any type of chemical additive must have the approval of the tank coating manufacturers This is usually done by the additive manufacturer prior to marketing his product In addition to the variety of emulsifying solvents, saponifying agents, etc, there are a large number of other products available to the operator committed to coated tanks. These products include deodorizers, passivating paste for stainless steel, hydrocarbon dispersants, degreasant, etc. The operator must temper the manufacturers' recommendations with his own experience. Additive quantities and concentrations stipulated by the manufacturers are sometimes on the high side and since none of these products are cheap it is advantageous to the operator to become familiar with each product so that an economical and effective point can be reached.

if it is considered necessary to perform further cleaning after the preliminary cleaning, more demanding techniques may be utilised.

1. Saponifying with caustics.
2. Cleaning with detergents
3. Dissolving with a solvent.
4. Chemical reaction.
5. Steaming

Vegetable and animal oils are easily saponified with an alkaline like Caustic Soda or Caustic Potash. The remaining soap from Caustic Potash is readily washed away with water whereas the soap from Caustic Soda tends to form hard brittle particles, which are almost insoluble in water. The schedule below can be used to determine how many kilograms of Caustic Soda necessary to obtain a required pH value of the tank cleaning water

After a cargo of mineral oil or its derivatives synthetic soaps or special cleaning agents which are mixtures of synthetic soaps (detergents) and other emulsifiers can be used for the final cleaning. Some cleaning agents also contain solvents, and will consequently be able to give positive hydrocarbon test after the cleaning. Hence the tanks must be washed thoroughly with water after use of such cleaning agents.

Some residues have very high melting points, which makes them difficult to emulsify. To clean such residues it may be necessary to use a solvent. Frequently used solvents are toluene or white spirit. Both may be applied by spraying or by the lift method (see below) Some residues are persistent enough to make it necessary to heat the sol- vent, and care should be taken to choose a solvent with a sufficiently high boiling point.

Whenever possible the cleaning procedures adopted should not involve personnel entering a non-gas free tank. If however it is necessary to enter the tank, all precautions should be taken to protect the personnel involved from the health hazard of the cleaning solvent and a flammable sol- vent should only be used for spot-cleaning and never for spraying in a non-inerted tank.

Table 1. Determining table for quantity of caustic soda (USCG,1990)

CAUSTIC SODA SOLUTIONS						
Tons of	**Kilogram of Caustic Soda**					
water	**pH 11.5**	**pH 12**	**pH 12.5**	**pH 13**	**pH 13.5 1**	**pH 14**
3	0.40	1.2	3.8	12	38	120
3,5	0.45	1.4	4.4	14	44	140
4	0.50	1.6	5.1	16	51	160
4.5	0.57	1.8	5.7	18	57	180
5	0.63	2.0	6.3	20	63	200
5.5	0.70	2.2	7.0	22	70	220
6	0.76	2.4	7.6	24	76	240
6.5	0.82	2.6	8.2	26	82	260
7	0.89	2.8	8.9	28	89	280

Chemical reactions are rarely used for tank cleaning purposes, but may be the only alternative if some unwanted reaction during the voyage or during the initial cleaning has left an insoluble residue on the tank walls. Furthermore chemical reaction may be used to remove rust (iron oxide) from the coating and the piping. When undertaking an operation involving chemical reactions, advice should be sought from competent companies.

Another way to dissolve solid residues is by steaming or even by steaming with a solvent (for example toluene) or an alkaline cleaning agent. Steaming with solvents like toluene should only be carried out in inerted tanks due to the risk of ignition by static electricity.

All the above-mentioned cleaning agents may be applied in a number of ways, which in brief can be described as follows:

The İnjection Method

This method is practised by injecting the cleaning agent (caustic, detergent or solvent) directly into the tank cleaning line either on deck or In the pump room. There are several methods to use by injection with chemicals during tank cleaning, into the mechanical tank wash system but the method preferred for tank cleaning at sea is:

Inject the chemical directly into the tank-wash line on deck. The chemical is injected from a 200 litre drum directly into the tank-wash line on deck by means of an air operated pump on the drum, a small needle valve and a short hose, connected to a spare tank-wash hose valve. The main benefit of this method is that the injection and correct dosage of chemical can be regulated and controlled at any place on deck, close to the tanks being washed.

The Recirculation Method

In general this method of tank cleaning with a chemical solution is highly effective. One of the vessel's tanks is used to mix a suitable solution of the cleaning agent (for example a 0.2% detergent solution). The mixture is pumped through the cleaning line and the cleaning machines and is stripped back to same tank. To work properly this method demands a good preliminary cleaning as otherwise the cleaning mixture will quickly become inefficient. A great advantage of the re-circulation method is that both heat and chemicals are recovered and used over and over again until one or more tanks are completely cleaned. The effect of cleanliness may improve if a suitable filtering system can be used between the pump and the cleaning machines. The most common system is to insert a strainer into the X-tree when connection is made on the pump stack. Recirculation is only permitted between inerted tanks or gas-free tanks.

Recirculation with Chlorinated Solvents

The preferred products purchased/supplied should be noncontaminated Trichloroethylene and or Perchloroethylene. If the moisture content is not more than a few hundred ppm, the chlorinated solvent should be acceptable for most recirculation operations.

A larger quantity (10 to 15 tons) of Methylene Chloride (MEC) is usually requested for cleaning after discharging of isocyanates like Toulene Diisocyanate (TDI) and Diphenlymethane Diisocyanate (MDI), but only when compatible with the coating. Equipment for recirculation and must be clean and chemical resistant to chlorinated solvents. Furthermore, chlorinated compounds tend to hydrolyse in the presence of water and form organic or mineral acid.

Bleach

Bleach is also known as Clorox and Oixichlor. The chemical name is Sodium Hypochlorite Solution (11 -13%), which is a strong oxidizer. The name “Bleach” is used throughout this procedure. Precaution: The product is very aggressive pH 14, - in particular to stainless steel and the aggressiveness increase with raised temperatures. Any bleach solution must not be allowed to dry on any tank lining or stored in cargo tanks as cleaning solution or slops. Bleach solution should mainly be used in coated tanks and when diluted to maximum 1% strength.

Diluted bleach is used for following purposes:

Removal of odour, if present after normal tank cleaning.

Removal of colour, if present after normal tank cleaning. (Colour may be present after last cargoes having strong colour which is also the case after dyed gasoline).

Improving the Permanganate Time Test, if low after normal tank cleaning. (Low PTT is often the result of a reducer remaining on the tank surface, which originates from an inhibitor or the cargo itself). The bleach is known to be contrary to a reducer, which is an oxidation agent.

Procedure

After any seawater washing, ensure to thoroughly fresh water rinse the tank before preparing the bleach solution.

Prepare the tank for re-circulation. Add fresh water into the tank enough for the re- circulation and add maximum 1% of bleach into the tank by the drop line. Secure the tank and start recirculation immediately. Apply the tank heating system and bring the temperature up to maximum 50 °C.

On completion close the tank-heating system. if a second tank needs the same cleaning method, it should be prepared for recirculation prior to transferring the used bleach solution.

During recirculation temperature should not exceed 50 C due to the solution's aggressiveness. Hand spraying is not recommended. Immediately after recirculation, rinse the tank with warm sea or fresh water for three machine cycles. After the end of rinsing, take a sample from the discharge line and inspect it for traces of remaining bleach, odour, foam, Ph-value etc.

If the bleach solution is still present, the rinsing should continue until outcome rinsing water is free of bleach and pH value is the same as the incoming rinsing water. On completion of rinsing, continue with chloride free distilled water in order to remove the salt/chloride because if bleach is still present in the coating, it will affect the chloride test. If bleach solution is not washed off immediately after recirculation or if it is stored in cargo tanks, in particular stainless steel tanks, corrosion and or coating damage can be expected very soon.

The Lift Method

In some situations it may be convenient or necessary to apply a solvent or cleaning oil to the tank walls. This is done by pouring the solvent into a tank and then slowly lifting the solvent by pumping water in below it. The lift should not exceed about 1 metre per hour, and thus the method is very slow. When the tank is full the water level is lowered again by pumping the water to a slop tank. When the tank is almost empty the rest of the cleaning agent is pumped into the next tank and the procedure starts all over again. Toluene has often been used as the medium. Toluene is a highly static electricity generator, so extreme care must be taken with the bonding of all equipment used for the operation. One of the leading tank cleaning laboratories in the world, Dr. Verwey, does not recommend Toluene Floating.

Hand Spray Method

The method is undertaken by spraying a cleaning agent directly onto the surfaces of the tank. After a certain time, during which the cleaning agent works on the residues, the tank is water washed in a normal pattern. This method is very efficient and the consumption of cleaning agent is reasonably low, but it should be borne in mind that it is very important to protect the crew involved in the operation, as many cleaning agents are rather dangerous to personnel. Also, this method should never be used with a flammable cleaning agent due to the risk of an electrostatic ignition.

Type of spray equipment to be employed varies from simple hand operated sprayers to compressed air driven pumps, pressure tanks, all connected via sufficient length of chemical resistant hose to a suitable spray gun. For manual spraying it is highly recommended to use airless type spray guns, thus spraying tankcleaning solvents under pressure without air-atomisation.

All personnel who enter the tank during inspection, control, repair, maintenance etc, must wear soft soled shoes. This is of special importance for epoxy-coated tanks, which have been exposed to chemicals, softening the coating.

Atomisation Method

The principle is the same as mentioned for the hand spray method, but instead of sending men into the tanks to apply the cleaning agent, a lance-like apparatus with fine nozzles is introduced into the tank. The cleaning agent is pumped through the nozzles and after some time the tanks are water washed. As this method almost invariably will generate large electrostatic potentials, it should only be used in inerted tanks or in gas-free tanks with a non-flammable cleaning agent.

Steaming Method

This procedure is mostly done after tank cleaning, and before loading of chemicals. To make the tanks free of hydrocarbons, chlorides, also for a Permanganate Time Test. For this matter we have a choice of several types of chemicals, like aromatics, alcohols, ketones and products like perchloroethylene or trichloroethylene. It is a matter of fact that the choice of chemical for steaming complies with instructions of the coating supplier. When steaming the tank with chemicals one have to consider about the lower flammable limit (Lower Flammability Limit (LFL) or Lower Explosive Limit (LEL).

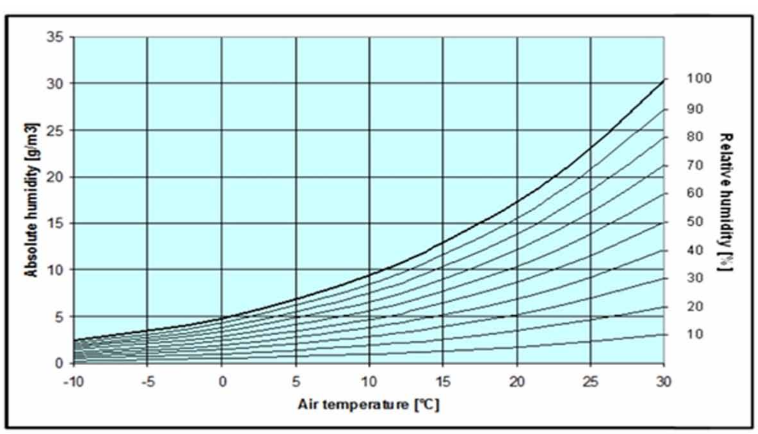
Fresh Water Flushing

For all kinds of tanks it may be necessary to undertake a final rinsing with fresh or even destilled water to remove any chlorine residues or residues from cleaning agents, which may react with the next cargo.

Ventilation and Drying

Any tank cleaning operation is concluded by ventilating and drying the tanks with air. The drying of the tanks is in fact done in the way that the air blown into the tank picks up the humidity of the tank atmosphere, and thereby removing the water from the tank when the air again leaves the tank. However it is important to remember a few fundamental principles of how air can accumulate/contain humidity.

Figure 3. Dewpoint curve diagram (International Chamber of Shipping (ICS), 2006



The relation between the temperature of the air and the water content in g/m is so, that the air is able to contain a higher amount of humidity at a higher temperature as it is seen from the curves:

On the diagram is given the absolute humidity in g/m^3 on the left axis, and the relative humidity in % on the right axis as a function of the temperature. When the air reaches a relative humidity of 100% the air is saturated and then no longer capable to take up more humidity.

An example will show that only about 1,5 grams of water vapour can be removed per of supplied air if the air blown in has a temperature of 20 ^oC and a relative humidity of 90%, which is not unusual when at sea. One also has to be aware that there is no reason in trying to dry tanks if the empty tanks are surrounded by cold ballast tanks where the steel temperature is below the dew point of the air blown in. From the curves can be read as an example that a 20 ^oC warm air with a relative humidity of 90% will start to condense if the temperature of the air falls to below about 18°C. So therefore it can be recommended that the dew point of the air is determined and compared with the steel temperature of the tank if in doubt whether it is worthwhile to start drying tanks now or wait until the relative humidity is lower.

In some ships it is possible to dry the air before it is blown into the tanks. This can be done by means of for example a "Münters Dryer" or by blowing the air through receptades (cylinders) filled with a moisture absorbing substance, which later can be regenerated. Using those methods the dew point of the air can be significantly lowered, and the air will therefore be able to remove considerably larger quantities of water per m air and furthermore it will be possible to dry even very cold steel bulkheads. If the tanks are equipped with heating coils or if the ship is equipped with an air heater then it will be possible to heat up the tanks during the drying, and it will be seen from the curve above that a raise in temperature from for instance 20 ^oC to 25 ^oC will make it possible to remove about 8 grams of water per m instead of only 1,5 grams per m^3. The heating will of cause also result in a higher steel-temperature, so condensation will be less probable; but in practice it is often seen that it is difficult to "catch" the underside of the deck, which results in condensation under the deck and "rain" in the tanks.

Non-Drying Oils (Vegetable and Animal Oils)

To ensure that the simplest and easiest tank cleaning procedures are adopted, it is of paramount importance that all of the liquid cargo is discharged, and that as far as possible there are no large solidified lumps of waxy residue remaining in the tank. To achieve this condition several practical conditions must be obtained.

Many vegetable, fish or animal oil cargoes must be carried in a heated condition to ensure that they are sufficiently fluid for pumping to shore tanks. Any instructions regarding the carriage and discharge temperatures of the cargo must be strictly followed. It must be remembered that overheating a cargo can many instances, be as detrimental as allowing it to cool and solidify. When there are very ray seawater temperature at discharge layers of cargo product must be physically agitated with heating coils in use. The solidified lumps will melt and they can be pumped away along with the rest of the cargo. It is important that tank heating is maintained for the duration of the cargo discharge. Keeping the product fluid during discharge is important, but it should always be kept flowing in the correct direction - that is towards the suction. It is therefore crucial that the ship be trimmed so that the product will flow continuously to the discharge point ensuring that the cargo pumps maintain a positive suction at all times. The cleaning of non-drying oils from a tank need not be done immediately after discharge such as is necessary for drying of semi-drying oils.

Non-drying oils should be pre-washed directly with hot water (70 - 80 C).

Drying Oils and Semi-Drying Oils

The degree which oil will dry in the presence of oxygen is governed by the concentration of the glycerides contained in the oil, particularly the linoleic acids. The affinity of oils for iodine is used as a method of grading them into drying, semi-drying, or non-drying types. The oils with the greatest affinity (i.e. highest iodine number) to iodine are the fastest drying oils. The lowest iodine values are characteristic of non-drying oils. The process by which oil dries is called OXIDATION. The film of oil upon the cargo tank sides absorbs oxygen from the atmosphere hardens and adheres to any surface it contacts. This process occurs with both natural oils and man-made products in which natural oils are mixed with synthetic resins, chlorinated rubber, etc. These properties are utilized in the production of binders in paints and varnishes.

GAS FREEING

The term ‘gas freeing’ refers to the process of diluting and/or displacing a tank atmosphere with fresh air until such time as hydrocarbon gas levels are below the Lower Flammable Limit (LFL), their Threshold Limit Value (TLV) and the oxygen content has been restored to 20.9%. More precise definitions are contained in the current edition of International Safety Guide for Oil Tanker and Terminal (ISGOTT). Effective dilution is defendant upon a turbulent air flow and the penetrating ability of the incoming stream of air to break up layers of heavy gas in the bottom regions of a tank.

The axial flow, portable gas freeing fan has established itself as a safe, reliable and efficient tool to gas free cargo tanks. It will deliver large volumes of air at high velocity and in so doing will effectively gas free large cargo tanks in a relatively short space of time. Its effectiveness relies upon the fan working against the least possible back pressure and in designing such a fan the manufacturers tacitly assume that it will work close to its free air discharge point i.e. that there will be adequate exhaust capability from the tank to prevent a significant rise in back pressure.

In ships fitted with inert gas systems, prior to gas freeing, tanks must first of all be purged with inert gas until the level of hydrocarbons measured in the efflux has been reduced to less than 2% gas by volume as measured on a Gas Measuring Unit, Tank scope or similar instrument. This procedure ensures that the tank atmosphere will not re enter or pass through the flammable range when air is admitted into the tank.

FUTURE RESEARCH DIRECTIONS

Chemical tanker are highly risky transporters. On board, personnel should be prepared for cargo-related accidents and hazards. Intervention plans prepared by IMO should be reminded to seafarers through regular training and workshops. Risk analyses should be carried out for cargo transported in chemical tankers. Risk analysis is very difficult for some cargoes. Generally, risk analyses may not cover most hazards. Therefore, more comprehensive risk analyzes should be developed for chemical loads. Chemical tanker ships need special terminals. These terminals should be installed in safe areas away from other terminals. No unauthorized personnel should enter the site during operation. For this reason, the terminal areas should be designated high security with the application of the proper measures of occupational safety standards. For this reason, the terminals need to establish more comprehensive safety rules specific to the loads they handle.

CONCLUSION

In parallel with the development of the world industry, transportation takes place in the rapidly changing and changing chemical sector. A significant part of chemical transportation is carried out with chemical tankers. There are many types of chemical substances and each has its own risks and dangers. Seafarers work in chemical tankers should know both ship types and cargoes. Because it is not possible to know all the cargoes by mind, the sources related to chemical cargoes should be well known. In order to use these resources correctly, a complete chemistry physics and mathematics infrastructure should be established during the training of the seafarers. On the other hand, loading, discharging, tank cleaning, and gas free operations are carried out. Each operation is carried out in its own hierarchical discipline. The seafarers should have the necessary knowledge, observation, attention and experience to perform these operations. The slightest mistake in chemical tankers operations can lead to environmental pollution, human health and commercial disasters. To prevent this, the training of the seafarers and the inspection of the ships should be carried out with care. Working conditions on ships should be improved and people's physical and mental conditions should be followed well. This chapter is a guide for chemical tanker operations for seafarers and students.

REFERENCES

Akyuz, E., & Celik, M. (2016). A hybrid human error probability determination approach: The case of cargo loading operation in oil/chemical tanker ship. Elsevier, 424-431.

Arslan, O. (2009, March). Quantitative evaluation of precautions on chemical tanker operations. (S. Direct, Dü.) Elsevier (Vol. 2), 113-120.

Arslan, O., & Er, I. D. (2008, June). SWOT analysis for safer carriage of bulk liquid chemicals in tankers. Elsevier, 1-3(154), 901-913.

Britton, L. G. (1999). *Avoiding static ignition hazard in chemical operations*. New York: American Institute of Chemical Engineers. doi:10.1002/9780470935408

Celik, M. (2010, February). Enhancement of occupational health and safety requirements in chemical tanker operations: The case of cargo explosion. Elsevier, 195-203.

Cheng, H., & Karimi, I. (2006). Scheduling trans-shipment operations in maritime chemical transportation. *Industrial & Engineering Chemistry Research*, 1955–1973.

IMO. (2007). *International code for the construction and equipment*. London, UK: International Maritime Organization.

IMO-IMDG. (2016). *International maritime dangerous goods*. London, UK: International Maritime Organization.

IMO-Marpol. (1978). *Marine pollution*. London, UK: International Maritime Organization.

IMO-SOLAS. (1974). *International Convention for the Safety Life at Sea*. London, UK: International Maritime Organization.

International Chamber of Shipping (ICS). (2006). International oil tanker and terminal safety guide. London, UK: International Chamber of Shipping (ICS).

TaeChang, Y., Roh, Y., & Park, H. (2014). Assessing noxious gases of vessel operations in a potential Emission Control Area. Elsevier, 91-97.

USCG. (1990). *USCG chemical data guide book for bulk carriers*. New York: United States Coast Guard.

Chapter 17
Operational Process in Lpg and Lng Gas Ships in Maritime Transportation Logistics

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ABSTRACT

Liquefied petroleum gas is used as an energy source in many areas of the world. It is among the most important fuels used worldwide. Transport of this type of petroleum products between ports is carried out on a large scale. These cargoes are transported in ship types called LPG tankers. Transported LPG gas formation must be carried in liquid form. Particularly in these liquid formations, the transportation of the LPG vessels is divided into different types and it is carried under the name of Fully Refrigerated, which authors call full cooling. LPG is a highly sensitive, flammable, and explosive property, but it is also necessary to know special precautions regarding its transportation. Load operations are difficult processes for LPG tankers. The most complex of these processes is the change of load called grade change. The chapter guides LPG vessels' workers and students in the education process.

DOI: 10.4018/978-1-7998-1397-2.ch017

INTRODUCTION

Sea transportation logistics is one of the most important building blocks of the logistics sector with the globalization of the economy. In order to better understand and understand this maritime transport area, it is first necessary to examine how sea transport is carried out and what processes are going on. Considering the transportation economy, sea transportation is one of the most used methods with the least amount of transportation. It also provides a safe transportation of cargo. In sea transportation, many types of ships travel in the seas and realize the largest part of transportation. Liquefied petroleum gas and liquefied natural gas, which is the most complex and difficult type of transportation models, should be examined in detail.

According to the data of the Chamber of Shipping 2017 sector report, the transportation of the LPG segment has led to a strong demand increase since 2012, according to Clarkson Research. This increase significantly increased both earnings and orders. In early 2017, the LPG fleet consisted of 30.3 mcbm (22.4 mDWT) and 1,382 vessels. This tonnage represents an increase of 17.2% over the previous year in terms of capacity. This is a function of high returns observed in 2014. Although the weak freight rates observed in 2016 (0.7 million DWT 12 vessels) restrict the order activity, the LPG order book at the beginning of 2017 still includes 115 units with a volume of 3.7 million DWT. The world tanker fleet, together with gas tankers, crude oil tankers, chemical tankers and product tankers, has 12262 units. 1770 of this number is indicated as gas tankers. As stated in the numbers, the gas tank market is small in volume but small in volume.

There are also differences in the variety of gas tankers. 5 different types of liquefied petroleum gas vessels traveling in global sea trade are identified. They have differences, such as full-pressure gas vessels, semi-pressurized gas vessels, ethylene vessels, fully-refrigerated gas vessels, and liquefied natural gas ships. Full-pressure vessels, semi-pressure vessels and ethylene tankers can be specified as small-sized liquefied gas carriers. Fully refrigerated gas tankers and liquefied natural gas carriers come in large size and tonnage. The most prominent feature of the first three types of vessels is that they perform close coastal voyages and carry out partial transportation in low tonnage. Other liquefied petroleum gas and those carrying liquefied natural gas are transported with large load capacities to long distances due to their large size. Another difference is the different operations in the cargo operations. With different types of equipment, transportation of different species is also easily provided. The major reasons for the separation of these ships are the differences in the cargoes carried and the different locations of the voyages.

In this section, the main aim is to give information about the difference in the operations of LPG (Liquid Petroluem Gas) tankers. Ship operators show the high freight rates in LPG tankers as an interesting area. It is very important to know the operational processes in gas tankers. The most important reason for this is the transport of explosive materials, which cause serious loss of life and property in accidents caused by operational errors in gas tankers. Therefore, information is given about careful review of the operational process and what needs to be done at the stage. In addition, the largest and most time-consuming load exchange operations on gas tankers have been mentioned. Having different operations in different gas tankers brings to the fore the need for well-trained personnel.

In this process, the following stages are mentioned; 1-Gas tanker ship types 2-Cargo tanks design Differences 3-Lpg tanks 4-Used load pumps 5-Relification cycle 6-Preparing for loading stage 7-Drying 8- Inert operation 9-Gassing Up operation 10-Cool Down operation 11-Discharge operation 12-Grade Change operation

It is the lack of knowledgeable and experienced staff who can do all the operations mentioned above briefly. In the processes mentioned in this study, information is given to guide the education sector and the personnel working on such ships.

A liquefied gas is liquid at ambient temperature and under atmospheric pressure. Most of the liquefied gases are hydrocarbons and are the basic properties of hydrocarbons. The world's primary energy source is LPG flammability and makes them naturally dangerous. Since these gases are used in large quantities, it is imperative that they be controlled and safety precautions taken.

The most important feature of the liquefied gas in relation to pumping and storage is the saturated vapor pressure. The liquid is equilibrated with its own vapor with absolute pressure at a certain temperature (Paltrinieri, et al., 2009). The International Maritime Organization (IMO) relates the saturated vapor pressure to temperature for Gas Carrier Codes purposes and makes the following definitions for liquefied gases transported by sea:

- Liquids with vapor pressure exceeding 2.8 bar at 37.8 ° C
- An alternative way of describing a liquefied gas is by the saturated vapor pressure = atmospheric pressure.

Some liquefied gases carried at sea are compared in terms of their vapors. The pressure at 37.8 ° C is evaluated in terms of the description of the IMO and the atmospheric boiling point. Table 1 shows the physical properties of some liquefied gases (Sigtto, 2017).

Based on the above IMO definition, ethylene oxide (see Table 1) is characterized as liquefied gas. However, the Construction and Equipment of Ships with Bulk Liquefied Gas in International Law is also indicated in the International Gas Carriers code (Martyn, 2017). Because the boiling point in atmospheric pressure is so low that it is impossible to carry the load in any way other than that for liquefied gases (Sigtto, 2017).

Transport, unloading and loading of the above-mentioned loads on LPG vessels should be made with separate rules for each load (Piasecki, 2018). At the same time, the operational process continues during the transportation of these loads on the ships.

Liquefied petroleum gases include propane, butane and mixtures of the propane/butane. Butane, which is stored in tubes and therefore known as bottled gas, fuel for heating and cooking in remote locations. However, it is also a key engine gasoline octane enhancer and a basic petrochemical raw material.

Table 1. Liquified gases (Sigtto, 2017)

Liquified Gases	*Vapour Pressure at 37.8^0 (Absolute Bar)*	*Boiling point at Atmospheric pressure*
Methane	*Gas**	*-161.5*
Propane	*12.9*	*- 42.3*
n-Butane	*3.6*	*- 0.5*
Amonia	*14.7*	*- 33.4*
Vinly Chloride	*5.7*	*- 13.8*
Butadiene	*4.0*	*- 5*
Ethylene Oxide	*2.7*	*+ 10.7*

Propane is also used as a bottle gas, especially in cold climates (where steam pressure is low) (Premuda, 2013). However, LPG is mainly used for energy production, industry. Metal cutting and petrochemicals are used as raw materials. Approximately 169 million tons of LPG is produced annually in the world, of which 43.7 million tons are transported by sea (Sigtto, 2017).

LITERATURE REVIEW

Transport by ships constitutes a big part of the logistics. Different types of LPG vessels are needed for the transportation of petroleum gases in sea transportation. It is important to evaluate cargo operations on these ships to prevent accidents by detailed analyzes.

Properties of hydrogen fuel were investigated in the transport of liquefied petroleum gas and compressed natural gas was researched by Demirbaş, 2017. In addition, the transport of LPG and CNG and the gases in its content are mentioned (Demirbas, 2017).

Captain T. W. V. WOOLCOTT examined and described LPG gas operations. The sections of the publication describe details of the different gas carriers and their cargo operations (Woolcott, 1987).

Cognitive reliability and error analysis method (CREAM) were used to examine the application of human reliability model in the loading process of LPG tankers. In this study, the number of personnel employed in LPG tankers is one of the important topics. In addition, the safety and environmental safety at sea has been evaluated by CREAM technique. Crew performance at operational levels was evaluated (Akyuz & Celik, 2015).

The study of LPG tankers published at 1969 by United State Patent Office, has been examined. The structure of ship tanks is explained in detail. In addition, cooling system is mentioned and information is given (USA Patent No. 3,453,836, 1967).

Another study examines the analysis of operational risks in Liquified Natural Gas (LNG) tankers. High-risk levels were investigated in LNG transport and operational processes. Risks were determined by looking at accidents on LNG vessels (Vanem, Antão, Østvik, & Comas, 2008).

International Gas Carrier Code, Ships Carrying Liquefied Gases in Bulk has been mandatory under SOLAS chapter VII since 1 July 1986. With this code, the criteria that should be mandatory for the structural and systematic of the ships are determined. Approved and published by the maritime organization, we can see the properties of liquefied gas tankers. Safety precautions and how necessary equipment should be given with reference values.

LPG TANKER TYPES

Depending on the load, the gas carriers can be grouped into four different categories according to the load and the transport condition. These are listedas follows (Soumya, 2017):

- Fully pressure vessels
- Semi-pressure vessels
- Ethylene ships
- Fully cooled LPG vessels

The first three types of ships in the list are suitable for small and chemical gas loads. These types of ships are mostly used in regional locations and among short-distance ports (Gray, 2004). Full-cooled LPG vessels are used to transport large quantities of liquefied gas and ammonia in deep seas and trans-ocean ports.

Full Pressure Vessels

The fully pressurized vessels are the simplest of all gas carriers. Tank systems and load handling equipment have been established for many years (Vms, 2016). These vessels carry loads at ambient temperature. They are fitted with 'C' type tanks (pressurized tanks). These tanks are made of carbon steel with a pressure of about 18 barg (LGC, 2009). At higher pressures, ships can carry cargo and they can operate at 20-bar pressure. No heat insulation and re-liquefaction equipment are available. They discharge their loads with pumps or compressor systems (Martyn, 2017).

Due to the design pressure, the load tanks are heavy. As a result, full pressure vessels are designed to carry less than 4000m3 and 6.000m3 lpg and ammonia.

Semi Pressure Ships

Semi-pressure vessels are similar to full pressure vessels depending on the tank type. Maximum operating pressures are 5 to 7 bar. Compared to full pressure vessels, tank thicknesses are thinner. However, because they are also cooled, the insulation is more in the tanks. This type of gas carrier vessel was created to carry loads of optimum value (Dnv, 2008). They are LPG, vinly cloridhe, propylene and butadiene. They are mostly seen in the coastal transportation of coastal areas. It is one of the most preferred ship types by operators. The reason is that small tonnage loads can be handled comfortably.

It has a C-type tank and is in the range of 3,000 m3 to 20,000 m3. The tanks are designed for low temperature loads. Both pressurized and cooled loads are easily handled on such vessels (Paltrinieri, et al., 2009).

Ethlene Ships

Ethylene ships are usually manufactured for certain processes, but vessels carrying LPG or Chemical gases normally have capacities ranging from 1,000 to 12,000 m3 (Soumya, 2017). Ethylene is normally carried in a completely cold state under atmospheric boiling conditions. Normally type 'C' pressure tanks are used and a secondary barrier is required. Thermal insulation and a high-capacity operation are seen on such vessels. A complete double body is required for all loads transported below -55 ° C (Chopra, 2016). The load tanks are of type 'A', 'B' or 'C'.

Fully Refrigirated Ships

Completely cooled vessels carry their loads at an atmospheric pressure and are designed to carry a large amount of LPG and ammonia (Boult, 2000). Four different load systems are used on these ships. These are as follows:

- Single-hull independent tanks but double-base hanger tanks

- Dual-body independent tanks
- Integrated tanks (double body) and
- Semi-membrane tanks (double body)

The most commonly used arrangement for this ship class is listed above. Here, the tank itself is an 'A' type prismatic pedestal unit that can provide maximum working pressure. The maximum working pressure is 0.7 barg. The interior design of the tanks is made of steel suitable for temperatures of -48 ° C (Chopra, 2016). The size of the fully cooled vessels is approximately 20,000 to 100,000 m3.

A typical full-cooling vessel has six cargo tanks. Each tank is equipped with transverse washing plates and compartments that will reduce the effect of a longitudinal free partition in the midline. This is done so as not to cause loss of stability of the free-circulating load. Tanks are usually placed on wooden wedges to prevent the movement of the tank under static and dynamic loads (Chopra, 2016). Tanks also have anti-flotation wedges to prevent lifting in case of ballast tank leakage. Heat insulation and reprocessing equipment must be installed due to low temperature conditions. It maintains the operational flexibility of the fully cooled vessels and the heater and supporting pumps that allow the evacuation to be carried out as desired (LGC, 2009). In this respect, it is seen that it is more useful than other ship types. Type A has tank structure. Double barrier required.

LPG CARGO OPERATIONS

The process, which will be passed until the LPG vessels come back from the shipbuilding to the shipyard, is defined with the steps in table 2. Here, the operation of the Fully Refrigirated ship is considered. In this table, the important steps in load operations are drying, inerting, gassing up, cool down, loading, evacuation and load change stages.

Drying

Drying is a necessary operation to be done before the load filling in the cargo handling system. This means that water vapor in the tank and water must be disposed of. Vapors or water that does not flush will cause icing. This means that the load systems do not work properly. Drying can be carried out by the inert gas supplied by the coast or by nitrogen or inert gas provided by ship facilities. It can also be done by air-drying system on the ship.

Inerting

This method is used so that cargo tanks, cargo pumps and pipelines do not form a non-flammable state during the initial degassing by cargo. For this purpose, the oxygen concentration should be reduced from 21 percent to a maximum of five. However, another reason for inerting is that gases for some of the more reactive chemicals, such as vinyl chloride or butadiene, are required to avoid a chemical reaction with steam from low oxygen levels, such as 0.1 percent (LGC, 2009). Such low oxygen levels are usually achieved by the removal of nitrogen from the shore.

Table 2. Sequence of LPG operation (Dnv, 2008)

Tank Inspections
Drying
Inerting
Gassing Up
Cool Down
Loading
Laden Voyage
Discharging
Ballast Voyage
Grade Change

Gassing Up

Neither nitrogen, nor carbon dioxide or inert gas are gases of the type that are not recycled in the load cycle system (Premuda, 2013). These gases must be removed from the tank. In order to remove the inert gas from the tanks, it is necessary to remove the inert gas and the inert gas from the top of the tank. This process is called gassing up. It is used in the same way in load exchange operations. In this principle, the displacement method of the load vapor is used.

Cool Down

The cooling takes place by slowly spraying the liquid from a load tank into the other tank. With this spraying method, the cooling starts slowly from the top of the tank and not gradually. Before loading, the tanks are cooled according to the load to be loaded. The purpose of this is to not create thermal stress when the load enters the tank with low temperature. No more than 10 degrees of cooling per hour.

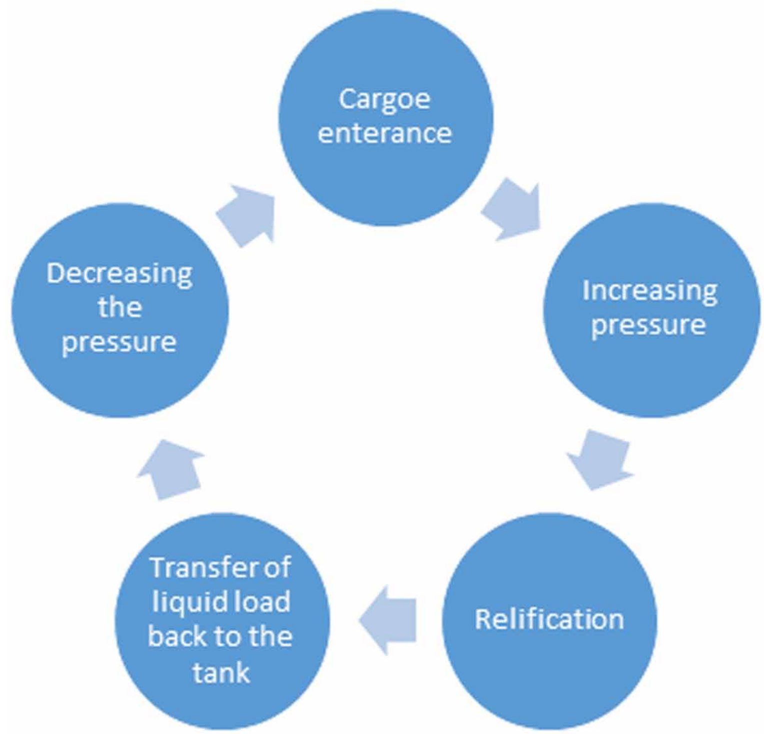
Loading

It is the process of loading the cargo into vessel tanks. The load level, tank temperature and pressure figures called tank radar must be monitored here. Most importantly, the load pressure must not exceed the safety limits of the steam. Here, the gas must not be released into the atmosphere. The charge gas is equal to the load. In order to keep the cargo on board, LPG is transported to the load tank by means of compressors which are load handling system. The cycle diagram is shown below figure 1.

Laden Passages

The pressure and temperature values of the load at the same load are checked during the journey. The load surveys are examined by the load surveys before the load is discharged. The load owner or tenant requests the same values as the load in the load. If the load is loaded at -40 C^0 it must be evacuated at the

Figure 1. During loading stages



same temperature value. Therefore, it may be necessary to reduce the heated load during sail. Likewise, if there are abnormal elevations in pressure, the pressure drop is reduced as in the loading (Woolcott, 1987).

Discharging

There is an operation process opposite of the installation. In this process, we need to know first; During the discharge, the pressure of the pumps in the tank is to be met. We can't cover this vacuum with air. In other words, we need to avoid the vacuum with the gas of the load. In order to do this, it is ensured that the seawater, called a thin circuit, passes through the system, which passes the gas into the tank through the system that heats up and heats the load and the gas, is introduced into the tank. Logic is simply the continuation of the positive pressure without creating a vacuum in the tank.

CARGO PLANT

The cargo handling and containment system is designed for loading, reliquefying and discharging cargoes of liquefied gases, the cargo being contained in independent cargo tanks.

Cargoes

LPG (Liquified gas Carriers) vessels are certified to carry the following cargoes: Anhydrous Ammonia, 1,3 - Butadiene, Butane (iso and normal), Butylene, Propane (Pure), Propane (Commercial – having a maximum of 2.5 mole% Ethane), Propane and Butane mixed in any proportion, Propylene, Vinyl Chloride Monomer (reduced filling limits).

Reliquefaction System

The reliquefaction plant, comprising three distinct compressor units, is necessary for the following reasons: Condensation of vapour produced by heat ingress to cargo whilst at sea and in port (thereby maintaining the tank pressure at the desired level). Condensation of vapour displaced by liquid as the vessel is loaded where no vapour return to shore is available or is used. Reduction of the temperature of a cargo whilst in transit to the unloading port, in accordance with charterer's requirements. Cooldown of a warm cargo tank prior to loading a refrigerated cargo. The cargo compressors may also be used separately for purging vapour ashore, transferring vapour between tanks, clearing lines of liquid, assisting in inerting, purging and gas freeing. The cargo compressors are arranged to allow one stage operation, two-stage operation with no interstage cooling and two stage operation with interstage cooling. The reliquefaction plant and system are optimised to provide maximum capacity with good operation and flexibility.

Equipments

Some of the equipment used in cargo operations in LPG tankers are given in table 3 as below.

Cargo Manifolds

Each liquid and vapour manifold is fitted with a fail-safe actuated valve at both ends, these valves being linked to the cargo plant emergency shutdown system, as well as being capable of local operation. In addition to these actuated valves, the liquid manifolds are fitted with manual isolation valves in series for additional security (Woolcott, 1987).

All manifolds are provided with pressure indicators at both ends with an additional pressure indicator being fitted on each distance piece outboard of the isolation valves as a safety check prior to removal of blind flanges, loading arms etc. The liquid manifolds also have temperature indicators at both ends.

Table 3. The equipment that should be available on fully refrigerated lpg vessels (NBG Ship management, 2015)

condensate return	*puddle heating*	*liquid fill*	*vapour*	*ventilation*
thermal relief system	*vent*	*Ventilation hatch*	*pilot sensing*	*level switch*
access manhole	*sample tube vapour space*	*sampling*	*vapour cooling*	*deepwell pumps*
pump removal hatch	*temperature transmitters*	*level indicators*	*bulkhead valve spindle*	*Level transmitters*

Deck Lines

Cargo lines on deck can be sub-divided into four basic categories i.e. liquid, vapour, hot gas/condensate and vents/drains/thermal relief, with the interconnections between the categories shown on the ship's diagrams.

The principal "cross-connections" between the categories are as follows:

Liquid connected to hot gas/condensate to allow cargo liquid to be sprayed into the top of the tank for cooldown.

Compressor discharge to hot gas/condensate system to enable the use of compressed cargo vapour to clear lines and for puddle heating.

Vapour/ liquid at each tank to the vent system to allow inerting/purging/gas freeing to be carried out, venting directly to atmosphere.

In the liquid lines, thermal relief valves are fitted to all "locked-in" sections of pipe of volume greater than 50 litres e.g. between two isolation valves. These valves relieve any developed overpressure in the line due to thermal expansion, to the thermal relief lines in which the vapour is passed back to the cargo tanks.

INSTRUMENTATION AND CONTROL SYSTEMS

Local Reading Instruments

Pressure

Local pressure gauges installed in the cargo system, installed directly onto pipework or onto machinery or supported on local panels, are of stainless steel construction with glycerine-filled cases to dampen out any effects of vibration. The range of each gauge is generally selected such that the normal operating range of the item of plant to which the gauge relates is covered by 20% to 80% of full-scale deflection of the gauge (Sigtto, 2017).

In certain applications, local indication is by means of a digital readout, which uses the signal from the transmitter, which provides the cargo control panel readout.

Temperature

Local temperature gauges installed in the cargo system, installed either directly onto pipework, or machinery or supported on local panels, are of stainless steel construction, nitrogen filled actuation with glycerine-filled cases to dampen out any effects of vibration. The range of each gauge is generally selected such that the normal operating range of the item of plant to which the gauge relates is covered by 20% to 80% of full-scale deflection of the gauge.

The probe for each gauge is inserted into the process stream inside a stainless steel thermowell, thereby allowing it to be removed with the system under pressure.

In certain applications, local indication is by means of a digital readout, which uses the signal from the transmitter, which provides the cargo control panel readout.

Level

Local level gauges installed in the cargo system are mounted directly onto the item of equipment to which they relate and are of the reflex sight glass type (borosilicate glass), or may be provided as a local indicator function of a level transmitter.

Materials of construction are principally stainless steel with both the casing and the glass designed to withstand pressures in excess of the maximum anticipated pressure for the relevant item of equipment.

The visible range of the gauge is selected such that the normal operating level is visible in the glass, from minimum to maximum normal operating level, and this may not be the full depth possible in the vessel or equipment.

One exception to the foregoing is the level gauges fitted to the cargo tanks. These are by necessity required to display the full range of levels from empty to full and are of the radar type. The radar tank gauge is fitted to a tank adapter flange mounted at the top of the stand pipe assembly on the top of the tank. The readout of level is given digitally in millimetres on the top assembly via the radar sensors and the level is also transmitted electrically to the cargo control room.

The level gauges fitted to the deck tank are of the float-operated type. The float is suspended on a wire from the top mounted measurement and indication assembly. The readout of level is given digitally in millimetres on the top assembly via a spring drive motor from the float movement, and the level is transmitted electrically to the cargo control room.

Flow

Local flow indicators are installed only in the freshwater/glycol heating-cooling system for the cargo compressors and are of the flapper type with glass windows. The indicators provide only an indication that flow is present but do not quantitatively give the actual flowrate. The total freshwater/glycol flow from each compressor can be read from the flow switch in the freshwater/glycol return line.

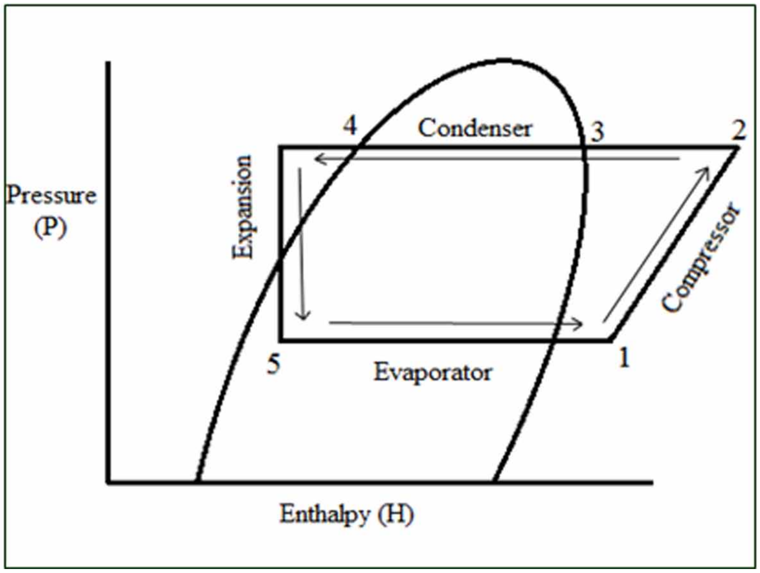
CARGO RELIQUEFACTION

Basic Concept of the Direct Reliquefaction System (for LPG)

The concept of the direct reliquefaction system is to take vapour from the cargo tanks (produced either from heat ingress from the surroundings or during loading as flash and/or displaced gas), to compress it and then to condense it back to liquid before returning it to the cargo tanks (Plomaritou & Papadopoulos, 2017). The pressure to which the gas has to be compressed is determined by the temperature of the seawater, which is used to condense the gas.

If the reliquefaction system removes heat from the cargo tanks (by the action of drawing off vapour and returning liquid) at the same rate as it is input, then the pressure will be maintained at a constant level in the cargo tanks. If the system removes heat faster than it is input, the temperature and pressure of the cargo will be reduced i.e. cooling down of the cargo. The reliquefaction process can conveniently be represented on a diagram relating enthalpy (energy content) to pressure, known as a Mollier diagram.

Figure 2. Mollier Diagram (Bolaji, 2014)



Point 1 represents liquid in the cargo tank, stored at its boiling temperature at pressure Pt (the Mollier diagram indicates the boiling (saturated) temperature of liquids at varying pressure at the intersection of the temperature curves with the left hand side of the envelope curve), and point 2 represents the saturated vapour above the liquid.

This vapour is drawn by the compressor and due to pressure losses in the line and heat ingress from the atmosphere (for cold gas) arrives at the compressor suction at Ps (lower than Pt) and Ts (higher than Tt) i.e. point 3. The gas is then compressed in the first stage of the compressor to the interstage conditions of Pi and Ti1 i.e. point 4.

The condensed liquid is then returned to the cargo tank. It should be noted that the level control valve on the outlet condenser utilises the difference in pressure between the condenser and the tank to operate but in so doing, results in a mixture of liquid and vapour (a 2 phase mixture) being returned to the tank.

Basic Concept of the Reliquefaction System (Single Stage)

When operating in single stage, the reliquefaction system can utilise the cylinders of the compressor in parallel, thus increasing the capacity of the system compared to operating the cylinders in series. However, this configuration is limited to operation where the pressure ratio across the compressor is below about 4.5 (based on absolute pressures – e.g. suction pressure 1.1 bar abs, discharge pressure 4.95 bar abs).

Basic Concept of the Reliquefaction System (Two Stage with Economiser)

The basic concept of using an economiser is to improve the efficiency of the reliquefaction plant by reducing the temperature of the condensate returned to the tanks. A portion of the condensate is flashed across a level control valve, and sprayed into the shell of the economiser. This causes the remaining condensate, which passes through the heat exchange coil, to be cooled to near the interstage saturation temperature.

The spray also partially cools the discharge gas from the first stage. In this way, all the spray condensate is evaporated and returned to the second stage of the compressor at point 5, with the level control valve regulating the amount of spray.

Since the extra vapour generated by the cooling of the condensate is compressed from an intermediate pressure, rather than from suction pressure, the extra cooling duty is handled more efficiently. The gains in performance are greatest where the suction pressure is low and the condensing pressure is high. There is little improvement when the discharge pressure is below 10 – 12 bar gauge, and the economiser should not be used in these circumstances.

In particular, the economiser should not be used for the following cargoes and for these cargoes single stage operation can normally be used: C4's, Butadiene, VCM, LPG mixtures with large quantities of C4's (>75%) .

Single stage operation is limited to cargoes whose condensing pressure can be reached without exceeding either the pressure ratio limit or the differential pressure limit across the first stage cylinder of the compressor. If the cargo tank pressure is at its maximum value of 0.40 bar then the maximum pressure that can be reached using single stage compression is limited by the pressure ratio limit of 4.5, not the maximum differential pressure of 7.5 bar.

Max Pressure ratio = 1.4 x 4.5 = 6.3 bar

Max Pressure differential =1.4 + 7.5 = 8.9 bar

This limits single stage operation to Butadiene, iso and n-Butane and Butene, or NH_3/LPG in very low ambient temperatures.

Special Cargoes and Conditions

There are some cargoes, which require special consideration in relation to the reliquefaction plant, and special conditions, which should be borne in mind as follows:

Butadiene - in order to prevent polymerisation (with subsequent serious potential damage to the compressor), the compressor discharge temperature must be limited to +60°C Vinyl Chloride Monomer (VCM) – in order to prevent polymerisation (with subsequent serious potential damage to the compressor), the compressor discharge temperature must be limited to +90°C. VCM in water forms a highly corrosive hydrochloric acid solution and it is therefore essential that dry inert gas is used for inerting purposes (Ukpandi, 2019). Also, the lubricating oil, which is hygroscopic by nature, should not be exposed to the atmosphere for long periods to minimise any water absorption.

Cargo Changeover

When changing cargo from ammonia to butadiene, the lubricating oil may contain commercially unacceptable concentrations of the former cargo (due to dissolution of cargo into the oil) and it may therefore be necessary to change the oil.

Ethanol Injection

Certain products may contain water which can cause hydrates at low temperature e.g. on the outlet of the control valve after the pressure is reduced, thereby blocking the system. A common method of removing hydrates is to inject ethanol at the outlet of the cargo condenser.

Inhibited Cargoes

Certain products require inhibitor to prevent reactions and/or decomposition during storage but in general, these inhibitors will remain in the liquid and not be carried over into the vapour. To prevent the accumulation of uninhibited liquid in the condenser and condensate return lines, these items should be cleared using cargo vapour or nitrogen if the reliquefaction plant is not in use. Therefore, it may be necessary to inject additional inhibitor into the condenser and condensate return line to prevent the accumulation of uninhibited liquid.

High Discharge Temperature

Initially, where high first stage discharge temperatures are encountered, especially for butadiene, VCM and ammonia cargoes, the guidelines below should be followed to ensure the compressor discharge temperature is reduced. If high discharge temperature is still encountered, then condensate spray into the cargo tank vapour space and compressor suction line should be carried out.

The following are procedures for reduction of compressor discharge temperature, which should be followed in a progressive manner until the reliquefaction system is operating satisfactorily.

i) The first stage in preventing high compressor discharge temperatures is efficient purging to minimize the quantity of incondensibles.
ii) Once beginning compressor operation, if suction temperature is high, start with flow from closest cargo tank to minimise pipe run.
iii) If initial suction temperature is significantly greater than the tank temperature (say 10 °C), start the compressor with the condenser bypassed i.e. use hot gas line valve fully open to minimise the discharge pressure) to allow the suction flow to cool down the lines. The return from the Compressor should be directed to the tank bottom (if cooling the cargo tanks, rather than performing pressure maintenance on a loaded cargo, the return to the tanks must be directed to the top sprays, and not the bottom of the tanks once condensate is being generated). Use 100% capacity mode for Compressors as soon as possible to maximise gas flow (this should be possible around 1 minute after compressor start). Adjust the FW-Glycol cooling temperature to be as low as possible in the prevailing SW temperatures.
iv) Once cold vapour is going to the Compressors from the tank (observed by a reduction in the 1st stage suction temperature), direct the flow to the Condenser but with condensate return level control manual valve closed, until a liquid level is observed in the Condensate Accumulator.
v) The vent pressure setting of the Condensate Accumulators should be adjusted to take account of the cargo and seawater temperature.

Manual venting should be used to control the discharge pressure until stable operation is achieved. Venting should preferably be to the vent mast, if there are incondensibles, to avoid build up of incondensibles in the cargo tank vapour space, and hence the compressor suction.

If condensate is not being generated it indicates insufficient seawater flow, a vent setting that is too low, or too high a concentration of incondensibles, which would need to be vented.

vi) Once liquid is present in the Condensate Accumulator, condensate return manual valve should be opened and level control in the Condensate Accumulator should be obvious by the normal operation of the condensate level control valve.

vii) If the second stage discharge temperature is high and the economiser is not in operation, cooling of the second stage suction can be achieved by injection of condensate into the economiser shell using the shell level control valve bypass. During condensate injection operations, care must be taken to prevent the accumulation of liquid in the suction separator or economiser that will result in the compressor tripping. To reduce the likelihood of the compressor tripping on economiser high level, the economiser vessel has an automated drain valve. The drainage system can be operated automatically using a hydraulically actuated valve. The actuated valve will provide a method to return automatically the liquid to the condensate return line. The drain valve can operate in automatic or manual mode. This can be selected on the HMI. When in automatic mode, the economiser drain valve will automatically open and close to allow for any liquid in the shell to drain back to the cargo tank. When in manual mode the economiser drain valve will only open when the associated local or control room push buttons are operated.

viii) If required, suction and vapour space injection may be used to further cool the inlet flow to the compressor (see guidelines below).

Vapour Space and Compressor Suction Injection

The purpose of the cargo tank vapour space and compressor suction spray is to cool the vapour suction to the compressors to reduce discharge temperatures. This is most likely to be required with ammonia, or cargoes which have lower required discharge temperatures (butadiene, VCM) though it could be required with any cargo if the suction temperature is high (this is most likely to occur at compressor start-up after cargo tank purging).

Vapour Space Injection

For condensate spray of the cargo tank, vapour space the manual inlet valve to the cargo tank vapour space spray line should be gradually throttled open. The suction temperature should be monitored and the valve opened or closed slowly as required. The spray rate for the cargo vapour space should be as low as possible to minimise any reduction in reliquefaction plant efficiency.

Compressor Suction Injection

For effective compressor suction injection, there are a number of considerations based on the cargo and other process conditions. There will be some trial and error in nozzle selection and operators are advised to monitor the compressor operation for a time after start-up. Nozzle selection depends not only on the cargo, but also on the suction temperature, condensate temperature and the quantity of incondensibles in the system; For example, if suction temperature does not decrease sufficiently or the suction separator liquid level is increasing at an unacceptable rate, then it would be advisable to select a different nozzle size. In general, for ammonia, the small injection nozzles provided should be used (low flow, high condensing pressure) and for VCM/butadiene the larger injection nozzles (higher flow, lower condensing pressure).

The spray nozzles should be directed to spray upstream in the vapour suction line and the amount of suction injection has to be monitored and controlled to avoid the high-level alarm in the suction drum. As the suction cools, the amount of spray which can be evaporated by the incoming gas is reduced and the spray quantity must be reduced (by closing the suction injection manual needle valve, or, if necessary, reducing nozzle size).

When starting the suction spray, it is advised to start with the suction injection manual needle valve shut and open it gradually until a satisfactory suction temperature is achieved (Stosic, Kovacevic, & Smith, 2019). If the nozzle selection proves too small (suction injection valve fully open and suction temperature still too high), the nozzle should be changed for a larger nozzle and the start-up process repeated until a satisfactory suction temperature is achieved.

EMERGENCY SHUTDOWN SYSTEM (ESD)

The cargo plant emergency shutdown system can be activated by two means:

a) Pressing one of the emergency shutdown pushbuttons or
b) Melting of a fusible plug in fire conditions.

The fusible plug system is based on a pressurised air header, fitted with plugs, the fusible (melting) element of which is designed to melt at between +98°C and +104°C in the event of fire (LGC, 2009). When the element melts, air pressure will be lost from the system, thereby activating the low-pressure switch and initiating the ESD.

CARGO SYSTEM OPERATIONS

Basic System Philosophy

The philosophy behind the design of the cargo system is to produce a system, which will operate such that the number of remote and/or automatic functions are limited to only those which protect equipment against excessive pressure, temperature, level etc.

The starting of equipment is manual and local to the equipment but automatic stopping is incorporated where required to ensure equipment is protected at all times.

The cargo valves are being operated hydraulically or manually the hydraulically actuated valves generally have remote/local operation. They are capable of local push button operation and emergency override with hand pump.

SAFETY PRECAUTIONS

The following points should also be checked before cargo operations:

1) Pressure is established in the fire main or the system is ready for remote start and fire hoses are run out and readily available.
2) Dry powder equipment has been run out and prepared for operation.
3) Portable extinguishers are made available.
4) Gas detector is calibrated and full operational.
5) Cargo alarm system is full operational.
6) Communications between ship and shore have been established and emergency procedures agreed.
7) Onboard communications are operational.
8) Breathing sets are charged, tested and available and the breathing air compressor is operational (if available).
9) All personnel are correctly dressed with appropriate protective clothing including goggles.
10) Compressor and electric motor room ventilation is operational.

In addition to the foregoing points, a clear chain of responsibility must be established and maintained and operation of the vessel should be left to as few personnel as is safe and practical. An accurate record of all events must be kept and the senior person in charge must always be aware of the existing “State of Affairs”.

FUTURE RESEARCH DIRECTIONS

LPG vessels carry higher risks than other petroleum products vessels. Therefore, the operational operations of the vessels are carried out at a high level and possible accident risks are kept at the lowest level. LPG vessels need special terminals due to their high security. This shows that the need for seafarers and port employees who are experts and experienced in LPG in both port operations and maritime transportation will increase. In the future, experts who are experts in LPG will need to be trained and regularly inspected. It is estimated that IMO, which has a say in the world maritime, will conduct more strict inspections and trainings on LPG in the future. For these reasons, seafarers and port workers are required to continuously renew and improve themselves on LPG.

CONCLUSION

Liquefied Petroleum Gases (LPG) are transported on ships in gas and liquid formations. This move carries out ongoing operations in the process of certain processes. The difficulties of these operations and the methods to be followed are mentioned. In the LPG vessels, people can see the load on other ships and can only be in contact with the monitoring and measurement equipment. On ships carrying chemical or petroleum products, there is a wash on load changes. It is done with manpower and equipment. However, the situation in LPG is different. There is no washing in LPG. You must prepare the load by replacing the gas with the gas. This process is mentioned as in the above embodiment. The gases used here are ammonia and LPG, which are used as inert, dry air, nitrogen and charge gas. One of the issues not mentioned in the study is the transition between the Butane and Propane loads called LPG. Since this load transition consists of compatible loads, the load is removed from the tank in liquid form and the heavy one is taken from below, the other load is taken from the top of the gas or the reverse operation is applied. The transition from NH3 to LPG or vice versa, the transition from LPG to NH3 has been mentioned. This operation is a very difficult operation. The slightest error can cause very large time losses and even equipment malfunctions. The time spent by the ship in this operational process will result in a burden and consequently a monetary loss. Before the operation, the ship personnel who will carry out this operation should meet with the machine department and the risks should be determined. The safety map of the personnel working according to the risk map should be taken into account and the equipment used should be checked. Danger of inert gas used in load change must be shared with personnel.

This operation has been carried out in 38,000 cbm fully cooled LPG tankers, and the difficulties and plans in the process have been mentioned. Due to the mistakes made in the transition from ammonia to LPG load at the first service of the ship, this process was examined in the records which lasted for 45 days. Later, it was seen that the ammonia gas was still in the LPG load and did not come out after years. It should also be said that this ammonia gas reduces the quality of the load. The information is given to prevent this temporal loss and to provide guidance for related ship workers.

REFERENCES

Akyuz, E., & Celik, M. (2015). Application of Cream human reliability model to cargo loading process of LPG tankers. Elsevier, 39-48. doi:10.1016/j.jlp.2015.01.019

Bolaji, B. (2014). Theoretical analysis of the energy performance of three low global warming potential hydro-fluorocarbon refrigerants as R134a alternatives in refrigeration systems. In *Proceedings of the institution of mechanical engineers Part A journal of power and energy*, 56-63. 10.1177/0957650913507252

Boult, M. (2000). Risk management of LPG transport activities in Hong Kong. Hazardous Materials, 85-100.

Chopra, K. (2016, July 21). Specifications and requirements for LPG and LNG ships to sail in international waters. Retrieved from https://www.marineinsight.com/maritime-law/specifications-and-requirements-for-lpg-and-lng-ships-to-sail-in-international-waters/

Demirbas, A. (2017). Fuel properties of hydrogen, liquefied petroleum gas (LPG), and compressed natural gas (CNG) for transportation. *Energy Sources*, 601–610.

Dnv. (2008). Liquified gas carriers. Hovik: Det Norske Veritas.

Emory, L., & Kerr, C. N. (1967). USA Patent No. 3,453,836.

Finder, V. (2019, Oct. 15). Marianne - LPG tanker. Retrieved from https://www.vesselfinder.com/vessels/MARIANNE-IMO-9474539-MMSI-477612300

Gray, R. (2004, Sept. 13). Bulk liquefied gas by sea. Retrieved from http://www.sigtto.org/media/7210/supplement-lng-history.pdf

LGC. (2009, July 7). Planning cargo operation. Retrieved from http://www.liquefiedgascarrier.com/cargo-planning.html

Martyn, R. (2017, April 20). Cargo handling and emergency shutdown. Retrieved from http://braemartechnical.com/files/Lecture-100-LNG-Cargo-Vessels-Handling-System.pdf

NBG ship management. (2015, March 03). LPG fleet. Retrieved from http://www.nbgship.com/index.html: http://www.nbgship.com/lpgfleet.html

Paltrinieri, N., Gabriele, L., Molag, M., Bonvicini, S., Spadoni, G., & Cozzani, V. (2009). Risk reduction in road and rail LPG transportation by passive fire protection. *Hazardous Materials,* 332-344.

Piasecki, T. (2018, May 1). Preparation of the cargo system for LNG discharge from a membrane steam turbine LNG vessel at an offshore LNG terminal. Researched from https://www.researchgate.net/publication/325202953_PREPARATION_OF_THE_CARGO_SYSTEM_FOR_LNG_DISCHARGE_FROM_A_MEMBRANE_STEAM_TURBINE_LNG_VESSEL_AT_AN_OFFSHORE_LNG_TERMINAL

Plomaritou, E., & Papadopoulos, A. (2017). Shipbroking and chartering practice. London, UK: e-publish.

Premuda. (2013, March 12). Cargo operations. Retrieved from http://sqems.premuda.net/cargo%20ops.pdf

Sigtto. (2017). Liquifed gas handling princibles on ships and on terminals. London, UK: Witherby & Company Limited.

Soumya, C. (2017, Sept. 30). Understanding the design of liquefied gas carriers. Retrieved from https://www.marineinsight.com/naval-architecture/understanding-design-liquefied-gas-carriers/

Stosic, N., Kovacevic, A., & Smith, I. K. (2019, May 27). An investigation of liquid injection in refrigeration screw compressors. Retrieved from https://www.researchgate.net/profile/Ahmed_Kovacevic/publication/237659424_An_Investigation_of_Liquid_Injection_in_Refrigeration_Screw_Compressors/links/0f317539340c57deae000000.pdf

Ukpandi. (2019, May 25). Liquefied gases. Retrieved from https://www.ukpandi.com/fileadmin/uploads/uk-pi/LP%20Documents/Carefully_to_Carry/C2C_Articles_2018/Liquefied_Gases.pdf

Vanem, E., Antão, P., Østvik, I., & Comas, F. (2008). Analysing the risk of LNG carrier operations. *Reliability Engineering & System Safety*, *93*(9), 1328–1344. doi:10.1016/j.ress.2007.07.007

Vms. (2016, Jan. 23). Gas tanker operating manual. Retrieved from http://seaworm.narod.ru/2/v-gom.pdf

Wartsilla. (2018, Oct. 13). Wartsilla dual fuelL engines to power four new LNG carriers. Retrieved from https://www.thefotosgratis.eu/w%C3%A4rtsil%C3%A4-dual-fuel-engines-to-power-four-new-lng-carriers.html

Woolcott, T. W. (1987). *LPG tanker practice*. Glasgow, UK: Nautical Publishers.

ADDITIONAL READING

• Bukola O. Bolaji. Theoretical Analysis of the Energy Performance of Three Low Global Warming Potential Hydro-fluorocarbon Refrigerants as R134a Alternatives in Refrigeration Systems. • Mark Boult. Risk management of LPG transport activities in Hong Kong. Hazardous Materials. • Karan Chopra. Specifications and Requirements for LPG and LNG Ships to Sail in International Waters. • Ayhan Dmirbaş. Fuel Properties of Hydrogen, Liquefied Petroleum Gas (LPG), and Compressed Natural Gas (CNG) for Transportation • Det Norske Veritas. Lıquefıed Gas Carrıers.

• Robin Gray. Bulk Lıquefıed Gas By Sea

• The Society of International Gas Tanker and Terminal Operators. Liquifed gas handling princibleson ships and on terminals.

• Western Marine Shipyard. Gas Tanker operating Manual

• Woolcott, T. W. LPG Tanker Practice.

KEY TERMS AND DEFINITIONS

Bulkhead Valve: Due to the large size of the vessel tanks, it is the intermediate section placed on the vessel tank to reduce the free sloshing effect.

Cool Down: It is the reduction of LPG load to the tank base by cooling with compressor.

Gassing Up: It is the raising of the LPG load from the tank base by giving heat to the top of the tank.

Puddle Heating: LPG Cargo is the rapid heating of the load with seawater and compressors.

Relification: The gas state of the cargo is brought into liquid state with the compressor and other auxiliary equipment.

Ethanol Injection: It is the addition of ethanol to the circuit to prevent freezing of the cargo circuits.

Sloshing: It is called the wave movement of the load in the ship tanks with the effect of free surface. This causes a negative condition to occur. This situaiton will damage to ships tanks.

Chapter 18
A Secure Bet in the Maritime Supply Chain:
Current Situation and Opportunities for Ports' Attractiveness

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ABSTRACT

Extended research has been conducted related to how ports are capable to offer differentiated services for their customers, as well as how these decide to do business with one port rather than another. However, the literature about ports' attractiveness is not conclusive. This chapter identifies main drivers with respect to their relevance for managerial practices and proposes an agenda that tackles the obstacles that ports may find when aiming at enhancing their attractiveness. The chapter reviews the relevant literature, reports, and media to provide a comprehensive and up-to-date picture. It further opens the discussion related to exogenous, endogenous, and subjective factor of port attractiveness and how they influence stakeholders' decisions. The study concludes with proposals for further research.

INTRODUCTION

If goods commerce were electricity, ports would be the electric centrals; if it were blood, ports could be the heart in the system, pumping commercial transactions strong enough to keep the world trade alive. Ports emerge as complex systems, somewhat connected to each other as well as to different transport hubs, working 365 days a year, all day long.

DOI: 10.4018/978-1-7998-1397-2.ch018

Nowadays, global economy demands for global scale solutions to deal with different limitations imposed by countries' insufficient infrastructure and inappropriate regulations. Global supply chains need not only be efficient, but also and especially integrated to take full advantage of opportunities for maintaining or enhancing their performance. More than 90% of the world commerce goes through oceans (International Maritime Organization-IMO), which means that maritime supply chains play a significant role in the global economy.

In 2017 and 2018, world merchandise growth rates ranged around 4.7 percent and 4.4 percent, respectively (WTO b, 2018), and is expected to be 4.0 percent in 2019. This motivates countries and organizations around the world to adapt their strategies and capabilities with respect to increased requirements for logistical capacities as well as *information and communication technology* (ICT).

As the maritime market experience high pressure on their margins, ports that succeed in boosting their efficiency, improve their infrastructure, be open for privatization processes, and connect themselves to other ports can achieve reductions on international maritime transport cost (see, e.g., Wilmsmeier et al., 2006; Cho, 2014; Olivier and Slack, 2006) and pass them to their customers. Customers could perceive this benefit as an attractive factor for port selection (Wilmsmeier et al, 2006). Anyhow, ports that are more efficient are not necessarily the ones who offer the lower rates (Sanchez et al, 2003; Wilmsmeier et al, 2006). In general, ports who can provide reliable, efficient, and economic services are more attractive to both shipping lines as well as shippers (Jiang et al., 2015).

Since ports are the natural link of connecting the hinterland with the waterfront and an integral platform for port users serving as a base for production, trading, logistics, and information transfer (see Lam and Yap, 2011; Cho, 2014; Si et al., 2018), they are key drivers for overall processes also in terms of costs (De Langen et al., 2018; Wilmsmeier and Monis, 2016; Zhang and Lam, 2014). As an example, ports are rated as "high" or "very high" quality infrastructure by 63% of top quintile logistics performers (World Bank, 2018). Accordingly, ports have a strong motivation to go beyond their traditional activities of discharging, loading and storing cargo, but extending to strategic value-added services (Wilmsmeier et al., 2006; De Langen et al., 2018). Certainly, the authors of this work recognize that the strategic value of ports lies in their geographic position, as "they cannot move to where the demand would like them to be". Nevertheless, they can attract demand by providing high-quality service by efficiently processing cargo (Sánchez, Ng and Garcia-Alonso, 2011; Tongzon and Heng, 2005) and position themselves well in their relevant supply chains (see also Ha et al., 2017; Talley and Ng, 2013) as we will show in this work.

The focus of this paper is to shed light about which port characteristics and attributes beyond geographical position drive ports to a higher attractiveness and to provide propositions for further research. We investigate ports in general, but the focus is on sea container/bulk ports as these are called by shipping lines and mainly treated by the literature. As a consequence, inland ports or dry ports are not considered here. By showing future directions for research, the authors will highlight the importance of ports in the current and future transportation network and thus global economy as well as prioritizing next steps for researchers and managerial decision making. According to this, the research questions are formulated as follows: i) which are the key drivers for ports' attractiveness from the managerial perspectives? ii) how can this knowledge be used to set the agenda for development projects on this topic in accordance with global trends in maritime supply chain management?

This chapter is based on a literature survey that extracts the main drivers of ports' attractiveness, identifying major trends and highlight how ports can improve their position in the global maritime supply chains beyond geographical boundaries. This includes academic literature as well as secondary data from high circulation business newspapers and official reports from well-recognized global organizations to capture the needs of maritime supply chain professionals in their daily life related to ports' activities.

Research gaps in the literature will be identified and prioritized with respect to global trends in international trade and potential operational risks in the next decades. These research gaps will be highlighted as a set of propositions for further research, organized by the current and future requirements of this organizational field.

The remainder of this chapter is organized as follows. The second part focuses on describing which drivers are considered important for ports' attractiveness and analyze different viewpoints. The third part discusses the results making a comparison between geographical drivers and others. The fourth section aims to organize the results in accordance of the current ports' needs, establishing a sequence regarding how problems must be tackled. Finally, the fifth section concludes and present future opportunities for research.

BACKGROUND

Port Attractiveness and Performance Vs. Port Competitiveness

There is a rich literature on analyzing the competitiveness of ports and the question of what renders ports attractive to their customers. The major part of the literature treats the terms "competitiveness" and "attractiveness" synonymously which also directly links to the performance of a port. The latter is generally regarded as the major criteria that triggers the decision whether to use a port despite its geographical position as a selection criteria. One definition of port attractiveness can be found in the work of Caschili and Medda (2015) who define port attractiveness as *the combination of the productive capacity of a port and its level of international competitiveness, which provides direct and indirect economic benefits,* where we note the interchangeable use of the terms. However, even if performance is translated into service levels, which render ports attractive, this does not necessarily, mean that market shares of ports increase and thus their competitiveness. As a result, competitiveness relates to the specific market a port is serving. For instance, the port of Hamburg serves the Scandinavian-Baltic market while the port of Rotterdam serves the Iberian Peninsula. Liner shippers would not switch to Hamburg for cargo transport in the Mediterranean as Rotterdam is more suitable. Thus, the ports are in the same region, but do not compete on market shares regarding the Baltic or the Mediterranean Sea region. Ng (2006) argues that treating these two issues interchangeably has led to underrepresented research investigating competitiveness of and especially between ports. This may be due to a missing theoretical framework. In this work, we focus on port attractiveness, i.e., its capability to attract shipping liners and freight forwarders' demands. Port competitiveness is the capability of gaining market shares from competitors operating in the same market which can be more specific than investigating general overall cargo demand.

Methods of Measuring Port Attractiveness

There are different methods used in the literature to measure port attractiveness and competitiveness; see Table 1. Among these are network analysis approaches (e.g., Wang and Cullinane, 2008, 2016) that study different aspects of what makes ports attractive to stakeholders from a maritime network point of view and how to measure this attractiveness. Other authors concentrate on analyzing the interdependencies of

Table 1. Non-comprehensive list of methods used in port attractiveness and selection studies

Methods	Authors
AHP	Gohomene et al. (2016), Yuen et al. (2012), Ugboma et al. (2006), Lirn et al. (2004), Ding et al. (2019), Yang and Chen (2016)
ANP/DEMATEL	Ha et al. (2017), Ding et al. (2019)
Network analysis	Wang and Cullinane (2008, 2016), Tram (2011)
SEM	Caschili and Medda (2015), Cho (2014)
Average significance score	Ng (2006)
Annualized slot capacity analysis	Lam et al. (2011)
Fuzzy logic in evidential reasoning	Yeo et al. (2013)
Multinomial logit models and regression analysis	Veldman et al. (2011)

Source: Own elaboration

different port performance measurements. For instance, Ha et al. (2017) appraises that literature focusses on providing lists of port performance measurements mostly concentrated on stakeholder's satisfaction and qualitative measurements. To overcome this, Ha et al. (2017) develop and provide a framework that considers interdependencies of *port performance indicators* (PPI) answering the question of what to measure and how to measure it. It takes quantitative indicators as well as qualitative indicators into account also regarding uncertainty of data (see Yang et al., 2009; Yeo et al., 2013). To provide a decision support tool to stakeholders, *analytical network process* (ANP) is used to capture the dependency of factors influencing decision-making and to make a pairwise comparison of large data inputs. They further apply *Decision Making Trial and Error Laboratory* (DEMATEL) to detect interdependent relations among selected PPIs; see also Si et al. (2018) for more information.

Many studies are qualitative-driven using survey or interview and comparison techniques (see also Ng, 2006) and thus analyzing opinions and perceptions of interviewees. Some combine these with quantitative data on port performance. As stated by Ng (2006), factors like port reputation, personal relations and regulations are rarely considered which can also influence port selections but are difficult to capture (see also Ugboma et al., 2006; Yeo et al., 2013). The work of Caschili and Medda (2015) includes the level of reliability and reputation, which is influenced by the level of piracy in the area as well as centrality of the ports in the international shipping network.

The major part of studies uses *analytical hierarchical processing* (AHP) to find hierarchies of preferences regarding port attractiveness mostly using similar selection criteria (see, e.g., Gohomene et al., 2016; Yuen et al., 2012; Ugboma et al., 2006; Lirn et al., 2004). Caschili and Medda (2015) use statistical methods, namely *structural equation modelling* (SEM), to examine and measure the significance of causal relationships among factors of attractiveness.

DRIVERS FOR PORTS' ATTRACTIVENESS

The literature on port attractiveness drivers is vast but dispersed regarding the question of what are the most important factors that render ports attractive hubs for international trade.

Ports are embedded in their countries and influenced by governmental regulation which can enhance or limit their efforts to improve their attractiveness. The same is valid for political stability (see, e.g., Gohomene et al., 2016). Therefore, when analyzing port attractiveness, these factors outside the direct control of ports need to be considered. The level of corruption in a country is another important factor in this regard although it does not seem to affect territorial development in that it does not highly affect the *gross domestic product* (GDP) growth rate per capita of a country (see also Caschili and Medda, 2015).

Determinants of port attractiveness can be grouped differently, e.g., according to stakeholders' viewpoints or regarding their nature which determines the control level of ports on them, e.g., endogenous, exogenous, and subjective (see Caschili and Medda, 2015) where, e.g., endogenous factors concern the port directly such as its infrastructure, monetary cost factors, logistic efficiency, and accessibility. Exogenous factors encompass factors indirectly influencing a port's performance, e.g., national and local economic competitiveness, geographic location, shipping line characteristics whereas subjective components contain the ports reputation perceived by sector operators (see Caschili and Medda, 2015). Their results show that the territorial development level, port assets, and port reputation influence the attractiveness of ports. Accordingly, Ng (2006) argues that most studies on the matter focus on finding the "most important" factor of port attractiveness, but they do not consider reputation or relationships documented in specific contracts or "packages" that provide stakeholders with port services and cost agreements. These need to be taken into consideration when analyzing port attractiveness via interview and comparison techniques. Additionally, this is especially important towards shipping lines as they have a great influence on ports as their power grows with the cargo volumes they transport (see also Tongzon and Sawant, 2007).

Different Viewpoints: Selection Criteria of Major Stakeholders

In this chapter, we analyze the literature regarding the selection criteria of maritime partners. The question what ports can do to enhance their attractiveness and how maritime players select the ports to call has been subject to a great body of literature dating back to 1985 with Slack analyzing containerized traffic between North American Mid-West and Western Europe; see also Jiang et al. (2015) and the references therein. Different stakeholders can have different interests that may be conflicting, so that their viewpoints need to be considered when investigating questions of port attractiveness.

For instance, Yuen et al. (2012) present a study on container port competitiveness accounting for all three-port user groups, i.e., shipping lines, forwarders and shippers. They provide an AHP analysis on six major ports in Asia from a user perspective thus interviewing industry experts. The factors and sub-factors are given in Figure 1.

Yuen et al. (2012) reveal with their study that for shipping liners, the most important factors in port competitiveness are given in Table 2.

There seem to be similarities, but the importance of sub-factors to the factors vary quite considerably among the different user groups. The results show that different users have different viewpoints and interests in what renders a port competitive. Thus, ports need to differentiate these user groups and consider which are the most important stakeholders to them when thinking about measurement to increase their competitiveness (see Yuen et al., 2012).

A characteristic of the maritime world that needs to be considered when discussing port attractiveness, competition, and port selection is the nature of maritime players. As Ng (2006) state, maritime players are conservative decision makers, so even if port facilities would need to improve their facilities

Figure 1. Factors and sub-factors of AHP for port competitiveness where the color orange gives the most important factors to the stakeholders.
Source: Yuen et al. (2012)

Table 2. Top criteria for port selection for user groups

Top Criteria	Shipping Lines	Forwarders	Shippers
1	Cost at ports	Port location	Port location
2	Customs and government regulations	Hinterland connections	Hinterland connections
3	Hinterland connections		Cost at ports
4	Terminal operators		Customs and government regulations

Source: Yuen et al. (2012)

and services they are using, they would not be very open to change and deviate cargo streams to other ports. This may also be due to the averseness of maritime partners towards environmental uncertainty, risks, and arising from difficulties to adapt to unfamiliar environments that, in a high-investment prone asset area, can immediately lead to high transaction costs (Cho, 2014; Ugboma et al., 2006). As a result, contractual performance of partners including their communication, negotiation, and coordination skills are key elements to keep environmental uncertainty at a minimum (see also Cho, 2014).

One would expect that these changes in the light of economic reasoning and the overall fierce competition on price and margins that tighten not only due to the crises in 2008/09. Therefore, we should expect to see that port attractiveness is directly linked to prices and cost-related issues as one of the most important factors. Surprisingly, this does not seem the case when analyzing the literature about port attractiveness where other factors are revealed to be more important, e.g., service quality (Ugboma et al., 2006) especially regarding information flows and data availability (see e.g., Ng, 2006), but the picture is diffuse on that matter. For instance, Tongzon and Sawant (2007) highlight that there is a maximum price that shipping lines would be willing to pay regarding service quality, thus as long as the maximum price threshold is not passed, service quality has precedence over price. Accordingly, the authors cite Maersk Sealand Asia's regional chief executive says, "One should always bear in mind that if shipping lines find a better, more efficient, and less expensive place along their route, they shift." As a result, port operators should enhance their efficiency and quality of services to attract shipping lines who are – we may state quite safely – one of the key stakeholders when it comes to port selection.

Liner Shipping Selection Criteria

Business is triggered by demand which for ports manifests in liner shippers calling a port to discharge and load cargo on their ships. We find many different studies evaluating decision criteria for ports' attractiveness. Some are listed in Table 3 to show the different results.

Despite these factors, also the size of the liner shipping fleet can have an influence on the port selection (see Jiang et al. (2015) and the references therein) as the suitability of ports depend on the depth of their berths. For instance, postpanamax ships have a draft of around 15 meters.

We note that most studies on decision criteria use interview technique, which is also used by ports when evaluating their performance. However, ports should not adopt the "stated preference approach" which is a survey method where stakeholders should evaluate the importance of certain factors within their decision-making process. According to Tongzon and Sawant (2007), shipping lines tend to be significantly overestimate certain factors, so that results of such questionnaires are not reliable.

Shippers Selection Criteria

The criteria of port selection by freight forwarders (shippers) is related to time-distance and cost criteria. Talley and Ng (2013) present the following criteria for ports selection for shippers that they found in the literature: 1) Distance between exporter or importer location and port location, 2) Port prices, 3) Port frequency of ship calls, to be translated into higher turnover times of cargo thus less waiting time and less inventory holding cost charges for the shipper; see also Tongzon (2009), 4) Port frequency of cargo loss and damage, 5) Service quality, 6) Port efficiency, 7) Port equipment availability, 8) Port information services, 9) Size of the shipper.

From a shipper's perspective, the frequency of port calls is important because it influences transit times (see also Tongzon, 2009). Congestion events are further important criteria that influence transport times. There are factors representing disadvantages and obstacles for ports' attractiveness that can be caused by third parties limiting port performance (Pahl and Voss, 2017). For instance, delays of *esti-*

Table 3. Resume of some study results regarding port selection criteria

Yuen et al. (2012) [Mainland China, Hong Kong, Asian cities]	**Tongzon and Sawant (2007) [Malaysia/ Singapore Region]**	**Yeo et al. (2019) [Taiwan]**
Cost at ports	Efficiency	Ample cargo sources (→ cargo volumes)
Customs and government regulations	Charges and port connectivity	Favorable port charges (→ prices)
Hinterland connections	Location	Dense ship network and routes
	Infrastructure	Low transshipment costs (→ prices)
	Range of port services	Efficient wharf operations (→ efficiency, berth availability)
		Adequate wharf and back-line land

Source: Own elaboration

mated times of arrivals (ETAs) of ships calling a port can easily delay port operations and play havoc with planned time schedules which heavily influence port performance and can lead to severe delays and related congestion in the port area and beyond (Pahl and Voss, 2017).

Tongzon (2009) also analyzes the selection criteria of shippers in the Southeast Asian area and find that port efficiency, shipping frequency, adequate infrastructure, geographical location, port charges, quick responses to port users' needs, as well as reputation for cargo damages are the most important selection criteria.

Anyhow, the shipper's process of selecting a port can be described as follows according to Tongzon (2009). The first step is to investigate which ports provide the required service and ranking those that have suitable services according to price and other criteria, e.g., port performance. Tongzon's study shows that the major part of shippers (ca. 75%) first select the shipping line and then choose a port of those served by this specific line. Only ca. 23% first decide upon the port before selecting the shipping line. Consequently, port operators should concentrate on the shipping lines regarding their strategies on enhancing their attractiveness. This is put into question by Olivier and Slack (2006) who analyze behavioral studies concerning stakeholders' port choices that somewhat see ports as "passive victims of overarching structural forces".

The analysis of management control functions provided by Steven and Corsi (2012) reveal that the importance placed on management control factors depend on the size of the shipper.

Ports Selecting Preferred Customers

So far, we were concerned with the question which factors are important for customers to select ports as cargo transportation service points whereas the question, which characteristics does have, the ideal business partner for ports is also interesting. This question is much less investigated or not at all until 2013 as stated by Talley and Ng (2013) possibly because the main assumption pertains that have ports wanted to maximize profits and thus accommodate every cargo request. However, some customers are more attractive than others are.

It is straightforward that ports want to increase their cargo throughput to increase profits. An increased throughput does not only mean increased margins, but also increased utilization of port equipment and services and all financial aspects that come with it, e.g., decreased payback periods of equipment and better *returns on investments* (ROIs). To achieve this, investments in port infrastructure and equipment needs to match future predicted utilization achieved by stable increased cargo throughputs. As a result, ports prefer long-term contracts with shipping lines and shippers with a guaranteed minimum cargo throughput (see also Talley and Ng, 2013; Cho, 2014). Their willingness to invest in, e.g., dredging port channels and berths to accommodate larger ship sizes wished by shipping lines that want to benefit from economies of scale at sea is also higher in case of guaranteed port calls from shipping lines with specific requirements (see Talley and Ng, 2013). The motivation of liner shippers and freight forwarders to agree on long-term contracts can be enhanced by local authorities using beneficial tax schemes (see Talley and Ng, 2013). These could motivate shippers to invest in the port area by building, e.g., distribution centers in port vicinity.

For a port, it is favorable to have discretionary cargo to improve their throughput (see also Talley and Ng, 2013). Discretionary cargo is cargo where the ultimate destination is not the nearby consumer market of the port, i.e., transshipments. In case of non-discretionary cargo that has the local consumer market as its ultimate destination, the intermodal transport options and thus the hinterland connection of the port become highly important and raises inter-port competition of those in vicinity to each other (see also Talley and Ng, 2013). For instance, Ng et al. (2006) analyze ports serving as transshipment hubs regarding their attractiveness (see also Lirn et al., 2004). Results of his survey state that monetary costs and time efficiency as well as accessibility of the port and cases of delay in loading/unloading are among the most important factors for port selection. Geographical location is also important, but not ranging highest most probably due to the nature of transshipments.

Important Factors of Port Attractiveness

In this study, we discuss the factors that make ports more attractive than others for their stakeholders/ users. The structure of this subchapter is starting at exogenous factors that are influencing port attractiveness, but are outside the direct control of port operators, passing on to factors that become more and more controllable by port operators, i.e., endogenous factors like port infrastructure (including accessibility), assets, and organizational issues that determine port performance and efficiency. Subsequently, we discuss subjectable factors like reputation that are hard to quantify, but that can greatly influence the perception of attractiveness in a very conservative maritime world.

When discussing preferences of ports due to their attractiveness, we need to take into consideration the nature of users evaluating port attractiveness. Liner shippers tend to reduce environmental uncertainty by forming long-term contracts with ports (see Cho, 2014 or Ugboma et al., 2006) whereas freight forwarders and independent shippers are less contractually bound to specific ports and do need more often to evaluate ports (see also Tongzon, 2009).

Exogenous Factors

Exogenous factors are those factors that are outside the direct control of ports and contain factors that are not easily changeable by ports such as their geographical location, country and governmental characteristics, port connectivity, and their relation to other ports within the maritime supply chain. The latter factors are in between exogenous and endogenous factors becoming more and more influence able by ports.

Geographical Position

The geographical position of a port as a link on a specific path where cargo needs to be transported is very important specially to freight forwarders and shippers to minimize time-distance metrics for their cargo. This is less important for ports that serve as transshipment hubs. The destinations of the cargo together with the amount of cargo to be transported determines the importance of ports as a linking platform. Other factors interplay, prevent or promote beneficial geographic positions of ports in the overall maritime transport network which we discuss in the following.

Country Characteristics of Port Location

Very closely related to the geographical position of ports in terms of attractiveness to port users is the country characteristics including government rules and regulations as well as political stability, which influence the state of a country. These rules and regulations allow setting the basis and proper conditions for foreign investment and, for example, the establishment of public-private partnerships (Falkland Islands Government, 2013). The overall state of the country and its political stability and history influences its current and future infrastructure which further influences logistical port efficiency and capacity to grow (see Caschili and Medda (2015) and the references therein). As a result, ports have very different capabilities of attracting national as well as foreign investments to improve their infrastructure, efficiency, and thus performance. For instance, the Chinese company Cosco Shipping Ports Limited get together with Volcan Mining, a Peruvian company, to invest US$3 billion in the port of Chancay, a city located 50 kilometers far from the most important port in Peru, Callao (Gestión, 2019; Andina, 2019). Furthermore, Caschili and Medda (2015) reveal that countries that are richer than others can attract higher foreign investments. Governmental regulations and rules as well as the level of corruption are further factors influencing port attractiveness. Piracy adds to this, i.e., high number of piracy events prevent stakeholders from passing their cargo through the areas where these events happen to limit the risks of cargo loss but also higher insurance fees. This is confirmed by the study of Caschili and Medda (2015) which shows that less attractive ports are also those situated in areas with higher piracy activities.

Port Connectivity

There is quite an amount of work analyzing port attractiveness in the context of maritime transport networks and state that port users rather base their selection on the maritime supply or transport chain where a port is embedded in rather than on the port per se (see Talley and Ng (2013) and the references therein).

Jiang et al. (2015) argue that the higher the connectivity of ports, the more attractive the port will be regarding the ease of transporting cargo and keep transportation times and costs at a minimum and thus the more competitive in comparison to others. By port connectivity, Jiang et al. (2015) understand the degree to which a port is connected to others in the maritime transportation network and its accessibility by regular liner services.

Wilmsmeier et al. (2006) studied 16 Latin American countries and revealed that inter-port connectivity has a significant impact on international maritime transportation costs. Additionally, Wilmsmeier and Hoffmann (2008) study the interdependencies between liner service structures, port infrastructure, and liner shipping freight rates in the Caribbean. Their studies helped to develop an index for measuring overall *liner shipping index* (LSCI) that combine factors of maritime transportation that is used and published by the *United Nations Conference on Trade and Development* (UNCTAD) to assess countries regarding their maritime connectivity. This allows policy makers to promote better services and reduce the costs of transportation.

Wang and Cullinane (2016) take the concept of centrality from network analysis to apply it in the maritime network context to assess ports in their (strategic) importance within the network; see also the references therein for a review on the initial application of the concept. Previous work of these authors (Wang and Cullinane, 2008) that applied the concept of influence measures like the eigenvector centrality to assess the accessibility of ports within the maritime network, suggest, among others, that the degree of shipping opportunities measured in frequency and capacity available in ports affect their competitive position. The same is valid for connections to high accessibility ports rather than to low accessibility ports. The authors apply all the three-centrality measures, i.e., degree, closeness, and betweenness in a study to capture correctly the competitive position of a port within the maritime network, as the single measures do not show the correct overall picture. Moreover, they provide a framework able to assess ports centrality based on the three measures including multiple perspectives on ports' position and competitiveness within the maritime network, i.e., the capability of a port to process cargo (out-degree centrality), popularity (in-degree centrality), accessibility (closeness centrality), and intermediacy (betweenness centrality). Interestingly, Caschili and Medda (2015) analyze the port attractiveness of African ports by applying a port attractiveness index. They reveal that the capacity of a port to be integrated in the international shipping network and their commercial relations to other ports is significantly higher than port quality.

Port Competitiveness and Inter-Port Relationships

Literature on ports mainly take the focus of excavating and distinguishing factors that enhance the position of ports with respect to competitiveness or attractiveness for their users (see also Lam and Yap, 2011). Even if ports are in competitive position towards each other which needs to be answered considering the specific markets, inter-port relationships and collaboration of ports in competitive positions can lead to complementary effects for both (see Lam and Yap, 2011). For instance, Lam and Yap (2011) use slot capacity analysis to measure inter-port relationships as well as complementarity of ports that is presented by services that are initiated or removed from both ports at the same time. The removal of a port call at one port and the adding of a call at the other port would speak for an enhancement of competition of one over the other port.

There is significant growing amount of maritime literature that acknowledges the view of port users on the overall maritime supply chain when making decisions. As a result, the selection of port calls cannot be made on isolated factors that only regard the port but concerns the maritime supply and transportation chains where ports are linking elements.

As shown by Lam and Yap (2011), ports and related governments or local authorities should concentrate on network effects in between ports rather than focusing on competition. It might not be possible for ports to serve overall expansions of demands in an entire area and multiple maritime supply chains may develop with the help of inter-port dynamics. The presence of terminal operators at multiple ports in a region can be a sign of port complementarity where these terminal operators position themselves as important nodes in the respective supply chain offering service packages to shipping lines used by calling their portfolio of terminals in different locations. Accordingly, Olivier and Slack (2006) state that there has been a significant increase in privatization on the container terminal level especially for developing countries between 1990 and 2001, and especially at Asian ports. This issue is important especially for governments and local authorities when developing strategies to boost local areas and making infrastructural decisions.

Endogenous Factors

Endogenous factors encompass those that can be directly controlled by ports, e.g., port infrastructure and assets, monetary cost factors, logistic efficiency, and accessibility to the hinterland.

Port Efficiency and Performance

Port efficiency and performance are the components bear the greatest potentials to enhance port attractiveness as the benefits are directly visible to stakeholders in terms of times and costs for cargo transport.

In fact, many studies such as the empirical study of Tang et al. (2011) reveal that the most important factor for increasing the attractiveness of ports is port efficiency (see also Ugboma et al., 2006; Tongzon, 2002). This is in line with Wilmsmeier et al. (2006) that found that doubling the efficiency of ports could be equivalent to reducing half of the distance between both. Cho (2014) analyze determinants and effects of logistics costs in container ports using a transaction cost perspective and is in accordance with these statements. Interestingly, he reveals also that a high level of asset specificity leads to higher transaction costs as it involves more specifically trained personnel and may have lower utilization levels. Thus, standardization can reduce transaction costs. This finding should draw the attention on policy makers decisions related on how they can facilitate local alternatives that ports can employ to increase their efficiency. Furthermore, increasing ports' efficiency tend to generate lower freight costs, once ports have already deal with specific factors such as distance, type of product, among others (Sánchez et al, 2003).

Si et al. (2018) investigate the performance of ports as part of their competitive force and attractiveness. They individuate six core dimensions with 16 principal PPIs (see also Table 4) and 60 sub-PPIs via their literature review that they use to determine interdependencies among them.

Regarding port core activities, ports can enhance their competitiveness if they can improve their speed of operations and productivity while reducing their variability. Moreover, supporting activities including port organizational administrative processes can significantly enhance performance of ports especially in case of high-talented human resources that cannot easily be imitated by competitors. Moreover, the use ICT can significantly improve organizations performance (see also Albadvi et al., 2009). Service costs seem to be one of the most important selection criteria for port users, so that ports can significantly enhance their competitive position if they provide a good balance of service quality in relation to its price (see Si et al. (2018) and the references therein). As a key link in the maritime supply chain, ports also have coordinative roles that can lead to facilitating collaboration in between supply chain partners linked via the port. The use of integrative IT can also in this case be of significant aid to improve the competitive position of a port.

Ha et al. (2017) analyze the competitiveness of four Korean ports that are locating in open and trade-oriented countries and compete on the global market. Their study reveals the prominence of productivity, output, lead-time, service fulfilment, information capital and profitability as the most important factors influencing/impacting the principle PPIs. Productivity related to port assets that ranges also among the most important criteria according to the study of Caschili and Medda (2015) as it directly influences efficiency that is directly influenced by processes and flows of operations that need to be in place to achieve optimal productivity.

Table 4. Hierarchy of port performance indicators (PPI)

Dimensions	Principle PPIs
Core activities	Output, productivity, lead time
Supporting activities	Human capital, organizational capital, information capital (IT systems, database, network)
Financial strength	Profitability, liquidity & solvency
User's satisfaction	Service fulfillment, service costs
Terminal supply chain integration	Intermodal transport system, value-added services, information & communication integration (e.g. EDI, IT to share data, etc.)
Sustainable growth	Safety and security, environment, social engagement

Source: Ha et al. (2017)

The study of Ugboma et al. (2006) on four Nigerian ports show the same picture with efficiency, frequency of ship visits, and adequate infrastructure were most important. Anyhow, the perception of the importance of cost and price-competitiveness are surprising as they were evaluated much less important than the aforementioned factors. The analysis of the 60 sub-PPIs in the study of Si et al. (2018) suggests that the most important PPIs for port competitiveness are throughput growth, vessel turnaround, crane productivity, overall service reliability, vessel call size growth, and IT systems whereas environmental-related factors, e.g., waste recycling, water consumption, and carbon footprint are the factors evaluated the least important. On the other hand, the chair of the British Ports Association, Martin Lawlor, made a call to ports' managers to take care about the contamination in berths and navigation channels due to ports' operations (Portstrategy a, 2019). This shows that much more work needs to be done to convert environmental-relevant so that advantages can be capitalized. The methodology developed by the authors can help ports to benchmark their performance to similar ports in their area and to better allocate their resources and improve crucial fields determined by their stakeholders to become more attractive to port users due to their performance despite their geographical position.

Yang and Chen (2016) study the region of Taiwan, Korea, and Japan using AHP and revealing that the cost factors are ranked highest, thus the top assessment criteria are transport costs, convenience at customs clearance procedures, harbor and stevedoring costs, cost of land, and the soundness of investment system and incentive measures.

Congestion phenomena of ports and their likelihood that can be due to various factors are directly linked to port performance and operational flows, thus they are rarely mentioned by stakeholders as influencing selection criteria although the create major problems. Recently, ports have had significant performance problems linked to factors that led to congestion and thus increased transactional costs, e.g., strikes by terminal employees (Cho, 2014), peak times of discharging and loading large ships, delays in ship arrivals, etc. (Pahl and Voss, 2017).

Innovations in Information and Communication Technology

Closely related to port efficiency are innovation drivers such as ICT that can enable ports to enhance their operational performance. ICT is not only mentioned itself an important factor as shown in Figure 1 with port information system. However, it also indirectly involved in many (sub-) factors mentioned to be decisive for port attractiveness such as costs at ports, container handling efficiency, customer service to users and safety and accident handling (see also Carlan et al., 2017; Heilig and Voss, 2016; Feibert et al., 2017). However, *information technology* (IT) and ICT have a far greater role than reflected in the responses of stakeholders with respect to port attractiveness. It supports making better plans and execute daily operations regarding the port's infrastructure capacity usage as well as reacting to unexpected events that can create congestion that, in turn, can lead to great logistical problems and high costs are due to not only unmet deadlines and related contractual penalties (see, e.g., Kirstein (2018).

Digital innovations in the port area target the efficient exchange of information provided by *electronic data interchange* (EDI) innovations, solutions that monitor cargo and vehicles, as well as applications supporting cargo flows (see Carlan et al., 2017) that also considers safety and security issues (Riedl et al., 2018). As an example, *port community systems* (PCS) based on EDI are such platforms that allow for an efficient and digital information exchange providing a single window for main stakeholders of ports as well as the implementation of compliance processes (Fedi et al., 2019; Heilig and Voss, 2016; Kirstein, 2018). Besides, *terminal operation systems* (TOS) support terminal operators to efficiently plan, schedule, and use their resources according to their stakeholder's demands.

Besides creating network platform where stakeholders can exchange information, "Smart Port" initiatives emerge globally that have as key characteristics the ability to meet changing demands of users, keep up with rapid developments in ICT as well as master and smoothly integrated new technologies (see Attia, 2016). Innovative technologies that are named in this context pertain to the field of the Internet-of-Things with its concept to automizing the communication and process flow between entities in a network that builds a cyber-physical system (see, e.g., see Attia, 2016; Kirstein, 2018). These include, e.g., robots, *radio frequency identification* (RFID), (W)LAN, *global positioning system* (GPS) technologies, cloud systems, mobile device applications ("apps"), blockchain technology, and big data analytics approaches. Automation is the key driver enabling *automated guided vehicles* (AGVs) to process goods without the immediate interaction with humans leading to great potential in cost reductions (see Sánchez & Mouftier, 2016). For instance, the smart port initiative at the German Port of Hamburg aims at doubling capacities – in terms of times and usage but not space – by 2025 while reducing operating as well as logistics costs (see Riedl et al., 2018). Within the smart port concept, sensors are placed nearly everywhere, e.g., in quay walls, roads, railways, bridges, etc. to submit online real-time data on and/or the environmental conditions. The costs of such systems have already reduced significantly, so that their ROI is short which is especially interesting for countries with high personnel costs. Besides, equipment monitoring can reveal the bottlenecks in handling and infrastructure (see Riedl et al., 2018).

Especially with the emergence of big data and recent innovations in the area of data science that enables better prediction of events in the port and its environment (see, e.g., Heilig and Voss, 2016; Fruth and Teuteberg, 2017; Sánchez and Mouftier, 2016). For instance, the prediction of *estimated times of arrivals* (ETAs) of ships is a major research topic as planned and actual ship arrival times can significantly vary thus containing great potential for disrupting operations and leading to congestions (see also Pahl and Voss, 2017). As shown by Carlan et al. (2017), reducing congestion is also one of the most important goals regarding environmental objectives of ports. Additionally, Riedl et al. (2018) argue that in cargo handling, systems with real-time information can save up to 10% from operating costs by reducing idle times and energy use. Environmental concerns and energy utilization are becoming more and more important for ports and their stakeholders (see also Sánches & Mouftier, 2016). This is where ICT can have a significant impact. Stakeholder report that they massively collect data, but seldom use it to generate useful information to be shared with others (see Feibert et al., 2017). Heilig et al. (2019) have identified a lack of data-driven approaches for container terminals. Therefore, there is a great research potential regarding the development of such approaches that can be used in practice.

The development of appropriate ICT platforms requires strong collaboration of main stakeholders. Nevertheless, this is also a barrier for ICT innovations despite uncertainty regarding legislation, as well as drifting apart of local versus global needs expressed by decisions of headquarters (see Carlan et al., 2017). However, Carlan et al. (2017) reveal that regulations and standardization are neither a significant barrier nor a facilitator of ICT innovation processes. The main obstacles are restricted trust among the stakeholders, coordination issues also regarding standardization, as well as deviating objectives.

Finally, with new technological advances that connect equipment and operators to communicate via digital networks shift the focus from "what is possible" to "how can we protect it from being misused or destroyed" and thus cybersecurity (see Kirstein, 2018; Sánchez and Mouftier, 2016).

Subjective Factors

According to Caschili and Medda (2015), the capacity of a port to be integrated in the international shipping network is four times more important than port quality, i.e., a wide network of commercial relations with other ports and business partners enhance port attractiveness. This is also triggered by positive mouth-to-mouth propaganda. If ports succeed in transforming themselves in hubs able to exploit collaborative and cooperative schemes, they can enhance their position in the maritime transportation network.

Ugboma et al. (2006) state that perception of port performance of shippers can take precedence of actual performance of ports. Tongzon (2009) experiences the same result. Furthermore, according to the increasing global trend for sustainability related to shipping and ports business activities (Lee, Kwon & Ruan, 2019), relations between port and cities turn important to hold a good reputation with several ports' stakeholders. Merico, Dinoi and Contini (2019), developed a model for the measurement of pollution in coastal cities, even separating pollution generated by ships to the one generated by ports' internal operations, in order to ensure good air quality standards. In addition to this, Karimpour, Ballini and Ölcer (2019) propose a multi-stakeholder initiative focused on ship-originated waste management, including collaborative activities among ports and local municipalities. Involving local communities and government in sustainability projects such as the circular economy, ports can enhance attractiveness by boosting their reputation within the port-city relationship and with the interesting policy makers. According to Chen and Lam (2018), the ports of Singapore, Hong Kong, and Busan are the ones that show best sustainability practices, enhancing their port capacity as well as their cargo demand while focusing on a low carbon economy and high control of the emissions. Other studies analyze sustainable port-city relationships by the implementation of energy management strategies using smart grid infrastructure (Yigit and Acarkan, 2018), which minimizes the negative environmental effects of ports in their surroundings. Besides, ports are also hubs alive with intensive interaction among many people with different backgrounds, which implies the formation and endurance of groups within the ports' vicinity (Brandon, Frykman and Roge, 2019). Considering this, port-cities are already embedded in multi-level social relations that increase the sustainability challenges to achieve and represents another issue for ports to take care about in order to enhance their reputation, and then their attractiveness (see also Sánchez and Mouftier, 2016).

ENHANCING PORTS' ATTRACTIVENESS: OBSTACLES AND ACTION PLAN

In this section, it is aimed to integrate the literature review with some current projects related to ports, expert opinions from professionals of the industry, and policies and rules promoted by governments in order to enhance ports' attractiveness. By the end of the section, we propose a step-by-step guide focused on port managers and how they can increase the attractiveness of their ports, besides no consensus found in the literature regarding this matter.

Future alliances between governments and private sector will allow maritime supply chains to invest and develop new maritime routes that could be more efficient, such as the Northern Sea Route (Pahl and Kaiser, 2018), where DP World already have an agreement with Russia to enhance ports' activity on that route, providing the adequate infrastructure to properly operate ports alongside (Portstrategy b, 2019). This investment is expected to increase and develop the maritime traffic in this zone, and delivering efficient processes for ports, shipping lines, and forwarders, which is expected to increase ports' attractiveness (Ugboma et al., 2006; Tongzon, 2002).

Ports' waterfront as well inland connectivity is extremely important in order to improve attractiveness for major stakeholders, even more when the port has not the transshipment feature (Talley and Ng, 2013) or have the opportunity for inter-port connectivity (Wilmsmeier et al., 2006). According to this, Canadian government will invest nearly US$35 million on Halifax port's infrastructure, but also on rails that achieve inter-port connectivity, and several traffic signals and highway improvements around port's area in order to avoid the containers congestion (Portstrategy c, 2019). Canadian Halifax port has a strategic geographical position that links it not only to Asia through the new transpolar routes (Pahl and Kaiser, 2018), but also to Europe. Hence, improving overall connectivity for ports will grant lower transaction costs and better lead times, both key drivers for port's attractiveness (Si et al., 2018). Port's connectivity is strongly related to the availability of rails, local road networks, major road networks, among other intermodal options, as well to their proper operational conditions. It needs also a transport strategy that depends on public policies effectiveness and the coordinated action of the maritime supply chains (UK Department of Transport, 2017).

Choosing customers may be a privilege that not everyone has. According to own resources and goods that countries produce, ports are able to decide their services according to attract a specific target group of customers, whom they can serve better regarding their facilities and processes. The same benefits from long-term contracts with shipping lines and freight forwarders, related to maximize cargo throughput and increase infrastructure utilization rate (Talley and Ng, 2013; Cho, 2014), can be obtained also from contracts and long-term relationships with goods owners, such as Rotterdam's 60-hectare 'Food Hub' project focused on 'agro-food' companies, which is considering also the investment in new warehouses and refrigerated facilities, turning them from a traditionally fuel oriented equipment to food specific infrastructure (Portstrategy d, 2019). Offering suitable equipment and facilities for a specific industry increases port's attractiveness and allow it to negotiate better business conditions and long-term beneficial contracts with customers, leveling its utilization of resources and distributing its costs efficiently. On the other hand, port managers need to achieve long-term relationships with important stakeholders to secure sustainable competitive positions as stakeholders can have interests that may be conflicting and affect port performance (Ha et al., 2017).

According to the Review of Maritime Transport 2018 (UNCTAD, 2018), ports need to combine their development efforts to technology and digital innovations as reliable mechanisms for cost reduction as well as for cargo tracking and tracing, which represents strong drivers for their attractiveness indeed. Daniel Elroi, CEO of NSGIS, a company which provide technology solutions related to *geographic information system* (GIS), explained that GIS projects in ports such as Los Angeles, Long Beach, among others are different from each other, and emphasized that nowadays digital transformation evolved the capacity of GIS systems to track dynamic elements such as vessels, people and containers, besides the static elements that they usually can track (Portstrategy e, 2019). Moreover, Albadvi et al. (2009) argue that the integration of ICT into ports operations allow them to enhance their processes and to have more efficiency transactions. The incorporation of technological innovations is a global trend that ports need to be aware of, to attain high levels of attractiveness and perform better.

Finally, the need for sustainable ports' operations and low-carbon shipping lines commerce have to be a common effort among every stakeholder related to maritime supply chains industry around the world (CNN, 2019). According to Lee, Kwon and Ruan (2019), sustainability practices are already demanded for global operational trends, which push ports to think about their environment and include those stakeholders within their strategy in order to increase their attractiveness, by leveraging their reputation.

We propose a possible five-step action plan including sequence for ports to enhance their attractiveness as follows:

1. Analyze your position in the maritime transport and supply chain.
2. Find out and know who your customers are: analyze their needs but avoid to directly asking them; concentrate on shipping lines first (Tongzon, 2009) as shippers firstly select shipping lines and then ports that are called by this specific line to transport their cargo.
3. Concentrate on port efficiency and the use of information technology. The studies of Tongzon (2009) and Ugboma et al. (2006) are in line with the result that port efficiency is the top selection criteria for freight forwarders / shippers, who are the stakeholders making majorly port selections. Following Tongzon and Sawant (2007), when two ports are within the same region (same hinterland connection) with the same threshold of efficiency the one port that has lower charges, provision of new value adding services, adequate infrastructure put into an integrated package would be selected over the other one. Innovations in automation and digitization will give port operators leading advantages in raising port efficiency and know-how of optimizing the use of resources as well as dealing and resolving unexpected events such as congestion. Benefits of automation and digitization of port-related processes include reduced costs and higher flexibility.
4. Tailor specific contractual packages to them that can lead to long-term partnerships by reducing the environmental uncertainty to all players and reducing transactional costs. This sometimes means to adapt market strategy to the stakeholders (see also Ugboma et al. (2006).
5. Collaborate with other ports to form inter-port networks and benefit from network effects. Establish collaboration initiatives also with local stakeholders such as municipalities, customers, and policy makers, in order to increase port's reputation towards the vicinity by the adoption of sustainable practices.

CONCLUSIONS AND FURTHER RESEARCH

The present study did not find consensus about the drivers that can enhance ports' attractiveness, but port managers can follow this five-step action plan formulated and guided by the literature review and what port managers are doing regarding infrastructure projects, ICT integration, public-private associations, etc.

- There is no consensus in the literature about which elements give more attractiveness to ports. Besides diverse viewpoints about these drivers, perhaps the different combination of exogenous, endogenous and subjective factors that each port exhibits could be the reason for its attractiveness.

Hence, conduct additional research exploring this combination is needed, to understand how these three factors work together and provide synergy.

- There are reasons, other than their geographical position, while one port is more attractive than the other one and thus selected by stakeholders for their operations, but there is no consensus either on why is the case for that. According to our results, port selection seems to follow no specific pattern, but at the same time, each case has a convincing explanation about its decision-making process. Further research needs to go deeper into qualitative research methods and approach with multi-case studies that allow extract more details and different perspectives.
- Current managerial needs and actions plans follows most theoretical proposals related to the key drivers capable to increase ports' attractiveness. Nevertheless, as we explained earlier, we find contradictory statements in the literature. However, we also find some managerial strategies such as industry-related infrastructure or public-private associations that are not considered throughout the literature. These gaps between theory and practice need additional future research, where both sides can benefit from each other, aiming to develop this organizational field.
- According to ports' attractiveness drivers, there are issues that need to be tackled in a specific sequence by port managers, to increase their potential for being choose. Despite that some drivers are being covered by port managers such as digital integration, efficient processes or strong connectivity, this study focused on identify which of them have been implemented and which others were not, finding in this gap a partial explanation why some ports are preferred rather than others. We would suggest approaching this from two sides: (i) A macro-economic study on the environmental factors (position in the maritime network) as well as from (ii) a behavioral stakeholder analysis point of view concentrating on revealed preferences and the establishment of long-term contracts, so that investments in port vicinities take place that attract more maritime players, e.g., freight forward agents as well as industry.
- Finally, as there is no consensus on what renders ports attractive, so it is also difficult to propose an agenda for port operators. We think that a pragmatic view on this and a customized agenda may help ports, but there is no certainty of that. Besides this, we propose a five-step action plan that includes evidence from both, literature and managerial practices, shedding additional light into this still open question regarding ports' reasons for being selected to work with.

REFERENCES

Agbesi, K. (2013). The impact of ICT on the clearing of goods at Ghana ports: A study of Tema and Takoradi ports. *SAVAP International Part I: Natural and Applied Sciences*, *4*(3), 87–95.

Albadvi, A., Keramati, A., & Razmi, J. (2007). Assessing the impact of information technology on firm performance considering the role of intervening variables: Organizational infrastructures and business processes reengineering. *International Journal of Production Research*, *45*(12), 2697–2734. doi:10.1080/00207540600767780

Andina (2019). *Chancay port terminal to boost economic development in Peru.* Retrieved from: Internet Source: https://andina.pe/agencia/noticia-chancay-port-terminal-to-boost-economic-development-in-peru-740184.aspx

Attia, T. M. (2016). Importance of communication and information technology and its applications in the development and integration of performance in seaports. *Renewable Energy and Sustainable Development.*, *2*(2), 137–146. doi:10.21622/resd.2016.02.2.137

Brandon, P., Frykman, N., & Roge, P. (2019). Free and unfree labor in Atlantic and Indian ocean port cities (Seventeenth-Nineteenth Centuries). *International Review of Social History*, *64*(S27), 1–18. doi:10.1017/S0020859018000688

Carlan, V., Sys, C., Vanelslander, T., & Roumboutsos, A. (2017). Digital innovation in the port sector: Barriers and facilitators. *Competition and Regulation in Network Industries*, *18*(1-2), 71–93. doi:10.1177/1783591717734793

Caschili, S., & Medda, F. (2015). The port attractiveness index: Application on African ports. *Région et Développment*, Nr. 41-2015. 41, 47-82

Chen, Ch., & Lam, J. S. L. (2018). Sustainability and interactivity between cities and ports: A two-stage data envelopment analysis (DEA) approach. *Maritime Policy & Management*, *45*(7), 944–961. doi:10.1080/03088839.2018.1450528

Cho, H.-S. (2014). Determinants and effects of logistics costs in container ports: The transaction cost economics perspective. *The Asian Journal of Shipping and Logistics*, *30*(2), 193–215. doi:10.1016/j.ajsl.2014.09.004

CNN. (2019). *The shipping industry must go carbon neutral to survive*. Retrieved from: https://edition.cnn.com/2019/08/08/perspectives/climate-shipping-sustainable-green/index.html

De Langen, P., Turró, M., Fontanet, M., & Caballé, J. (2018). *The infrastructure investment needs and financing challenge of European ports, Report prepared for the European Seaports Organisation (ESPO).* Retrieved from: https://www.espo.be/publications/the-infrastructure-investment-needs-and-financing-

Ding, J.-F., Kuo, J.-F., Shyu, W.-H., & Chou, C.-C. (2019). Evaluating determinants of attractiveness and their cause-effect relationships for container ports in Taiwan: Users' perspectives. *Maritime Policy & Management*, *46*(4), 466–490. doi:10.1080/03088839.2018.1562245

Falkland Islands Government. (2013). *Call for Expression of Interest.* Retrieved from: https://www.falklands.gov.fk/home/call-for-expression-of-interest/

Fedi, L., Lavissiere, A., Russell, D., & Swanson, D. (2019). The facilitating role of IT systems for legal compliance: the case of port community systems and container verified gross mass (VGM). *Supply Chain Forum: An International Journal*. 20(1): 29-42

Feibert, D. C., Hansen, M. S., & Jacobsen, P. (2017). An integrated process and digitalization perspective on the shipping supply chain – a literature review. In *2017 IEEE International Conference on Industrial Engineering and Engineering Management IEEE*. Pages 1-5 10.1109/IEEM.2017.8290113

Fruth, M., & Teuteberg, F. (2017). Digitization in maritime logistics – What is there and what is missing? *Cogent Business & Management.*, *4*(1), 1–40. doi:10.1080/23311975.2017.1411066

Gestión (2019). *Primera fase del puerto de Chancay de Cosco Shipping y Volcan demandará US$1,300 millones.* Retrieved from https://gestion.pe/economia/empresas/primera-fase-puerto-chancay-cosco-shipping-volcan-demandara-us-1-300-millones-256546

Gohomene, D. A., Yang, Z. L., Bonsal, S., Maistralis, E., Wang, J., & Li, K. X. (2016). The attractiveness of ports in West Africa: Some lessons from shipping lines' port selection. *Growth and Change*, *47*(3), 416–426. doi:10.1111/grow.12133

Ha, M.-H., Yang, Z., Notteboom, T., Ng, A. K. Y., & Heo, M.-W. (2017). Revisiting port performance measurement: A hybrid multi-stakeholder framework for the modelling of port performance indicators. *Transportation Research Part E, Logistics and Transportation Review*, *103*, 1–16. doi:10.1016/j.tre.2017.04.008

Heilig, L., Stahlbock, R., & Voss, S. (2019). From digitalization to data-driven decision making in container terminals. *Computing Research Repository (CoRR).* Preprint. International Maritime Organization (IMO). *Introduction to IMO.* Retrieved from http://www.imo.org/en/About/Pages/Default.aspx

Heilig, L., & Voss, S. (2016). Information systems in seaports: A categorization and overview. *Information Technology Management*, *18*(3), 179–201. doi:10.100710799-016-0269-1

Jiang, J., Lee, L. H., Chew, E. P., & Gan, C. C. (2015). Port connectivity study: An analysis framework from a global container liner shipping network perspective. *Transportation Research Part E, Logistics and Transportation Review*, *73*, 47–64. doi:10.1016/j.tre.2014.10.012

Karimpour, R., Ballini, F., & Ölcer, A. I. (2019). Circular economy approach to facilitate the transition of the port cities into self-sustainable energy ports – a case study in Copenhagen-Malmö Port (CMP). *WMU Journal of Maritime Affairs*, *18*(2), 225–247. doi:10.100713437-019-00170-2

Kirstein, L. (2018). Information sharing for efficient maritime logistics. International Transport Forum, Case-Specific Policy Analysis, OECD/ITF. Pages 1-34.

Lam, J. S. L., & Yap, W. Y. (2011). Dynamics of liner shipping network and port connectivity in supply chain systems: Analysis on East Asia. *Journal of Transport Geography*, *19*(6), 1272–1282. doi:10.1016/j.jtrangeo.2011.06.007

Lee, P. T.-W., Kwon, O. K., & Ruan, X. (2019). Sustainability challenges in maritime transport and logistics industry and its way ahead. *Sustainability*, *11*(5), 1–9. doi:10.3390u11051331

Lirn, T. C., Thanopoutou, H. A., Beynon, M. J., & Beresford, A. K. C. (2004). An application of AHP on transshipment port selection: A global perspective. *Maritime Economics & Logistics*, *6*(1), 70–91. doi:10.1057/palgrave.mel.9100093

Merico, E., Dinoi, A., & Contini, D. (2019). Development of an integrated modelling-measurement system for near-real-time estimates of harbour activities impact to atmospheric pollution in coastal cities. *Transportation Research Part D, Transport and Environment*, *73*, 108–119. doi:10.1016/j.trd.2019.06.009

Ng, K. Y. A. (2006). Assessing the attractiveness of port in the north European container transshipment market: An agenda for future research in port competition. *Maritime Economics & Logistics*, *8*, 234–250. doi:10.1057/palgrave.mel.9100158

Olivier, D., & Slack, B. (2006). Rethinking the port. *Environment and Planning A. Economy and Space*, *38*(8), 1409–1427.

Pahl, J., & Kaiser, B. (2018). Arctic port development. In I. N. Verstergaard, B. A. Kaiser, L. Fernandez, & J. Nymand Larsen. (Eds.), *Arctic Marine Resource Governance and Development* (s. 139-184). Springer. Springer Polar Sciences.

Pahl, J., & Voss, S. (2017). Maritime load dependent lead times – An analysis. In *Proceedings of the International Conference on Computational Logistics* (vol. 10572, pp. 300-305). Cham, Switzerland: Springer. 10.1007/978-3-319-68496-3_20

Portstrategy a. (2019). *BPA urges 'grown-up' scrubbers conversation.* Retrieved from https://www.portstrategy.com/news101/world/europe/scrubber-clarity-call-at-uk-parliament

Portstrategy b. (2019). *DP world to operate new Russian ports.* Retrieved from https://www.portstrategy.com/news101/world/europe/dp-world-to-operate-new-russian-ports

Portstrategy c. (2019). *CAD$47.5M to improve Halifax efficiency.* Retrieved from https://www.portstrategy.com/news101/world/americas/cad$47.5m-to-improve-halifax-efficiency

Portstrategy d. (2019). *From fuel to food.* Retrieved from https://www.portstrategy.com/news101/insight-and-opinion/the-analyst/from-fuel-to-food

Portstrategy e. (2019). *Cross-port benefits of geospatial technology.* Retrieved from https://www.portstrategy.com/news101/port-operations/planning-and-design/Cross-port-benefits-of-geospatial-technology

Sánchez, R. J., Hoffmann, J., Micco, A., Pizzolitto, G. V., Sgut, M., & Wilmsmeier, G. (2003). Port efficiency and international trade: Port efficiency as a determinant of maritime transport costs. *Maritime Economics & Logistics*, *5*(2), 199–218. doi:10.1057/palgrave.mel.9100073

Sánchez, R. J., & Mouftier, L. (2016). Reflections on the future of ports: From current strains to the changes and innovation of the future. *ECLAC United Nations, ISU Infrastructure Service Unit. Natural Resources and Infrastructure Divison*, *352*(8), 1–9.

Sánchez, R. J., Ng, A. K. Y., & Garcia-Alonso, L. (2011). Port selection factors and attractiveness: the service providers' perspective. *Transportation Journal*, *50*(2), 141–161. doi:10.5325/transportationj.50.2.0141

Si, S.-L., You, X.-Y., Liu, H.-C., & Zhang, P. (2018). DEMATEL Technique: A systematic review of the state-of-the-art literature on methodologies and applications. *Mathematical Problems in Engineering*, *2018*, 1–33. doi:10.1155/2018/3696457

Talley, W. K., & Ng, M. (2013). Maritime transport chain choice by carriers, ports and shippers. *International Journal of Production Economics*, *142*(2), 311–316. doi:10.1016/j.ijpe.2012.11.013

Tongzon, J. (2002). Port choice determinants in a competitive environment. *The International Association of Maritime Economists Annual Conference 2002 Conference Proceedings*, Panama.

Tongzon, J. (2009). Port choice and freight forwarders. *Transportation Research Part E, Logistics and Transportation Review*, *45*(1), 186–195. doi:10.1016/j.tre.2008.02.004

Tongzon, J., & Heng, W. (2005). Port privatization, efficiency and competitiveness: Some empirical evidence from container ports (terminals). *Transportation Research Part A, Policy and Practice*, *39*(5), 405–424. doi:10.1016/j.tra.2005.02.001

Tongzon, J., & Sawant, L. (2007). Port choice in a competitive environment: From the shipping lines' perspective. *Applied Economics*, *39*(4), 477–492. doi:10.1080/00036840500438871

Ugboma, C., Ugboma, O., & Ogwude, I. C. (2006). An analytic hierarchy process (AHP) approach to port selection decisions – Empirical evidence from Nigerian ports. *Maritime Economics & Logistics*, *8*(3), 251–266. doi:10.1057/palgrave.mel.9100160

UK Department of Transport. (2017). *Transport infrastructure for our global future. A study of England's port connectivity.* Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/710030/transport-infrastructure-global-future-a-study-england-port-connectivity.pdf

UNCTAD. (2018). *Review of maritime transport 2018*. Retrieved from https://unctad.org/en/PublicationsLibrary/rmt2018_en.pdf

Veldman, S., Garcia-Alonso, L., & Vallejo-Pinto, J. A. (2011). Determinants of container port choice in Spain. *Maritime Policy & Management*, *38*(5), 509–522. doi:10.1080/03088839.2011.597450

Wang, Y., & Cullinane, K. (2008). Measuring container port accessibility: An application of the principal eigenvector method (PEM). *Maritime Economics & Logistics*, *10*(1-2), 75–89. doi:10.1057/palgrave.mel.9100192

Wang, Y., & Cullinane, K. (2016). Determinants of port centrality in maritime container transportation. *Transportation Research Part E, Logistics and Transportation Review*, *95*, 326–340. doi:10.1016/j.tre.2016.04.002

Wilmsmeier, G., & Hoffmann, J. (2008). Liner shipping connectivity and port infrastructure as determinants of freight rates in the Caribbean. *Maritime Economics & Logistics*, *10*(1-2), 130–151. doi:10.1057/palgrave.mel.9100195

Wilmsmeier, G., Hoffmann, J., & Sanchez, R. J. (2006). The impact of port characteristics on international maritime transport costs. *Port Economics Research in Transportation Economics*, *16*, 117–140. doi:10.1016/S0739-8859(06)16006-0

Wilmsmeier, G., & Monios, J. (2016). Container ports in Latin America - challenges in a changing global economy. In P. T.-W. Lee, & K. Cullinane (Eds.), *Dynamic shipping and port development in the globalized economy* (pp. 11–52). Basingstoke, UK: Palgrave Macmillan.

World Bank. (2018). *Connecting to compete 2018: Logistics performance index (LPI).* Retrieved from https://lpi.worldbank.org/

World Bank News. (2018). *Strong trade growth in 2018 rests on policy choices.* Retrieved from https://www.wto.org/english/news_e/pres18_e/pr820_e.htm

World Trade Organization – WTO a. (2018). *Annual report 2018.* Retrieved from https://www.wto.org/english/res_e/publications_e/anrep18_e.htm

World Trade Organization – WTO b. (2018). *Strong trade growth in 2018 rests on policy choices*. Retrieved from https://www.wto.org/english/news_e/pres18_e/pr820_e.htm

Yang, Y.-C., & Chen, S.-L. (2016). Determinants of global logistics hub ports: Comparison of the port development policies of Taiwan, Korea, and Japan. *Transport Policy*, *45*, 179–189. doi:10.1016/j.tranpol.2015.10.005

Yang, Z., Bonsall, S., & Wang, J. (2009). Use of hybrid multiple uncertain attribute decision making techniques in safety management. *Expert Systems with Applications: An International Journal*, *36*(2), 1569–1586. doi:10.1016/j.eswa.2007.11.054

Yeo, G.-T., Ng, A. K. Y., Lee, P. T.-W., & Yang, Z. (2013). Modelling port choice in an uncertain environment. *Maritime Policy & Management*, *41*(3), 251–267. doi:10.1080/03088839.2013.839515

Yigit, K., & Acarkan, B. (2018). A new electrical energy management approach for ships using mixed energy sources to ensure sustainable port cities. *Sustainable Cities and Society*, *40*, 126–135. doi:10.1016/j.scs.2018.04.004

Yuen, C.-L., Zhang, A., & Cheung, W. (2012). Port competitiveness from the users' perspective: An analysis of major container ports in China and its neighbouring countries. *Research in Transportation Economics*, *35*(1), 34–40. doi:10.1016/j.retrec.2011.11.005

Zhang, A., & Lam, J. S. L. (2014). Impacts of schedule reliability and sailing frequency on the liner shipping and port industry: A study of Daily Maersk. *Transportation Journal*, *53*(2), 235–253. doi:10.5325/transportationj.53.2.0235

ADDITIONAL READING

Cheung, S. M. S., & Yip, T. L.Shuk Man Sherman Cheung; Tsz Leung Yip. (2011). Port city factors and port production: Analysis of Chinese ports. *Transportation Journal*, *50*(2), 162–175. doi:10.5325/transportationj.50.2.0162

Ducruet, C., & Lee, S. (2006). Frontline soldiers of globalization: Port-city evolution and regional competition. *GeoJournal*, *67*(2), 107–122. doi:10.100710708-006-9037-9

Gonzalez-Perez, M. A., & Leonard, L. (2013). *International business, sustainability and corporate social responsibility*. Bingley, United Kingdom: Emerald Group Publishing Limited. doi:10.1108/S2051-5030(2013)11

Gonzalez-Perez, M. A., & Leonard, L. (2016). *Climate change and the 2030 corporate agenda for sustainable development*. Bingley, United Kingdom: Emerald Group Publishing Limited. doi:10.1108/S2051-5030201719

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, *78*(6), 1360–1380. doi:10.1086/225469

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, *91*(3), 481–510. doi:10.1086/228311

Rodríguez-Álvarez, A., Tovar, B., & Wall, A. (2011). The effect of demand uncertainty on port terminal costs. *Journal of Transport Economics and Policy*, *45*(2), 303–328.

Sheffi, Y. (2001). Supply chain management under the threat of international terrorism. *International Journal of Logistics Management*, *12*(2), 1–11. doi:10.1108/09574090110806262

Southern, R. N. (2011). Historical perspective of the logistics and supply chain management discipline. *Transportation Journal*, *50*(1), 53–64. doi:10.5325/transportationj.50.1.0053

KEY TERMS AND DEFINITIONS

Container: A 20-foot capacity box, usually made of steel. Its main task is to facilitate transport of goods. One container is referred in logistics terms as one TEU (twenty-foot equivalent unit).

Freight Forwarder: An intermediary between the customer and the logistic services suppliers.

Network: A group of nodes connected by ties, building an interconnected system.

Postpanamax: This name is given to ships that can cross through Panama Canal, having a cargo capacity between 4,000 and 5,000 TEU.

Shipping Line: A company that own cargo vessels and it is responsible for the sea transport.

Supply Chain: A logistic process that includes warehousing and transport activities and involves two or more participants connected by trade transactions.

Terminal: An area of the port where transports load and unload the cargo.

Chapter 19
Green Logistics Practices and Sustainable Business Model

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ABSTRACT

This chapter presents a broad introduction to the knowledge of green logistics in a practical manner; definition and dimensions of green logistics practices; factors of green practices and their roles and impacts. Given the importance of logistics in global economic and increasing concern in environmental sustainability, this chapter looks at the work model in green leadership for fostering competitiveness and sustainability development in the world. It will look at how green attributes can be transformed into the practical lives of today's leaders, and take away the essence, insights, and tools of green leadership, and step up to the next level as a true firm, definitely from a logistics service provider perspective.

INTRODUCTION

Logistics industry has been acknowledged as one of the main causes to environmental impact such as CO_2 emissions (Kengpol and Tuammee, 2015). The need to include environmental concerns into logistics industry is essential. Yet, there is a lack of forces to merge green logistics, which can empowered benefits of profits to firms and values to customers, community and planet. To date not many logistics service providers (LSPs) comply with the environmental management standard (ISO 14001) and at present, they are still facing challenges and obstacles in environmental issues (Kengpol and Tuammee, 2015).

Noorliza and M-Hasmi (2016a) reveal that sustainable business model is not a choice but it is rather crucial for competitive advantage in this dynamic business. The future competitiveness of firm counts on the sustainable business model creating the holistic value on the principles of 4p sustainability: Product/Process/Service, Profit, People and Planet. Literally, firms that proactive react and adjust to internal or external changes; most recently halal and environmental sustainability will obtain a competitive advantage or business success. Noorliza and M-Hasmi (2016b) find that firms actively involved in sustainable practices such as Halal have witnessed an improvement in the 4p sustainability principles.

DOI: 10.4018/978-1-7998-1397-2.ch019

Thus, environmental sustainability and business success are closely connected and complementary. The notion of sustainable practices in firms hence, is an urgent promise that needs to be the strategic imperative by all industries.

Meanwhile, the environmentalism, green issues or sustainability have been an acknowledgement since the early 1990s, yet green leadership has not built in actively into a firm's vision and mission (Piecyk and McKinnon, 2010). Conventional businesses do not include environmental issues instead focusing on minimizing costs and maximizing profits. Consequently, environmental concerns in logistics just appeared since 1995, involving purchasing-related issues and reverse logistics field, hence much needs to be known concerning the green logistics practices in logistics. However, due to limited knowledge and awareness about environmental concern and its effects, the implementation of green logistics practices have been hinder and delayed. Many logistics firms perceived the operational cost would increase if adopting green logistics practices without realizing the benefits of its implementation. However, due to ecological responsibility, corporate viability, corporate value, good corporate citizen, government regulations, environmental management system (international certification standards) and changing consumer demands, environmentalism has become an important social and business issues. Accordingly, this chapter attempts to comprehend the evolution of green logistics and practices and such a role in fostering operational and environmental performance and further to provide a comprehensive green logistics practices and performance outcomes model.

BACKGROUND

The divine message about the world and humanity reveals that we are the custodian or agent of the planet. We must govern the universe in a full respect, right and fair manner. As humankind, we are commanded to respect, treat well to all humankind and universe, and do not seek to cause harm and wasting resources and engage in unethical conduct. We are made to exist to govern not only human social and economic relationship but also the environment in the perfect and balance systems. The most honourable decision is being moderator in all aspects and actions e.g. the consumption of materials, water and energy, economic planning and social conduct. These verify the knowledge revealed about the world, humanity and sustainability that the universe is everyone's responsibility to protect, respect, nurture and care the perfect of environment.

The logistics industry is a key contributor to the global economic growth for empowering human and goods movement. The growth of logistics industry is growing exponentially as the global economy increases. Indeed, it is strategically prominent for meeting customer demands globally fostering the right place at the right time with the right goods in the right quantity and the right package, at the right cost. For instance, the increasing growth of online shopping and home delivery leads to the rapid growth in transport and traffic. This dynamic economic growth has increased the significant demand on logistics industry, which in turn contributes to serious environmental degradation. The logistics activities and transport lead to consume more fuel, release more carbon emissions and increase climate change. This stringent relationship between economic growth and carbon emissions from logistics industry has asserted the urgent efforts to empower green leadership among logisticians and LSPs through sustainable practices that are crucial for the development of green logistics and environmental sustainability.

Certainly, logistics is one of the main contributors to environmental degradation. The main contributor of carbon dioxide (CO_2) and greenhouse gas (GHG) emissions and environmental risk comes from transportation sector in logistics activities (Abduaziz et al., 2015; Noorliza and M-Hasmi, 2016a). Fossil fuels and GHG emissions are identified as the main causes of the environmental impact of global logistics operations (Maas, Schuster & Hartmann, 2014). The burning of fossils fuels from the transport sector in logistics releasing GHGs, such as CO_2 and GHG necessarily gives a negative impact on human health (Piaralal et al., 2015). Globally acknowledges logistics industry as one of the main causes for GHG emissions (CO_2), it has increased and accounted for about 5.5 percent of total CO_2, known as the second largest contributor of carbon dioxide emissions generated from transport vehicles and vessels that affects global warming. This evidence shows the logistics industry is responsible for GHG emissions from transport particularly caused by freight transport. For instance, it is reported that the transportation sector contributes to GHG and carbon dioxide emissions (CO_2) by 15% and 23% respectively. Another study reported a 45% growth trend in CO_2 emissions from 1990 to 2007 and further predicted that it would continue at a rate of 40% until 2030.

Accordingly, in the era of fourth industrial revolution (Industry 4.0), the emergence of green leadership is imperative, agile and relevant. Currently, consumers claim on ecological products/services, and stakeholders insistence tightening the environmental regulation and greater corporate social responsibility. To response to these changes, it is important for logistics firms to consider how the services they provide affect both people and environment. This definitely has forced firms to incorporate green logistics in their logistics operations for delivering green products/services more environmental friendly and responsible about environmental sustainability and subsequently enhancing sustainable development and competitiveness. Certainly, firms must provide service that are innovative that improve the energy efficiency and reduce carbon dioxide emissions (CO_2) for environmental protection Yet, research and knowledge concerning green logistics and practices have received limited observation so far and a more comprehensive holistic view in logistics industry is urgently needs (Ubeda, Arcelus, and Faulin, 2011; Noorliza and M-Hasmi, 2016c). Many reviews have focused on users' perspectives e.g. manufacturing operations; reverse logistics or green supply chain management or supply chain integration (Islam, Tseng, Karia and Lee, 2018; Tseng, Islam, Karia, Fauzi and Afrin, 2019).

EMERGING GREEN IN LOGISTICS INDUSTRY

In the fourth industrial revolution, environmentalism will remain a major concern to LSPs and logisticians. The logistics industry has lesser environmental impact than manufacturing; however, it is more harmful to the environment than other service industries. Despite the growing demand on environmental practices, the adoption of green practices among LSPs and its performance outcomes are not comprehensive and less defined. Given the significant growth for green logistics, a better insights understanding of environmental practices and LSP performance outcomes is urgently necessary.

LSPs are the players that carry the green products and services to the green consumers across the green supply chain integration right from green suppliers, green manufacturers, green distributors, and green retailers to green customers. Considering giving a good product/service to people and caring the planet well in addition to advance profit leads to a more sustainable result and firm performance.

Environmental concerns, green issues or sustainability become the growing importance and emergent challenges for logistics industry. Contemporary logistics is intensely related to the sustainable development as its activities often contribute to environmental degradation. Logistics system hence is designed for a more competitive, sustainability and environmental friendly. Consequently, it is highly crucial for LSPs to make great efforts or provide advanced service to transform their operations and strategies into more sustainable distribution system. Specifically, green technologies can lead to an innovation of logistics concerning on environmental, sustainability and green that can grant to the development of sustainable distribution system.

In reality, the issues of LSPs' environmental sustainability are complex involving co-ordinations and an uncertainty to operationalise. Specifically, environmental sustainability within logistics and freight transportation are relatively new and just recently to offer green logistics (e.g. green warehousing/building). LSPs companies including all the players involved such as third-party logistics (3PL) (serving multiple shippers), various shipping/transport operators and mid-sized hauliers are liable for the environment right from forward logistics process, the acquisition of raw materials, production, packaging, transport, storage to the delivery to end users; to the reverse logistics dealing with waste recycling and disposal. Nevertheless, subcontractors carry out the majority of logistics activities in physical transport whereby the small-sized road hauliers dominate the road transports and the integration among these logistics players is still weak.

This fragmentation of logistics services and large number of subcontracted service providers, hauliers and subcontractors in the logistics industry make managing environmental sustainability and overall environmental development very challenging, dynamic and complex. It requires a more inclusive view and new integrated model to confront the complication of this integrated problem in a fragmented industry. Considering the fragmentation in the logistics industry, so far the green logistics practices and their impacts are currently under-investigated and lack of sufficient knowledge to provide insights real-life of LSP cases performing such activities. These shortcomings acknowledge a clear direction for future research on environmental sustainability in logistics and transportation perspective.

Given the significant knowledge and awareness about environmental degradation caused by LSPs, practices regarding green logistics should be the ultimate concern in the fourth industrial revolution, especially in transport and distribution system. The management of green logistics designs sustainable practices to anticipate environmental sustainability, distinguish from competitors, target new group of customers, open new opportunity to enter new market, improve competitiveness and obtained economic and social benefits. As a result, LSPs implement green initiatives in order to enhance environmental performance or minimize the negative impact of logistics activities. LSPs can gain competitive advantage by being the first to adopt environmental sustainability and implement green logistics practices. Mainly large LSPs are embracing on the environmental sustainability; yet small and medium sized LSPs still show the unwillingness in adopting environmental sustainability practices.

Logisticians and LSPs need to consider all the implications of their service and witness that become good corporate citizens can be beneficial to all stakeholders. Appropriately, it is mandatory for logistics sector to improve their environmental performance. Green logistics practices or initiatives should be emphasized for improving green knowledge, awareness and practices from the logistics industries including all the LSPs and logistics players involved. The practical definition of "green" is often associated with environmental friendly; or environmental concerns (air, water, soil and energy consumption and efficiency), waste and recycling for reducing the negative impact of human activities. "Green logistics" is a logistics system responsible for the environment or a firm's value of delivery to customers, suggesting the transport and distribution of environmental friendly; or green delivering or green distribution. Specifically, green logistics is an approach of green delivering, innovation services or operations that enhances environment, economic and social sustainable development e.g. reduces operating cost, save energy, not harmful to environment and society while increasing the living standard.

GREEN LOGISTICS PRACTICES

The green logistics practices (GLPs) means the intentions, commitments, efforts or exercises of transport and distribution of environmental friendly. GLPs focus on the entire green physical distribution (inbound and outbound logistics) for managing the movement of green materials or green products/service right from the green suppliers to the point of green consumption including greening in transportation, warehousing and inventory, order processing, materials handling and packaging. These prevent logistics firms from doing harmful to the environment.

The term GLP is regarded as logistics system or transport and distribution efforts in minimizing environmental damage or negative impact on environment or values for environmental performance. It is an approach of green delivering that can has a positive effect on environment, economic and social performance e.g. reduces operating cost, save energy, not harmful to environment and society while increasing living standard. Literally, the concept of GLP describes the intention of distributing green products/goods in a sustainable way, giving minimum or zero impact on environment as possible while taking account of cost and social factors.

GLPs involve the green built in across all activities associated with distribution and material handling of green goods. For example, clean vehicle, energy and fuel efficiency, freight consolidation, standardization of trucks and sustainable carrier selection. Using green fuel, reusable containers, green packaging and hybrid engine; building a green warehouse that eliminates waste and pollution CO_2 emissions level. Consolidation of shipments are the most efficient in reducing GHG emissions. Such environmental-friendly logistics service is one of green initiatives that has its significant impact on the environment.

GLPs have been identified and practiced by LSPs; e.g., green packaging, green warehouse, inventory and material handling; green transportation and green management system; mode choice and intermodal transports, logistics system design, transport management system, partners choice, environmental management system, environmental measurement and monitoring (Noorliza and M-Hasmi, 2013; 2016c; Abbasi and Nilsson, 2016; Evangelista, Colicchia, and Creazza, 2017).). Table 1 summarizes the emergence of green logistics practices in LSPs that associates with sustainability.

Logistics firms should consider GLPs, other environmental strategies or any new environmental initiatives that can foster the logistics environmental performance or has implications for the environmental impact. Figure 1 shows Green Logistics Practices. In theory, GLPs are designed to produce positive effects on environmental performance as well as operational, financial, economic, organizational and social performance. Indeed, the green-based LSPs have witnessed an improvement in these performance outcomes.

Table 1. Summary of green logistics practices

No	Green logistics practicing	Description
	Using Managing Monitoring Practicing	Green delivering that: Saving energy – reduce energy consumption Improved efficiency and efficiency – install software or hardware equipment of storage management, warehouse layout Reducing pollution – prevent environmental pollution
1	Technologies Vehicle technologies Clean technologies	Advanced technologies applied in order to generate less or no pollution Engine and exhaust systems, aerodynamic profiling, reduction in vehicle tare weight and improved tire performance Recycling, using environmental friendly materials, infrastructure and tools when logistics service is performed. Hybrid vehicle – generate low amount of carbon dioxide Electric vehicle – no carbon dioxide emissions
2	Alternative fuels Alternative energy (AE)	Switching to a fuel with low carbon intensity Using green fuels such as low sulfur content and alternative fuels such as liquid natural gas Renewable and low sulfur energy resources other than fossil fuel
3	Mode choice and intermodal transports: Efficient and carbon neutral transportation (TPT)	Carbon intensity of different modes (road, rail, sea and air) varies and the proportion amongst them thus affects environmental impact. Intermodal transports refer to a combination of different transport modes. Control carbon footprint during transportation process. For example, improvement of vehicle performance and intermodal transportation.
4	Internal management Behavioral aspects: Green value added service (VAS)	Management supports top management, commitment from senior managers, and cross-functional cooperation for environmental improvements and training for workers Eco-driving - to lower environmental impact from transports. Environmental concerns: community, employee health and safety Environmental solution for customers: reverse logistics and eco-friendly packaging.
5	Logistics system design Lean process Environmentally Conscious Design Eco-design Electronic information and communication (EIC)	The distances that goods are transported Centralized versus decentralized distribution structures Increase amount of goods delivered on time Proper logistics integration with the operations to minimize environmental impact Pre-planning processes that reduce lead-time, inventory and waste such as Just-in-time logistics Green packaging and transport Usage of seamless information flow and communication will lead to effective and efficient logistics operations, which enhance supply chain visibility and responsiveness thus lower waste and redundant workflow
6	Transport management Distribution Strategies and Transportation	Fill-rate and distances of empty-running vehicles are aspects of importance for environmental performance. Route-planning and freight consolidation Environment-friendly distribution Environmentally friendly transportation
7	Warehousing and Green Building Inventory and warehouse management (IWM):	Sustainable efforts include activities such as terminal and warehouse location and design, enhancing inventory control system, proper storing and disposing of hazardous materials, and energy efficient storage and movement More environmentally in warehouse to save energy efficiency and building design sustainability Decrease inventory levels
8	Materials handling and packaging	A recyclable or biodegradable materials in packaging techniques Using packaging which is harmless to the environment Made from recycle materials or environment friendly materials such as paper or biological gradable plastics. Reduce the cost of waste disposal, resource consumption and prevent environmental pollution.
9	External management Choice of partners	Collaboration and relational to lower the environmental impact of supply chains. Collaboration with customers and others firms/3PLs and suppliers.
10	Environmental management systems/ standard	Environmental management system, such as ISO 14001 or EMAS ISO 14001 certification
11	Knowledge Awareness	understanding and minimizing the ecological impact of logistics activities
12	Environmental assessment and monitoring system	Measuring and monitoring the environmental impact of transport Emissions- and energy data CO2 emissions is one common indicator to measure.

The "green-based logistics service providers" is regarded as being the green provider of industrial logistics service that offers green logistics services and delivers green products/services. They are expected to deliver green logistics services within the dynamic green market, technologies and knowledge. For instance, DHL have used various green capabilities (e.g. green technologies) to advance its greenness, to obtain superior outcomes in sustainable development terms, and to attain an effective management of environmental issues.

Figure 1. Green logistics practices

Factors of Green Logistics Practices

The increasing knowledge and pressure on environmental or sustainability issues, organizational structures, climate and culture rationalize the green interest integrated and invested in logistics sector. Concerned citizens world-wide on the environmental degradation have urged both government and business to respond and emphasize on these issues. In recent years, number of large LSPs have increased more interest on the sustainability issues primarily due to increased environmental concerns and competitive pressures.

The successful implementation, key factors or motivation for adopting green logistics practices mainly are due to both external and internal factors. The external factors refer to the institutional pressures such as legislative (e.g. regulation) and regulatory compliance (environmental standard); the customer pressures, competitive pressures, motive to enhance competitive advantage and performance, public or social pressures, supplier integration and business opportunities. LSPs that emphasize the sustainability as a strategic priority will involve stakeholders and customers' expectation for environmental concerns into their decision making process. The stakeholders' attitudes significantly influence company awareness, the adoption of environmental sustainability, the implementation of green logistics practices and the LSPs' environmental performance. Customers are increasingly concerned with the environmental impact of logistics industry and trade activities, promoting green consuming hence encourages LSPs to develop corporate strategies and adopt green logistics. The role of competitors is crucial for large LSPs to increase their commitment to adopt green practices. The stringent pollution regulation or standard set by government and environmental responsible business/logistics will enhance the green adaptation among LSPs to preserve the environment. The role of government to set policies like vehicle emission standard, alternative fuels, noise control and recycling requirements to support research and provide investment and to monetary incentives may lead to LSPs involvement in green logistics. Environmental regulations is fundamental to achieve a reduction of ecological damage. Moreover, the legal and financial penalty on environmental mismanagement, coupled with bad publicity may lead LSPs to act green. As sole largest buyer of good and services, government can use its power to buy green by providing monetary incentives for government contractors. The supply chain integration (SCI) has forced LSPs to be part of green supply chain management (GSCM) practices in improved environmental performance. SCI between hauliers and depots can reduce the long queues of prime movers of the hauliers at the depot that can improve haulier's operational and environmental performance. These external drivers affect behaviour and decision of the company within the logistics system and its supply chain that may influence the adoption of green logistics initiatives or practices.

Along with external factors, internal factors have an impact within the company's and on its internal process that may influence the green adoption e.g. the strategic imperative on environmental sustainability like ecological responsibility, corporate viability, corporate value, good corporate citizen, economic motivation (efficiency increase and cost reduction) and company reputation. When growing demands for green products, LSPs that deliver these products should be green-based and logisticians should identify and develop environmentally responsible logistics decisions. Organizational capabilities and encouragement, the quality of human resources and green knowledge have a positive relationship with the intention to adopt green logistics or green innovations. Corporate culture on green or environmental culture showing the organizational support from top management is essential in advancing green logistics practices adoption. Further, this can encourage employee's motivation and provide sufficient knowledge through environmental training program when LSPs decide to adopt green practices. Employee's involvement reveals a significant factor or driver of quality human resources to implement green practices. Knowledge within the firm about green practices can increase the willingness to adopt green practices or undertaken green actions.

LSPs act to green due to these internal motives by reducing cost, resources used, reusing and recycling useable materials. Indeed, LSPs realize benefits exceed costs when investing in green packaging to protect the products from damage; warehouses performing freight consolidation for utilizing transport capacity more efficiently. Although using reusable containers or recycle pallets adds cost to LSPs, it can give benefits in the long term. Green logistics practices might be more expensive but the increasing market share might bring more benefits to offset the added costs. Logisticians hence should aware about the green logistics impact on their firm's reputation.

Specifically, Noorliza and Muhammad (2016a) have concluded that the sustainability adoption largely driven by the 4p sustainability principles (Product/Process/Service, Profit, People, and Planet). First, green leadership or environmental issues should be the strategic priority by top management commitment (logisticians and LSPs) to deliver products or offer services that are environmental friendly. Therefore, LSPs' environmental behaviour is determined by becoming environmentally responsible logistics to carry and deliver green products; environmentally and socially aware; and economic motivation. In conclusion, the successful of green logistics practices depends on the green adoption determinants such as organizational context (organizational commitment, knowledge and awareness, training and education, environmental assessment), environmental context (customers, politics and society, regulation), technological context and individual context.

Impact of Green Logistics Practices

In a rapid changing environment the profits maximization is not the only measure of successful business. The importance of cost, quality and time criteria is not enough without emphasizing on the environmental performance. The environmental performance of LSPs is essential and confronting to emphasize, yet environmental issues have little attention from small and medium sized LSPs. The knowledge about environmental sustainability issues and performance of LSPs is scarce.

The objective of GLPs is to maximize benefits of profit (economic) for firms and values for products/service, people (society) and planet (environment). Apparently, firms gain economic benefits from moving towards environment. By improving and redesigning the existing logistics system to green distribution, firms can minimizing the negative environmental impacts as well as maximizing the positive performance impacts. The GLP hence is not only for planet but also adds values for product/service and people; and benefits for profit as well. It is imperative for organizations to be competitive and obtain profit

The environmental strategies of logistics firms or green logistics strategies are crucial for improving logistics environmental performance and can contribute to long-term competitiveness improvement. Hence, GLPs can be a business opportunity for LSPs that significantly reduces logistics costs and improves supply chain performance by becoming the green leadership as a strategic priority. Currently, only large LSPs including DHL, Schenker, have increased their commitment to adopt and focus on environmental sustainability practices.

Due to environmental liabilities, LSPs increasingly pay more attention to the level of energy efficiency and its impact on the environment. The practical implications indicate that green transportation and inventory and green warehousing are the most significant for LSPs to develop their environmental performance as transportation vehicles and warehouses consume large amount of energy. Efficient transportation, the optimization of transport routes, the use of alternative vehicles and energy-efficient warehouses lead to lower inventory cost, energy reduction, and better inventory and create less harm to the environment. Lean or efficient process is vital to improve the environmental performance as it leads to efficient workflow, timely supply chain solutions and waste reduction. Green value-added such as reverse logistics and eco-packaging enable sustainable environmental performance.

Green logistics performance is regarded as ability to deliver the right green products/services in the right quantity, right condition, right place, right customer, right cost and right time as required by the green customers. Conducting green services consider about not only environmental performance but also employees, customers, community, profit and company's reputation. Firms that do not consider the impact of their decisions on all these stakeholders or fail to respect to environment or engage in unethical conduct experience lost sales and reduced profits.

Logisticians seek for ways to reduce the environmental impact of their operations and services, whether from materials handling, ordering and packaging, vehicles, transportation, warehousing and inventory and distribution. LSPs may find that their decisions regarding improved company environmental performance may lead to both tangible and intangible benefits. Tangible benefits includes economic or environmental performances. LSPs are measuring their environmental impact on planet using the carbon footprint as measure of total of greenhouse gas (GHG) emissions. The most common GHG produced by human activities is carbon dioxide, primarily from burning fossil fuels from electricity generation, heating and transport. Environmental performance hence relates to a firm's ability to reduce ecological damage such as air emission, effluent waste, liquid and/or solid waste, and consumption of hazardous, harmful and toxic materials; and frequency of environmental accidents. Economic performance relates to firm's ability to reduce costs associated with energy consumption, waste disposal, waste reduction and environmental accidents. Financial performance relates to firm's return on investment while reducing environmental issues. Social and environmental sustainability will not continue without economic sustainability that reflects to how firms persist in business. The persistence of business measured by profits can also determine economic sustainability.

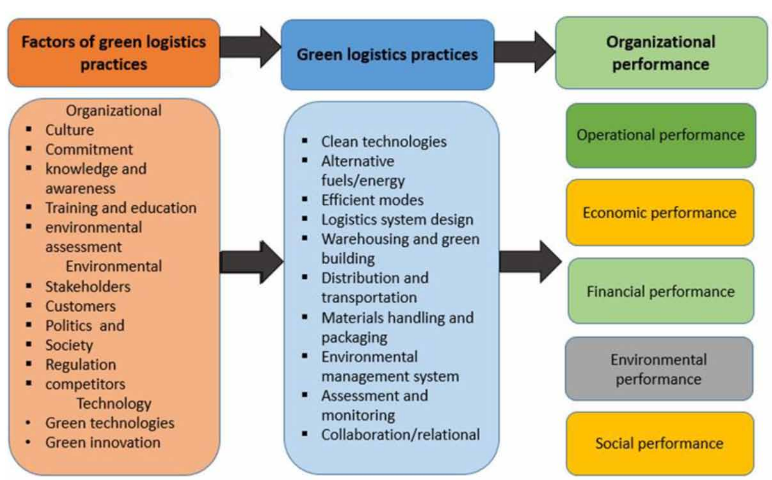
As for intangible benefits, the alternative measures that point to a successful business includes enhanced service quality, service innovation, corporate image/reputation, employee morale, better quality life for people and universe, increased motivation of stakeholders to environmental issues and make a firm more attractive to suppliers and customers, to potential employee and to shareholders. Hence, firm operational performance relates to firm's capabilities to serve and deliver green products to customers. Organizational performance relates to firm's performance as compared to other firms. LSPs acknowledge how their logistics systems and activities affect people by anticipating the importance of practicing green logistics over time; preventing exposure from harmful and toxic to human health; improving organizational happiness index through healthy and safe workplaces and promoting quality of life, health and wellness.

A WORK MODEL OF GLPS-PERFORMANCE OUTCOMES

The work model of GLPs-performance outcomes builds upon resource-based view (RBV) (Noorliza and M-Hasmi, 2013), natural-resource-based view (NRBV) and contingency theory; and interviews with managers from seven cases of LSPs. The RBV explains that firm resources-capabilities are essential for firm's commitments or practices that lead to competitiveness and organizational performance. The NRBV emphasizing on firm-specific environmental capabilities creates competitive advantage. Contingency theory explains that commitments or practices are designed to achieve an organizational performance. It suggests that individual aspects of GLPs should create a positive impact on performance outcomes. The GLP factors as firm resources-capabilities are necessary antecedents to influence GLPs implementation. GLPs are anticipated to have a direct or indirect impact on environmental, economic, financial, operational and social performance, which in turn enhance organizational performance. Figure 2 displays the green logistics practices-performance outcomes model.

Green logistics hence should be the strategic priority for enhancing environmental sustainability as well as competitiveness and profit. Conventionally, firms associate environmental initiatives to an additional cost on firms, which might not necessarily improve financial performance. Nevertheless, scholars

Figure 2. Green logistics practices and performance outcomes model



acknowledge that green commitment and practices have a positive impact on improving environmental, economic, financial, operational and social performance; and subsequently enhance organizational performance. Empirically, the GLPs factors are the most effective way to increase the adoption of green logistics practices that improve LSPs performance outcomes.

CONCLUSION

The chapter contributes to the knowledge of logistics industry, green logistics and sustainable development; and the practical understanding of green logistics practices that transform into benefits of profits and values. In future, only firms that make green delivering will achieve a competitive advantage. Firms with green practices are more likely to have positive outcomes, whereas those with less concerned will not sustain in the long term. Today's successful firms counts on sustainable practices as a strategic priority. In other words, firms aimed at the sustainability as ultimate goal will achieve competitive advantage in future. Therefore, green logistics is imperative for organizations to be competitive and obtain profit.

Rapid growth in freight and transport has increased concerns about the environmental degradation from logistics industry. LSPs are liable to improve environmental sustainability through green logistics practices. LSPs that emphasize green logistics practices as a competitive priority can improve the environmental performance by reducing air emissions and greenhouse gases and empower benefit to firm to achieve green or sustainable products/service/process, cost saving, increase sales and market share, exploit new market opportunities and greater profit margin. In fact, green leadership has a significant impact on reducing environmental problem: greenhouse effect and energy consumption and reduce cost; minimizing operating costs, paying more attention to greening and saving energy, high efficiency and low pollution. The green logistics practices thus focus not only on the environmental (planet) improvement, but also on the improvement of green product/process/service, profit and people.

Consequently, green knowledge and awareness are the determinant of sustainable practices. Additionally, the 4p sustainability principles will increase as the green perceived value enhances. The sustainable business is built in the eminence of green in organizations by persistently conforming to law/ethical requirements, enhancing products/services excellence, maximizing profits, human and universe well-being. Future research should verify the above concept by investigating the model success and green logistics integration in the logistics industry context.

ACKNOWLEDGEMENT

This research is supported by Research University Grant, Universiti Sains Malaysia (1001/PMGT/8016031)

REFERENCES

Abbasi, M., & Nilsson, F. (2012). Themes and challenges in making freight transport sustainable: A logistics service providers' perspective. *TRF Annual Forum, Tampa Sweden*, 1–16.

Abduaziz, O., Cheng, J. K., Tahar, R. M., & Varma, R. (2015). A hybrid simulation model for green logistics assessment in automotive industry. *Procedia Engineering*, *100*, 960–969. doi:10.1016/j.proeng.2015.01.455

Evangelista, P., Colicchia, C., & Creazza, A. (2017). Is environmental sustainability a strategic priority for logistics service providers? *Journal of Environmental Management*, *198*(1), 353–362. doi:10.1016/j.jenvman.2017.04.096 PMID:28494424

Islam, M. S., Tseng, M. L., Karia, N., & Lee, C. H. (2018). Assessing green supply chains practices in Bangladesh using fuzzy importance and performance approach, *Resources, Conservations, and Recycling,* pp. 131, 134-145.

Kengpol, A., & Tuammee, S. (2015). The development of decision support framework for a quantitative risk assessment in multimodal green logitics: An empirical study. *International Journal of Production Research*. doi:10.1080/00207543.2015.1041570

Maas, S., Schuster, T., & Hartmann, E. (2014). Pollution prevention and service stewardship strategies in the third-party logistics industry: Effects on firm differentiation and the moderating role of environmental communication. *Business Strategy and the Environment*, *23*(1), 38–55. doi:10.1002/bse.1759

Noorliza, K., & M.-Hasmi, A. H. A. (2013). Green innovations in logistics industry: sustainability and competitive advantage. In K. S. Soliman (Ed.), *Entrepreneurship vision 2020: Innovation, development sustainability, and economic growth, international business information management association,* Jakarta, pp. 456-462.

Noorliza, K., & M.-Hasmi, A. H. A. (2016a). Halal business and sustainability: strategies, resources, and capabilities of Halal third-party logistics (3PL). *Progress in Industrial Ecology, an International*, 10(2-3), 286-299.

Noorliza, K. (2016b). Halal value creation: Its role in adding value and enabling logistics service. *Production Planning and Control: The Management of Operations*, *27*(9), 677–685. doi:10.1080/09537287.2016.1166276

Noorliza, K., & M.-Hasmi A. H. A. (2016c). Transforming green logistics practice into benefits: a case of third-party logistics (3PLs). In *Proceedings of the International Conference on Industrial Engineering and Operations Management (IEOM)*, March, 2016, p. 178.

Piaralal, S. K., Nair, S. R., Yahya, N., & Karim, J. A. (2015). An integrated model of the likelihood and extent of adoption of green practices in small and medium sized logistics firms. *American Journal of Economics*, *5*(2), 251–258.

Piecyk, M. I., & McKinnon, A. C. (2010). Forecasting the carbon footprint of road freight transport in 2020. *International Journal of Production Economics*, *128*(1), 31–42. doi:10.1016/j.ijpe.2009.08.027

Tseng, M. L., Islam, M. S., Karia, N., Fauzi, F. A., & Afrin, S. (2019). *A literature review on green supply chain management: Trends and future challenges* (pp. 141, 145–162). Resources, Conservations, and Recycling.

Ubeda, S., Arcelus, F. J., & Faulin, J. (2011). Green logistics at Eroski: A case study. *International Journal of Production Economics*, *131*(1), 44–51. doi:10.1016/j.ijpe.2010.04.041

Chapter 20
In the Green Logistics Vision:
The Zero Waste Goal With Recycling Logistics

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ABSTRACT

In this chapter the studies made on an international level in line with the zero waste goal with recycling logistics in green logistics vision are examined. Businesses acting sensitive to the changing environmental conditions, adopting the zero waste with recycling logistics in green logistics vision in line with their development goals are within the contemporary production targets. In a global view, the goal is both creating a livable world and reducing the life cycle costs. In this regard, the chapter researches the status of the recycling logistics to create awareness on the role and importance of the logistics services and operators in the waste industry. Also, to scan the available literature with the reported applications in the less-developed countries in line with the zero waste goal with green logistics vision and to emphasize the importance of these applications.

INTRODUCTION

The technological developments, industrial breakthroughs and increasing population in the world brought forth the consumption is polluted the environment. The developed countries, in order to resolve the waste problems raised due to the consumptions, took important steps, whereas in the economically developing countries this issue is still a problem. In the fight against waste in the green logistics vision, the fundamental element is to reach the zero waste goal. In this regard, the approach in the matter of manufacturing of the products as not to damage the environment with the thought of reusing them, their consumption, processing, storage, recycling and disposal should be radically changed. The nature consumed for centuries cannot overcome the consumption anymore in the process of replenishing it-

DOI: 10.4018/978-1-7998-1397-2.ch020

self. Thus, for the protection of the environment, green products, policies and behaviors in line with the zero waste goal are needed. All the individuals need to have an environmental awareness. In the green logistics the goal is, as in the other green activities, to use the limited natural resources for a longer time and to minimize the environmental damages. The zero waste goal is one of the most important steps to achieve this. Green logistics application brings for the companies strategies of using air, water, energy, the green and nature more efficiently and effectively.

Waste is the scrap material that requires disposal as it is broken, worn down, out of use or malfunctioning in any other way, unwanted extra substances and wares. The international law regulates the disposal methods of the wastes. These legal restrictions are applied in the social, financial and commercial scopes. The environmental legislation covers the reduction and management of the waste flow, storage, recycling and disposal of the wastes. The priority in the waste management is defined as reduction at the source. It consists of activities designing the prevention of the waste in order to reduce the waste volume or damage to the environment including the design and production of less harmful, minimal material volume and long life products. Prevention of waste at the source provides a series of advantages to the consumers and businesses via reduction of the pollution and environmental effects, energy saving, protection of natural resources. It will be ensured that the environmental friendly technologies providing the reduction of the produced wastes at the source and recycling of these wastes. Thus, it is aimed that a "Waste Management System" that is sustainable and continuously improvable shall be formed and the wastes are used as secondary raw materials or if no other option is available wastes shall be utilized as energy sources.

The important elements in the waste management are to focus on the minimization of the wastes and on the prevention of waste production via reusing the waste materials via recycling. This links carefully the process of redesigning the material, supplier selection, demounting and reverse logistics transactions to the direct supply issues where the produced waste amount can be decreased or the recycling and reuse can be facilitated. When the industrial systems are designed, a series of strategies aiming the sustainable material management, the material flow, resource efficiency, reduction of wastes, protection of natural capital and reduction of the effects of the wastes. Moreover, the waste management as a part of the material flow is considered as a part of the sustainable material management as it would reduce the waste amount, impact positively the resource efficiency and support the protection of the natural capital.

All these approaches are based on the concept of "Zero Waste" where all the wastes are seen as a potential resource and that requires efficient use of our natural resources. These approaches provide that the products while designed for the environment, to have potential of repair, reuse or recycling, and also require that we shall maximize our current recycling and reuse efforts. Zero Waste success obliges that the "waste" concept should be accurately perceived in our society. In line with the zero waste goal, there are many forcing reason for reduction, reuse and disposal via recycling of the wastes. Primarily, it is an environmental responsibility in line with the environmental awareness. Recycling has an economic return. People, via using the materials and products and through waste reducing smart shopping habits, can decrease their spending. The consumption of the natural resources shall decrease.

The reuse of the disposed material and products via recycling protects the environment. As the storage fields and waste incineration facilities cause air and water pollution, it shall reduce the environmental problems due to these facilities. It provides energy conservation. By these aspects, recycling is an inseparable part of the economy and a representation of a social awareness level.

It is determined that the approach towards the zero waste goal with the recycling logistics in the green logistics vision is related with the national and international commercial activities. These are using of recyclable materials, waste assessment centers, reduction of dependence on fossil fuels, encouragement of renewable resources. Moreover, some measures are important in the consumption field, and the consumers become more aware on the subject, become organized and it is ensured that they take measures. Similar studies are conducted also in production, the raw material and production techniques that shall not pollute the environment are encouraged, the production is taken under the control of the environment, subsequently logistics is taken under control. The negative impact of the logistics on the environment is tried to be taken under control as "green logistics". In parallel to all these studies, it is determined that the economically developed countries have taken important steps and legal regulations are made. It is tried to be supported with international conventions, the business are encouraged in steps towards the zero waste goals, the public and private sectors are acting with this awareness; whereas the investments of the developing countries are not yet at the desired level but they are following similar improvement steps.

BACKGROUND TO GREEN LOGISTICS, WASTE MANAGEMENT AND ZERO WASTE MANAGEMENT

Consuming natural resources rapidly for the purpose of maintenance of modern life, destruction of nature, difficulty of disposal of wastes, which are arising from environmental pollution and consumption, imposed people obligation to use resources as optimum. The society and industrial systems must begin to mimic nature and move from being primarily linear to being cyclical. Each material must be used as efficiently as possible and must be chosen so that it may either return safely to a cycle within the environment or remain viable in the industrial cycle.

The management of the process developed for decreasing the adverse environmental impacts that may occur in transport, storage, packaging or wrapping and other logistics activities is called green logistics (Bolat et al., 2011). Waste is the scrap material, unwanted extra substances or wares that are broken, worn down, out of order or otherwise disrupted thus require disposal (CIPS 2007).

Waste Management is a management method consisting of minimization, collection separately at the source, interim storage for the domestic, medical and hazardous, and non-hazardous wastes, establishment of transfer centers for wastes when necessary, transportation, recycling, disposal of wastes, operation of recycling and disposal facilities, and the closure, post-closure maintenance, monitoring-control processes (www.yöntemizlik.com).

Zero Waste Management is an active, continuously evolving management strategy that provides the use of available sources at minimal level and minimizing the environmental damage. With the implementation of this strategy, the reduction of wastes at their source is provided, the wastes are collected separately at their source and the wastes that are collected separately are recycled.

Recycling waste is the reacquiring of the recyclable waste materials that are used in a way and now are out of use, to the production processes as raw materials with various methods (Öcal, 2014).

FOCUS OF THE CHAPTER

Green Logistics

The renewable energy, recyclable waste, financial continuity, sustainability of the human and ecosystem services are the economic activities and systems that have eco-innovation for the green economy (Allen and Clouth, 2012). In this regard, among many activities that can be assess also as social responsibility, there are the environmental friendly applications of the companies (Kardeş, 2011). With the depots constructed as green buildings there is an opportunity for saving on costs like electricity and water, and they can be efficient in treatment of wastes. In addition, projects related to the solar energy for energy usage are performed (Taha et al., 2016). Logistics is an element increasing costs, as it requires out sourcing (Lynch, 2000). While the cost of a product in another sector is about 8% to 13%, the cost of the logistic activities that contain storage and transport functions in economy is around 10% to 15%. According to the international money fund, the size of the logistic services is equivalent to 29% of world GDP. This ratio is measured as 20% in Turkey (Taha, et.al., 2016). The green logistics application brings forth for the firms the strategies to use the air, water, energy, the green and the natural environment more efficiently and effectively.

One of the common problems of the modern civilization is the unchecked growth in the waste amount due to production and consumption. The developed countries, as a measure against this, have defined the concept of "zero waste" that adopts the 100% recycling ratio in waste prevention (Zaman, Lehmann, 2011). All consumption pollutes the environment. The resources are used intensely both to meet the fundamental needs and to gain profit. However, the nature renews itself in great extent and presents its resources over and over again for the humanity (Güner & Coşkun, 2013). The nature, being consumed for centuries, no longer manages to overcome the consumption in its process of renewal. Thus, for the preservation of the environment green products, policies and behaviors in line with the goal of zero waste are needed. All individuals should have an environmental awareness.

The damages made on nature with various reasons have shown their adverse impacts at the highest level today, become a threat for the future of the humanity, and caused global environmental problems to occur (Güner &Coşkun, 2013). The goal in green logistics, as in other green activities, is to use the limited natural resources for longer periods and to minimize the environmental damages. The goal of zero waste is one of the most important steps to accomplish that.

For a livable world, these steps should be taken. Every step towards the zero waste, besides its critical importance for the environmental and human health, via its aspect of opening the way of new opportunities for new enterprises, new business, increasing sales and income volumes, shall be an important economic aspect for the waste industry. (Urošević, et al. 2012). In line with the goal of zero waste, there are many mandating reasons for decreasing and disposal of wastes via reusing and recycling. Primarily, it is an environmental responsibility in line with the environmental consciousness. Recycling has an economic return. The people, reusing materials and products and with smart shopping habits decreasing waste, can save from their expenditure. It decreases the consumption of natural resources. Reuse of disposed materials and products via recycling protects the environment. Considering that the storage areas and waste burning facilities cause air and water pollution, it decreases the environmental problems caused by these facilities. It provides energy saving. With these aspects, recycling is an inseparable part of the economy and is a statement of the level of social awareness.

Waste

The wastes are the "substances or objects that are out of their commercial cycle or utilization chain" (HMSO 1990). There are some disputes on the waste definition. First, the materials that can be used or that carry the possibility of a use are not defined as wastes. Moreover, if the stored materials shall not be recycled this is not sufficient for them to be defined as side products (Makkonen et al., 2002).

All kinds of substances that complete their economic lives or that incur within the production system, that their release to the ecosystem can be dangerous to the human and environmental health are defined as wastes. Reuse concept is defined as to use again the various elements of the materials that are separated as wastes. Reuse slows down the additional raw material production thus prevents the unnecessary use of resources and the production of waste. Besides the saving on the production costs, the reuse also prevents the effect the production shall create regarding the environment. In addition, it creates additional employment in fields like second hand sales, used part sales, repair etc. and contribute to the economy (Öcal, 2014). The wastes can be considered in four categories (HMSO 1990; CIPS 2007):

- Materials and objects that are still on use for the purpose they built for (also after repair) which are worn but still functioning.
- Substances or objects which can be immediately used by special a waste recycling organization or that are used as raw materials within the building blocks, like taking ash from an electrical power plant.
- Materials or objects that are degenerated to the extent that they can only be used by institutions and enterprises that are specialized in waste recycling. These kinds of materials can only be released of being a waste when they are recycled.
- Materials or objects that are not wanted by their owner and are discarded. If materials or objects are sent to waste collection process, these become wastes however, when they become appropriate for use in their current forms by another person they are wastes no more.

Among the waste types packaging wastes, disposed batteries, vegetable waste oils, electronic wastes, construction wastes, medical wastes, organic wastes and domestic wastes can be listed.

Zero Waste System

When zero waste management model is to be used in an institution, first a seven-stage road map should be is followed. These stages are listed as follows:

- Determining focal points
- Current status determination
- Planning
- Determination of needs and provision
- Education and Awareness Building
- Application
- Reporting

Determination of Focal Points

The institution to realize a Zero Waste Project, primarily determines the officials that may manage efficiently the system at the institution. The officials to take duties in the institution should consist of two persons in total as one permanent and one substitute. These persons determined should form a team to provide the zero waste management. In case there is more than one unit in the institution, the officials should be increased. Figure 1 shows the zero waste management officials.

Current Status Determination

After the officials are determined, in order to establish the Zero Waste Management System under the scope of the Zero Waste Project, the current status determination must be performed. Determining the condition of the institution regarding the wastes and to progress accordingly is important. When the current status is determined, the number of personnel employed in the institution, the existence of a unit responsible of waste management, the amount of the waste produced in the institution, their properties, sources, methods of collection and accumulation, existence of temporary waste storage areas, the information of the disposal or recycling facilities the wastes are given to, and whether the records are kept regarding these should be monitored.

Planning

After the status is determined, the types, amount and frequency of the wastes produced in the institution should be known. Accordingly, depending on the status, an institution specific planning based on the Zero Waste Management Plan Format should be done. In planning, the instructions regarding the collection, transport, temporary storage and how, when, the method of and who will be performing the application shall be prepared. The area with the most waste production should be determined and measures for reduction should be taken.

Figure 1. Zero waste management official
Source: (Sıfır Atık, ''https://sifiratik.gov.tr'', 2019)

Determination of Needs and Provision

Under the scope of the Zero Waste Project, after the planning is complete, the needs and necessary equipment (collection boxes, bags, containers, education material, monitoring schedules) are determined considering every unit in the institution and before the application is started they are provisioned. It is mandatory that the collection equipment are colored conforming to the Zero Waste Color Scale.

In addition, the temporary waste storage areas are established where the wastes are temporary hold for a time before they are sent to disposal or recycling facility. Under the scope of the Zero Waste Project, the color scale the institutions shall use on their collection equipment and information posters according to the types of the wastes is as follows:

- Blue for paper-cardboard wastes
- Yellow for plastic wastes
- Green for glass wastes
- Gray for metal wastes
- Black for wastes with no recycling possibility
- Transparent for hazardous wastes and electronic wastes
- Brown for organic wastes
- Purple for bread wastes
- White for food wastes

For medical wastes, red on bags, orange for buckets and containers are mandated to be used under the Regulation for Control of Medical Wastes.

After the provision of the chambered waste collection boxes to be placed in the institution are provisioned, they are provided to be placed as one for 40 person and along the corridors where everyone can access easily and locations that are visible once every 50 meters.

At the same time, the issues like when, how and by who the collection, transport and temporary storage shall be managed, what shall be done in case of a possible accident, the locations the waste shall be delivered and the officials for these should be clarified.

A comprehensive guide covering all these matters shall be prepared. The headings the guide should cover are:

- The measures to be taken during the preparatory process before collection,
- Collection route,
- How the wastes shall be collected and transported,
- The recording of the collected wastes,
- Temporary storage process,
- Response during an accident
- Declaration and delivery process of the wastes,

In addition, for the Temporary Storage Area where the wastes shall be accumulated before sent to the determined licensed facilities, a proper area shall be determined and the establishment should be performed. In the establishment of the temporary storage area, size of the area according to types and amounts of the wastes and how many sections shall be and the sizes of the containers must be determined.

Education and Awareness Building

After the provision of equipment is realized, to start the application, first of all the target audience should be trained on the matter. These trainings to be held under the scope of the Zero Waste Project being practical is very important. Besides, on the website of the institution notices and information should be posted related to the application to be performed. Besides, informative mails should be sent to all employees in the institution on the Zero Waste Project and the works conducted.

The target audience to be determined in the institution should cover the focal points, maintenance and repair personnel, temporary storage area personnel, cleaning personnel and all the employees.

Application

After the completion of the education and awareness building works for the Zero Waste Project, the application phase can start. At the point of application, it should be cared for that the collection equipment are at locations where the personnel can access easily, the information posters are placed on the equipment in a visible position and the collection equipment are conforming to the color scale.

For the hazardous waste, there is no need to place a collection equipment at every location however; the hazardous wastes should be carried in transparent bags to the temporary storage areas without being mixed with other wastes.

The transportation work of the wastes accumulated at waste collection points in the institution should be performed with in-house lidded transportation vehicles. The medical waste personnel should carry the medical wastes produced separately from the other wastes.

The organic wastes like fruit and vegetable wastes, kitchen wastes, tea pulps, and park and garden wastes can be turned into compost to be used as fertilizer at the institution garden. Composting process is a process where the organic materials are stabilized by the microorganism at aerobic and anaerobic conditions. Composting can be performed in open fields or via machines.

Waste vegetable oils stick in the wastewater collection systems and cause clogging. Besides, they cause pollution at the water resources at the points of discharge and thus prevent the living organisms in the water to access to oxygen. In case of discharge to the ground, they cause ground and underground water pollution. Therefore, the waste oils should be gathered separately.

Waste batteries carry heavy metals thus should be gathered separately and the possible adverse effects on the environmental and human health should be prevented. Waste electrical and electronic wares carry heavy metals therefore they are wastes that can cause harmful effects on environmental and human health and they should be collected separately and delivered to recycling.

Hazardous wastes are inflammable, explosive, incendiary, irritant, carcinogenic and toxic wastes and must absolutely be collected. The wastes in the hazardous waste class are the toners and cartridges, contaminated packages and filters, and pressurized containers.

Medical wastes are wasted causing diseases like cholera, leprosy, plague, dysentery, tuberculosis, malaria, hydrophobia etc. Therefore, in no condition, they should be mixed with other wastes, and they should be gathered separately.

Waste fluorescent bulbs should firstly go into bulb breaking machine then delivered to the related licensed waste treatment plant. In cases where bulb-breaking machine cannot be provisioned, then the waste fluorescent bulbs should be kept in their packaging and then sent to the licensed facility.

The collected wastes are stored at the Temporary Storage Area. The waste brought to the Temporary Storage Area shall primarily be recorded by the official and dumped into the proper containers according to the waste type. The recyclable wastes (plastic, paper, glass, metal wastes) are sent to the licensed recycling facilities and others are sent to the licensed disposal facilities.

Reporting

The institutions that realized the Zero Waste Project, in order to assess the efficiency of the application, should perform works for monitoring in regular intervals and assess to find out the failing points in the application and improve them.

The reporting of the results and data acquired from the application shall increase the efficiency of participation in the application. The assessment of the environmental effects of each waste paper, plastic, glass, metal that recycled, vegetable waste oil, organic waste and hazardous waste and maintaining these gains monthly is very important for monitoring the application efficiently.

The amount of waste stored at the temporary storage facility for non-hazardous wastes can be reported as follows.

Waste Management

The processes of collection, transport, recycling and disposal of wastes□. Waste management has become a complex field legally, technically and commercially. Very few institutions are collaborating with local authorities for waste management liabilities, many firm are required to execute contracts with licensed, expert companies to dispose of the wastes or to fulfill their legal liabilities (CIPS 2007). In waste management, minimizing, energy efficiency, source reduction and waste exchange concepts can be grouped under "eco efficiency" heading. Eco-efficiency is to produce more from the same amount or to use fewer resources to produce the same amount (ACBE 1998). The fundamental principles of the modern waste management stipulate "the development and use of the clean technologies where natural resources are used as minimal as possible, minimizing the hazardous effects on the environment in production, use and final disposal of the products, and development and application of proper techniques for final disposal of the hazardous material within the recyclable wastes and thus minimizing the hazards of the wastes to environment and humans." (www.yöntemizlik.com).

The important elements in waste management are to focus on minimizing the wastes and preventing production of wastes via reuse of the waste material through recycling. This directly links to careful material and suppliers, process of redesigning demounting and reverse logistics processes, direct provision where the produced waste amount is reduced or facilitates recycling and reuse (CIPS 2007). In waste management, the main processes are collecting, transporting, recycling/reuse, treatment and disposal. Bringing the wastes back in to the economy is an issue to be handled with multiple dimensions. A company active in waste recycling creates additional investment and employment through the collection and transformation of the wastes. As known, for a business active in another branch of manufacturing industry and creating wastes, the recycling of the waste, if not performed within the business, creates disposal, storage or transportation costs and if planned to be processed within the business then causes need for additional investment and employment (Öcal, 2014).

Ideally, the products can be designed as recyclable, reusable and reproducible to reduce the consumption of the non-renewable resources and to keep the products out of the waste flow. Considering the current recycling technology, it is not easy to achieve this ideal (Öcal, 2014). The reused materials are recovered and later reused in their original forms (CIPS 2007). Reducing at the source of the produced wastes and usage of the environmental friendly technologies providing the recycling of these wastes are required. Thus, a sustainable and continuously improvable "Waste Management System" is formed and the use of wastes as secondary raw materials or if otherwise impossible utilizing wastes as energy resource can be aimed for. Figure 2 below is an expression of the Waste Management System.

Waste Hierarchy

Waste hierarchy is the ordering of the waste management options from the most desirable to least desirable regarding the environment. To make savings in your waste costs and reduce the impact on the environment, following the waste hierarchy helps to identify different options by ranking them in order of environmental impact. Accordingly, the waste hierarchy consists of the steps outlined in Figure 3 below:

1. Prevention/Reduction
2. Recycling
3. Energy Recovery
4. Disposal

Figure 2. A prescriptive process flowchart for waste management
Source: www.researchgate.net

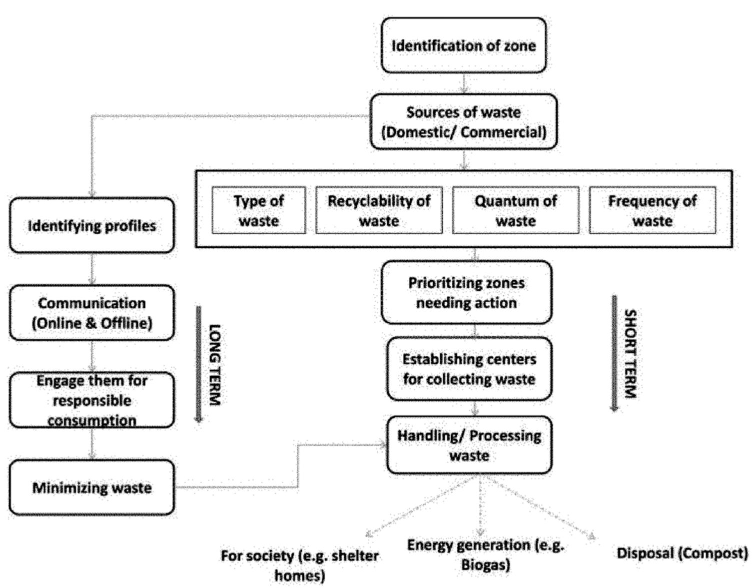
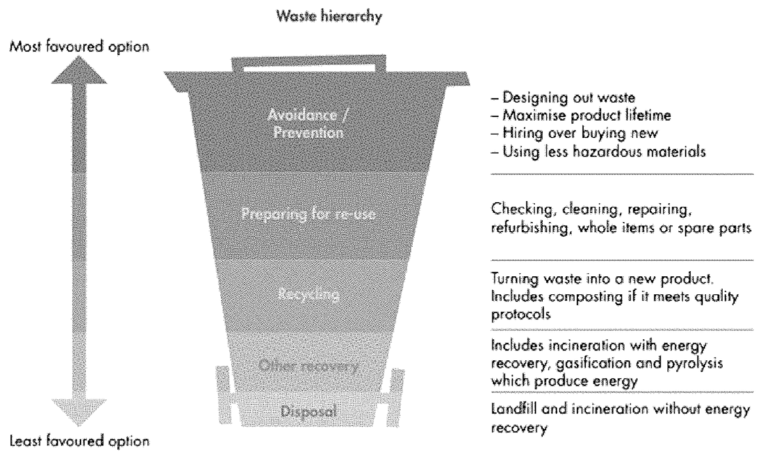


Figure 3. The waste hierarchy
Source: www.recycledevon.org



Prevention/ Reduction

The first priority in waste hierarchy is to prevent waste at the source and if not possible to reduce them. Some examples are:

- Development and use of clean technologies where the natural resources are used as minimal as possible,
- Using less hazardous materials
- Extending the use lives of products
- Reducing packaging amount on the products
- Purchasing materials in big volumes
- Giving emphasis on electronic communication
- Reuse of the materials separated as wastes

The primary benefits of preventing/reducing wastes at the source regarding the environment can be listed as follows:

- Protection of natural resources
- Energy saving
- Reduction of pollution
- Reduction of hazardous wastes
- Financial savings

Recycling

The second priority in waste hierarchy is to research the recycling opportunities of the wastes. The recycling is a series of activities consisting of the following:

- Collection of wastes made of recyclable materials
- Separation of the recyclable material according to type and processing them to transform into raw materials.
- Production of new products from raw materials.
- Recycling also covers obtaining compost via composting the food wastes, garden wastes and other organic wastes.

While there are environmental impacts of the processes used in recycling, the principle environmental benefits can be listed as follows:

- Reduction of production of greenhouse gasses
- Reduction of wastewater production
- Energy saving
- Provision of valuable raw materials for the industry
- Creation of employment
- Triggering the development of clean technologies
- Preserving natural resources for the future of our children
- Reduction of needs for new waste storage areas and waste incineration facilities.

Energy Recovery

Energy recovery from the wastes is to transform the non-recyclable waste materials to usable heat, electricity or fuel via various processes including incineration, gasification, pyrolysis, airless treatment and obtaining landfill gas. Processes of energy recovery from wastes contributes in preservation of natural resources however if they are not meticulously managed they are processes that generally have important environmental impacts.

Disposal

The least desirable option regarding the environment in the waste management strategies is the disposal of the wastes. The landfills are the most commonly known waste disposal method and are also an important component of an integrated waste management system. It is possible to burn the wastes in incineration facilities for gaining area at the landfills. The methane gas created as a side product of the decomposed waste at the anaerobic environment of the landfills can be gathered and used in electricity production as fuel. When landfills reach their end they are covered and the land on top can be used for recreation like parks, golf courses and ski tracks.

Zero Waste Goal and Logistics

In the globalizing economy and in all the intermediary functions of the supply chain we can see logistics. As the place where the economic life begins is the existence of supply and demand, today the logistics carry great importance for the continuity of the production and consumption functions (Taha et al., 2016). The thoughts regarding all the wastes as potential resources and the requirement of using our natural resources efficiently had found their place in the "Zero Waste" concept. It ensures that the products have the potential for repair, reuse or recycling in designing for the environment and it requires that we maximize our current recycling and reuse efforts. The success of the "Zero Waste" perspective is dependent on changing the understanding of the concept "waste" in all the industrial institutions and consumers. When industrial systems are designed sustainable material management follows a series of strategies aiming the material flow, resource efficiency, reduction of wastes, protection of natural capital, and reduction of impacts of the wastes. The waste management should be considered as the sustainable material management as it, as a part of the material flow, shall decrease the waste amount, positively affect the resource efficiency and aid the protection of the natural capital. Consumers acting with an awareness of recycling, taking domestic wastes to recycling and reform their consumption habits with the perception of zero waste are expected.

Zero waste means to minimize the waste production and at the same time to recycle most of the produced wastes; this shows that the new material flows and therefore more complex and efficient waste logistics are needed (Stojanović & Knežević, 2017). Recycling concept is to passing wastes with reevaluation possibility through various physical and chemical processes and transform them to secondary raw materials to reintegrate them into the production process. Via adding consumed materials to the recycling circle again, first the raw material need decreases and it is prevented for the increasing consumption to disrupt the natural balance and to damage the nature. In addition, it makes large amounts of energy saving possible (Öcal, 2014). In more details, it can consist of separation and collection, transportation, temporary storage, transfer, recycling/reuse, treatment, waste management system and final disposal processes. One of the most important steps in recycling is apparently the logistic process and related activities. This fact shows that the logistics has a vital importance in waste management (Stojanović & Knežević, 2017). Green Logistics is a subset of environmental management and it is a power that has properties with multiple dimensions and technical depth, and that forms economic, social and environmental values and achievements. This power represents the sensitivity, conformity and sustainability of especially the transportation activities and all other logistic activities (storage, packaging, distribution, reverse logistics) and stakeholders against the economy, society, environment and nature in an economic and efficient way (Taha et al., 2016).

In recycling, utilizing certain physical and chemical properties of the materials, it is tried especially to extrication of rare earth elements present in the wastes (Öcal, 2014). Besides, all the process of repair and reuse of the products, determination of the functioning parts of the product and using them in other products, reproduction of the products, some products being recycled and thus acquiring raw materials provide lesser resource usage (Fleischmann et al., 2003).

In developed countries, the waste problem is mostly under control however, in developing countries the vital importance of logistics in waste management is emphasized (Fehr, 2014). In some regions, it is indicated that the collection and transportation in the solid waste management system of the municipalities constitutes more than 60% of the general budget and these costs can reach up to 85% of the total waste expenses (Kinobe, et al., 2012). Therefore, with the legal regulations and the increase in environmental awareness the firms were encouraged to improve and invest in this field (Sadowski, 2010). The businesses should determine the issues like how to collect, transport, temporarily store the wastes produced during manufacturing and the maximum storage time in the scope of the legislation. When the wastes are produced they should be collected separately according to their types at the source (Öcal, 2014).

As the domestic waste amount increases depending on the continuous economic growth, the importance of the recycling industry becomes apparent (Kim et al. 2009). With the reverse logistics system, these are returned to the manufacturer as raw materials and reintegrated into the production (Gilanlı, et al., 2012). The studies conducted showed that the applications of reverse logistics contains many motivations like reducing operational costs, fulfilling the legal liabilities, forming strong brands and achieving economic value (Sorkun & Onay, 2018). As a strategic decision, the main reason for outsourcing logistics are reduction of costs, service development, operational flexibility or businesses focusing on fundamental qualification (Wilding & Juriado, 2004). As in the traditional supply chain flows, the waste operators can perform one or more logistic processes. For collecting different types of wastes, they may use their own fleet and also the third parties (Stojanović & Knežević, 2017). It is accepted that the support of the outsourced supplier to the system is one of the key factors for the collection, transfer and transportation of the solid wastes (Guerrero et al., 2013).

The management of back flow of the products, compared to the forward logistics management (management of the flow of the products from the manufacturing point to the consumption point), has many hardships specific to it. In reverse logistics, not knowing the condition, amount of the product to be recycled and recycling performance make the management of this process harder (Kara et al., 2007). In low- and middle-income countries, the waste logistics systems generally have wrong collection systems (Kularatne, 2015), and knowledge deficiency regarding the collection timing (Hazra & Goel, 2009). The logistically insufficient infrastructures (Moghadam et al. 2009), rough roads, old and insufficient transportation fleets for waste collection (Henry, 2006), and as a result decrease in efficiency and the increase of costs of transportation and logistics are seen.

In cases where waste production cannot be prevented and the recovery processes indicated above cannot be applied, the wastes that cannot be reevaluated are disposed of with methods like burning and storage. The wastes, as cannot be controlled by the users as products, when they are left in the ecosystem they cause the environment and society to be harmed. Due to such risks, especially the hazardous wastes should be collected separately then the other wastes and should be processed according to the legislation (Öcal, 2014). The modernization of vehicles and equipment, rendering landfills conforming to the EU standards, adopting integrated and holistic strategies and regionalizing the collection and transportations services are required (European Commission, Directorate-General Regional Policy 2004).

According to the literature, logistic outsourcing can decrease the costs, increase the service quality and let the focal firms to focus on fundamental activities. For decades, logistics suppliers are evolved from the firms that provide basic activities to the global companies with integrated, complex and specialized logistics services, including the waste logistics solutions. Logistics costs can have an important share in general reverse flow costs. More importantly, once the reverse network is established, the operational costs shall be key factors for the sustainability of the established network. Therefore, they should be defined in the reverse network, well estimated and controlled. Only in that case, the policy makers and stakeholder can form a proper model for the logistics management within the waste management or can take other very important decisions to reach general goals related to waste recycling and management like legal scope and tax incentives (Stojanović & Knežević 2017). Aksen et. al., (2009) showed that when the state pays fees for the products the companies collected back and supports the firms with various policies more products can be collected and firms can profit more.

Waste in International Law and the Measures Taken

European Union has reported that each year 2 billion tons of wastes are produced in Member States and this number is tendency to increase. The best solution of this elevating mountain of waste is suggested as to recycle the components where ecologically and economically feasible methods are present and to reintroduce them to the product cycle (www.europa.eu). The international law regulates the disposal methods of wastes. These legal restrains are applied in social, financial and commercial scopes. The environmental legislation covers the reduction and management of the waste flow, storage, recycling and disposal.

In the European Union (EU), in order to develop a low carbon economy, various strategic papers, directives and initiative have been started. Among these documents there are the EU Sustainable Development Strategy (SDS, European Commission 2009) issued in 2006 and revised in 2009; EU Road Map 2050 (European Commission 2011; European Parliament, Council 2008) and recycling society directive (Directive 2008/98/EC, European Parliament, Council 2008). Another important document is the Europe 2020 Strategy for smart, sustainable and inclusive growth where one of the titles is related to climate and energy. In addition, the European Commission has started a strategy in 2012 called Innovation for Sustainable Growth a Bio economy for Europe (COM, 2012). The commission has indicated that in order to overcome the increasing global population, fast depletion of many resources, increasing environmental pressure and climate change, Europe should radically change its approach in production, consumption, processing, storage, recycling and disposal of biological resources. In addition, the European Commission, for creating a common and coherent EU framework to encourage global economy, had adopted "Towards a global economy: A zero waste program for Europe" (COM, 2014). The outputs of a global economy contain the following: increasing recycling and prevention of loss of natural materials; job creation and economic growth; models encouraging the eco-design of new business models, zero waste and reduction of greenhouse emissions and environmental impacts of the industry. The new Coherence Policy in the 2014-2020 Program Cycle expects that the national and regional authorities shall develop research and innovation strategies that aim "smart specialization".

The waste management is realized within the scope of a certain "hierarchy" in line with the "European Union Waste Framework Directive". The processes the waste should be subjected to are ordered in priority: This priority list is to prevention, preparation for reuse, recycling, subjecting to other recovery processes and if cannot be recovered disposal of the wastes. The priority in the waste management is defined as the reduction at source. Including the design and production of products with lesser hazards, minimal material volume and longer use life, it consists of the activities designing the prevention of the waste in order to decrease the waste volume and the damage to the environment. Prevention of the waste at the source provides a series of advantages to consumers and businesses due to protection of natural resources, energy saving, reduction of pollution and environmental impacts (www.environment-agency.

gov.uk) The legal and social responsibilities of the businesses and the individuals having environmental awareness forced firms to be green in many fields from production to transportation (Karaca, 2013). Extended manufacturer liability principle is developed for several types of wastes like batteries and accumulators, waste oils, vehicles completed their lives, oils used domestically, packaging materials and paper. Extended manufacturer liability programs aim the establishment of a connection between the different actors present in the entire life cycle of a product starting from the design of the product ending at the collection and recycling of the acquired wastes. This connection, having originally the manufacturer as the main actor, is established via giving different financial and operational responsibilities to the different actors within the life cycle. They are believed to be successful in increasing the collection and recycling rates, while they are seen to be less successful in encouraging eco-design (OECD, 2011). In USA several initiatives are added to the sustainable material management policies like defining priorities for the safe and sustainable material design, products and processes with life cycle approach, incentive of developments via public promotion or tenders. It contains US Environment Protection Agency's (USEPA) "Green Chemistry, Green Engineering, Design for Environment and Environmentally Preferable Purchasing" programs. As the result of some of these programs information and tools that support design are developed (OECD, 2011).

In Turkey according to the Environment Law no. 2872 Article 8, "It is forbidden to present to, store in receiving medium any type of wastes or residues directly or indirectly and to conduct similar activities." The principles related to the management of the packaging wastes are determined by the Ministry of Environment and Forestry in "Regulation on Control of the Packaging Wastes" came into force when issued in the Official Gazette date 06/11/2008. In addition, no 27046, the "Regulation on Control of the Waste Batteries and Accumulators" came into force on 01 January 2005 after being issued in the Official Gazette date 31 August 2004 and no 25569, the "Regulation on Control of the Waste Vegetable Oils" came into force when issued in the Official Gazette date 19 April 2005 and no 25791, the "Regulation on Control of the Waste Electrical and Electronic Wares (AEEE)" issued in January 2008, the "Regulation on Control of Excavation Earth, Construction and Wreckage Wastes" came into force when issued in the Official Gazette date 18 March 2004 and no 25406, the "Regulation on Control of Medical Wastes" came into force when issued in the Official Gazette date 22 July 2005 and no 25883, the "Regulation on Control of the Solid Wastes" came into force when issued in the Official Gazette date 14/3/1991 and no 20814. These regulations explain how the wastes in Turkey shall be disposed of and the wastes are tried to be taken under control.

In the Tenth Development Plan (2014-2018), there is the goal of taking the intergenerational equity and sustainability as basis in use of natural resources. In order to reach the development goals completely, the determination that "the development should be sustainable and the wellbeing should be generalized, the quality of life and living standards at the places where people are present should be increased as sensitive to the environment" and the policy that "the recycling and recovery applications in industry shall be emphasized" are present.

The Europe Green Point concept developed by the German recycling organization Duales System Deutschland (DTD) indicates that the package manufacturers and distributers can transfer their mandate to recover and reuse or arranging the recycling of the used packages to a third party as an alternative (Zaman and Lehmann, 2011). The commercial wastes in England are taken from the location from the areas they are gathered within the company by the national or local contractors or local authorities when they give such a service or using in-house vehicles. In some cases the commercial wastes, generally illegally, may be taken to the domestic recycling centers (McLeod and Cherrett, 2007). Finland has started to work on decreasing and managing the material and energy flow in a sustainable way, and developing long term goals that may use the natural resources in a sustainable way and increase the eco-efficiency. While so, at the same time it is tried to consolidate the coordination of the natural resource policy. Moreover, regarding the social and economic aspects, new ways are tried to be found that shall increase the general wellbeing and create new job opportunities based on natural resources. A "Natural Resource Strategy" is developed for Finland. The strategy compiled by a group of experts and managed by the Finland Innovation Fund (SITRA), is supporting the competition with the natural resources, the wellbeing and an approach encouraging the environmental responsibility (OECD, 2011).

Sweden created 16 "Environment Quality Goals" with three action strategies and a series of environmental indicators. "Environment Quality Goals" are created for improving human health, preserving biological diversity and the natural environment, protecting the cultural environment and cultural heritage, protecting the long-term ecosystem efficiency and to provide the smart management of natural resources. The general aim is determined as the resolution of the important environmental problems faced now within one generation. Many of the goals that also include social and economic aspects contain provisions for protection and renewal of the natural resources (OECD, 2011). In Belgium, it is aimed that measures for design and management of material, product and processes shall be taken. There is a need for high level measures for decreasing the amount of the wastes that are going for incineration or storage. The extended manufacturer liability principle is developed for several types of wastes like batteries and accumulators, waste oils, vehicles completed their lives, oils used domestically, packaging materials and paper. Extended manufacturer liability programs aim the establishment of a connection between the different actors present in the entire life cycle of a product starting from the design of the product ending at the collection and recycling of the acquired wastes. This connection, having originally the manufacturer as the main actor, is established via giving different financial and operational responsibilities to the different actors within the life cycle. They are believed to be successful in increasing the collection and recycling rates, while they are seen to be less successful in encouraging eco-design (OECD, 2011). Not only in many developed countries but also in Balkan countries there are successful steps taken for prevention of the wastes and decrease of the common wastes in application (Ancuța, et al. 2014; BMZ 2012; Agency for Environmental Protection, 2015a). In India, both public and private sector are efficient in waste management. In developing countries, there is a new tendency for encouraging the private sector to get into solid waste management activities. Waste collectors, waste purchasers, small and medium scale businesses within the recycling industry, the large scale operators in the recycling industry, public based institutions, non-governmental organizations and non-profit micro organizations are present (Shafiul, 2004).

The Purpose of Recycling

The purpose of recycling is to prevent the depletion of the resources and to decrease the waste garbage amount. Materials like glass, paper, aluminum, plastic, batteries, motor oils are recycled and rendered reusable, and this has an important role in the country's economy. It also prevents the problems like storage and transportation of the solid wastes in the countries.

How is Recycling Performed?

The recycling is conducted in four stages.

a) Separate collection at the source; Recyclable wastes are separated from garbage at where they are produced and accumulated.
b) Classification; the wastes collected separately at the source are classified as glass, metal, plastic and paper bases.
c) Revaluation; the wastes are processed through physical and chemical modifications and reintroduced to economy as a new material.
d) Introducing the new product to the economy; the recycled product is presented for use as a new material.

The Benefits of Recycling

It provides the protection of natural resource and energy saving. It decreases the waste amount and facilitates garbage-storing processes. It prevents air and environmental pollution. It prevents beneficial wastes to be discarded. It contributes to the economy.

Recyclable Materials

- Chemical wastes
- Glass
- Paper
- Aluminum
- Plastic
- Batteries
- Motor oil
- Accumulators
- Concrete
- Organic Wastes
- Electronic wastes
- Iron
- Textile
- Wood
- Metal

Contributions of Recycling to the Economy and the Environment

Recycling is the name given to the reprocessing of the materials that are used and not to be used again and to be presented to the use of the consumers. The recycle materials cover all materials that lost their usage potential from plastic bottles to car tires, from broken glass pieces to metal parts not to be used.

These materials are brought to the recycling plants and decomposed to their raw materials. Then, these materials that are transformed into raw materials are used to create a new product. This entire process is called the Recycling Process.

Creates a Worldwide Effect

The benefits of recycling have the potential to affect the entire world both in social and economic aspects. The first of these benefits is the environmental health. Due to recycling the waste amount released to the nature is decrease greatly and in addition, the wastage is prevented. However, its benefits are not limited to this.

Economic and Environmental Contributions of Recycling

To list the contributions of recycling, these contributions are divided into two as environmental and economic contributions:

Economic Contributions

- The contribution of recycling to the economy is primarily the prevention of wastage. It is via preventing of discarding of the waste material that can be beneficial to be able to present them to the use of the society.
- It helps to remove the problems like transportation or storage of the waste materials and garbage.
- It causes decrease of raw material consumption.
- It prevents unnecessary energy usage.
- It present the waste materials that are not used as a new product to the service of consumers.
- It prevents the waste materials in heavily populated areas to cause a problem.
- It creates a new branch of business and increases employment and decreases unemployment.
- It decreased the amount of raw materials needed to be imported from other countries via providing reproduction of the waste material to raw materials. Thus it decreases greatly the import expenses.

Environmental Contributions

We can list the environmental contributions of recycling as follows:

- By the favor of recycling the protection of trees, minerals and water resources is supported.
- It decreases greatly the new raw material expedition for production of consumption material. Thus it prevents both the air and environmental pollution.
- It contributes to decreasing greenhouse gas emissions.
- The compost materials and fertilizers produced from domestic wastes increases the fertility of the land. Thus, both organic and high nutritional value products can be achieved.

SOLUTIONS AND RECOMMENDATIONS

The businesses acting sensitive to the changing environmental conditions, adopting zero waste with recycling logistics in green logistics vision in line with their development goals is one of the goals of the modern production. In line with the zero waste goal the public and private sector should act together and adopt a common understanding. Due to the international conventions, there are liabilities given to the private and public sector, strategies are determined in national level, new definitions are made over law and regulations, new restrictions are drawn, incentives supporting recycling are created. In a global view, the goal is both to leave a livable world behind and to decrease the costs of cycle.

The thoughts regarding all the wastes as potential resources and the requirement of using our natural resources efficiently had found their place in the "Zero Waste" concept. It ensures that the products have the potential for repair, reuse or recycling in designing for the environment and it requires that we maximize our current recycling and reuse efforts. The success of the "Zero Waste" perspective is dependent on changing the understanding of the concept "waste" in all the industrial institutions and consumers. In line with the goal of zero waste, there are many mandating reasons for decreasing and disposal of wastes via reusing and recycling. Primarily, it is an environmental responsibility in line with the environmental consciousness. Recycling has an economic return. This provides cost advantage to the businesses. Considering that the storage areas and waste burning facilities cause air and water pollution, it decreases the environmental problems caused by these facilities. Recycling, providing energy saving is an integral part of the economy and a statement of awareness level and development of the society.

In green logistics vision, the fundamental element in fight against waste is to reach the goal of zero waste. Accordingly, it is required that the production, consumption, processing, storage, recycling and disposal approaches of the products should be radically changed considering the reuse and as not to damage the nature. The logistics operations have vital important for successful waste management. They can be performed within the company by operators with focus point is recycling, treatment and disposal activities or it can be outsourced. Logistic outsourcing and development of expert logistics companies is among the main trends in logistics around the world. The policy makers and stakeholders can form a model proper for the logistics management within the waste management or can make very important decisions to reach the general targets related to the waste recycling and management like legal frameworks and tax incentives. In order to decrease the waste amount produced in each category, it should be aimed to develop corporate strategies, to decrease costs utilizing recycling and to maximize the gains acquired by the disposal of the non-conforming wastes.

In general, the municipalities should have transfer stations for domestic wastes and other excavation wastes. As a rule, the municipality is responsible for at least a part of the infrastructure and equipment for the collection, transportation and transfer of the domestic wastes. At the logistics centers formed by the zero waste perspective, it can be suggested that applications that will encourage the private sector besides the public opportunities for the use of recycling technologies that will provide the utilization of both the developed and developing countries at the highest level should be developed and maintained. Considering the cost effectiveness and the advantages it brings in acquiring a better financial input for the institutions, it shall be an expected condition that the firms shall show this environmental sensitivity.

FUTURE RESEARCH DIRECTIONS

Additional research will need to be done to gain further knowledge and a better understanding of the barrier and opportunities of behavior change and sustainable consumption in the context of waste avoidance. Decoupling of economic growth, technological improvement and potential environmental burden would need to be understood within the product stewardship and resource recovery contexts. Additional study would be done to explore further possibilities though case-study base research method. Further study on the complexity and opportunities in implementation of the five zero waste principles will also be required. This study primarily focuses on the holistic key principles of the zero waste, green logistic and recycling waste. Ttherefore more specific provisions like transport of goods and services or waste collection services have not been taken into consideration.

Historically, waste management systems were developed long before the development of our modern civilization as we see it now. Different key innovations have been taken place in waste management development history. If we consider major key innovations in waste management systems, four major innovations can be identified with different major technologies, methods and tools for waste management systems. Figure 1 shows the schematic waves of innovations in waste management systems (time and significance of the waves are not presented in scale) adopted from the UNEP and the Natural Edge Project 2004.

- The first wave of innovation is, open dumping and which is still available in many low-income countries.
- The second wave of innovation is uncontrolled landfill.
- 3rd wave of innovation is, composting is common practice in China
- The 4th wave of innovation is the recycling and controlled landfill.

Recycling other than organic waste composting was first recorded in Philadelphia where paper was produced from recycled fiber from waste. After great global oil crisis in 1970s, resource recovery and recycling of waste has been spreading widely around the globe.

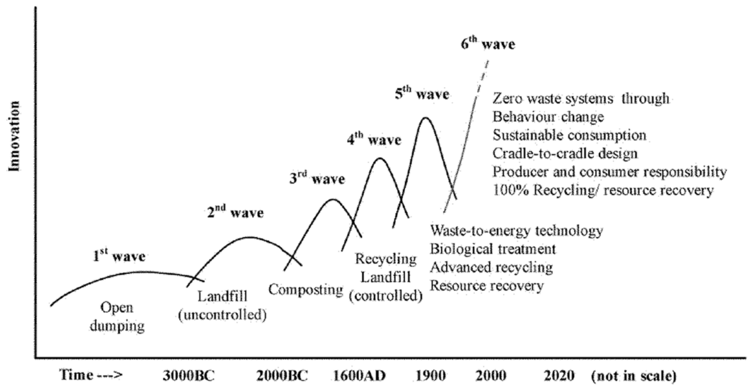
- Therefore, the 5th wave of innovation of waste management systems in the twentieth century is the waste-to-energy technologies such as incineration, pyrolysis-gasification, plasma arc etc., advanced biological treatment, anaerobic digestion for example, advanced recycling and resource recovery facilities.
- The zero waste is the 6th wave in waste management and the most holistic innovation of twenty first century for waste management systems for achieving a true sense of sustainable waste management systems. Zero waste systems include a holistic approach of cradle-to-cradle closed-loop design systems, sustainable resource consumption and resource recovery from waste.

Development in this direction should continue.

Figure 4 below indicate the waves of innovation in waste management systems.

All activities carried out in the face of uncontrollable growth of environmental problems are very important. in this context; the decisions of local authorities would be very good example to other institutions and public people. Trying to alternative channels of municipal transport services and using of the system will cause less damage to the environment is the key of the keeping' World clean.

Figure 4. Waves of innovation in waste management systems
Source: (UNEP and the Natural Edge Project, 2004)



Increasing population, urbanization and industrial activities in the world increases the amount of waste indirectly. Due to this increase, it is necessary to carry out waste management studies in order to ensure human and environmental health. Two of the processes of waste management, collection and transport, are considered as vehicle routing problems in the literature. Vehicle routing problems are important related to the design of optimum routing while carrying out distribution / collection of vehicles.

Environmental issues in today's manufacturing enterprises need more and more attention because of increasing awareness of environmental concerns by customers and some domestic and international regulations. One of the most powerful techniques to use for being an environmentally sensitive enterprise is to recycle its scraps and wastes as much as possible. Some enterprises can do this useful technique by constructing a recycling unit in their manufacturing facilities. Because of this reason, some operational and transportation activities regarding recycling take place in their facilities and a recycling network becomes structured eventually.

CONCLUSION

Waste concept can be defined as the scrap material, unwanted extra substances or wares that are broken, worn down, out of order or otherwise disrupted thus require disposal. The international law regulates the disposal methods of wastes. These legal restrains are applied in social, financial and commercial scopes. The environmental legislation covers the reduction and management of the waste flow, storage, recycling and disposal. The priority in the waste management is to decrease at source. Thus, the costs shall be decreased. Prevention of the waste at the source provides a series of advantages to consumers and businesses due to protection of natural resources, energy saving, reduction of pollution and environmental impacts. It shall provide the use of technologies environmentally preferable that ensure the recovery of the wastes and reduction of produced wastes at source. Thus, a sustainable and continuously improvable "Waste Management System" is created and it can be aimed to use the wastes as secondary raw materials and otherwise is impossible to benefit from the wastes as an energy source.

The important elements in waste management are to focus on minimizing the wastes and preventing production of wastes via reuse of the waste material through recycling. This directly links to careful material and suppliers, process of redesigning demounting and reverse logistics processes, direct provision where the produced waste amount is reduced or facilitates recycling and reuse.

As the result of the research, it is determined that there is an approach towards the zero waste with recycling logistics in the green logistics vision in national or international commercial activities. It is seen that economically developed countries have taken important steps, the legal regulations are done, these are tried to be supported via international conventions, the businesses are encouraged in steps towards zero waste, the public and private sectors are acting in this perspective and however the investments of the developing countries are not at the desired level but also they are following a similar progress.

REFERENCES

Agency for Environmental Protection. (2015). *State of the environment in the republic of Serbia* - a brief overview, ministry of agriculture and environmental protection, Belgrade. Retrieved from http://www.sepa.gov.rs/index.php?menu=5005&id=19&akcija=showExternal

Aksen, D., Aras, N., & Karaarslan, A. G. (2009). Design and analysis of government subsidized collection systems for incentive-dependent returns. *International Journal of Production Economics*, *119*(2), 308–327. doi:10.1016/j.ijpe.2009.02.012

Allen, C., & Clouth, S. (2012). *A guide book to the green economy;* ıssue 1: green economy, green growth, and low-carbon development – history, definitions and a guide to recent publications. UN Division for Sustainable Development, UNDESA.

Ancuța, C., Olaru, M., Ivan Ișfănescu, R., & Ianăș, A. (2014). Characteristics of the pollution by solid municipal waste in Timișoara City and its surrounding area. *Carpathian Journal of Earth and Environmental Sciences*, *9*(1), 141–148.

BMZ - Federal Ministry for Economic Cooperation and Development. (2012). *Economic instruments in solid waste management* - Case study Bulgaria. Retrieved from http://www.giz.de/de/downloads/giz2013-en-economic-instruments-bulgaria.pdf

Bolat, H. B., Bayraktar, D., Öztürk, M., & Turan, N. (2011). *A model proposal for the vehicle routing problem in the green logistics chain*. XI. Research Symposium of Production (pp. 536-548). June.

CIPS. (2007). *How to develop a waste management and disposal strategy CIPS The chartedred İnstitute of Purchasing Supply knowledge,* works 1-27. Retrieved from https://www.cips.org/Documents/About%20CIPS/Develop%20Waste%20v3%20-%2020.11.07.pdf

COM. (2012). 60 final (2012) *Innovating for sustainable growth: A bioeconomy for Europe;* published on Feb. 13, 2012. Retrieved from https://ec.europa.eu/research/bioeconomy/pdf/official-strategy_en.pdf

COM. (2014). 0398 final (2014) *Towards a circular economy: A zero waste programme for Europe;* published on July 2, 2014. Retrieved from http://www.ipex.eu/IPEXL-WEB/dossier/document/COM20140398.do

Control regulation of electrical and electronic waste products (AEEE). (2012). Official newspaper. Retrieved from http://www.resmigazete.gov.tr/eskiler/2012/05/20120522-5.htm

Control regulation of electrical and electronic waste products municipal application guide. (2016). Retrieved from https://recturkey.files.wordpress.com/2016/11/aeee_rehberi.pdf

Control regulation of herbal waste oil, RG. (2005). Number 25791. Retrieved from http://www.resmigazete.gov.tr/eskiler/2005/04/20050419-4.htm

Control regulation of medical waste RG. (2005). Number 25883. Retrieved from http://www.vertic.org/media/National%20Legislation/Turkey/TR_By-law_Medical_Waste_Control.pdf

Control regulation of packaging wastes. (2011). Number 28235. Retrieved from http://www.resmigazete.gov.tr/eskiler/2011/08/20110824-6.htm

Control regulation of waste battery and accumulator. (2004). Number 25569. Retrieved from http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.7118&sourceXmlSearch=&MevzuatIliski=0

Devon, R. (2019). The waste hierarchy. Available at https://www.recycledevon.org/at-work/resource-efficiency

Environmental Law, RG. (1983). Number 18132. Retrieved from http://www.mevzuat.gov.tr/MevzuatMetin/1.5.2872.pdf

European Commission. (2011) *A roadmap for moving to a competitive low carbon economy in 2050.* Communication. European Commission European Commission, Brussels, Belgium. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1560718490833&uri=CELEX:52012IP0086

European Commission, Directorate-General Regional Policy. (2004). Resource book on PPP case studies.

European Parliament. Council. (2008). *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives.* Directive. European Parliament European Parliament, Brussels, Belgium. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1560718830307&uri=CELEX:32008L0098

Fehr, M. (2014). The management challenge for household waste in emerging economies like Brazil: Realistic source separation and activation of reverse logistics. *Waste Management & Research*, *32*(9), 32–39. doi:10.1177/0734242X14541985 PMID:24990590

Fleischmann, M., Van Nunen, J. A., & Gräve, B. (2003). Integrating closed-loop supply chains and spare-parts management at IBM. *Interfaces*, *33*(6), 44–56. doi:10.1287/inte.33.6.44.25189

General principles of waste management, RG. (2008). Number 26927. Retrieved from http://www.resmigazete.gov.tr/eskiler/2008/07/20080705-7.htm

Gilanli, E., Altuğ, N., & Oğuzhan, A. (2012). Comparison of forward and reverse logistics in enterprises. *Trakya University Journal of Social Science, 14*(1).

Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management (New York, N.Y.)*, *33*(1), 220–232. doi:10.1016/j.wasman.2012.09.008 PMID:23098815

Güner, S., & Coşkun, E. (2013). Environmental perceptions of small and medium-sized enterprises and the effects of buyer supplier relations on environmental practices. *Ege Akademik Bakış*, *12*(2), 151–167.

Hazra, T., & Goel, S. (2009). Solid waste management in Kolkata, India: Practices and challenges. *Waste Management (New York, N.Y.)*, *29*(1), 470–478. doi:10.1016/j.wasman.2008.01.023 PMID:18434129

Henry, R. K., Yongsheng, Z., & Jun, D. (2006). Municipal solid waste management challenges in developing countries – Kenyan case study. *Waste Management (New York, N.Y.)*, *26*(1), 92–100. doi:10.1016/j.wasman.2005.03.007 PMID:16006111

HMSO. (1990) *Circular 11/94 department of the environment HMSO,* pp. 41-42. Retrieved from http://products.ihs.com/Ohsis-SEO/107325.html

Kara, S., Rugrungruang, F., & Kaebernick, H. (2007). Simulation modelling of reverse logistics networks. *International Journal of Production Economics*, *106*(1), 61–69. doi:10.1016/j.ijpe.2006.04.009

Karaca, Ş. (2013). Investigation of consumers' attitudes towards green products. *Ege Academic Review*, *13*(1), 99–111.

Kardeş, İ. (2011). *Effects of environmentally friendly applications of brands on consumer brand preference,* Ege Akademik Bakış 11(1), pp. 165 -177

Kim, J., Hwang, Y., & Park, K. (2009). *An assessment of the recycling potential of materials based on environmental and economic factors*; Case study in South Korea. *Journal of Cleaner Production 17,* pp. 1264-1271.

Kinobe, J. R., Gebresenbet, G., & Vinneras, B. (2012). Reverse logistics related to waste management with emphasis on developing countries – a review paper. *Journal of Environmental Science and Engineering B*, *1*(9), 1104–1118.

Kularatne, R. K. A. (2015). Case study on municipal solid waste management in Vavuniya township: Practices, issues and viable management options. *Journal of Material Cycles and Waste Management*, *17*(1), 51–62. doi:10.100710163-013-0225-7

Lynch, C. F. (2000). Logistics outsourcing: A management guide, Illinois, Council of Logistics Management Publications, IL.

Makkonen, H., Heino, J., Laitil, L., Hiltunen, A., Pöyliö, E., & Harkki, J., (2002). *Optimisation of steel plant recycling in Finland: dusts, scales and sludge*, Resources, Conservation and Recycling 35, pp. 77-84

McLeod, F. N., & Cherrett, T. J. (2007). Maximising efficiency in domestic waste collection through improved fleet management. In *Proceedings of the Logistics Research Network Annual Conference,* September, Hull, UK.

Ministry of Development Electronic Working Group Report. (2015). *10th Development Plan 2014-2018.* Retrieved from http://www.kalkinma.gov.tr/Pages/OzelIhtisas

Ministry of Development, Iron-Steel Working Group Report, Ankara, Turkey. (2014). *Ministry of Development, Tenth Development Plan (2014-2018),* Ankara, Turkey. 2013. Retrieved from http://www.cka.org.tr/dosyalar/Ozel%20Ihtisas%20Komisyonu%20Raporlar%C4%B1/Demir-%C3%87elik%20%C3%87al%C4%B1%C5%9Fma%20Grubu%20Raporu.pdf

Moghadam, M. R. A., Mokhtarani, N., & Mokhtarani, B. (2009). Municipal solid waste management in Rasht City, Iran. *Waste Management (New York, N.Y.)*, *29*(1), 485–489. doi:10.1016/j.wasman.2008.02.029 PMID:18448322

Öcal, Y. (2014). *Waste management in iron and steel industry*. (Specialization Thesis). General Directorate of Economic Sectors and Coordination T. C. Ministry of Development, Publishing Numer: 2911

OECD ENV/EPOC. (2011). *Working group on waste prevention and recycling, policy principles for sustainable materials management,* Paris, France. Retrieved from http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/EPOC/WPIEEP(2011)20/FINAL&docLanguage=En

Regulation on control of excavation soil, construction, and demolition wastes, RG. (2004). Number 25406. Retrieved from http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.5401&sourceXmlSearch=&MevzuatIliski=0

Regulation on control of solid wastes RG. (1991). Number 20814. Retrieved from http://www.resmigazete.gov.tr/arsiv/20814.pdf

ResearchGate. A prescriptive process flowchart for waste management. Available at https://www.researchgate.net/figure/A-prescriptive-process-flowchart-for-waste-management_fig2_276535861

Sadowski, P. (2010). *Green logistics - Foundations, approaches and background for optimizing energy efficiency in logistics* (pp. 4–53). Saarbrücken, Germany: Müller.

Shafiul, A. A., & Ali, M. (2004). Partnerships for solid waste management in developing countries: Linking theories to realities. *Habitat International*, *28*(3), 467–479. doi:10.1016/S0197-3975(03)00044-4

Sorkun, M. F., & Onay, M. (2016). Effect of product modularity on supply chain strategies through reverse logistics processes. *Journal of Social Sciences and Humanities*, *8*(2), 41–57.

Stojanović, D., & Knežević, V. (2017). *Logıstıcs operators ın waste management ın the republıc of Serbıa.* See discussions, stats, and author profiles for this publication at https://www.researchgate.net/publication/314949050

Taha, E., Tokur, İ., & Gülbahar, F. (2016). *Sustainability in logistics sector green logistics*. Istanbul, Turkey: MUSIAD.

UNEP/GRID-Arendal. A history of waste management; UNEP/GRID-Arendal: Arendal, Norway. (2006). Available at http://maps.grida.no.go/graphic/a-history-of-waste-management

Urošević, S., Pejčić, B., & Đorđević, D. (2012). Contemporary tendencies in waste management in Serbia. *Economics Management Information Technology*, *1*(3), 159–166.

Waste, Z. (2019) *Zero waste management official.* Available at https://sifiratik.gov.tr

Wilding, R., & Juriado, R. (2004). Customer perceptions on logistics outsourcing in the European consumer goods industry. *International Journal of Physical Distribution & Logistics Management*, *34*(8), 628–644. doi:10.1108/09600030410557767

Yöntem ve Türk Telekominikasyon. (2019). *Zero waste project*. Retrieved from http://ww.yöntemizlik.com.

Zaman, A. U., & Lehmann, S. (2011). Urban growth and waste management optimization towards 'zero waste city'. *City, Culture, and Society*, *2*(4), 177–187. doi:10.1016/j.ccs.2011.11.007ACBE. (1998) *Eighth progress report to and response from the deputy prime minister and the secretary of state for trade and ındustry, Advisory Committee for Business and the Environment,* HMSO, London. Retrieved from https://webarchive.nationalarchives.gov.uk/20031221205354/http://www.defra.gov.uk/environment/acbe/

ADDİTİONAL READİNG

Faerber, T., & Ve Herzog, J. (2010), "Solid Waste Management and Environmen- tal Remediation", Nova Science Publishers, Inc. Chapter 11 Sf. 383- 406. New York, USA.

Grant, T., James, K., Lundie, S., & Sonneveld, K. (2001). *Stage 2 Report for Life Cycle Assessment for Paper and Packaging Waste Management Scenarios in Victoria*. EcoRecycle Victoria.

HALDEMAN, Tracey and TURNER, Jeanine, W. (2009), "*Implementing a Community-Based Social Marketing Program to Increase Recycling*", Social Marketing Quarterly, Volume 15/3, ss.115-127.

HEINE,H. (1993), *"Reducing Waste Through Reverse Logistics*", Foundry Ma- nagement & Technology, ss.28-29.

Hoornweg, D., & Tata, B. Perinaz (2012), " What a Waste: A Global Review of Solid Waste Management ", Urban development series;knowledge papers no. 15. World Bank, Washington, DC. © World Bank.

JESSON, Jill (2009), "*Household Waste Recycling Behavior: A Market Segmentation Model"*, Social Marketing Quarterly, Volume 15/2, Summer 2009, ss.25-38.

Lund, J. R.LUND Jay R. (1990). Least-Cost Scheduling of Solid Waste Recycling. *Journal of Environmental Engineering*, *116*(1), 182–197. doi:10.1061/(ASCE)0733-9372(1990)116:1(182)

Min, H., & Kim, I. (2012). Green supply chain research: Past, present, and future. *Logist. Res.*, *4*(1-2), 39–47. doi:10.100712159-012-0071-3

Xu, L., Mathiyazhagan, K., Govindan, K., Noorul Haq, A., Ramachandran, N. V., & Ashokkumar, A. (2013). Multiple comparative studies of green supply chain management: Pressures analysis. *Resources, Conservation and Recycling*, *78*, 26–35. doi:10.1016/j.resconrec.2013.05.005

KEY TERMS AND DEFINITIONS

Green Logistics: Supply chain management practices and strategies that reduce the environmental and energy footprint of freight distribution.

Recycling: Recovery and reprocessing of waste materials for use in new products.

Recycling Management: Plans and controls the recycling and disposal processes for waste materials, stocks of obsolete finished products, recyclable materials, and loading equipment such as packaging, pallets, and containers.

Waste: Substances or objects that are out of their commercial cycle or utilization chain.

Waste Hierarchy: It is defined as the order of the most desirable and least desirable options for the environment. A common interpretation of the 'waste hierarchy' in the EU is: prevention > reuse > recycling > composting > incineration with energy recovery > landfill with energy recovery > incineration without energy recovery > landfill without energy recovery.

Waste Management: Waste Management is a management method consisting of minimization, collection separately at the source, interim storage for the domestic, medical and hazardous, and non-hazardous wastes, establishment of transfer centers for wastes when necessary, transportation, recycling, disposal of wastes, operation of recycling and disposal facilities, and the closure, post-closure maintenance, monitoring-control processes.

Zero Waste: Waste prevention, high levels of recycling and recovery of all resources from waste; and behavioral change.

Zero Waste Goal: Designed to be done, prevention of waste, high level of recycling and recovery of all resources from waste; and behavior change.

Zero Waste Management: Achieve zero waste goals by developing zero waste strategy and by integrating and promoting zero waste initiatives (in communities and industry) through waste management policy.

Chapter 21
The Effect of Reverse Logistics Activities on Brand Equity and Customer Satisfaction:
A Case Study in Turkey

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ABSTRACT

In the last few decades, the rapid development of customer awareness of environmental issues has encouraged many enterprises to adopt reverse logistics activities, which resulted in growing importance among enterprises of enhancing customer satisfaction and improving brand equity. This chapter examines the effect of reverse logistics activities in Turkish firms which are required to act responsibly towards the environment, and explains the relationship between reverse logistics processes and customer satisfaction and brand equity. The findings of this study contribute to understanding that an increasing number of them have integrated reverse logistics practices into their operations to develop a sustainable competitive advantage. The findings also indicate that reverse logistics plays an active role in Turkish enterprises improving brand equity and customer satisfaction while preserving the environment in the local and the global communities.

INTRODUCTION

Consumption of a vast variety of products has increased globally since the 1990s according to the growth of population and living standards. The increasing concern about environmental and energy conservation leads enterprises to reconsider their position in the international market. Regulatory pressure for environmental protection is especially influential for enterprises seeking to compete in the international market. After consumption, the firms are equally responsible for the consumption of raw material from the earth.

DOI: 10.4018/978-1-7998-1397-2.ch021

Environmental groups such as suppliers, customers and manufacturers in the supply chain expect to reduce harms caused to the natural environment by their products and operations. According to the aforementioned reasons, reverse logistics activities are developing daily for sustainable development. With the consumption of natural resources and growing population, adoption of reverse logistics implementation will turn into a necessity for every industry. Reverse logistics is defined as a management approach by which an enterprise takes back previously shipped products or parts from the point of consumption for repair, remanufacturing, reusing, reconditioning, recycling and disposal (Carter and Ellram, 1998; Dowlatshahi, 2010).The aim of taking back used materials and components is to be used again in the supply chain (Fagundes et al. 2017). The name was coined because it is based on the logistics implementations of redirecting products from their regular final destination with the goal of recapturing value or proper disposal inside an organization in the opposite direction of the usual activities of the supply chain (Mimouni et al. 2015; Rogers and Tibben-Lembke, 2001).

Reverse logistics has garnered attention nowadays by academicians and industrialists and it is outstanding in the quantity of studies published on reverse logistics in recent decades (Acar et al. 2015). Firms are experiencing environmental degradation at a high level due to pollution and a solution is urgently needed. In spite of this, only some enterprises are familiar with the redistribution of returns, and very few enterprises take responsibility for their goods. Enterprises perform these activities due to compliance with environmental regulations specific to the country or region (Brito et al. 2002). The emergence of stricter environmental regulations has forced businesses to begin considering environmental operations management with the list of reverse logistics activities (Govindan and Bouzon, 2018). Reverse logistics activities are needed in order to adapt vast processes such as the utilization of human resources, procedures, leadership values, innovation in technology and recovered quantities of products.

The Turkish government has paid attention to environmental management such as establishing more strict environmental regulations and promoting green production. Although existing studies have researched the importance of reverse logistics, its activities have yet to be well investigated regarding the relationship between reverse logistics, value and customer satisfaction. This study focuses on evaluating the implications of reverse logistics practices. We explore the five dimensions of justice in reverse logistics and how they affect brand equity and customer satisfaction. Turkey was selected for this case study because of its close proximity to the logistics and trade centers of Asia and Europe. The automation industry was chosen because building brand equity and corporate reputation are given significance in this sector. Automation service managers need to pay attention to reverse logistics activities in order to manage customer relationships and loyalty as well as to improve service quality and customer satisfaction.

Customer environmental awareness is mentioned as the customer word-of-mouth effect (Chen et al. 2018). Consumers have a chance to return products due to several known or unknown reasons such as customer dissatisfaction, defects or damage. Customer satisfaction is a post-decision experience (Martin et al. 2011). Brand equity and customer satisfaction are closely related to reverse logistics and has been identified to add incremental value, utility and fundamental capital for vast organizations (Ioannou and Rusu, 2012).

Reverse logistics is an important issue for improving sales and competitiveness, providing strategic advantage and creating a positive brand image (Jayaraman and Luo, 2007). Moreover, it increases ecological protection, effective utilization of resources and decreases the cost of operations (Khor et al. 2016).

In this study, it is aimed to address gaps in the literature by examining the causal relationship between reverse logistics, brand equity and customer satisfaction. This paper is organized as follows: Firstly, a thorough review of previous studies is presented to identify dependent and independent variables. Second part of study introduces the concept of reverse logistics in terms of implementation, customer satisfaction and brand equity. Third part of the paper details research design, data collection and develops upon existent hypotheses. The fourth part of the study tests the hypotheses, analyzes data, and discusses the results of reverse logistics implementation in automation sectors in Turkey. Lastly, the conclusion of this study is presented.

LITERATURE REVIEW AND RESEARCH FRAMEWORK

Reverse Logistics

Nowadays, environmental concerns of business stakeholders, legal regulations and various organizations that pay attention to sustainable development encourage the adoption of reverse logistics activities. These applications enable businesses to perform effectively and efficiently in the organization (Prajapati et al., 2011). Many research studies have suggested that there is a lack of such reverse logistics policies in most countries. Despite developing countries being responsible for the majority of manufacturing in the world, the improvement of reverse logistics is still in its infancy in these developing countries (Lau and Wang 2009). Thus, the lack of government regulations and policies in many countries across the globe is a critical issue for lack of implementation of reverse logistics (Abdulrahman et al. 2014).

Reverse logistics is identified as the process of planning, implementing and managing of goods from their final destination back to their point of origin (Rogers and Tibben-Lembke 1999; Dowlatshahi, 2010). Reverse logistics is an essential part of sustainable management, which comprises a series of activities such as reconditioning, recycling, reuse, remanufacturing and repair (Srivastava, 2006).The aim of reverse logistics is to focus on the reverse flow of materials by adding their value in marketing, inbound logistics, outbound logistics and in reducing environmental burdens (Kannan et al. 2009). Reverse logistics are so named because it is in fact the opposite of forward supply chain and is definedd by the process of planning, implementing and managing the return flow of products, which includes inspection, disposal, recovery and recycling activities, the advantages of which save money for the producers (Fleischmann et al. 1997; Srivastava 2007). The goal of reverse logistics contains decreasing energy use by achieving a more efficient back-to-front process intended to eliminate disposal of industrial products in landfills (Guide et al. 2000).

Many researchers have performed a comprehensive perspective review of reverse logistics in the literature: 449 relevant articles by Prajapati et al. (2019), 150 published articles by Pokharel and Mutha (2009), 242 articles by Agrawal et al. (2015) are selected, categorized, and analyzed. Jack et al. (2010) point out that the obligations of contractual and resource commitments positively affect reverse logistics abilities and cost savings. Otherwise, Thierry et al. (1995) introduced the concept that reverse logistics is comprised of different activities related to repair, reprocessing, renovation and cannibalization. Gehin et al. (2008) reported that sustainable design of products can begin to resolve many difficulties of recycling, remanufacturing and reusing of different parts.

Nowadays, an increasing number of manufacturers insist upon attracting more customers with a return policy which creates competitive advantages (Carter and Easton, 2011). End-of-use returns, guarantee returns, end-of-life returns, commercial returns and product recalls are important elements in the return of products into the supply chain (Han and Ponce-Cueto, 2016; Fleischmann et al. 1997). Product returns are a necessary process to substantially improve customer satisfaction and increase product sales. The return policy of enterprises can take many forms such as exchanging the products, refund of the selling price (full or partial) or no payment (Mukhopadhyay and Setoputro, 2004). Firms become aware of return policy as a competitive tool, which affects selling prices and inventory decisions. As pointed out by Li et all. (2013),it's emphasized that return policy, product quality and pricing strategies of enterprises all have an impact on customer purchase and return decisions. Reconditioning comprises repairing, testing, replacing and some level of product disassembly if the product is suspected to fail soon. In addition, it can help to restore the existing used product to stated working conditions as required.

French (2008) pointed out that developing internal reuse programs through product reuse decreases waste and enhances sustainability. Bouzon et al. (2014) considered reverse logistics activities related to recycling to be limited to some articles and a few sectors. Ravi (2012) provided a more detailed discussion about a new quality evaluating system to measure the quality of recycling. Ostlin et al. (2009) argued for the balance of the product return rate and the demand for remanufactured products. They declared that remanufacturing is an effective process because returned products have a chance at the same characteristics as a new product after reprocessing. Moreover, it helps firms to balance supply and demand. Kerr and Ryan (2001) showed that remanufacturing is the most eco-efficient process regarding reuse of used products. Junior and Filho (2012) investigated recent literature on production planning and control for remanufacturing. Robotis et al. (2005) presented the effect of remanufacturing on the process of product acquisition. Lately, the secondary market has played a key role in increasing the environmental impact of products and adding economic value unless the remanufactured products are accepted for sale in the primary market alongside new products (Rogers et al. 2010). Therefore, it helps to guarantee that the returned products are reprocessed appropriately or simply disposed of responsibly (Saavedra et al. 2013). Disposal is the last choice, which is appropriate in the absence of any relevant remaining value, and includes the process of properly disposing of or incinerating parts or products. This option is chosen on the condition that alternatives are considered to be too complex or may not otherwise be made to be beneficial (Chanintrakul et al. 2009).

Gonzalez-Torre et al. (2004) provided evidence that there is a difference between the environment and reverse logistics activities implemented in Spain and Belgium. Lee and Chen (2009) proposed adopting RFID into reverse logistics assets to trace returned products and recover value from the products more efficiently. Bostel et al. (2005) have comprehensively evaluated implementation in reverse logistics of varied industries and products. Lee et al. (2012) emphasized that reverse logistics activities are able to create value regarding design and to develop sustainable products and services by increasing the efficiency of related processes.

Reverse logistics activities can turn into a very lucrative process for enterprises. When many firms make an effort to implement the reverse flow of products in compliance with current legislation, they have a chance to prevent the generation of waste (Coelho and Mateus 2017). Reverse logistics stands to become a beneficial and sustainable business strategy for enterprises (Lai et al. 2013). Its activities can improve the profitability of manufacturers (Weeks et al. 2010) and achieve competitive advantages by minimizing costs and enhancing both customer satisfaction and corporate social legitimacy (Rogers and Tibben-Lembke, 2010).

Brand Equity

Brand equity is defined as a set of brand assets and obligations linked to a brand, its name and its symbol, that adds value provided by a product or service to enterprises and its customers.

Nowadays, enterprises encourage customer trust by studying intangible factors and by increasing the number of customer service and product purchase (Chen and Chang, 2008).The concept of brand equity emphasizes the importance of taking a long-term view of marketing decisions and enhances the importance of the brand in marketing strategy (Keller, 2008).

Brand equity includes many sub-factors such as brand awareness, brand loyalty, brand association and perceived quality. Brand awareness is conceptualized as the durability of a customer's experience in their memory, skill of the customer to recall the brand and the strength of a brand node in consumers' capacity (Aaker, 1991). The enhancement of brand awareness is a critical area relating to decreased risk of revenue loss and recognition of the brand among competing brands (Keller, 1993; Bharadwaj et al. 1993). Accordingly, researchers argue that brand awareness has a key role in building brand equity and that it is necessary that the brand be known by customers. On the other hand it is not possible to construct brand equity (Rust et al. 2004).

Brand loyalty can be explained as loyal customers involved with the focal brand who are regarded as having a strong conviction about such a brand. According to Poppa and Woratschek (2017), customer satisfaction has no positive influence on community loyalty while the impact of identification on brand loyalty is mediated. Bloemer et al. (1998) defined brand loyalty as a considerable aspect of brand value. The consumer relationship with a product category positively affects attitudinal loyalty towards a preferred service provider's brand (Russell-Bennett et al. 2007). In addition, Aaker (1996) demonstrated that brand loyalty is an important element for appraising a brand in terms of value as it composes profit.

Brand association is an impressive driver to improve a customer's memorable experience of a particular brand (Yoo and Lee, 2000). In the first stages, brand image is a fundamental factor that is composed and developed from constant brand association with customers (Ross et all. 2006; Keller, 2009). Brand association is linked in brand node and investigated with customer's memory contains meaning information of the brand in the decision process of the customers (Keller, 1993). Aaker (1991) provides empirical evidence that the creation of a positive association of the brand with the customer is due to the relationship with the brand name.

Perceived quality is a significant property of fundamental functions, performance, characteristics, perfection economic life of the brand product and brand service quality (Aaker, 1996). Perceived quality evaluates personal reaction to the product or service features from a subjective viewpoint (Kwun, 2011). Brand image and perceived quality are comprised by the emotional stage of the customer purchasing activities. Perceived quality is described as a consumer's perception of the comprehensive excellence of a product or service and the inconsistency between customers' expectations and their perceptions of the product or service.

Customer Satisfaction

In today's competitive age, enterprises need to pay attention to customer demands and requirements and meet their expectations (Nadiri et al. 2008). Customer satisfaction is an indicator of word of mouth suggestion and repeated purchases. It is defined as the judgment administered by a customer regarding a service encounter related to the extent to which the service fulfilled customer wants or expectations.

A customer's feelings of satisfaction or disappointment concluded from comparing the outcome with personal expectations and the product's perceived performance (Kotler and Keller, 2009).

The perceived performance of service features by the customer is used as a fundamental input in the modeling of customer satisfaction. Therefore, it can be identified as an assessment corresponding to a comparison between customers' experience and their initial reference base from the cognitive processes and interest in the quality of the products or services provided to the customer in a positive manner. Customer satisfaction is admitted to be an intrinsic variable that clarifies the post-behaviors of purchasing products and services by returning customers (Szymanski, and Henard, 2001). It positively affects customer loyalty which enhances customer willingness (Xu and Gursoy, 2015).

The level of customer satisfaction is also considered to be improved, along with an enhanced level of perceived quality of the product or service. Customer satisfaction occurs when customers realize that products or services exceed their positive expectations (Santini et al. 2018). Customer satisfaction is the most influential factor in a business's socially responsible actions (Miles and Covin, 2000).

Many studies confirm that customer satisfaction is a precursor to increase a company's income, profit, market share, and leads to positive advertising by word of mouth and creates value for customers (Bernhardt et al. 2000; Dominici and Guzzo, 2010). Prior studies present that brand image affects customer satisfaction (Lai et al. 2009), and customer satisfaction has a positive impact on brand loyalty (He et al. 2012). Customer social responsibility is a critical factor for customer satisfaction that results in customer loyalty. Jiang and Zhang (2016) examine the roles of service quality and demographic variables in explaining customer loyalty in the air transportation industry and found the relationship between customer satisfaction and customer loyalty.

Mikulic and Prebezac (2011) explained that strong brands could improve customers' trust in products and enable them to better figure out intangible ingredients, which have a significant containment for a firm's long-term cash flow and future profits. Cao and Chen, (2011), Anderson et al. (2009), Yeo et al. (2015) and Arif et al. (2013) found that service quality has a positive effect on customer satisfaction in the transportation sector. Lee et al. (2012) highlighted the roles of service quality, efficient operations and employee engagement in achieving customer satisfaction through the interaction process in healthcare industries. Forozia et al. (2013) argued that achieving customer satisfaction is essential while delivering services to customers in the tourism sector. Baron and Kenny (1986) provide useful insights into how brand image mediates the relationship between customer satisfaction and customer loyalty.

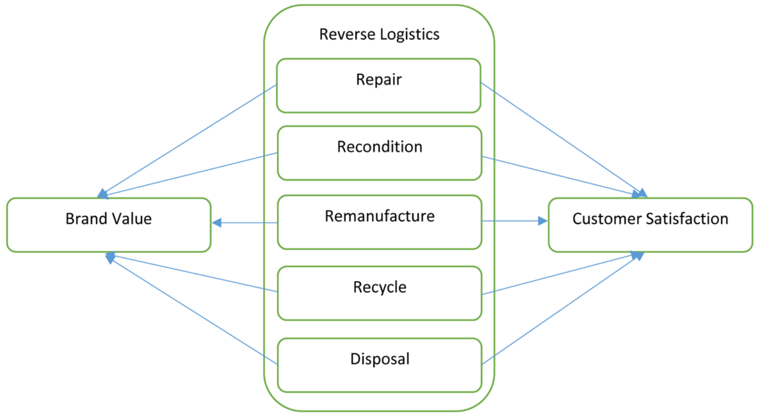
In addition, Cronin et al. (2000) distinguished between direct and indirect effects on customers' behavioral intentions and determined that service quality could be directly related to customer satisfaction. Zeithaml et al. (1996) explained that increasing perceived service quality can improve customers' favorable behavioral intentions. Crow (2014) examined the impact of service quality and customer complaints on customer satisfaction in air transportation industries. Results show that there is no significant relationship between customer satisfaction and on-time performance. Despite disappointment among customers in the service quality of an air transportation company, they do not complaint.

Research Framework

Reverse logistics is becoming an increasingly popular issue among academicians and several commercial sectors, which is a valuable process for managing long-term relationships with customers. Nonetheless, reverse logistics research is not particularly common in the automation sector.

The research framework and associated hypotheses are shown in Figure 1.

Figure 1. Research framework



The sampling frame consisted of Turkish medium sized enterprises in the automation sector. The sample respondents were recruited using random sampling in Turkey. The two hypotheses are tested by survey data collected from a sample of Turkish firms. The survey was refined and conducted a pilot test to 30 managers in the automation sector. This industry was selected because it is viewed to have the most direct and observable impact on reverse logistics. Repair, recondition, remanufacture, recycle, disposal add value to suppliers and manufacturers which are members of the supply chains in the automation sector, and they focus on recovering part of the original value of used goods, and producing social, economic, and environmental benefits. The sample size of 300 in this study is valid.

The survey was executed from January to May 2019. The questionnaire was given to the selected specialist or manager such as logistics marketing, sales, and customer service departments in the automation industry. In this study, exploratory factor analysis was analyzed to refine the scales using the data collected from the pilot test and refined the survey instrument to conclude the questionnaire. Data were collected from a survey of enterprises in Istanbul and analyzed using SPSS 24. The aim of this study is to examine (1) reverse logistics activities in automation sector in Turkey and (2) the association between reverse logistics, brand equity and customer satisfaction.

Reverse logistics factors include repair (4 items), recondition (3 items), remanufacture (3 items), recycle (3 items) and disposal (2 items) which were used by Khor et al. (2016). Customer satisfaction was measured using the customer satisfaction scale from Lam et al. (2004), and brand equity was measured using the brand equity scale developed by Yoo ve Donthu (2001), Aaker (2002), Aaker (1991). The selection of articles from literature reviews was taken from the databases of ProQuest, EBSCOhost, Google Scholar, Scopus and Web of Science. Two different versions of the questionnaire were prepared. Informants were sent a short external version prior to the interview, whereas a more detailed internal version was designed to support the interviewers. Questions were organized into two main sections. The first section included general information on the interviewee and the company. The second section included questions concerning reverse logistics implementation, brand equity and customer satisfaction. All questions were answered using a five-point Likert scale.

The gender, age, education level, duration of operation of the enterprise and job experience are presented in Table 1.

Table 1. Profile of respondents (n = 300)

Gender	Frequency	%	Age	Frequency	%
Female	135	45	18-25	45	15,0
Male	165	55	26-30	110	36,7
Education	**Frequency**	%	31-40	70	23,3
High school	35	11,7	41-45	35	11,7
Associate	55	18,3	46-50	28	9,3
Undergraduate	160	53,3	51 and over	12	4,0
Master	50	16,7	**Job Experience**	**Frequency**	%
Duration of Business	**Frequency**	%	Less than 1 year	21	7,0
3-5 years	10	3,3	1-2 years	29	9,7
6-10 years	25	8,3	3-5 years	75	25,0
11-15 years	75	25,0	6-10 years	80	26,7
16-20 years	45	15,0	11-15 years	50	16,7
20 years and over	145	48,3	16 yeas and over	45	15,0

The profiles of respondents and the general information of the companies are displayed in Table 1. Results reveal that the respondents were female (% 45) and male (% 55). Despite the fact that they work in the automation sector, the proportions of male and female employees are so close to each other. Recently, projects aimed at increasing the employment of women in business have increased in Turkey. Of the participants in the study, a majority of the respondents were older than 26 years. The largest age group that participated in the study were the 26 - 30-year-olds numbering 110 total.

Considering the educational status of the participants: 11.7% of them are high school graduates, 18.3% hold an associate degree, 53.3% hold an undergraduate degree and 16.7% have attained a master's degree. The majority of the participants (n = 160) were found to hold a bachelor's degree. This result showed that the level of education is high due to the institutional nature of the enterprises they work in. The enterprises in the sample were determined to have maintained their presence in the sector for many years. 48.3% of enterprises have continued their operations in the sector for 20 years or more. It reveals that over % 58,4 of respondents have worked in the automation industry for more than 5 years. The finding means that respondents have abundant practical experience in reverse logistics implementation in their firms.

FINDINGS OF THE EMPIRICAL RESEARCH

KMO and Bartlett Sphericity tests were performed for each scale in this study. With KMO-Bartlett sphericity test, the suitability of the variables for factor analysis is determined. KMO revealed that the resulting value should be greater than 0.5. If there are variables less than 0.5, these variables are not added to the analysis. If the value is between 0.70 - 0.80, the value is acceptable.

Measures were subjected to an exploratory factor analysis using SPSS 24. According to the KMO test results in the sample, the rate of reverse logistics is 0,857, brand equity's rate is 0,826 and customer satisfaction's rate is 0,731. This is a value between 0.70 and 0.80, so the sampling rate was found to be excellent. When the Bartlett sphericity test results are interpreted, the value of the sample in 3 variables is 0.0005. Since this value does not exceed 0,005, it is shown that the sample is meaningful.

The reliability values used in the research are indicative of the criteria for the participants to reach the same result in coherent and repeated evaluations. The reliability analysis test, which was established to test the propositions in the foundations of the research, was performed for all of the scale expressions found in the survey study. In the reliability test performed on all propositions, the alpha value was found to be 0.915. Since this value is a value between 0.80 <a <1.00, it suggests that the research propositions are highly reliable. Using SPSS, the results of exploratory factor analysis, with the assumption of extracting via principal components method and varimax rotation.

The reliability of constructs was tested using Cronbach's coefficient alpha, which ranged from 0.89 to 0.93, much larger than the standard of 0.7. Since all measurements were based upon prior relevant literature and were often used or adapted in research, evidence of content validity was provided. The alpha (α) value of reverse logistics scale, which is one of the research factors consisting of 13 propositions, has been determined to be 0.936. Another important factor of the study was the brand equity with12 propositions. The revised version of the scale was calculated as 0.912 as a result of alpha (α) calculations. The customer satisfaction scale, which was measured with 4 suggestions in the study, was determined to be 0,783 when the alpha (α) value for the reliability of the scale was revised.

To determine the differences among the reverse logistics activities, one-way ANOVA was used and the descriptive statistics are shown in Table 3 and post-hoc comparisons are shown in Table 4. According to the test results, because of the non-homogeneity of variances (Levene Statistic:14,417, p:0,000), Tamhane's T2 criterion was used. The results emphasize that repair and recondition are more important

Table 2. Results of reliability and KMO test

Measures	N	Mean	S.D.	Cronbach's Alpha	KMO	Bartlett's Test
Reverse logistics	300	34,978	0,94944	0,936	0,857	0,0005
Brand equity	300	41,964	0,65087	0,912	0,826	0,0005
Customer satisfaction	300	41,458	081567	0,783	0,731	0,0005

Table 3. Descriptive statistics of Reverse Logistics Activities

Measures	N	Mean	S.D.	Std. Error of Mean
Repair	300	3,7333	1,28656	0,07428
Recondition	300	3,7944	1,01657	0,05869
Remanufacture	300	3,4056	1,20708	0,06969
Recyle	300	3,1333	0,95261	0,05500
Disposal	300	3,2667	1,08758	0,06279

Table 4. Post-Hoc comparisons of Reverse Logistics Activities

Hospital Type			Operational Performance			
		Differences in Means	Standard Error	p	95% Confidence Interval	
					Lowest	Highest
Repair	Recondition	-0,06133	0,09118	0,962	-0,3104	0,1877
	Remanufacture	0,32733*	0,09118	0,003	0,0783	0,5764*
	Recyle	0,60000*	0,09118	0,000	0,3510	0,8490*
	Disposal	0,46667*	0,09118	0,000	0,2176	0,7157*
Recondition	Remanufacture	0,06133	,09118	0,962	-0,1877	0,3104
	Recyle	0,38867*	00,09118	0,000	0,1396	0,6377*
	Disposal	0,66133*	0,09118	0,000	0,4123	0,9104*
	Repair	0,52800*	0,09118	0,000	0,2790	0,7770*
Remanufacture	Recondition	0-,32733*	0,09118	0,003	-0,5764	-0,0783*
	Recyle	-0,38867*	0,09118	0,000	-0,6377	-0,1396*
	Disposal	0,27267*	0,09118	0,024	0,0236	0,5217*
	Repair	0,13933	0,09118	0,544	-0,1097	0,3884
Recyle	Recondition	-0,60000*	0,09118	0,000	-0,8490	-0,3510*
	Remanufacture	-0,66133*	0,09118	0,000	-0,9104	-0,4123*
	Disposal	-0,27267*	0,09118	0,024	-0,5217	-0,0236*
	Repair	-0,13333	0,09118	0,587	-0,3824	0,1157
Disposal	Recondition	-0,46667*	0,09118	0,000	-0,7157	-0,2176*
	Remanufacture	-0,52800*	0,09118	0,000	-0,7770	-0,2790*
	Recyle	-0,13933	0,09118	0,544	-0,3884	0,1097

than the other activities, and remanufacture is also more essential than recycle and disposal. These findings show that repair, recondition and remanufacturing activities have priority in the automation sector.

In this study, the Pearson correlation technique was used to observe the relationship among the variables. When interpreting the results of this analysis, it is seen that the coefficient varies between -1 and +1. The closer the value is to 1, the higher the force is, the closer to 0 indicates that the force. The R coefficient - the value of the relationship is inversely proportional to the value of the values + the value of the relationship shows that the relationship is proportional.

Table 5 whether there is a relationship among reverse logistics implementations (repair, recondition, remanufacture, recycle, disposal), brand equity and customer satisfaction in the automation sector. In the correlation analysis, the results point out significant relationships between reverse logistics activities, brand equity and customer satisfaction.

Regression analysis was performed in order to evaluate the hypotheses that were formed to investigate the relationship between reverse logistics, brand equity and customer satisfaction variables.

According to the results found in Table 6, a positive correlation was found between the reverse logistics activities and the brand equity (R = 0.615). The R^2 coefficient was found to be 0,378. It can define 3% of the effect of reverse logistics factor as brand equity. Since the significance level of ANOVA

Table 5. Correlation coefficients of Reverse Logistics, brand equity and customer satisfaction

	R1	R2	R3	R4	R5	BV	CS
R1:Repair	1						
R2:Recondition	0,768**	1					
R3:Remanufacture	0,664**	0,795**	1				
R4:Recyle	0,548**	0,704**	0,646**	1			
R5:Disposal	0,395**	0,632**	0,586**	0,517**	1		
BV:Brand equity	0,212**	0,521**	0,463**	0,412**	0,351**	1	
CS:Customer satisfaction	0,062	0,305**	0,241**	0,165**	0,192**	0,785**	1

** Correlation is significant at the 0.01 level (two-tailed).

Table 6. Regression analysis between Reverse Logistics and brand equity

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2,963	0,122		24,218	0,0005
	Repair	-0,254	0,038	-0,503	-6,777	0,0005
	Recondition	0,474	0,065	0,740	7,250	0,0005
	Remanufacture	0,112	0,043	0,207	2,604	0,010
	Recyle	0,050	0,045	0,073	1,102	0,271
	Disposal	-0,046	0,037	-0,077	-1,248	0,213

analysis is less than 0.05, the effect of reverse logistics activities on brand equity is significant. In the regression analysis, it is explained that repair, product renewal, and reproduction activities increase the brand equity. It has been concluded that recycling and disposal practices are not effective in increasing brand equity in the automation sector.

R2: 0,378 F:35,683

Dependent Variable: Brand Equity.

Considering the regression analysis, it is seen that repair and recondition activities have direct and positive impacts on customer satisfaction, which is the dependent variable of the study. It is declared that this fact explains the 17,5% of the changes in customer satisfaction. Table 7 indicates that there is a positive correlation between reverse logistics activities and customer satisfaction (R = 0.418). In the regression analysis, it is concluded that only repair and product renewal activities increase customer satisfaction. It was concluded that reproduction, recycling, and destruction practices were not effective in increasing customer satisfaction.

R2: 0,175 F:12,466

Dependent Variable: Customer Satisfaction

A summary of the comparisons, all the results of the hypotheses and the outcomes as either support or non-support are shown in Table 8. Correlation and regression analysis conducted to investigate the effect of reverse logistics activities on brand equity and customer satisfaction revealed a positive relation-

Table 7. Regression analysis between Reverse Logistics and customer satisfaction

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3,333	0,177		18,879	0,0005
	Repair	-0,283	0,054	-0,447	-5,228	0,0005
	Recondition	0,548	0,094	0,683	5,814	0,0005
	Remanufacture	0,068	0,062	0,101	1,100	0,272
	Recyle	-0,085	0,066	-0,099	-1,297	0,196
	Disposal	-0,054	0,054	-0,072	-1,002	0,317

Table 8. Summary of hypotheses tests

Hypothesis	Relationship	Results
H1a	Repair Brand equity	Supported
H1b	Recondition Brand equity	Supported
H1c	Remanufacture Brand equity	Supported
H1d	Recyle Brand equity	Not supported
H1e	Disposal Brand equity	Not supported
H2a	Repair Customer satisfaction	Supported
H2b	Recondition Customer satisfaction	Supported
H2c	Remanufacture Customer satisfaction	Not supported
H2d	Recyle Customer satisfaction	Not supported
H2e	Disposal Customer satisfaction	Not supported

ship. Hypotheses 1a-1b-1c are further supported. Our empirical results indicate that repair, recondition and remanufacture have direct, positive effects on brand equity. Hypotheses 2a-2b are supported for customer satisfaction.

RESULTS AND CONCLUSION

Closed-loop supply chain and reverse logistics topics are paid attention to by researchers and practitioners based on economic, social, legal and environmental factors. The literature related to reverse logistics is not entirely current at present. When approached to become integrated into the management and organization of enterprises' logistics processes, there is a demand for investigation in this area (Lu and Bostel, 2007). Enterprises are pressed to become more accountable by customers, suppliers and environmental groups for decreasing damage to the natural environment (Zhu et al. 2010). Moreover, growing focus on environmentalism and public awareness of the depletion of raw material resources have forced governments to set regulations on environmental protection. Enhanced global competition and shorter product life cycle encourage enterprises to process product returns at the end of their first use for reusing, recycling, remanufacturing, reconditioning and remarketing. Increased environmental awareness of customers makes them more aware of the recycling of used products. Our research results particularly support these developments. In the research, recycling and disposal of products by enterprises are less important topics compared with the other reverse logistics activities.

Reverse logistics is well known activity for playing a considerable role in gaining competitive advantage. An effective reverse logistics program provides enterprises with a variety of economic advantages such as inventory reduction, lower costs, lower capital investment and cost efficiency. In addition, it is a strategic instrument for achieving a win-win situation and improving customer satisfaction and corporate social image (Kenne et al. 2012). Brand equity increases as the brand becomes better known and as the firm assists the brand at distinct contact points. Therefore, efficient and effective connection with the consumer, investigation, skillful advertising and development investment are required to sustain competitive advantages for companies (Gabay et al. 2009). Existing literature has investigated whether brand equity had significant effects on customer satisfaction. Joung et al. (2016) concluded that perceived quality had a positive and direct impact on customer satisfaction. Therefore, as the level of perceived quality improves, the level of overall customer satisfaction improves as well (Yu et al. 2005). Our research findings support this effect.

The aim of this study is to exert a comprehensive review of the existing reverse logistics literature and evaluate the relationship between reverse logistics implementation, brand equity and customer satisfaction. Moreover, it endeavors to realize a more exhaustive understanding of reverse logistics implementation in the automation sector. According to the correlation analysis, it was found that there is a strong relationship between reverse logistics activities and brand equity. The empirical results suggest that repair, recondition and remanufacture have statistically significant positive influences on brand equity. However, recycle and disposal don’t appear to have a significant influence on brand equity. This study explains that repair and recondition were found to significantly impact customer satisfaction, but remanufacturing, recycling and disposal do not positively impact customer satisfaction. Conversely, recycling and disposal implementation are not meaningful variables on customer satisfaction and brand equity inducing initiatives in the face of regulatory pressures. The results provide empirical evidence on improvements to brand equity and customer satisfaction as a result of adopting reverse logistics for sustainable economic development. These results are also important guidelines for enterprises to adopt and implement reverse logistics in the automation sector.

Brand equity assessment is a significant issue of strategic value for use in reverse logistics activities. Brand value can be valuable to logistics managers in planning investments in promotions, pricing and other strategies. If logistics managers can forecast how much spending is required to increase brand equity in the logistics process, they can decide whether the expected increase in revenue compensates possible product investments.

The main limitation of this study is that collected data was solely from several enterprises in Istanbul. Although Istanbul is one of the most important provinces in Turkey from a development perspective, it is not representative of Turkey as a whole. Results cannot be generalized for the whole country and automation sector. The limitation of this study may be evident in the selection of articles which was only selected from peer-reviewed journals publishing in the English language.

REFERENCES

Aaker, A. D. (2002). *Building strong brand*. UK: Free Press Business.

Aaker, D. A. (1991). *Managing brand equity: Capitalizing on the value of a brand name New York*. Free Press.

Aaker, D. A. (1996). Measuring brand equity across products and markets. *California Management Review*, *38*(3), 102–120. doi:10.2307/41165845

Abdulrahman, M., Gunasekaran, A., & Subramanian, N. (2014). Critical barriers in implementing reverse logistics in the Chinese manufacturing sectors. *International Journal of Production Economics*, *147*, 460–471. doi:10.1016/j.ijpe.2012.08.003

Acar, A. Z., Önden, İ., & Kara, K. (2015). Evaluating the location of regional return centers in reverse logistics through integration of GIS, AHP and integer programming. *International Journal of Industrial Engineering*, *22*(4), 399–411.

Agrawal, S., Singh, R. K., & Murtaza, Q. (2015). A literature review and perspectives in reverse logistics. *Resources, Conservation, and Recycling*, *97*, 76–92. doi:10.1016/j.resconrec.2015.02.009

Anderson, E. W., & Sullıvan, M. W. (1993). The antecedents and consequences of customer satisfaction for firms. *Marketing Science*, *12*(2), 125–143. doi:10.1287/mksc.12.2.125

Arif, M., Gupta, A., & Williams, A. (2013). Customer service in the aviation industry An exploratory analysis of UAE airports. *Journal of Air Transport Management*, *32*, 1–7. doi:10.1016/j.jairtraman.2013.05.001

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. doi:10.1037/0022-3514.51.6.1173 PMID:3806354

Bernhardt, K. L., Donthu, N., & Kennett, P. A. (2000). A longitudinal analysis of satisfaction and profitability. *Journal of Business Research*, *47*(2), 161–171. doi:10.1016/S0148-2963(98)00042-3

Bharadwaj, S. G., Varadarajan, P. R., & Fahy, J. (1993). Sustainable competitive advantage in service industries: A conceptual model and research propositions. *Journal of Marketing*, *57*(4), 83–99. doi:10.1177/002224299305700407

Bloemer, J. M. M., de Ruyter, K., & Peeters, P. (1998). Investigating drivers of bank loyalty: The complex relationship between image, service quality and satisfaction. *International Journal of Bank Marketing*, *16*(7), 276–286. doi:10.1108/02652329810245984

Bostel, N., Dejax, P., & Lu, Z. (2005). The design, planning, and optimization of reverse logistics network. In A. Langevin, & D. Riopel (Eds.), *Logistics systems: design and optimization* (pp. 171–212). New York: Springer. doi:10.1007/0-387-24977-X_6

Bouzon, M., Augusto Cauchick Miguel, P., & Manuel Taboada Rodriguez, C. (2014). Managing end of life products: A review of the literature on reverse logistics in Brazil. *Management of Environmental Quality*, *25*(5), 564–584. doi:10.1108/MEQ-04-2013-0027

Brito, M. P., Dekker, R., Flapper, S. D. (2002). Reverse logistics: A review of case studies. *Econometric Institute Report,* EI-21.

Cao, C., & Chen, J. (2011). An empirical analysis of the relationship among service quality, customer satisfaction, and loyalty of high-speed railway based on structural equation model. *Canadian Social Science*, *7*(4), 67–73.

Carter, C., & Easton, P. (2011). Sustainable supply chain management: Evolution and future directions. *International Journal of Physical Distribution & Logistics Management*, *41*(1), 46–62. doi:10.1108/09600031111101420

Carter, C. R., & Ellram, L. M. (1998). Reverse logistics: A review of the literature and framework for future investigation. *Journal of Business Logistics*, *19*, 85–102.

Chanintrakul, P., Mondragon, A., Lalwani, C., & Wong, C. (2009). Reverse logistics network design: A state-of-the-art literature review. *International Journal of Business Performance and Supply Chain Modelling*, *1*(1), 61–81. doi:10.1504/IJBPSCM.2009.026266

Chen, C. F., & Chang, Y. Y. (2008). Airline brand equity, brand preference and purchase intentions - the moderating effects of switching costs. *Journal of Air Transport Management*, *14*(1), 40–42. doi:10.1016/j.jairtraman.2007.11.003

Chen, D., Ignatius, J., Sun, D., Zhan, S., Zhou, S., Marrad, M., & Demirbag, M. (2018). Reverse logistics pricing strategy for a green supply chain: A view of customers' environmental awareness. *International Journal of Production Economics*, 1–13.

Chow, C. K. W. (2014). Customer satisfaction and service quality in the Chinese airline industry. *Journal of Air Transport Management*, *35*, 102–107. doi:10.1016/j.jairtraman.2013.11.013

Coelho, E. K. F., & Mateus, G. R. (2017). A capacitated plant location model for reverse logistics activities. *Journal of Cleaner Production*, *167*, 1165–1177. doi:10.1016/j.jclepro.2017.07.238

Cretu, A. E., & Brodie, R. J. (2007). The influence of brand image and company reputation where manufacturers market to small firms: A customer value perspective. *Industrial Marketing Management*, *36*(2), 230–240. doi:10.1016/j.indmarman.2005.08.013

Cronin, J., Brady, M. K., & Hult, G. T. M. (2000). Assessing the effects of quality, value, and customer satisfaction on consumer behavioral intentions in service environments. *Journal of Retailing, 76*(2), 193–218.

Dominici, G., & Guzzo, R. (2010). Customer satisfaction in the hotel industry: A case study from Sicily. *International Journal of Marketing Studies*, *2*(2), 3–12.

Dowlatshahi, S. (2010). A cost-benefit analysis for the design and implementation of reverse logistics systems: Case studies approach. *International Journal of Production Research*, *48*(5), 1361–1380. doi:10.1080/00207540802552642

Fagundes, L. D., Amorim, E. S., & Da Silva Lima, R. (2017). Action research in reverse logistics for end-of-life tire recycling. *Systemic Practice and Action Research*, *30*(5), 553–568. doi:10.100711213-016-9408-1

Fleischmann, M., Bloemhof-Ruwaard, J. M., Dekker, R., Van, L., Van, N., & Van, W. (1997). Quantitative models for reverse logistics: A review. *European Journal of Operational Research*, *103*(1), 1–17. doi:10.1016/S0377-2217(97)00230-0

Forozia, A., Zadeh, M. S., & Gilani, M. H. (2013). Customer satisfaction in hospitality industry: Middle East tourists at 3-star hotels in Malaysia. *Research Journal of Applied Sciences, Engineering, and Technology*, *5*(17), 4329–4335. doi:10.19026/rjaset.5.4425

French, M. L. (2008). Improving sustainability through effective reuse of product returns: Minimizing waste in a batch blending process environment. *Journal of Cleaner Production*, *16*(15), 1679–1687. doi:10.1016/j.jclepro.2008.01.006

Gabay, G., Moskowitz, H. R., Beckley, J., & Ashman, H. (2009). Consumer centered "brand value" of foods: Drivers and segmentation. *Journal of Product and Brand Management*, *18*(1), 4–16. doi:10.1108/10610420910933326

Gehin, A., Zwolinski, P., & Brissaud, D. (2008). A tool to implement sustainable end-of-life strategies in the product development phase. *Journal of Cleaner Production*, *16*(5), 566–576. doi:10.1016/j.jclepro.2007.02.012

Gonzalez-Torre, P. L., Adenso-Diaz, B., & Artiba, H. (2004). Environmental and reverse logistics policies in European bottling and packaging firms. *International Journal of Production Economics*, *88*(1), 95–104. doi:10.1016/S0925-5273(03)00181-6

Govindan, K., & Bouzon, M. (2018). From a literature review to a multi-perspective framework for reverse logistics barriers and drivers. *Journal of Cleaner Production*, *187*, 319–327. doi:10.1016/j.jclepro.2018.03.040

Guide, V. D. R. Jr, Jayaraman, V., Srivastava, R., & Benton, W. C. (2000). Supply-chain management for recoverable manufacturing systems. *Interfaces*, *30*(3), 125–142. doi:10.1287/inte.30.3.125.11656

Han, H., & Ponce-Cueto, E. (2016). Formalization of reverse logistics programs: A theoretical framework. *Brazilian Journal of Operations & Production Management*, *13*(2), 160–172. doi:10.14488/BJOPM.2016.v13.n2.a3

Ioannou, M., & Rusu, O. (2012). Consumer-based brand equity: a cross-cultural perspective. *Journal of Promotion Management*, *18*(3), 344–360. doi:10.1080/10496491.2012.696462

Jack, E. P., Powers, T. L., & Skinner, L. (2010). Reverse logistics capabilities: Antecedents and cost savings. *International Journal of Physical Distribution & Logistics Management*, *40*(3), 228–246. doi:10.1108/09600031011035100

Jayaraman, V., & Luo, Y. (2007). Creating competitive advantages through new value creation: A reverse logistics perspective. *The Academy of Management Perspectives*, *21*(2), 56–73. doi:10.5465/amp.2007.25356512

Jiang, H., & Zhnag, Y. (2016). An investigation of service quality, customer satisfaction and loyalty in China's airline market. *Journal of Air Transport Management*, *57*, 80–103. doi:10.1016/j.jairtraman.2016.07.008

Joung, H., Choi, E., & Wang, E. (2016). Effects of perceived quality and perceived value of campus foodservice on customer satisfaction: Moderating role of gender. *Journal of Quality Assurance in Hospitality & Tourism*, *17*(2), 101–113. doi:10.1080/1528008X.2015.1042620

Kannan, G., Pokharel, S., & Kumar, P. S. (2009). A hybrid approach using ISM and fuzzy TOPSIS for the selection of reverse logistics provider. *Resources, Conservation, and Recycling*, *54*(1), 28–36. doi:10.1016/j.resconrec.2009.06.004

Keller, K. L. (1993). Conceptualizing, measuring, and managing customer-based brand equity. *Journal of Marketing*, *57*(1), 1–22. doi:10.1177/002224299305700101

Keller, K. L. (2008). *Strategic brand management: Building, measuring, and managing brand equity*. Upper Saddle River, NJ: Pearson Prentice-Hall.

Keller, K. L. (2009). Building strong brands in a modern marketing communications environment. *Journal of Marketing Communications*, *15*(2–3), 139–155. doi:10.1080/13527260902757530

Kenne, J. P., Dejax, P., & Gharbi, A. (2012). Production planning of a hybrid manufacturing–remanufacturing system under uncertainty within a closed-loop supply chain. *International Journal of Production Economics*, *135*(1), 81–93. doi:10.1016/j.ijpe.2010.10.026

Khor, K. S., Udin, Z. M., Ramayah, T., & Hazen, B. T. (2016). Reverse logistics in Malaysia: The contingent role of institutional pressure. *International Journal of Production Economics*, *175*, 96–108. doi:10.1016/j.ijpe.2016.01.020

Kotler, P., & Keller, K. L. (2009). *Marketing management, New Jersey*. Upper Saddle River, NJ: Pearson Education.

Kwun, D. J. W. (2011). Effects of campus foodservice attributes on perceived value, satisfaction, and consumer attitude: A gender-difference approach. *International Journal of Hospitality Management*, *30*(2), 252–261. doi:10.1016/j.ijhm.2010.09.001

Lai, F., Griffin, M., & Babin, B. J. (2009). How quality, value, image, and satisfaction create loyalty at a Chinese telecom. *Journal of Business Research*, *62*(10), 980–986. doi:10.1016/j.jbusres.2008.10.015

Lai, K., Wu, S. J., & Wong, C. W. Y. (2013). Did reverse logistics practices hit the triple bottom line of Chinese manufacturers? *International Journal of Production Economics*, *146*(1), 106–117. doi:10.1016/j.ijpe.2013.03.005

Lam, S. Y., Shankar, V., & Murthy, E. M. K. B. (2004). Customer value, satisfaction, loyalty, and switching costs: An illustration from a business-to-business service context. *Journal of the Academy of Marketing Science*, *32*(3), 293–311. doi:10.1177/0092070304263330

Lau, K., & Wang, Y. (2009). Reverse logistics in the electronic industry of China: A case study, Supply Chain Management. *International Journal (Toronto, Ont.)*, *14*, 447–465.

Lee, C., & Lam, L. (2012). Managing reverse logistics to enhance sustainability of industrial marketing. *Industrial Marketing Management*, *41*(4), 589–598. doi:10.1016/j.indmarman.2012.04.006

Lee, C. K. M., & Chan, T. M. (2009). Development of RFID-based reverse logistics system. *Expert Systems with Applications*, *36*(5), 9299–9307. doi:10.1016/j.eswa.2008.12.002

Lee, S. M., Lee, D., & Kang, C. Y. (2012). The impact of high-performance work systems in the health-care industry: Employee reactions, service quality, customer satisfaction, and customer loyalty. *Service Industries Journal*, *32*(1), 17–36. doi:10.1080/02642069.2010.545397

Li, Y., Xu, L., & Li, D. (2013). Examining relationships between the return policy, product quality, and pricing strategy in online direct selling. *International Journal of Production Economics*, *144*(2), 451–460. doi:10.1016/j.ijpe.2013.03.013

Lu, Z., & Bostel, N. (2007). A facility location model for logistics systems including reverse flows: The case of remanufacturing activities. *Computers & Operations Research*, *34*(2), 299–323. doi:10.1016/j.cor.2005.03.002

Martin, J. C., Roman, C., & Espino, R. (2011). Evaluating frequent flyer programs from the air passengers' perspective. *Journal of Air Transport Management*, *17*(6), 364–368. doi:10.1016/j.jairtraman.2011.02.008

Matsumoto, M. (2010). Development of a simulation model for reuse businesses and case studies in Japan. *Journal of Cleaner Production*, *18*(13), 1284–1299. doi:10.1016/j.jclepro.2010.04.008

Mikulic, J., & Prebezac, D. (2011). What drives passenger loyalty to traditional and lowcost airlines? A formative partial least squares approach. *Journal of Air Transport Management*, *17*(4), 237–240. doi:10.1016/j.jairtraman.2010.09.005

Miles, M. P., & Covin, J. C. (2000). Environmental marketing: A source of reputational, competitive, and financial advantage. *Journal of Business Ethics*, *23*(3), 299–311. doi:10.1023/A:1006214509281

Mimouni, F., Abouabdellah, A., & Mharzi, H. (2015). Study of the reverse logistics' break-even in a direct supply chain. *International Review on Modelling and Simulations*, *8*(2), 277–283. doi:10.15866/iremos.v8i2.4901

Mukhopadhyay, S. K., & Setoputro, R. (2004). Reverse logistics in e-business: Optimal price and return policy. *International Journal of Physical Distribution & Logistics Management*, *34*(1), 70–89. doi:10.1108/09600030410515691

Nardi, L., Silva, R., Ribeiro, E., Valle, S., & Oliveira, W. (2017). Proposal for a methodology to monitor sustainability in the production of soft drinks in ref PET. *Journal of Cleaner Production*, *151*, 218–234. doi:10.1016/j.jclepro.2017.02.181

Ostlin, J., Sundin, E., & Bjoerkman, M. (2009). Product life-cycle implications for remanufacturing strategies. *Journal of Cleaner Production*, *17*(11), 999–1009. doi:10.1016/j.jclepro.2009.02.021

Poppa, B., & Woratschek, H. (2017). Consumers' relationships with brands and brand communities' roles of identification and satisfaction. *Journal of Retailing and Consumer Services*, *35*, 46–56. doi:10.1016/j.jretconser.2016.11.006

Prajapati, H., Kant, R., & Shankar, R. (2019). Bequeath life to death: State-of-art review on reverse logistics. *Journal of Cleaner Production*, *211*, 503–520. doi:10.1016/j.jclepro.2018.11.187

Ravi, V. (2012). Evaluating overall quality of recycling of e-waste from end-of-life computers. *Journal of Cleaner Production*, *20*(1), 145–151. doi:10.1016/j.jclepro.2011.08.003

Robotis, A., Bhattacharya, S., & Van Wassenhove, L. (2005). The effect of remanufacturing on procurement decisions for resellers in secondary markets. *European Journal of Operational Research*, *163*(3), 688–705. doi:10.1016/j.ejor.2004.01.013

Rogers, D. S., Rogers, Z. S., & Lembke, R. (2010). Creating value through product stewardship and take-back. *Sustainability Accounting*, *Management, and Policy Journal*, *1*(2), 133–160.

Rogers, D. S., & Tibben-Lembke, R. (1999). *Going backwards: Reverse logistics trends and practices*. Pittsburgh, PA: Reverse Logistics Executive Council.

Rogers, D. S., & Tibben-Lembke, R. (2001). An examination of reverse logistics practices. *Journal of Business Logistics*, *22*(2), 129–148. doi:10.1002/j.2158-1592.2001.tb00007.x

Ross, S. D., James, J. D., & Vargas, P. (2006). Development of a scale to measure team brand associations in professional sport. *Journal of Sport Management*, *20*(2), 260–279. doi:10.1123/jsm.20.2.260

Saavedra, Y. M., Barquet, A. P., Rozenfeld, H., Forcellini, F. A., & Ometto, A. R. (2013). Remanufacturing in Brazil: Case studies on the automotive sector. *Journal of Cleaner Production*, *53*, 267–276. doi:10.1016/j.jclepro.2013.03.038

Santini, F. D. O., Ladeira, W. J., & Sampaio, C. H. (2018). The role of satisfaction in fashion marketing: A meta-analysis. *Journal of Global Fashion Marketing*, *9*(4), 1–17. doi:10.1080/20932685.2018.1503556

Srivastava, S. K., & Srivastava, R. (2006). Managing product returns for reverse logistics. *International Journal of Physical Distribution & Logistics Management*, *36*(7), 524–546. doi:10.1108/09600030610684962

Szymanskı, D. M., & Henard, D. H. (2001). Customer satisfaction: A meth-analysis of the empirical evidence. *Journal of the Academy of Marketing Science*, *29*(1), 16–35. doi:10.1177/0092070301291002

Weeks, K., Gao, H. M., Alidaeec, B., & Rana, D. S. (2010). An empirical study of impacts of production mix, product route efficiencies on operations performance and profitability: A reverse logistics approach. *International Journal of Production Research*, *48*(4), 1087–1104. doi:10.1080/00207540802566428

Xu, X., & Gursoy, D. (2015). Influence of sustainable hospitality supply chain management on customers' attitudes and behaviors. *International Journal of Hospitality Management*, *49*, 105–116. doi:10.1016/j.ijhm.2015.06.003

Yeo, G. T., Thai, V. V., & Roh, S. Y. (2015). An analysis of port service quality and customer satisfaction: The case of Korean container ports. *The Asian Journal of Shipping and Logistics*, *31*(4), 437–447. doi:10.1016/j.ajsl.2016.01.002

Yoo, B., & Donthu, N. (2001). Developing and validating a multidimensional consumer-based brand equity scale. *Journal of Business Research*, *52*(1), 1–14. doi:10.1016/S0148-2963(99)00098-3

Yoo, B., Donthu, N., & Lee, S. (2000). An examination of selected marketing mix elements and brand equity. *Journal of the Academy of Marketing Science*, *28*(2), 195–211. doi:10.1177/0092070300282002

Yu, C. J., Wu, L., Chiao, Y., & Tai, H. (2005). Perceived quality, customer satisfaction, and customer loyalty: The case of Lexus in Taiwan. *Total Quality Management & Business Excellence*, *16*(6), 707–719. doi:10.1080/14783360500077393

Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of Marketing*, *60*(2), 31–46. doi:10.2307/1251929

Zhu, Q. H., Geng, Y., & Lai, K. H. (2010). Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications. *Journal of Environmental Management*, *91*(6), 1324–1331. doi:10.1016/j.jenvman.2010.02.013 PMID:20223586

Chapter 22
Supply Chain Management in Health Institutions

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ABSTRACT

Today's innovative systems and approaches handle the supply chain function in the healthcare institutions in a broader way even though it is generally accepted as the material management. The supply in the hospitals is a comprehensive issue that covers regular material supply, the quality and the speed of services and maintenance process. As in the other sectors, the healthcare sector wants to get the required goods and services in the places where they are needed, when they are needed, with the desired quality and price. Besides, hospitals try to produce low-cost services because of today's competition conditions and increasing number of private hospitals. Today's supply chain management is carried out to decrease the costs, reduce the lean, and increase the quality.

INTRODUCTION

The aim of this study is to analyse the effects of supply chain factors, the integration of supply chain, demand forecasting and the effects of supplier performance on the elasticity of supply chain and all of these factors on the ability of official health institutions and the supplier of medical equipment to meet the customers' needs. Within this scope, supply chain risk factors, the integration of supply chain, supplier performance, demand forecasting, supply chain elasticity and the ability to meet the needs of customers are studied.

The concept of supply chain management, put forward by Oliver and Weber in 1982, is based on the handling every part of system as a whole and managing them in an integrated way. Material, information and finance flows between institutions are required to be realized effectively.

There are different definitions regarding the supply chain management. However, the key points which these definitions dwell on are; all partners have responsibility during the process of supplying goods/services to the customers, the flows of material, finance, information and services realize bi-directionally and the supply activities realize internal and external-based.

DOI: 10.4018/978-1-7998-1397-2.ch022

Hospitals, an important part of the healthcare sector, try to supply materials and services when they are needed, where they are needed, at desired quality and price in order to carry out their activities as in the other sectors. In addition, hospitals develop new methods to provide services with low prices without sacrificing patient care standards. Today, healthcare sector gives more weight to the supply chain management in order to reduce the costs, decrease the lean, prevent medical errors and increase the quality of services. In Turkey, the healthcare sector grows in parallel with the increase in accessibility to healthcare services and purchasing power, and taking supportive steps towards the sector. Taking sub-sectors such as medicine, provided services, insurance and medical materials into consideration, Turkey has come to an important position around the world. With the Health Transformation Program, started at the beginning of 2000s, it is aimed to improve the entire healthcare system. Within this framework, it is aimed to use effectively and efficiently the available resources and increase the success rate of provided services. Therefore, it is predicted that an important cost advantage can be taken with the increase in the provided services and using resources efficiently without lean.

THE CONCEPT OF SUPPLY

In dictionaries, it can be seen that supply is defined as; supply means a stock or amount of something available for use and providing something, goods or services with someone (Oxford Dictionaries, 2013). It is defined as “process of providing something that is wanted or needed” and “providing an amount of goods or services for a fee ((http://dictionary.cambridge.org).

It is making means and potentials, which is required to achieve management, goals ready for use by providing those (Baltacıoğlu et al., 2007). The concept of supply includes the supplying and activities of raw material, material, machinery and equipment or final products, which institutions need (Seyidoğlu, 2002).

Supply Function

Supply function finds answers these questions; which one of the raw material, material and machinery equipment that are necessary for product to be produced is provided out of the business, how are these inputs stored, how are they transported to the production sites, what are the distribution channels of final products and how are they transported to the market and how are the demands for goods to be supplied are used (Johnson et al., 2011).

As seen in the definition, supply function covers these fields: determination of material needs, the development of specification, material standardization, the determination of quality requirements, the determination of price and agreement conditions, the determination of proper time, the determination of purchasing policies, the determination of proper supply sources and choice of supplier, mutual problem solving with suppliers, supplier monitoring and analysis, communication during specification changes, improvement of efficiency and cost, the development strategies of supply source, market analyses (Hugos, 2011).

The strategical aspect of supply function is related to the activities that bring the business in competition advantage. While the operational aspect of supply carries the current duties, the strategical aspect seeks to answers how the supply function of business is made more effective and efficient (Johnson et al., 2011). In order for an effective supply function, it is important to carry out these elements (Timur

& Çekerol, 2013): searching for suppliers that put low prices and making price agreements, following closely the price changes in the market and the competition condition between the suppliers, finding methods to minimize the keeping in stock costs, search for the most proper transport channels.

While the success of supply function provides big advantages to businesses, not managing successfully the supply function brings extra costs. Every organization, either the manufacturer of goods/services or businesslike wholesaler or retailer, purchases goods and services from other organizations in order to continue its activities. It can be said that purchasing activities were accepted as they did not have any strategical importance and it was such an easy activity that even un-qualified people could do it in past. After the World War II, purchasing function started to gain an administrative nature when it was understood that maintaining the continuity of raw material and material supply was crucial for the success of production. Material shortages and high-rated price movements that started in 1970s also leaded the manufacturers to focus on purchasing functions (Nebol et al., 2013).

Supply Chain

Supply chain covers these processes; providing needed raw materials and materials with the most proper costs and conditions, supporting manufacturing activities to gain effective manufacturing processes and finally supplying the goods to final customers with desired conditions (Görçün, 2013). There are many definitions regarding supply chain in the literature. One of the most important reason for this is that the number of studies on supply chain has increased day by day. Although these definitions differentiate at some points, they focus upon similar issues. Some of the supply chain definitions in the literature can be listed as follows.

Supply chain is a supply and distribution activity, which consists of the supply of goods, services, financial activities and information from their sources to the final customers and is carried out by a group of enterprise, (Mentzer et al., 2001). According to Chopra and Meindl, supply chain represents a structure in which manufacturers, suppliers, transporting companies, storehouses, retailers and customers directly or indirectly participate during the process of fulfilling a customer demand (Chopra & Meindl, 2007).

In the dictionary of APICS (American Production and Inventory Control Society), supply chain is defined as “a network used to deliver goods or services by regulating the information flow, physical flow and cash flow, from the purchasing the goods to its transportation to the final customer” (APICS Sözlük, 2013). Aykaç and Bayraktar (2007) define the supply chain as “the integrated chains and successive processes, which constitute of the supply, production, distribution chains of raw materials, and the transporting chains of goods, which are produced by uniting them, to the final customers”.

Businesses, corresponding with the supply chain, can be more successful than their competitors in terms of product, process or services. In the past, businesses were used to focus on internal factors such as manufacturing, selling and finance, and push external factors into the background when they tried to determine their strategies. Today, it is understood that the ability of companies to correspond with their external environment by analysing plays a significant role in accessing to the physical sources and market power (Timur & Çekerol, 2013). In addition, businesses benefit from external system, with which they associate much more in order to improve their business processes and increase the efficiency due to the growing international competition.

According to the concept of supply chain, it can be said that businesses do not manage the processes of production and distribution of goods and services on their own (Dudek, 2009). This shows that competition and success of a product in the market do not depend on not only one business but also an entire supple chain (Stadtler & Kilger, 2005). Therefore, supply chain become a business union, which has common goals and aims to gain a competitive advantage by uniting their strengths (Christopher & Peck, 2004). Although the supply chain activities most of which are carried out jointly, are not legally binding on the members of chain, it leads to create a union, which economically binds companies with each other (Stadtler & Kilger, 2005).

Integrated supply chain strategy states that businesses should act jointly with every member of chain in order to create a value for their customers (Vickery et al., 2003). Supply chain carries out activities from a holistic perspective and includes several functions and systems within itself. Several business in the supply chain have to act jointly to get raw material, turn raw materials into final product and distribute them to retailers. This point of view argues that supply chain should not be handled as a structure, which consists of units or sub-systems, independent of each other, but rather a holistic structure (Beamon, 1999). This requires integration of evert activity which is carried out throughout the supply chain. Integrated supply chain strategy states that business should act jointly with every member of chain in order to create a value for its customers. It is necessary to deal with the supply chain as a strategy in order to reach an integrated structure (Alfalla-Luque et al., 2014).

While creating the supply chain, administrators/managers should make various analyses. Hence, they should consider factors, such as the transport cost of the products to the final customers and demand forecasting, the efficiency of supply chain and customer satisfaction. However, it is hard to follow one method for all of them because every supply chain is different from each other. In fact, businesses have recently started to make direct contact with the customers and reduced the stages of supply chain in contrast to their conventional being. Due to their short supply chain, businesses think that costs can be reduced and products can be transported more quickly. This is generally realized by reducing the number of intermediary companies. Hence, it is preferred to rather shorter supply chains while creating a supply chain (Christopher, 2011).

Members of Supply Chain

In this chapter, supplier, manufacturer/producer, distributor, retailer and customer stages are analysed within a general supply chain.

Manufacturer/Producer: Manufacturer or producer are businesses, which manufacture/produce goods and services. Raw material and final product manufacturers can be analysed within this scope. Manufacturers can produce concrete goods and services as well as abstract goods and services. Health institutions, software companies, designers, cleaning companies, training services can be exemplified as the abstract manufacturers/producers (Hugos, 2011).

Distributors: Distributors are the closest member of supply chain to the customers after retailers and dealers. They have opportunity to access many information regarding the customers because of the close relation with retailers and dealers. Hence, distributors are one of the members of supply chain, which properly understands the customer demands and affects the decision-making processes of manufacturers/producers (Görçün, 2013).

Retailers: Retailers can directly access to the information regarding customer demands, complaints and satisfactions because they personally deal with the customers during the selling of final products. Hence, retailers can detect risks and opportunities around them rather than other members of supply chain and answer them much quicker (Fredendall & Hill, 2001).

Customers: Due to the fact that the most important goal of supply chain is meeting the needs of customers, the customer satisfaction is seen as a primary goal within the supply chain. The needs and desires of customers, one of the important circle of supply chain, are always followed. For retailers and other participants within the supply chain, customer perceptions, expectations and complaints are seen as the most important factors that affect the demand (Timur & Çekerol, 2013).

Service Providers: This kind of companies provides various services to manufacturers, distributors, retailers and customers, all of which are the members of supply chain. Service providers have the background information regarding the activities that are needed within the supply chain and give special expertise support to other members. Because they have more knowledge level and can carry out duties better than the businesses, which are in need, they carry out the wanted activities with more success and lower cost than the business does with their own means (Fabbe-Coster et al., 2011).

SUPPLY CHAIN MANAGEMENT

At the late 1980s, rapid change in the industry and competition between businesses started to the transformation from the understanding of conventional logistic management to the practices of supply chain management. Fierce competition, which existed during that time, leaded the businesses, active around the world, to increase the customer satisfaction by presenting products with design flexibility, low-priced, high-quality and reliability. Supply chain management has emerged as a concept, which meets these needs of manufacturers/producers and suppliers in order to achieve this aim within a strategical cooperation. Oliver and Weber, who firstly mentioned Supply Chain Management in their study in 1982, states that the difference of supply chain from the system of conventional production control is that it is handled with a holistic approach rather than divided systems and the information system, which provide the integration is used (Stadtler & Kilger, 2005). Since the emergence of this understanding, several techniques and strategies have been developed. The effective flows of material, information and finance between institutions are generally focused (Kersten et al., 2007). Even though the concept of supply chain management was put forward at the beginning of 1980s, it became widespread at the beginning of 1990s.

Complexation of developing product and manufacturing systems that only one company could not overcome, the increase in the economic value of products which companies provide to their customers and understanding that they could not manage the cost-reducing efforts are among the reasons for which the approach of supply chain management was intensely handled in 1990s (Janver-James, 2012). There are several definitions regarding the supply chain management in the literature. One of the reasons why there are several and different definitions regarding the supply chain management is that the academicians and experts have different point of views and approaches about this concept. Supply chain management is the integration of all main business processes (Wisner et al., 2012). Supply chain management is “the proper and efficient management of products that are on-the-go from the suppliers to the last customers”. It is the designation and management activities of supply chain processes in order to meet the last customers’ needs (Ayers, 2006). Supply chain management is a holistic approach in the management of distribution channel flow from the suppliers to the last customers (Cooper et al., 1997).

It can be said that supply chain management definitions abovementioned have focused on four main points. The first one is that supply chain management covers every stakeholder that participates in the production of goods or services in the supply chain. The second one is the realization of proper material and information flows from the supplier at the beginning to the businesses that would produce the final goods or services, and to the final customers. The third one is the bidirectional flows of material, finance, information and services within the supply chain. The last one is that stakeholders in the supply chain carry out their activities in an integrated way.

HEALTHCARE SUPPLY CHAIN MANAGEMENT

Studies around the world have shown that the budget of healthcare services are limited. In addition, it is observed that sources, which are necessary for important treatments, are leaned because of the inefficient supply chain management. Consequently, institutions that provide healthcare services are in a struggle for improving the business processes and decreasing the costs. Health institutions' having extensive budget and realizing supply chain management in a more efficient way lead them to focus on healthcare services, which they provide to patients, as well as possible financial profits (Hersch & Pettigrew, 2002).

Healthcare supply chain management is defined as a complex system, the flow of the goods and services at desired conditions to the institutions that provide services to patients (Schneller & Smeltzer, 2006). Healthcare supply chain management consists of institutions or units that participate directly or indirectly in meeting the patient demand. It consists of internal chain members (medical units, hospital storage, patients etc.) and external chain members (manufacturers/producers, distributors, pharmaceutical warehouses etc.) (Rivard-Royer et al., 2002).

Healthcare supply chain management refers to the flows of information, money and goods/services. During this process, there are the flows of physical goods, information and finance. Physical product flow manages the flow of personal goods and services in order for the treatment. Information and finance flows are related to the supply chain decisions such as developed organizational performance (Kowalski, 2009). Institutions within the supply chain can be divided into four main groups: Manufacturers/producers, buyers, health institutions and patients. Among manufacturers/producers, there are operation material, medical devices and pharmaceutical manufacturers. Distributors or wholesalers keep the goods produced by the manufacturers in order to distribute. Health institutions cover hospitals, private clinics and pharmacies. Apart from these institutions, public institutions or insurance companies also participate in the supply chain (Burns, 2002).

Health institutions operate as both a supplier and a customer. Health institutions are considered as customers for the manufacturers and suppliers by realizing the flows of material and information throughout the supply chain (Dobrzykowsk & Vonderembse, 2009). Products are delivered from the manufacturers to the distributors or third-party logistical service providers and their flows from the retailers to hospital storages and finally health professionals and patients are realized (Jacobs & Chase, 2010). After the production, directly manufacturers (orthopaedic implants) or indirectly distributors (compression bandages) deliver products to the hospitals (Burns, 2002). Mustaffa and Potter (2009) states that supply chain of healthcare sector consists of manufacturers, distributors, wholesalers and health institutions.

Manufactures are divided into two categories as primary and secondary manufacturers. Primary manufacturers are companies that produce the active ingredients of the medicine. Primary manufacturers act as suppliers for the secondary manufacturers. After providing active ingredients of medicine from the primary manufacturers, secondary manufacturers make these ingredients usable products like capsules or tablets. Manufacturers make decisions regarding the production by taking into consideration medication prices, demand forecasting and competition (Kritchanchai, 2012).

Healthcare supply chain management have structure in which several different materials are provided from providers that have different features. Products of healthcare sector vary from compression bandages to advanced medical devices. How the products move throughout the chain is determined by the frequency of occurrence and prices (Smith, 2011).

In summary, it can be enabled to decrease costs, increase the efficiency, patient safety and satisfaction with hospital supply chain management by reaching an advanced point of views from simple one, such as storage of necessary products. Arkansas University "*The Centre for Innovation in Healthcare Logistics*" (CIHL) carried out a comprehensive questionnaire in order to determine the current situation of the implementers of healthcare supply chain management and healthcare supply chain management in 2008. The questionnaire, published on the internet, was filled out by 1381 personnel of healthcare supply chain. The study puts forward several features of healthcare supply chain (Nachtmann & Pohl, 2008). These are the expensiveness, limited information and activities, the lack of qualified personnel, not implementing the supply chain management and the strategical structure of the healthcare sector.

The department, which enables to manage efficiently the supply activity, is the supply management or material management department in the hospitals. The department of supply chain carries out duties such as purchasing, distribution and the control of inventory (Burns, 2002). Except from patients, physicians, nurses and other final consumers of the products are referred as internal customers. These customers participate in the activities of supply chain management like products selection, supply management, which are carried out daily (Schneller & Smeltzer, 2006).

CONCLUSION

The supply chain is the supply and distribution activity, carried out by a group of enterprise, which consists of the transportation process of goods, services, financial activities and information from the sources to the final customers (Mentzer et al., 2001). According to the concept of supply chain, it is understood that businesses do not manage the production and distribution of goods and services on their own (Dudek, 2009). This shows that the competitiveness of a product in the market depends not only one business but also the supply chain as a whole (Stadtler & Kilger, 2005). Therefore, the supply chain become a union for businesses, which have mutual goals and aim to get a competitive advantage by uniting their strengths (Christopher, 2011). The analysis of both health institutions and institutions that provide goods and services with them is thought as important in terms of revealing the situation of supply partners. In the literature of supply chain management, empirical researches have analysed the upwards or downwards of the supply chain. The number of the studies that has analysed both of them is limited. It is thought that this study contributes to the healthcare supply chain literature, which has limited studies and institutions in the sector in many ways.

The effort of only one company for the customer satisfaction is not enough. This can only be possible with the integration of all supply chain partners. The integration of supply chain increases the elasticity of supply chain and, consequently, the customer satisfaction. Jack and Raturi (2002) states that the integration and the elasticity of supply chain are related closely. Fawcett et al. (2008) claim that the increase in the ability to meet the needs of customers, customer satisfaction, decrease in the costs of purchasing and improvement of the ability to answer unexpected situations are among the benefits of the integration of supply chain.

Within the light of the findings in the study, health institutions and supplier companies in the healthcare supply chain should manage the demand forecasting process and activities with the suppliers in a conformable way and evaluate continuously the supplier performance in order to carry out their activities in a successful way and provide customer (patient) satisfaction. Therefore, the desired elasticity and, finally, the customer satisfaction can be provided in the structure of healthcare system in which the ambiguity is dominant.

REFERENCES

Alfalla-Luque, R., Marin-Garcia, J. A., & Medina-Lopez, C. (2014). An analysis of the direct and mediated effects of employee commitment and supply chain integration on organisational performance. *International Journal of Production Economics*.

American Production and Inventory Control Society. (2013). *APICS Dictionary (14. Bs.)*. Chicago, IL: APICS.

Ayers, J. B. (2006). *Handbook of supply chain management*. Florida: Auerbach Publications.

Aykaç, S. Ö., & Bayraktar, D. (2007). Proposing Snell's Law approach for service-level requirements in supply chain management. In D. Bayraktar, F. Çebi, & B. Bolat (Eds.), *Sıtkı Gözlü'ye armağanı* (pp. 37–48). Istanbul, Turkey: Çağlayan Basımevi.

Baltacioglu, T., Ada, E., Kaplan, M. D., Yurt, O., & Kaplan, Y. C. (2007). A new framework for service supply chains. *Service Industries Journal*, *27*(2), 105–124. doi:10.1080/02642060601122629

Beamon, B. M. (1999). Measuring supply chain performance. *International Journal of Operations & Production Management*, *19*(3), 275–292. doi:10.1108/01443579910249714

Burns, L. R. (2002). *The healthcare value chain: producers, purchasers, and providers*. San Francisco, CA: Jossey Bass, A Wiley Company Print.

Chopra, S., & Meindl, P. (2007). *Supply chain management strategy, planning, and operation*. New Jersey: Pearson Education. doi:10.1007/978-3-8349-9320-5_22

Christopher, M. (2011). *Logistics and supply chain management: Creating value adding networks*. London, UK: Pearson Education Limited.

Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *International Journal of Logistics Management*, *15*(2), 1–14. doi:10.1108/09574090410700275

Cooper, M. C., Lambert, D. M., & Pagh, J. D. (1997). Supply chain management: More than a new name for logistics. *International Journal of Logistics Management*, *8*(1), 1–14. doi:10.1108/09574099710805556

Dobrzykowski, D. D., & Vonderembse, M. A. (2009). Healthcare supply chain and IS strategies for improved outcomes In *Proceedings of Production and Operations Management Society 20th Annual Conference*, Florida.

Dudek, G. (2009). *Collaborative planning in supply chains: A negotiation-based approach*. Heidelberg, Germany: Springer Dordrecht.

Fabbe-Costes, N., Jahre, M., & Roussat, C. (2008). Supply chain integration: the role of logistics service providers. *International Journal of Productivity and Performance Management*, *58*(1), 71–91. doi:10.1108/17410400910921092

Fawcett, S. E., Magnan, G., & M. ve McCarter, M. W. (2008). Benefits, barriers and bridges to effective supply chain management. *Supply Chain Management*, *13*(1), 35–48. doi:10.1108/13598540810850300

Fredendall, L. D., & Hill, E. (2001). *Basics of supply chain management*. Boca Raton, FL: CRC Press.

Görçün, Ö. F. (2013). *Örnek Olay ve Uygulamalarla Tedarik Zinciri Yönetimi*. İstanbul, Turkey: Beta Basım A. Ş.

Hersch, G., & Pettigrew, P. (2002). Reenergizing the supply chain. *SSM*, *8*(6), 41–47.

Hugos, M. (2011). *Essentials of supply chain management*. Hoboken, NJ: John Wiley & Sons. doi:10.1002/9781118386408

Jack, E. P., & Raturi, A. (2002). Sources of volume flexibility and their impact on performance. *Journal of Operations Management*, *20*(5), 519–548. doi:10.1016/S0272-6963(01)00079-1

Jacobs, F. R., & Chase, B. (2013). *Operations and supply chain management: The core*. New York: McGraw-Hill/Irwin.

Janvier-James, A. M. (2012). A new introduction to supply chains and supply chain management: definitions and theories perspective. *International Business Research*, *5*(1), 194.

Johnson, P. F., Leenders, M., & Flynn, A. (2011). *Purchasing and supply management*. Columbus: McGraw-Hill.

Kersten, W., Hohrath, P. & Böger, M. (2007). An empirical approach to supply chain risk management: Development of a strategic framework.

Kowalski, J. C. (2009). Needed: A strategic approach to supply chain management. *Healthcare Financial Management*, *63*(6), 90. PMID:19526824

Kritchanchai, D. (2012). A framework for healthcare supply chain improvement in Thailand. *Operations and Supply Chain Management*, *5*(2), 103–113.

Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining supply chain management. *Journal of Business Logistics*, *22*(2), 1–25. doi:10.1002/j.2158-1592.2001.tb00001.x

Mustaffa, N. H., & Potter, A. (2009). Healthcare supply chain management in Malaysia: A case study. *Supply Chain Management*, *14*(3), 234–243. doi:10.1108/13598540910954575

Nachtmann, H. & Pohl, E. A. (2008). The state of healthcare logistics cost and quality improvement opportunities.

Nebol, E., Uslu, T., & Uzel, E. (2013). *Tedarik Zinciri ve Lojistik Yönetimi*. İstanbul, Turkey: Beta Basım A.Ş.

Oliver, R. K., & Weber, M. D. (1982). Supply-chain management: logistics catches up with strategy. In R. K. Oliver, & M. D. Weber (Eds.), *The roots of logistics: a reader of classical contributions to the history and conceptual foundations of the science of logistics* (pp. 183–194). Berlin, Germany: Springer.

Rivard-Royer, H., Landry, S., & Beaulieu, M. (2002). Hybrid stockless: a case study: Lessons for health-care supply chain integration. *International Journal of Operations & Production Management*, *22*(4), 412–424. doi:10.1108/01443570210420412

Schneller, E. S., & Smeltzer, L. R. (2006). Strategic management of the health care supply chain. San Francisco, CA: Jossey-Bass, A Wiley Print.

Seyidoğlu, H. (2002). *Ekonomik Terimler Ansiklopedik Sözlük* (3rd ed.). İstanbul, Turkey: Güzem Can Yayınları.

Smith, B. K. (2011). *An empirical investigation of supply chain excellence in healthcare*. (Unpublished Doctoral Dissertation). University of Arkansas.

Stadtler, H., & Kilger, C. (2005). *Supply chain management and advanced planning: Concepts, models, software, and case studies*. Heidelberg, Germany: Springer Dordrecht.

Svenson, G. (2002). The theoretical foundation of supply chain management: A functionalist theory of marketing. *International Journal of Physical Distribution & Logistics Management*, *32*(2), 734–754. doi:10.1108/09600030210452422

Timur, M. C., & Çekerol, G. S. (2013). *Tedarik Zinciri Yönetimi* (1st ed.). Eskişehir: Anadolu University.

Vickery, S. K., Jayaramb, J., & Dröge, C. (2003). The effects of an integrative supply chain strategy on customer service and financial performance: An analysis of direct versus indirect relationships. *Journal of Operations Management*, *21*(5), 523–539. doi:10.1016/j.jom.2003.02.002

Wisner, J. D., Tan, K., & Leong, G. K. (2012). *Principles of supply chain management*. USA: South-Western.

Chapter 23
A Digital Transformation in International Transport and Logistics:
Blockchain

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ABSTRACT

Firms must deal with the factors that increase performance, which support the delivery of the produced goods at minimal cost and time. In this respect, the advantages of digitization have been studied. The path to international trade in its quest to reduce logistics and supply chain costs cross with Blockchain technology. Blockchain technology isn't only an inter-user money transfer technology, but it also includes all the trade supply chain actors. Thus, a visible "supply chain network" that's directed by blockchain, which holds the record in real time and doesn't change pursuant to the sequence occurs. All actors on the network can access and track the flow and distribution of the transaction across borders. How does blockchain technology improve yield and reduce costs? To find the answer, the application areas of digital technology in trade have been investigated. In international trade, a transaction draft was created and the advantages and disadvantages of blockchain were exposed.

INTRODUCTION

By transportation, we understand transferring cargo and passengers from one place to another in order to achieve certain benefits. The one who provides the transfer and change of place of existing cargo and passengers across time and space using all types of means of transportation provides a technical service. Means of transportation are adjusted according to supply and demand. Transportation systems offer their services using various means of transportation depending on technological advancements.

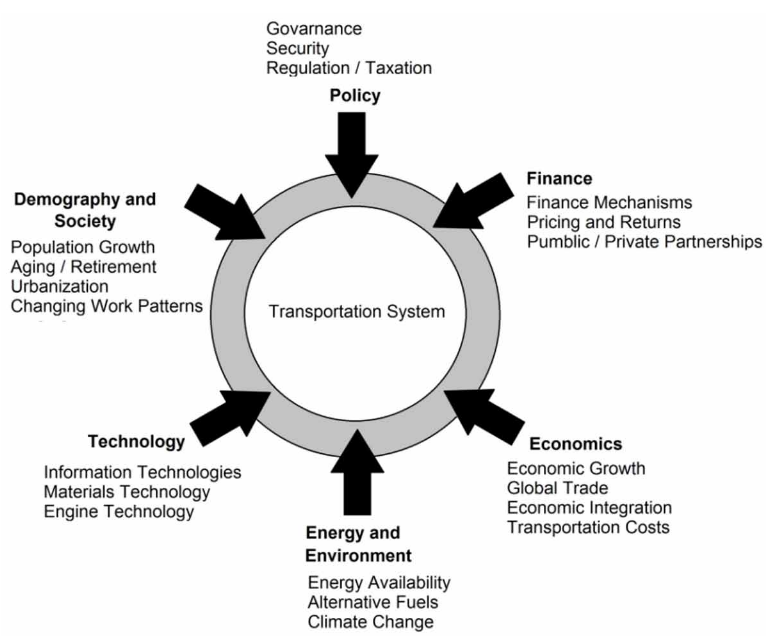
DOI: 10.4018/978-1-7998-1397-2.ch023

The choice of a particular transportation system by a state depends on the said state's resources, technological infrastructure and developments to be used. While choosing the right one it is necessary to approach the effectiveness of transportation systems as a multidimensional matter. By choosing the most effective and innovative system regarding our needs, a transportation service compatible with other systems should be provided (Janiç, 2017).

For centuries one or a few transportation systems were at times more utilised or demanded. The reason behind that is the ease provided by transportation systems to the users. On the other hand, the system in demand shows changes and development influenced by technological developments in provided services, state politics, the structure of population and society, type of energy in use, environment, economic developments and financial resources. Figure 1 shows the change factors of transport systems. Even if seemingly independent, these factors affect one another (Rodrigue et al., 2013). Respectively, international trade changing due to technological and economic developments is prominent among the new factors, which emphasise the effects of the aforementioned ones in recent years.

The Council of Supply Chain Management Professionals (CSCMP) defines logistics management as "that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements" (CSCMP, 2013). Logistics involves the whole of actions of planning, control and management of the stream of goods, services, and capital in which systems of control, communication, and information increasingly needed by the business world play a role. Thereby, logistics gathers together technology, production, service, and transportation. The basic difference between transportation and logistics lies in the fact that while transportation is responsible for transport itself, logistics involves the supply, planning, and cargo of goods which include transportation.

Figure 1. The factors affecting changes in transportation systems. (Adapted from Rodrigue et al., 2013).



Transportation has quickly brought countries together by shrinking the world with the use of technological advancements in the fields of information, microelectronics, and communication. Especially thanks to developments in information and communication technologies, transportation and communication costs have dropped. Natural barriers such as time and space which separated countries, people, and markets have largely disappeared (Artan & Kalaycı 2009; Kalaycı 2013).

International transportation and logistics provide development through international trade, production, and sales. Countries aim at selling their products abroad in order for them to gain more worth. Companies obtain a chance of selling their products for a higher price and buying cheaper goods from foreign markets by engaging in international trade. Thus, enterprises grow due to the difference in price between the product they sell and the product they buy and as a result, the national economy grows as well.

The process of global trade represents the removal by states of barriers to foreign commerce put before the stream of goods and rendering the world one market (Sabır, 2013&Kazgan, 1997). The most important factor affecting the competitiveness of a product on the international market is its cost. It is necessary for companies to assess all possibilities of decreasing product costs without compromising the quality. The price should be at a level allowing competition with other companies (Doğan, 2003).

The information age has affected the production model by replacing the philosophy of "first produce, then stock" with the idea of "first create a demand, and then form a mode of production". Such an approach requires a strengthened product information system. The supply chain should be designed according to various customer needs. In such a structure, the possible advantages regarding the chain of values and the production web will define the winning competitor. In order to achieve a win-win strategy that is an effective one in the global use of resources, it is a must to leave the old approaches to management aside and move on to internet-based business models (Çiçek & Bay, 2017).

Transportation is an operational field of logistics, which provides the movement, and change of geographical location of stocks (Başkol, 2010). It is one of the important expense items considered administratively by companies due to the importance of time management and its visible costs. Therefore, companies need to manage their supply chains with a holistic approach involving all production operations, transportation, and distribution.

The performance of supply chain management is important because it shows the decision-makers the continuously changing conditions. Finding oneself in the process of a dynamic change makes it easier to choose among suitable work and operation options and speeds up the adaptation to changing market conditions. The use of automated programs and intelligent systems in electronic marketplaces has increased the effectiveness of supply chain management (Çiçek & Bay, 2017).

All those technological developments have given a new shape to global economic actors. Technological possibilities and blockchain platforms cooperatively created by companies promise new possibilities and it will be examined in the following chapters.

GLOBAL ECONOMIC DEVELOPMENTS AND DIGITALISATION

Global Economic Developments

In today's global economy, logistic services gain prominence by allowing companies to achieve competitive power. Decreasing of transportation costs gains competitiveness to companies offered logistic services both on domestic and foreign markets. This, in turn, presents an important chance for entrepreneurs (Oda, 2008).

A new period in the global economy has begun. EU countries were affected by the negative results of the global crisis. Countries of the Union did not manage to achieve sustainable economic growth. The differences in employment rates among EU members as well as political fluctuations call into question the future of the Union. At the same time, it is hard to predict the political and economic effects of the stance presented by the USA.

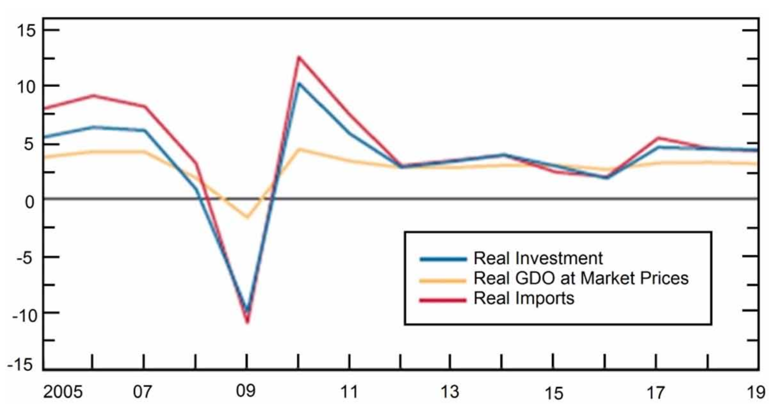
According to the International Monetary Fund's (IMF's) World Economic Outlook 2018, as can be seen in Figure 2, global investments will show a slower decline in 2018 and 2019 as compared to 2017, while a quicker decrease will be observed in trade growth.

In World Economic Outlook 2019 report, it is stated that global growth in the second half of 2018 and the first half of 2019 will show a more rapid decline in emerging markets and developing economies as compared to developed economies. It is predicted, however, that from the second half of 2019 on, developing economies will show a quicker growth. Moreover, the global growth which fell from 3.6 in 2018 to 3.3 in 2019 will recover to 3.6 in 2020 (World Economic Outlook April 2019).

The following regions are currently developing and are predicted to show growth and gain prominence regarding production and logistics: Asia-Pacific, Latin America, Africa-Middle East, and Eastern Europe.

In the same time, technological development is one of the signs of economic development of a country. Successes and high added-value production have provided countries' technologies to speed up their economic developments. While in the past the level of development of a country was measured by the amount of steel and energy produced, nowadays it is measured with the amount of information produced, processed, conveyed, and stored with the use of information technologies.

Figure 2. Global investment and trade. (Adapted from World Economic Outlook October 2018)



Economic policies enforced by countries can have a tremendous impact on their economic development. Especially from the perspective of the sources of economic growth, which itself is one of the most important indicators of economic performance, it is important to be able to generate technological growth, possibly employing country's own means. For this reason, it is important to understand technological development not as acquiring ready technologies but as "information necessary for production", "productive information", and "effective information". A country's progress is largely parallel to technological development and increase of effectiveness connected to it.

The high labour costs in the last 10 years have changed the position of production centres in the world. In addition, the merger of production and technology in the Far East has elevated it as a production hub. The rapid change in technological developments has also brought with it production technologies and industry 4.0. While industry 4.0 is perceived to require less manpower, the demand for educated and tech-savvy workers is rising. The fact that more educated manpower is to be found in the West signals that production centres will again move in this direction.

All terms developed to define and understand this transformation period notwithstanding, it is commonly accepted that technologies such as simulation, artificial intelligence and intelligent systems, sensors, augmented reality, Internet of Things (IoT), robotics and automation, big data analytics, cybersecurity and cloud informatics will play in it a defining role. As for the common point of all these seemingly so different from one another technologies which are to be used in radically different fields, it seems to be the fact that "information" constitutes their inputs and outputs. Therefore, the concepts of "information" and "informatics" are commonly used in describing this period of great change.

Digitalisation

Computer science is concerned mostly with transferring real-world data (information) sources into a digital space. Technological development provides a possibility of transferring information into the computer environment by turning it into digital data as well as conducting operations on such data easily. In return, the digitalisation of a business should be thought of as not only the digitalisation of data or data sources but also as the digitalisation of perception and management (Şeker, 2014).

Business operations of companies, which were previously managed by creating documentation, are now transferred to the digital environment. Thus, companies ensure more effective use of information and better management of problem solving. When a data source (asset) is digitalised, it can be endlessly copied, compared with other data, sent to another corner of the globe or accessed with different technological means in a different medium. In this regard, the digitalisation of production provides the following benefits:

- Perfect copies thanks to digital production
- Decrease in costs due to the storage of data on digital platforms
- Advanced operations on digitalised data such as searching, analysis, correction, and development

Through the digitalisation of information, we can always carry it by us or access it by cloud. Moreover, this information can be shared with the entire world and further developed. This information can be even bought or sold, thereby, creating a value. This exact situation is commented on as the digitalisation of the economy.

Digitalised data has certain special characteristics. Its most prominent features could be listed as follows: digital data is programmable, storable, can be linked, sent, attributed etc. While by means of these traits data can be used in different fields, various applications allow for conducting numerous operations on it and attaching to it new qualities.

The digitalisation of business means transferring all information and resources owned by it into a digital platform and managing them using new possibilities and issues in this new world. The digitalisation of a business could be considered as the digitalisation of work and operations conducted based on the individual experience of a particular company (Şeker, 2014).

Now technology is the strongest supporter of the business world. Digital technologies carry in themselves the potential to spark a revolutionary change in a wide range of production and consumption operations. The digital world presents itself as an opportunity and novelty of unprecedented speed and scale. Opportunities are born out of companies and economies use of digitalisation to create a new combination of physical and digital resources in order to achieve effectiveness and growth (Turkey Science Foundation, TBV, n.d).

There is a strong connection between the use of digital technologies and effectiveness. Digital technology increases the competitive strength of companies in domestic and foreign markets and has a positive effect on the economic development of countries. The spread of digital technologies in economic actions brings a certain increase in effectiveness and gross domestic product.

Digitalisation starts with transforming an unintegrated information technology infrastructure into a digital platform. This continues with the process of converting the sources digitalised in this medium into new revenue, growth, and operational results adding value to the business. In other words, digitalisation allows for the creation of new, more efficient and effective products and services by using new technologies and combining information and data belonging to the business resources in order to create new business models.

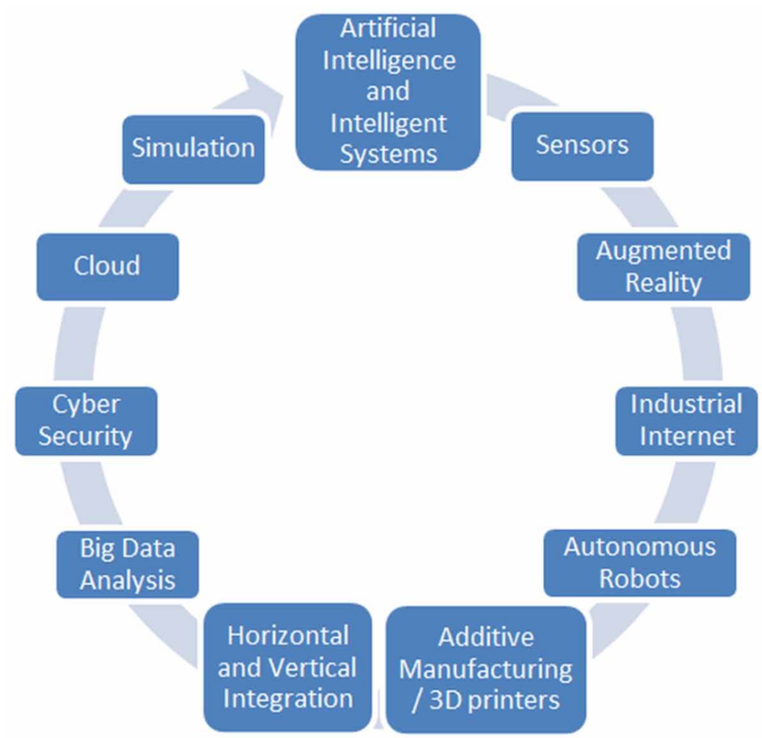
While generally, 9 technologies are used to describe in detail the technologies of digital transformation, Figure 3 below explains this change using 11 technologies (Turkish Industry & Business Association [TUSIAD] 2017a). These technologies are simulation, artificial intelligence and intelligent systems, sensors, augmented reality, industrial internet, autonomous robots, articulated production, horizontal and vertical integration, big data and analysis, cyber security and cloud technology, as shown in Figure 3.

Becoming a digital business means a significant transformation inside and outside the company. In order for businesses to become successful in the digital age, they need to develop certain key capacities. There are three dimensions of digital transformation:

- To integrate the digital strategy with the company's corporate strategy and strategic goals, as well as to develop new business models (digital strategies).
- To provide digitalised products and services and restructure customer-oriented actions (digital services).
- To digitalise internal operation and internal corporate cooperation (digital operational abilities) (TBV n.d.).

It will not be elaborated here on the road the data and network technologies have made from the past until now. However, it should be acknowledged that the first step in digitalisation was made in the 1800s with the use of electromagnet, while 1970s are the years when an inter-computer network technology

Figure 3. Technologies of digital transformation. (Adapted from TUSIAD, 2017a ; Nuroğlu & Nuroğlu, 2018)



came to use. Data digitalisation and sharing have developed rapidly from this stage on. In the 2000s, first the wireless network technology and then mobile internet connection became indispensable for the people and trade. This process continues until today and has prepared foundations, which allowed for the appearance of Blockchain technology.

Arguments Used in the Digital Trade

Sensors and processors, which could be named as the foundations of digital transformation, have both shrunk and cheapened over the years. For example, compared to 5 years ago, the price of a sensor decreased by half, the cost of setting up a cloud infrastructure is 1/20th, while the costs of computer processors are worth only 1/50th of the old price.

Additionally, it can be said that in the last 2 years the amount of data necessary for big data and its analysis as an important component of Industry 4.0 has grown significantly owing to sensors and the internet. All these developments have contributed day by day to the increased use of technologies enabling the digital transformation by businesses and customers (TUSIAD 2017a).

New technologies, on the one hand, provide for improvements in production processes and on the other hand give an opportunity to develop new business models. The integrated work of all these technologies and uninterrupted internet connection will shape the smart factories of the future and the production-consumption-logistics chains. Using digital technologies cooperatively will return to companies in the form of improvement of production processes, the decline in costs, and the increase in effectiveness and competitiveness in foreign markets.

Business and trade activities, which could be done by utilising open and closed networks using digital technologies is as follows:

- Electronic purchase of goods and services,
- Production planning and production chain organising,
- Placing an order,
- Making agreements,
- Electronic banking processes and the transfer of funds,
- Sending electronic shipping documents,
- Customs clearance,
- Monitoring production via an electronic platform,
- Tracking shipping through an electronic platform,
- Electronic money-related processes,
- Keeping and monitoring the trade registries,
- Digital (electronic) signature,
- Trusted third-party operations such as an electronic notary,
- Instantaneous distribution of digital content,
- Taxation in the digital environment (Kusadasi Chamber of Commerce (2013).

Digital technology can be used in every operation from production to consumption. This development allows for easier management of the supply chain.

In the following chapters, some of the trade activities realised with the use of digital technologies will be treated. The operations related to these actions, while previously conducted in the physical environment, nowadays are conducted both in physical and on a digital platform. In the same time, it is predicted that in the future that the realisation of many of sub-operations connected to these actions in the physical world will significantly decrease or disappear altogether.

DIGITALISATION IN INTERNATIONAL TRADE

Trade Conducted Using Digital Technologies

E-commerce

E-commerce shows similarities to traditional trade and is complementary and facilitating to it rather than presenting an alternative. Hence, it is hard to define where e-commerce starts and ends in e-communication. Therefore, all electronic communication, which brings commercial results, is accepted as e-commerce (Çam, 2014).

E-commerce appears because of especially technologic developments together with freeing trade around the globe (Kavcı, 2016). E-commerce resolved the issue of time by allowing businesses to wriggle themselves out of the physical shop space. The opportunity of selling 24/7 and the disappearance of geographical borders when it comes to reaching the customer provided businesses with increased accessibility of products. Moreover, a drastic decrease in manpower required to conduct processes and a decline in physical investments have led to a decrease in costs.

Important Factors in E-commerce:

As it happened in all forms of trade, the technological change has occurred also in e-commerce. New applications have shaped e-commerce. The three factors, which show the effects of the new age on e-commerce, are as follows (TUSİAD, 2017b):

- **Marketplaces:** E-commerce appears too many companies as a tempting channel to start a business or increase sales due to it being quick to carry out and not involving costs of classical retail. However, it requires, first, creating a website attracting the attention of customers and then capturing and maintaining necessary traffic. Before embarking on such an effortful process, marketplaces step in to serve businesses, which want to introduce their products to more customers and test their operational processes and competencies. Businesses, which sell in marketplaces with millions of visitors every day, can gain expertise in e-commerce by reaching an agreement with these companies and benefitting from their systemic infrastructure, network, know-how and traffic (TUSİAD, 2017b). The leaders of this sector in different aspects – eBay, Amazon, and Alibaba – have achieved very successful performance charts and gained an important share in the general retail sector with thousands of suppliers and millions of customers. Classical retailers aware of this danger originating in the digital environment have begun to move towards changes in their service models in order to maintain their competitive advantages. As an example, Walmart, one of the biggest retail chains in the world, entered the e-commerce market under the name Walmart Marketplace. Marketplaces quickly growing in various regions of the world have started to constitute a considerable share of e-commerce volume. It is expected that only the three biggest (eBay, Amazon, Alibaba) will comprise 40% of the e-commerce volume from 2020 (TUSİAD, 2017b).
- **Cross-Border E-commerce:** New dynamics and increasing trends in trade also provide possibilities for global entrepreneurs. By means of online channels, entrepreneurs started to reach with their products not only domestic but also foreign markets. Cross-border trade, which reached the level of 400 billion USD in 2016, is expected to grow by 27% every year to reach 1 trillion dollars by the year 2020 (TUSİAD, 2017a). Large marketplaces have started to make easier their logistics processes in order to reach more customers abroad. For example, when a foreign customer wants to purchase a product from the website, the price is decreased by the predicted amount of taxes to be paid in their home country and predicted customs are attached to it. Due to the fact that they take care of the client's customs transaction, marketplaces are since able to deliver products to customers abroad in a very short time.
- **Technological Trends:** Digitalisation and the use of technology have started to play an unprecedentedly important role in the lives of both consumers and businesses. While just a couple of years ago product delivery with the use of drones could be conceived to be a product of fantasy, nowadays there are companies which declare that they will provide such a service to customers

in the close future. With the adaptation of digitalisation and new technologies, businesses get the chance to answer to changing customer needs and expectations while making a competitive difference by optimising their operations. The price is no longer the only factor affecting the choices of customers who day by day increasingly adopt the new technologies. From now on customer choices are affected by factors such as ease, personalisation, becoming a community, receiving information and so on. Businesses aware of these opportunities answer customer expectations by creating workflows with the use of digitalisation actions employed in all their end-to-end processes and operations (TUSİAD, 2017b). Topics related to tools used by businesses and customers in their trading and banking processes such as e-invoice, e-money, and Bitcoin are covered below.

E-Invoice

In e-invoice (electronic invoice) execution, the process is started with a client purchasing goods or services. The seller prepares with an e-invoice service provider an e-invoice covering the business and goods or services sold and sends it to the customer. With the acceptance and confirmation of received e-invoice by the client, the e-invoice process is finalised. It has the character of an official document.

There are more important advantages than just low price, a smaller number of mistakes on the invoice, and the removal of posting processes. E-invoice is generally a practice, which increases the effectiveness of businesses, decreases the costs, is safe, and makes monitoring processes easier. Due to the possibility of inspecting the correctness of the created document in an instant on screen, verification and providing an instant solution to disagreements, the chance for mistakes is minimised. Data after inspection can be automatically transferred to the company's cash management and payment system.

The disappearance of archiving costs, shortening of invoice registering time, and the decrease in document mistakes provides for instant access to send and received invoices. Additionally, the prevention of tax loss and tax evasion is made possible due to quicker and more effective tax auditing by state authorities. On the other hand, international trade is made easier by the possibility of a merger with international companies and an easier document and information inspection by means of document standardisation.

E-Money And Digital Currency

E-money (electronic money) is constituted by payment mechanisms in which the amount is paid upfront in order to conduct a direct transfer between two devices or through open computer networks such as the internet.

It is possible to evaluate electronic payment systems under two distinct categories: employing cards and cardless. Payment systems utilising cards show differences depending on the type of card in use, the way it is used, and the time of payment/commitment. It is possible to further separate payment systems with cards into three sub-categories: credit cards, debit cards, and ATM machines. As for the cardless payment systems, we could list methods such as virtual cards, remittance, EFT, SEPA, SWIFT. At this point, with the development of personal computers, the proliferation of the internet, and mobile phones and smartphones, the diversification of payment systems is widely observed. The most important change within this diversification seems to drive the world towards the decrease in cash payments and the popularity of electronic payments. Meanwhile, the electronic payments themselves undergo diversification. The closest to the conventional (nominal) money is electronic money (Bilir & Cay, 2016).

Simply put, e-money is an electronic representation of conventional money. As a result, the aspects related to nominal money such as export by the central bank and the determination of its value by the central bank's fiscal policies are also valid for e-money. Virtual currencies are, in turn, not the responsibility of a certain person or institution and are not supported by any authority. Based on previously established algorithmic rules, the supply of virtual currencies cannot be defined by any person or authority on their own (Uzer, 2017).

E-money is exchanged within the scope of a central infrastructure realising the exchange and agreement regarding operations. The basic innovation introduced by virtual currencies is the use of Distributed Ledger technology, which allows for the transfer of value between partners in the absence of security and intermediaries.

A certain body manages E-money operations. Virtual money operations do not have one operator due to their decentralised structures. In the example of e-money, financial or other institutions conduct the role of the operator generally. Meanwhile, there is more than one intermediary providing technical support in virtual currencies (Uzer, 2017).

Virtual currencies have started to appear together with the proliferation of electronic payment systems. The most well-known of all virtual currencies is BitCoin. Ripple and LiteCoin are other virtual currencies, which are in use (Öztürk & Koç, 2006).

Digital currencies in questions are transferrable assets with safety provided by cryptologic encryption. All said digital currencies circulating today are not bound to any government and are produced by people, non-governmental organisation or companies. Moreover, there is no need to keep them in a bank account as it is with normal money. There is no central bank to control virtual currencies, too. Money safety depends absolutely on its owners, as it is with cash.

BitCoin

In a 9-page resolution published by Satoshi Nakamoto, the designer and the first implementer of the BitCoin system whose real identity is unknown, it is stipulated that this system aim at conducting the exchange of virtual currency without a secure intermediary. According to it, the removal of the intermediary institution will both allow for realising the operations between the sender and the receiver and decrease the costs caused by intermediaries (Nakamoto, 2008, Bilir & Cay, 2016).

The 2008 financial crisis has made cryptocurrencies and BitCoin attractive by preparing a fertile ground for their operationalisation, acquirement, and proliferation. Next chapter provides more detailed information on this topic.

E-Export

After the e-commerce market achieves certain maturity, foreign trade becomes an important point of focus from the perspective of perpetuating growth. E-export plays also an important role in realising country's export goals. E-commerce is one of the most critical channels serving to increase exports. It is also important for businesses holding an important share of the market to utilise the experiences they gained in the local market in new markets. There are certain obstacles before this important export channel, which limit the growth of the sector. In purchases from abroad, clients are made to think twice due to their fear that products from an unknown market will not arrive, the customs and customs processes, the time of transportation, and the possibility that product will not be as it was presented.

Many international studies around the globe are conducted to remove the obstacles faced by foreign trade. These studies propose that customs processes and laws should be redesigned to speed up the process, optimise it and make it easier. Studies conducted by International Chamber of Commerce support the idea that the amounts of customs exceptions should be raised in order to increase the volume of foreign trade and e-exports and support businesses which could open themselves to the world with the via these channels (TUSİAD, 2017b).

Generally, the problems below are also an issue:

- The refund processes of products are seen as an important issue in e-export operations. When a client abroad wants to refund a product, the product remains in courier company's customs warehouse for a long time due to the ongoing refund process.
- Global giants such as Alibaba, Amazon, and eBay are able to offer free shipment of their products to a significant part of the world. This decreases the competitive ability of smaller companies on the international market.

Types of e-Commerce Markets

Together with advancing technologies, specific business models were developed within e-commerce. Within those models, in turn, consumers, businesses, and public bodies are present.

"Business to Business" (B2B) is a model of sales between two businesses. It is also known as Electronic Data Interchange. Due to the fact that amounts per operation are much higher here than in C2C and B2C models, it can achieve much larger volumes. Alibaba.com is the best example of this model. It is a website set up to open China to global markets. "Business to Consumer" (B2C) is a model of sales between a consumer and a seller. The financial risk or stock risk depends on the type of product or service or the business model. The investment costs and stock costs of a typical stock-based B2C website are higher when compared to the C2C model. Amazon.com is the best example of this model. Customers can buy from business through online shopping platforms products such as computers, shoes, books, furniture, clothes, food, and phones.

"Consumer to Consumer" (C2C) is a model of sales between customers. It is a marketplace supporting the trade between customers themselves. These are product sales conducted by clients by gathering on safe webpages and using various payment channels. Due to the fact that the exchange of products or services occurs between customers, such pages do not carry a stock risk and play only the role of an intermediary. The scam risk in C2C marketplaces are higher than in B2B or B2C models, therefore, businesses specialised in this field have introduced procedures necessary to ensure that clients will not become victims of such practices. eBay.com is the best example of such a model (TUSİAD, 2014).

"Business to Government" (B2G) is a model of e-commerce between businesses and public administration. Tax payments are the best example of this model. It includes all trade, communications etc. done with the use of local ties between business and public administration. "Customer to Government" (C2G) is a model of e-commerce between customers and public administration. The publishing of public tenders on the internet and the presentation of bids by companies in the electronic environment constitute the first examples of this model. The others are applications such as tax, health, and legal processes, driver's ID, passport applications, social security premiums and tax payments.

"Business to Enterprise" (B2E) is a model defining in-house processes. Human Resources are its best example. It covers also the transfer of all in-house works performed on a daily basis to an e-work environment and in-house customer information sharing.

"Machine to Machine" (M2M) is a model of e-commerce which will be utilised in the future. Trade between machines can serve as an example. Recently, many devices can perform operations by connecting with one another.

"Peer to Peer" (P2P) is a web protocol in which a file transfer is conducted between two different users. In such a web protocol, there is no need for central coordination for users (peers) to share. With all necessary resources, the use of P2P network at its full performance allows free file transfer among peers. In this type of system, a user is both a producer and a consumer. Moreover, thanks to digital development, protocols used in payments allow for easy money transfers among people. As for recent developments in this field, Visa announced that it turned Visa Direct into a structure offering services on a global scale and established a partnership with Remitly, mobile payment solutions provider in order to offer real-time peer-to-peer payment services (Fintechtime, 2019).

Regulatory Support for Sector's Development

E-commerce is by nature carried out on a platform, which harbours the elements of many different disciplines from trade to technology and from law to marketing. Therefore, it includes domains of special arrangements. E-commerce sector connects consumers with its field of application within the scope of regulations related to data protection, distant sales, e-signature, e-money and payment services, e-invoice, and intellectual property rights, as well as tax regulations and other general regulations.

The European Union issued most of its directives related to e-commerce in the years 2000-2005. Moreover, the EU created in 2015 its "Digital Single Market Strategy" which includes e-commerce.

From the perspective of e-commerce's functioning, national legislative processes concerning Personal Data Protection are important. Even if such a law brings businesses workload related to processing and protecting personal data, it plays an important role in increasing customer trust, which is registered especially in the e-commerce sector. It is also quite important to observe a balance between the protection of consumer data and the development of the e-commerce sector in decisions to be taken regarding Personal Data Protection. In a secure environment improving due to their personal data being protected by laws and businesses, consumers will conduct more operations (TUSİAD, 2017b).

The Place of E-commerce in the Global Economy

The most used argument for the digital economy is e-commerce. It seems that it is quite hard to measure its share in the economy. Especially in developing countries, it affects to an important extent the production and trade, which, in turn, accelerates global e-commerce growth. United Nations Conference on Trade and Development (UNCTAD) in its report from April 2018 provided statistics related to B2B and B2C e-commerce market. It is presented in the report that global e-commerce reached 25, 3 trillion dollars in 2015. B2B sales were responsible for approximately 10% of the global trade or 2, 9 trillion dollars. The biggest shareholder in global e-commerce, China, reached 617 billion dollars with B2C sales, while the United States of America took the second position in the same market with 612 billion dollars. While the USA achieved 6 trillion dollars in C2C sales, Japan got the second position with 2, 4 trillion dollars. An interesting situation is observed in the Chinese market – it is the only country, which was in the top ten in all types of e-commerce markets (UNCTAD, 2018).

With regard to e-commerce markets, while at the present B2B inter-business e-commerce holds the biggest share, a significant increase is observed in B2C sales. Cross-border B2C e-commerce also was given place in the UNCTAD report with 189 billion dollars' worth of payments and 380 million people who made purchases from websites abroad. In 2015 1, 4% of global import of goods was done by B2C e-commerce (UNCTAD, 2018).

After analysing Figure 4, it can be observed that the percentage of social network users in developed countries is rather high and even surpasses some of the developed countries. This situation reveals that developing countries are open to the digital transformation and it is an opportunity for them. The lower ration of e-commerce in developing countries as compared to developed countries shows, then, that they can develop their markets and their share in e-commerce will grow quickly.

DIGITAL TRANSFORMATION IN INTERNATIONAL TRANSPORTATION AND LOGISTICS OF THE FUTURE

International Transportation and Logistics

Sea routes in global trade conduct 90% of transportation (International Chamber of Shipping, 2019). Sea route transportation is the lifeblood of intercontinental trade. Goods, which arrive at ports with seaway transportation, are transferred there to other transportation systems and are carried to their destination points as it is shown in Figure 5. In this way, the transport chain creates connections between transportation systems. When analysing the total cost of a given product, transportation and logistics services responsible for the realisation of transportation hold a significant share. Therefore, processes, which could create a decrease in the costs of transportation and logistics, will, consequentially, decrease the cost of the product and increase customer satisfaction. The improvement in price without compromising on the product quality will be possible to achieve by decreasing costs in transportation and logistics services, which constitute the most important expense item.

Figure 4. The percentage of online purchases and the use of social networks in selected countries. (Adapted from UNCTAD, 2018).

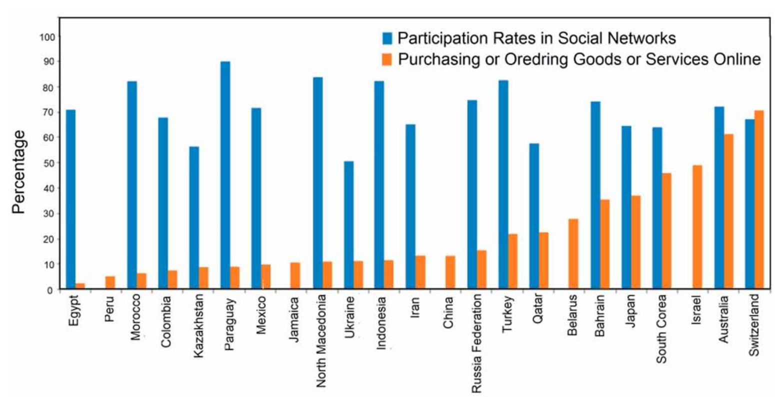
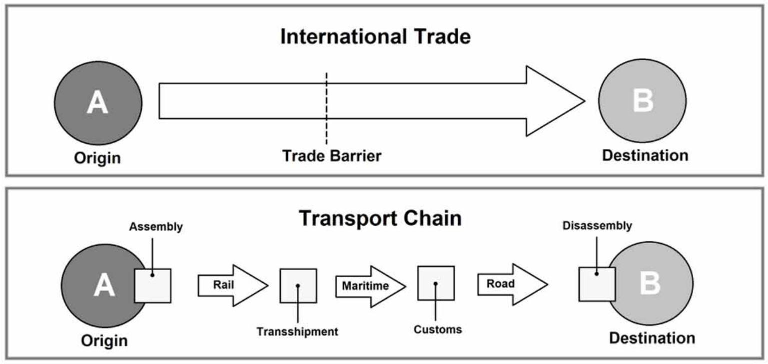


Figure 5. Transport chain in international trade. (Adapted from Rodrigue, n.d)



Apart from physical transportation, many processes in transportation were with the opportunities provided by communication and information technologies transferred to a digital environment, which is quicker, controllable, registerable, and allowing, double-check. Even though the digitalisation infrastructure was developed for other fields, it opens the possibility of using Blockchain technology in the logistics sector.

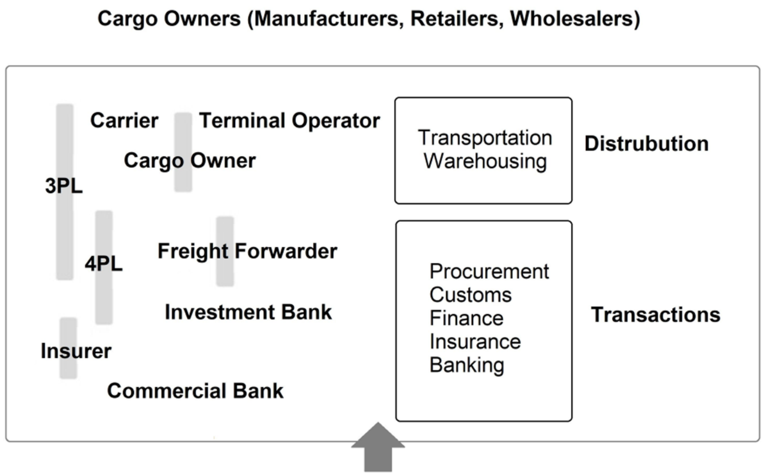
The Structure of the Logistics Sector

In the global economy, trade surpassed local borders and transformed into intercontinental trade and it internationalised trade-related transportation and logistics actions as well. Logistics sector due to the fact that it raises the added value of produced goods, is an important activity on a micro (for businesses) and macro (for countries) scale. A successful logistics sector in one-country results in the high international competitive power for its businesses. Companies, which have easier access to global markets, arrive at the point where they can make more sales due to their competitive power. As a result, one country's success in the logistics sector results in an increase in its exports. Concurrently, this rise in exports means also an increase in national income. This, in turn, implies the increase in the level of national wealth. Moreover, the increase in foreign demand will boost the employment level due to increased production in the country (Karamolla, 2015).

In international trade, distribution and transaction services are realised by many service providers and actors. As shown in Figure 6, distribution services include transportation and warehousing of commercial goods. While owners of goods may store and transport them on their own, they can also employ a carrier or a terminal operator to conduct those processes. As for the management of international trade actions, it is a part of the category of operational services. From raw material to its transformation into a final product, operations such as all production processes, the continuation of supply operations, the processes of accordance of customs transactions with national and international regulations, banking and financing processes and the insurance of goods and payments are all included in it.

Businesses have decided to use outsourcing in order to deliver goods to customers in an easy and economical manner. Companies specialised in providing logistics services offer actions named using various service classes. These actions are briefly defined below:

Figure 6. Logistic services supporting international trade (Adapted from Rodrigue, at al., 2017)



- 1PL – First Party Logistics: Logistics performed by producer, retailer or sender with their own means. Provided service is production and retail sale.
- 2PL – Second Party Logistics: Providing traditional transportation and storage services by businesses using their own truck, storehouses, and entrepots. These businesses work with producing companies and the service provided by them is transportation.
- 3PL – Third Party Logistics: Partially or totally handing over the materials management or product distribution to another company. These intermediary companies, similarly to other companies, which own their own investments, could employ in their organisation more than one 2PL companies. All logistics services are provided.
- 4PL – Fourth Party Logistics: Apart from services given in 3PL, it includes also information infrastructure, physical facilities, as well as planning and management of operations. Services provide include processes such as design, the transformation of the logistics process, and the implementation of the logistics process.

The design, construction, and management of a supply chain in its entirety are achieved by offering the businesses comprehensive supply chain solutions and integrating technologies, competencies, resources and experiences with 3PL businesses. The service is provided on an expert level.

Finally, it is expected that from now on more focus will be brought to non-physical services creating more added value. Especially the conveniences originating from digital technology have provided various opportunities in both production and postproduction. E-commerce solutions, which found themselves an important spot within 4PL, gained sector a significant boost in speed in this direction. The conveniences and digital platforms developed by e-business solutions within 5PL have caused a global increase in searches. Locally created information- and technology-sharing logistics applications have gained speed. By merging customer services provided online with other service channels and, therefore, achieving the omnichannel service concept, Customer Relationship Management solutions have been offered. Due to the fact that this process has prepared the ground for global-scale applications, electronic solutions have an important position in 5PL. As it is visible in Figure 7., 6PL, 7PL and so on are to come as well.

Figure 7. Where does outsourcing lead. (Adapted from Anonymous, 2017)

Transparency, communication, and trust are the key elements of 4PL. More than a supplied external seller, 4PL takes the place of a customer. It has to be objective while serving the interests of a customer and making decisions. Additionally, it is responsible for managing, planning, and coordination of relations among all 3PL suppliers.

While transparency, communication, and trust result in a focused solution in 4PL, in 5PL, in order to achieve lower costs, besides cooperation sustainable growth and unification strategies are applied. Figure 8 analyses the digital technological transformations of future solutions together with their empowerment of consumers.

New Trends in Logistical Customer Satisfaction

In the globalising world, new entities have appeared as the effect of factors such as newly developing logistics market, technologic developments, and customer requests. The systematic characteristics of these entities could be pointed out as shorter order circles to react quickly as well as smaller, tighter, more trustworthy delivery.

Customer expectations in logistics sector, as shown in Figure 9, are listed as low costs, quality of service, wide market opportunities, efficiency of operation and inventory management, follow-up power of operations.

The ability to meet customer's expectations and solving the arising issues swiftly and effectively without any reaction on the part of customer depend on the resources owned by businesses, especially technological and human resources (Kacar, 2014).

Figure 8. The road to the future for logistics service providers. (Adapted from Gruchmann, at al., 2018)

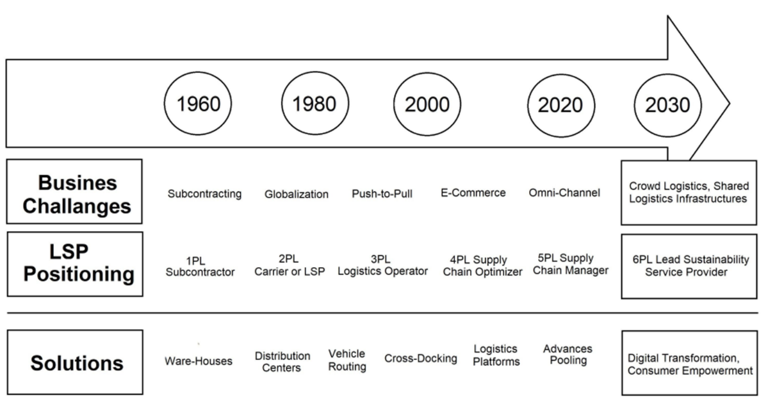
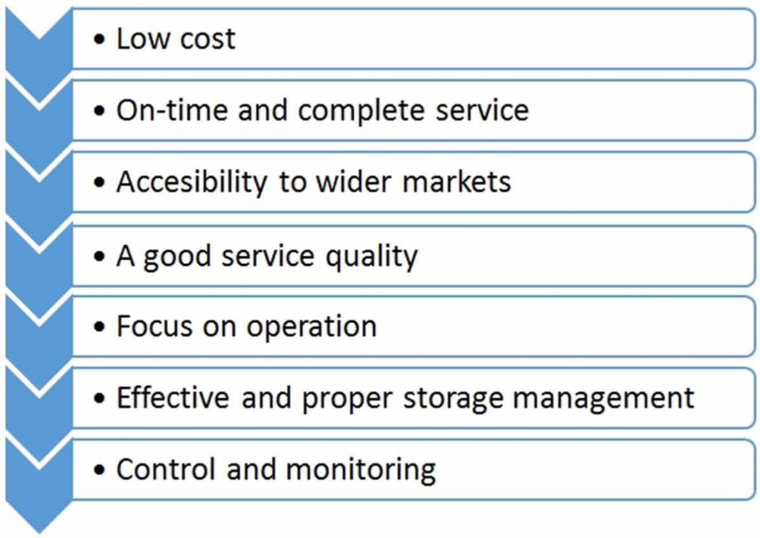


Figure 9. Expectations of customers receiving service in logistics sector (Author's work experiences)



Some of the problems experienced in the international logistics sector are gathered below.

- Possessing an insufficient international transportation infrastructure which doesn't meet the standards,
- Inequality of technological investments between countries,
- The dominance of overland shipment in underdeveloped and developing countries,
- The inability of customs regulations in some countries to keep up to the speed of transportation and problems faced in customs.
- The scarcity of cooperatives able to create synergy between businesses,
- No use of trusted, valid, and standard information system to monitor the logistics sector,
- The unwillingness of managers of companies in the logistics sector to share information,
- Being closed to receiving information from external sources and, consequentially, no crisis preparations and management,
- Businesses lack long term vision and instead of creating their own politics, prefer to copy
- Small scale and local operation capacity of businesses (Karamolla, 2015).

The problems experienced in international logistics and listed above can be solved quicker with trade based on communication and trust by developing technological infrastructures of businesses.

TREND IN TRANSPORTATION AND LOGISTICS: BLOCKCHAIN

Blockchain in The Supply Chain

Money is used in the purchase of goods and services with commercial value. Until the last 50 years, the actual currency was in physical environment. Later, instead of physical circulation, money was introduced into a number of digital instruments (such as bankcards) produced by banks.

There is a wide variety of digital payment methods. They can be used online or offline, without being connected to the internet. Some of the electronic payment methods include credit card, electronic credit card, mail order, virtual credit card, disposable credit card, PayPal, electronic money, e-cash, electronic cheque, smart card, e-card, peer to peer payment, mobile payment, escribe, IPIN, PcPay, First Virtual, etc. (Yüksel, 2015).

Krypto money is a virtual currency that is used in the internet environment that is not connected to any central authority or intermediary institution. Crypto monies can only be used by using passwords from virtual wallet where they are placed using certain passwords. In krypto currencies, individuals or institutions may spend, send, or accept money, just as they do with real money. There are quite a lot of crypto currencies in the world. These currencies are not physically available in the form of Dollar, Euro, etc. (Çetinkaya, 2018).

Krypto coins are not represented by a physical commodity, but by a “price” currency. Price currency is a new generation currency that is recognized (legitimate) by a government or an institution and whose value is protected.

In 2009, a person (or a group of people) named Satoshi Nakamoto publishes an article titled “Bitcoin: a Peer-to-Peer Electronic Cash System” for the most widely used crypto money bitcoin. This article tells us that instead of trust, what is needed is a payment system based on cryptographic evidence. Thanks to this system, any two parties will be able to transfer directly from person to person without the need for a third party (Özalp, 2018, Nakamoto, 2009).

Blockchain technology is used in bitcoin infrastructure. Blockchain is a technology that allows the system to distribute these records to each point in the network and to have the same records at every point. The database that keeps records of all transactions is called shared ledger, distributed ledger, or public ledger.

The global financial crisis in 2008 accelerated the use and spread of Bitcoin and crypto currencies by investors (Bustillos, 2013). With Bitcoin’s success, various crypto-currencies have emerged. It has the same design structure as bitcoin, and it continues its life cycle on a completely different Blockchain network, which is called “alt-coin” (alternative coin). Some of these coins are Bitcoin, Ethereum, Ripple, Litecoin, Binance Coin, Tether, Steller, Dash, Monero, Neo, Nem.

Blockchain is a general account system that records all users on the network. All approved transactions with all smart contracts are included in the blockchain. Blockchain’s ranking of accuracy and chronology is provided by cryptography. For this reason, the use of this technology is becoming widespread day by day, especially for the exchange of contractual monetary value (which may be in virtual value) (Özalp, 2018).

With distributed accounting technology, it provides an open, transparent platform to the businesses, the society and the customers it serves. However, blockchain gives the ability to do business in an environment where the parties can see each other and trust each other only within the framework of the process to be done. With this technology, a user can save money at different locations. They can also get different addresses to send money. This can help protect privacy. In the transparency environment that blockchain provides, forgery is eliminated and transactions are made with honesty. Blockchain does not allow unnecessary manipulation, dishonest addition or removal of something (Atabaş, 2018).

The fact that the system is intrusive and unchangeable from the outside provides the convenience of doing business on platforms where trust is not necessary, even from a fake world. Thus, it is possible to create a world of trust within and beyond the chain. Although blockchain technology is secure through smart contracts, users may have security vulnerabilities at the interface level of mobile phones, tablets or computers used to access the internet (World Trade Organization, 2018).

E-commerce platforms easily sell the seller's products to users. Thus, the product price is transferred from the buyer's account to the seller's account in digital environment. However, from time to time, even large organizations that serve to secure the security of information belonging to users are faced with hacking attempts. This shows that commercially available systems are not fully secure, but are often the targets of such attacks. Thanks to blockchain technology, users ' information has no security issues. The protocols that are the basis for trust (smart contracts) and the intermediaries that provide system and information security services are eliminated. With smart contracts, transactions are secured, thereby helping businesses reduce security costs associated with transaction data.

Block chains for public use can be as well as a specific group of users can be set up a block chain. The initiatives in this second group are called block chains (Özdoğan & Karğin, 2018).

Block chain types are basically divided into two categories:

- Unauthorized Block Chains (Public Block Chains): They are block chains where anyone with technical competence can be involved in the registration approval process without any prior approval or authorization, and often have monetary reward incentives. The most typical example is Bitcoin.
- Authorized Block Chains (Private block chains): These are block chains used for specific applications where registration is determined by an authority or consortium that will be involved in the approval process.

The use of block chain technology for inter-enterprise or in-house applications is increasing, in which it is inconvenient to open transactions to the public. However, it is developing rapidly in public institutions where the transaction flow can be monitored, such as document submission, document request and approval processes (Özdoğan & Karğin, 2018).

It offers benefits such as speed, low cost and security, which are found in a wide range of applications, increases the user's range day by day.

As an example of the use of blockchain in logistics and supply chain management, it is expressed in the fields of production, transportation, cyber security and energy (Underwood, 2016).

With the Kouvola Innovation Project wants to implement blockchain technology in the inter-agency supply chain. The information belonging to the project load units will be obtained with IoT sensors and will be shared with the stakeholders. The European Union has funded the work for the supply chain in the Scandinavian region. By creating blockchain with IBM to track Walmart products, it has been able to reduce the food supply chain monitoring time from 6 days to 2 minutes (Özalp, 2018).

Supply Chain Network and Traceability

The logistics and supply chain of transactions carried out in international trade has its own ecosystem. Users within the same ecosystem form consortiums to perform the targeted business transaction.

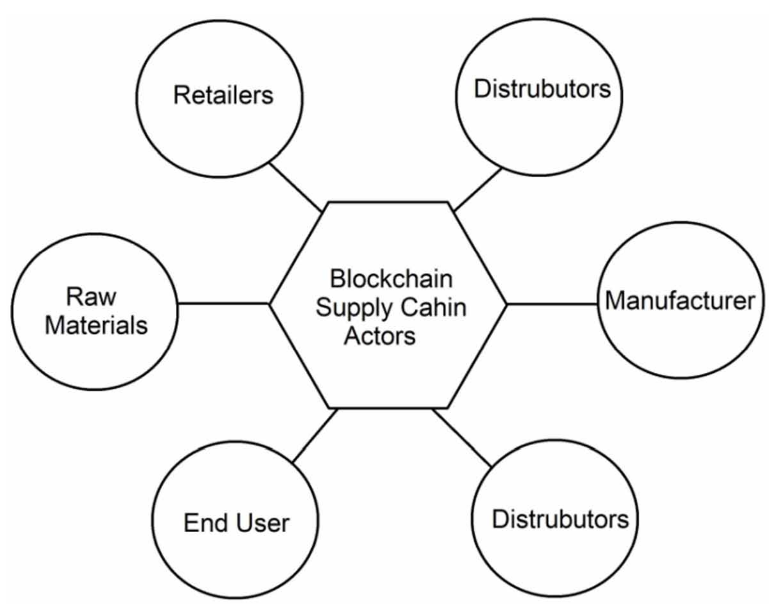
Supply chain starts with the supply of raw material and deals with the way the raw material is processed. After the raw material is transferred to the production, the product is delivered to the distributors, wholesalers and parakendeurs and to the end user. If the shipment or shipment of raw materials or products from different countries is the case, the transaction is called international trade in terms of commercial transactions. Custom procedures which mentioned before are also added.

In logistics and supply chain management, the data generated for all operations from production to consumption can be documented as a history of the product. Supply chain structure the blockchain is suitable for creating the interconnected as shown in Figure 10. Blockchain in the supply chain takes place when the records of the commercial transactions (orders, payments, all official documents, certificates and barcodes belonging to the product) are recorded in a physical environment, and when the transactions are recorded in a digital environment in such a way that they are approved by the parties.

Accuracy of the data enables automatic and error-free logistical processes, helping to speed up operations and save costs.

Coded smart contracts notify parties by making verification of the realization of the next step. Making a notification opens the switch to the next step. This means that the transparency of the work performed is increased when the transaction is reached to the network users. In addition, since each transaction has a time stamp, no change or forgery can be made in the document (Verhoeven, at al., 2018). The data belonging to the chain (transactions) is shared with those with access permissions. Once each job has been approved, it processes the block chain with the completion and approval of the other transaction queue

Figure 10. Blockchain supply chain actors (Adapted from Litke at al., 2019)



within the system. The database is specific to blockchain users. Each blockchain consists of members of the supply chain for their specific purpose. Some of them;

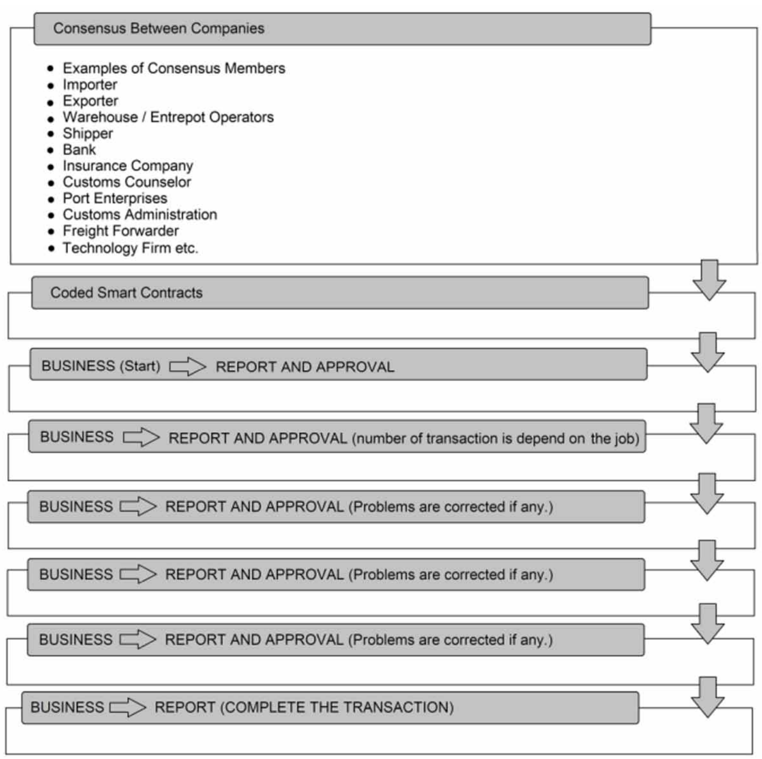
- Creating the order,
- Production and packaging.
- Monitoring of production certificates,
- Storage and shipping organization,
- Customs clearance procedures,
- Banking transactions, etc.

Thanks to smart contracts, all participants in the supply chain network can be monitored from the creation of orders, production, transportation, payment, to the delivery of the goods from seller to buyer. Figure 11 shows the flow of coded smart contracts through intercompany consensus and the process of workflow, report and approval processes and transaction completion process.

Assuming that the exporter and importer agree on the international commercial transaction;

- The exporter wants to make sure that the importer fulfils the payment obligations.
- However, importer wants to make payment as late as possible and after the seller's fulfilling all of its obligations.

Figure 11. Blockchain process design of logistics and supply chain in international trade (author's work experiences)



Both sides will be embodied transactions with blockchain practices related to international trade and will be able to achieve their goals through smart contracts. Distributed books allow them to view the same information about their goods at the same time. Therefore, even if there is no mutual trust between them, it will be easier to communicate directly to ensure fast and timely reconciliation in shipping-related issues (for example, defective or incomplete delivery of the ordered goods) (Güler, 2019).

By ensuring the participation of banks and distributors (shipping and freight forwarder companies) as financing partners to trade with blockchain:

- The exporter proves that the distributors agreed to deliver the goods ordered.
- It provides assurance to importers that they will receive the goods on time.

Such practices may be associated with each payment step in exchange for services provided (financing provided by banks and logistics provided by carriers). This means that the exporter will receive the goods more quickly because of the dispatch of the goods in less time and pay the banks immediately.

In other words, in general, production or consumption of goods in the economy will be more volatile and all parties participating in blockchain will be able to increase liquidity while reducing transaction costs in the financial sense (Güler, 2019).

Innovative applications such as blockchain are also important in terms of business sustainability vision. When evaluated in this direction;

- With the use of technology, it will be possible to reduce the negative impacts on the environment by providing more productive usage of various inputs such as energy, labor, paper costs.
- Because of cost advantages, competition advantages of firms will be increased.
- Transparency, traceability and trust-based cooperation of actors in the ecosystem will provide a social context of integrity.

It will also facilitate the achievement of economic, social and environmental targets for sustainable business.

Information about the goods (purchase document, invoice, certificate of conformity or form, bill of lading, insurance policy, etc.) sent by an exporter may be part of a block within the blockchain. Suppliers, carriers, buyers, regulatory agencies, and auditors can access information. For this reason, customs and other regulatory bodies will be able to see the necessary and accurate data about the goods (the seller, the buyer, price, quantity, carrier, finance, insurance, etc.) to be declared in real time and will be able to monitor where the goods are physically located. Such a comprehensive visibility will provide a customs function based on more data and better information on daily operations when placed at the base of the regulatory area. With blockchain technology, customs administrations and other border institutions will also contribute to facilitating trade (Güler, 2019).

Especially all commercial documents in international trade can be digitized and single - point windows, including customs procedures, can be created; transparency and monitoring can be provided.

It is recommended that businesses build blockchain on a small scale to see what they can do and the problems they can face before making new ventures and investments using this technology. It is recommended to measure the test process and performance as the problems that may be encountered at this stage will indicate the problems that may occur in the future.

Nowadays, Blockchain technology is used by companies that doing international trade transactions and have completed their digital infrastructures and, as well as the countries where the ports and customs of the countries where the trade takes place are harmonized. In the future, this technology is anticipated to be used by large, medium and small enterprises in the process from production to consumption, where all kinds of commercial transactions take place.

CONCLUSION

The importance of supply chain is increasing in the economies of developed and developing countries. Along with the rapid change in the supply chain, international trade companies have problems in planning, time and trust in the logistics services they receive. On the other hand, during the import and export controls in the countries, there are difficulties in different applications between the countries or in matters related to fraudulent and illegal transactions. More time is spent to resolve these issues and more money is spent for more control. Through Blockchain technology, in all stages from the creation of the order to the delivery of the products, with the permission of the parties, both businesses and the state can see the information known to be single and accurate in the flow of trade, transparent, secure, unalterable and through the traceability of the supply chain, the follow-up, payment and delivery of transactions can be seen by the parties.

Advantage:

- With a decentralized database, information flow is provided to chain members on a global scale.
- Businesses share the data they accept in the smart agreement.
- All activities performed (transactions) are dealt with in a distributed post, eliminating human error and fraud.
- Depending on contracts, the parties (despite the geographical distance of the parties) will be able to provide payment or transaction information in a very short period.
- The fact that a document and data entered into the records in foreign trade processes cannot be processed without authority increases the confidence environment.
- The use of RFID and IoT technologies by enterprises in the current situation, saving the data from there to blockchain increases blockchain performance.
- The visibility of transactions saves time by eliminating wait for the beginning of the next transaction.
- Timesaving costs will be reflected positively because they can move faster than traditional transactions.
- It creates cooperation opportunities for parties that have never cooperated before and improves the flow of information between parties that have already had business relations.
- With the inclusion of the process related to customs transactions in blockchain chain, the requirements of the country in which import and export transactions will take place are determined more easily, the suppliers are notified, and the product-related deficiencies are eliminated prematurely.

Disadvantage:

- Decision to use blockchain technology without evaluating whether the infrastructure of the enterprise is suitable for new technology.
- Companies are far from innovative approaches.
- Failure of enterprises due to lack of technological infrastructure by showing the behavior of "impersonating others".
- Innovation expectations for traceability without determining the investment costs for RFID and IoT technology and without measuring performance.
- To adopt and implement blockchain technology, enterprises cannot demonstrate consistent behavior in practice.

In logistics processes and systems, applications are developed at the rates where blockchain is strong and can provide advantages. Businesses should try to better understand blockchain technology and question their usage areas in order to develop competitive and differentiating logistics systems using their existing capabilities.

REFERENCES

Anonymous. (2017). Retrieved from https://lojistikplatform.blogspot.com/2017/04/4pl-dorduncu-parti-lojistik-nedir.html

Artan, S., & Kalaycı, C. (2009). The effect of the internet on international trade: the case of OECD countries. *Journal of Doğuş University*, *10*(2), 175–187.

Atabaş, H. (2018). *Blockchain technology and the new place of crypto coins in our lives*. İstanbul, Turkey: Ceres Publisher.

Başkol, M. (2010). Logistics and logistics management, Bartın University IIBF. *Journal of Faculty of Economics and Administrative Sciences*, *1*(2), 47–63.

Bilir, H., & Cay, S. (2016, April). A relation between electronic money and financial markets. *Niğde University Journal of Faculty of Economics and Administrative Sciences*, *9*(2), 21–31.

Bustillos, M. (2013, Sept. 7). The Bitcoin Boom, *The New Yorker*. Retrieved from http://btcworldnews.com/new-yorkers-maria-bustillos-the-bitcoin-boom/

Çam, E. (2014). E-commerce with yesterday, today, and tomorrow: Problems and solution proposals, (Master's thesis), Inönü University Institute Of Social Sciences.

Çetinkaya, Ş. (2018). Development of Crypto Coins and investigation of the place in money markets by swot analysis. *International Journal of Economics and Political Sciences*, *2*(5), 11–21.

Çiçek, E., & Bay, M. (2017). Strategic global supply chain management and logistics, Selçuk University IIBF. *Journal of Social and Economic Research*, *7*(13), 91–117.

Council of Supply Chain Management Professionals (CSCMP). (2013). *Supply chain management definitions and glossary.* Retrieved from https://cscmp.org/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx?hkey=60879588-f65f-4ab5-8c4b-6878815ef921)

Doğan, Ö. İ., Marangoz, M., & Topoyan, M. (2003). Factors affecting the competitiveness of enterprises in internal and external markets and an application. *Dokuz Eylül Üniversity Journal of Social Sciences*, *5*(2), 114–139.

FintechtimeD. (n.d.). Retrieved from http://fintechtime.com/tr/?s=p2p

Gruchmann, T., Melkonyan, A., & Krumme, K. (2018). Logistics business transformation for sustainability: Assessing the role of the lead sustainability service provider (6PL). *Logistics*, *2*(25), 1–19. doi:10.3390/logistics2040025

International Chamber of Shipping. (n.d). Shipping and World Trade. Retrieved from http://www.ics-shipping.org/shipping-facts/shipping-and-world-trade

International Monetary Fund (IMF). World Economic Outlook October (2018). Challenges to steady growth, International Monetary Fund, Publication Services, Washington, DC.

International Monetary Fund (IMF). World Economic Outlook April (2019). Growth slowdown, precarious recovery. International Monetary Fund, Publication Services, Washington, DC

Janiç, M. (2017). *Transport systems modeling, planning, and evaluation*. Boca Raton, FL: CRC Press, Taylor & Francis Group.

Kacar, A. Y. (2014*). Customer satısfactıon and Rfid technology in the logistics sector.* Retrieved from https://www.paranomist.com/lojistik-sektorunde-musteri-memnuniyeti-ve-rfid-teknolojisi.html

Kalaycı, C. (2013). Dıgıtal division, digital poverty and international trade, Atatürk University. *Journal of Economics and Administrative Sciences*, *27*(3), 145–162.

Karamolla, T. (2015). *Structure of logistics industry and solutions for the problems in the sector,* (Master's thesis), Celal Bayar University.

Kavcı, R. (2016). *Inspectıon of inspection crimes example*, Workıng Paper Serıes, Foreıgn Trade Instıtute, Wps No/ 43/2016-06.

Kazgan, G. (1997). *Globalization and the new economic order: What brings? What is it taking? Where is it going?* İstanbul, Turkey: Altın Books Press.

Kusadasi Chamber of Commerce. (2013). *E-commerce and tourism sector.* Retrieved from https://translate.google.com/#view=home&op=translate&sl=tr&tl=en&text=Ku%C5%9Fadas%C4%B1%20Ticaret%20odas%C4%B1

Litke, A., Anagnostopoulos, D., & Varvarigou, D. (2019). Blockchains for supply chain management: architectural elements and challenges towards a global scale deployment, MDPİ. *Logistics*, *3*(1), 1–17. doi:10.3390/logistics3010005

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system [online], BitCoin. Retrieved from https://bitcoin.org/bitcoin.pdf

Nuroğlu, E., & Nuroğlu, H. H. (2018). Industry 4.0 as an opportunity window for Turkey's Foreıgn Trade. *Journal of Management and Economics Research*, *16*(Special Issue), 329–346. doi:10.11611/yead.458090

Oda, S. (2008). *Logistics sector in Turkey and its effects on foreign*, (Master's thesis). Trakya Üniversity Social Sciences Institute.

Özalp, A. (2018). *International trade finance, principles, and blockchain*. İstanbul, Turkey: Türkmen Publisher.

Özdoğan, B., & Karğın, S. (2018). Blockchain technology's reflections on accounting and finance fields and expectations, *The Journal of Accounting and Finance*, October/2018, 161-175.

Öztürk, N., & Koç, A. (2006). Electronıc money, with other types of money comparison and potential effects. *Selçuk Universityi Journal of Social and Economic Research*, *11*, 207–243.

Rodrigue, J. P. (n.d.). GEOG 80-Trasport Geography. Retrieved from http://www.umsl.edu/~naumannj/Geography%20PowerPoint%20Slides/transportation%20geog/Geog%2080%20Topic%205_B.ppt

Rodrigue, J. P., Comtois, C., & Slack, B. (2013). *The geography of transport systems, Routledge*. New York, NY: Taylor & Francis Group. doi:10.4324/9780203371183

Rodrigue, J. P., Comtois, C., & Slack, B. (2017). *The geography of transport systems*, Hofstra University, Department of Global Studies & Geography. Retrieved from https://transportgeography.org

Sabır, H. (2013). Competition policy and developing countries in the globalized world, international. *Journal of Political Science & Urban Studies*, *1*(1), 121–133.

Şeker, S. E. (2014). Digitalization, management. *Information Systems*, *1*(1), 6–7.

Turkey Science Foundation (TBV). (n.d.). Accenture digitalization index Turkey results. Retrieved from https://www.accenture.com/tr-en/insight-accenture-digitization-index-report-2016

Turkish Industry & Business Accociation (TUSİAD). (2014). *Focal point of digital market E-commerce,* TÜSİAD-T/2014, 06-553.

Turkish Industry & Business Accociation (TUSIAD). (2017a). *Digital conversion efficiencies of industry in Turkey.* BCG. November 2017. *TÜSİAD-T*, *2017*, 12–589.

Turkish Industry & Business Accociation (TUSİAD). (2017b*). Efficıent power of the economy in the digitalized world: E-trade*, TÜSİAD-T/2017, 04-587.

Underwood, S. (2016). Blockchain beyond Bitcoin. *Communications of the ACM, 59*(11), 15-17. Retrieved from https://cacm.acm.org/magazines/2016/11/209132-blockchain-beyond-bitcoin/abstract Unıted Natıons Conference on Trade and Development (UNCTAD). (2018). *Digitalization and trade: A holistic policy approach is needed, Policy Brief*, April 2018, 64.

Uzer, B. (2017). *Sanal Para Birimleri,* Central Bank of Turkey Republic General Directorate of Payment Systems, Thesis of Expertise.

Verhoeven, F., Sinn, F., & Herden, T. T. (2018). Examples from Blockchain implementations in logistics and supply chain management: Exploring the mindful use of a new technology, MDPİ. *Logistics*, *2*(3), 1–19. doi:10.3390/logistics2030020

World Trade Organization (WTO). World Trade Report 2018. (2018). *The future of world trade: How digital technologies are transforming global commerce,* World Trade Organization. Retrieved from https://www.wto.org/english/res_e/publications_e/world_trade_report18_e_under_embargo.pdf

Yüksel, A. E. B. (2015). Lookıng at electronic money, virtual money, Bitcoin and Linden dollars from a legal perspective, *İstanbul Law Review C. LXXIII*, 2, 173-220.

KEY TERMS AND DEFINITIONS

Blockchain: It is a general account system that records and data related to transactions carried out over computer networks and which is recorded by taking into consideration the transaction sequence. This account system is open bookable because it is accessible to everyone on the network. It is a technology with internal access in blocks that cannot be changed by connecting encrypted data to the chain's rings. The process in this system, which has a time sequence, cannot be changed retrospectively. Because operations are stored in blocks connected to each other, a history-oriented operation cannot be deleted. All operations can be accessed and controlled when requested. This technology performs the processing sequence based on programmed contracts (smart contracts). With smart contract, many processes are automated, making complex and long-lasting processes easier to manage. First, it worked only with software and programmable protocols to transfer digital money. The current situation has improved rapidly with Blockchain 1.0, Blockchain 2.0 and Blockchain 3.0 for different purposes.

Blockchain 1.0: Includes digital money transfer.

Blockchain 2.0: Using smart contracts, it can perform all transactions in the Financial Field such as starting work, making compliance checks, closing the transaction, verifying and controlling the parties.

Blockchain 3.0: In addition to all transactions, all kinds of document verification procedures, supply chain, import export, financing, insurance and customs procedures can be carried out by expanding the transaction limits to be unpredictable.

Blockchain Supply Chain Network: It is a technology to monitor and approve the processes of participants in its own ecosystem (if the trade is international; customs procedures are included.) in real time, including the flow and distribution of goods.

Delivery: the displacement of cargo and passengers from one point to another for a purpose.

Digital Conversion: A process of renewal and change is applied as a whole in technology, business processes and lifestyle by digitizing existing information.

Logistics: It is the service of planning, implementing and supervising all kinds of products, services and information flow from the exit point to the destination in an efficient and productive way to meet the needs of the people. The productivity in logistics service depends on the right product reaching the right customer at the right amount, in the right conditions, at the right place, at the right time, at the right cost.

Supply Chain: includes the management of the supply and demand of the product, the supply of raw materials, production and assembly, storage, inventory management, order management and distribution of products to customers. The supply chain includes all the products and services from the supplier to the customer at the latest stage and all the activities, human resources, technology, company structures and resources that take place in this path.

Transport: A service that allows freight and passengers to move from one point to another for a purpose. The service must be serviced in the most economical way because a displacement is performed for providing benefits. Transport vehicles and transport systems vary according to the goods and services to be delivered. The expectation of transportation demand is to serve the minimum cost in maximum speed and safety.

Chapter 24
A Conceptual System of Blockchain-Based Electronic Bill of Lading

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ABSTRACT

Blockchain-based electronic bill of lading will reshape the global logistics industry, replacing old-style paper bill of lading documents. This chapter establishes blockchain-based electronic bill of lading conceptual model, with which stakeholders may be able to state and transfer cargo ownership rights without the hassle of the handling paper, and proposes an implementation of the framework for researchers. This chapter provides a way for stakeholders to exchange these documents digitally, securely, and with no possibility of fraud in a neutral environment – extremely quickly and much more affordably than currently possible. The ecosystem of blockchain-based electronic bill of lading services will transform the global logistics industry. The study findings offer logistics managers and software programmers the ability to develop their documentation strategies and own blockchain-based electronic bill of lading platforms.

DOI: 10.4018/978-1-7998-1397-2.ch024

INTRODUCTION

Rapid advances in information technologies enable the transfer of a bill of lading in the electronic environment instead of using ordinary paper. The printing of bill of lading costs billions of dollars every year to the shipping and transportation industry. Thanks to the electronic bill of lading, its stationery is significantly reduced in international trade and unexpected events such as the original bill of lading cannot reach the destination on time due to delays in courier services. Hence, consignee does not need to pay a considerable amount for guarantee letters to the banks. Addition to fast delivery of the electronic bill of lading, there are several advantages to the stakeholders in the logistics industry:

- Security in the issuance of electronic bill of lading: There is no central storage system (Bolero project etc.) which could be attacked by hackers. Electronic bill of lading is the most crucial document, which is to be encrypted and securely written on the blockchain network, accessible only with traders' private keys.
- Fast transfer of an electronic bill of lading: The electronic bill of lading provide to issue an electronic bill of lading instantly and is immediately available to the exporter. When the agreed conditions are met, the bill of lading is transferred to the legal owner of goods – instantly, without couriers in the middle.
- Paperless documentation: A blockchain-based bill of lading is an electronic bill of lading, which is legal and functional of a paper bill of lading. There is no need to print, send, store and archive it in a conventional way anymore.
- Cost reduction in the transfer of documents**:** The transfer of bill of lading originals with couriers making business extremely expensive and too slow. The average courier cost is around $100 and it takes up to 10 days to ship to the final destination. Millions of bill of lading are generated every year.
- Payment in the transfer of ownership: The issuance of bill of lading will be done by paying Ethereum coins. The stakeholders may buy electronic tokens from Ethereum network and they can easily transfer of funds to the exporter by Ethereum coins. It will protect exporter or importer from exchange fluctuations. On the other hand, the electronic bill of lading may offer a service that the importer may transfer money by using the electronic letter of credit conceptual models.
- Tracking of cargo and bill of lading: The blockchain based electronic bill of lading may offer real-time cargo tracking through Internet of Things technology.
- Backup of an electronic bill of lading: The stakeholders may view the archive of issued and received electronic Bill of lading.

Digitization in bill of lading has many attempts since 1980s. At the beginning of digitization, electronic bill of lading platforms were member-only systems, which have the central registries and controlled by the trusted organizations. When closed central registries make a transaction, the user should be registered to the system. In case of involvement of non-member to the system, a paper bill of lading should be used instead of an electronic bill of lading.

This is the major obstacle to use the electronic bill of lading platform for non-members. Addition to the membership, the insurance of transactions is another obstacle for electronic bill of lading' stakeholders. The stakeholders may avoid using electronic bill of lading so that every transaction should be insured in in central registry very costly (Bolero Project etc.).

Hence, this study aims to establish blockchain based electronic bill of lading by creating its own algorithm and that a conceptual model may help stakeholders who may able to state and transfer cargo ownership rights without the hassle of the handling paper and propose an implementation of the framework for researchers.

The article starts with a critical review of the literature on relevant technologies before explaining the phenomenon. The methodology section presents the conceptual model architecture and the creation of new algorithm for blockchain based electronic bill of lading. The findings are then presented and the study concludes with recommendations for future research.

LITERATURE REVIEW

A literature review with keywords and citations was performed on the topics about electronic bill of lading between 2015 and 2018. Throughout the interval, the study was carried out keyword searches on the database "Web of Science" and "Scopus" to identify relevant articles in the five premier journals. It was performed by using specific topic keywords ("electronic bill of lading", "blockchain", "bill of lading", "possession", "transferrable", "token", "key") and considered articles published in the 2015–2018 period. Then, these articles were reviewed by checking citations to find out relevant papers in these journals during the same period. Hereafter, this snowball procedure was followed by checking the relevant citation indexes to find out other articles published in these journals that cited the existing set of identified papers during the 2015–2018 period. Overall, this process resulted in a set of 12 articles published in the five premier technology and electronic business journals at different industry sectors.

Blockchain and Smart Contracts

A blockchain can be defined as a distributed database that saves a packed data into sealed blocks in a secure and fixed manner, chronologically. An incoming block will be linked to the end of block chain, which is a electronic ledger. Meanwhile each block will keep credentials to the previous content of the prior block. Its content may be already defined or randomly created by the users. However, the transactions is structured by the data regarding to the sealed blockchain structures.

When users connected to the blockchain network, they are so called a node. The blockchain node: (1) may login to the network, (2) saves updated block into the ledger, (3) listen all connections about transactions, (4) forward a eligible transaction into the network, (5) listen incoming blocks, (6) verify incoming blocks, and (7) handling a data on incoming blocks (Turkanovic et al, 2018).

The development of blockchain is identified as three phases or generations. Efanov (2018) suggests that the first development stage of blockchain is a digital currency, and it is followed by the digital economy, which is named as blockchain 2.0. Then the digital society comes along with the term blockchain 3.0. The literature of blockchain is still under development and focus on the applications of blockchain 1.0 and 2.0.

Apart from the applications (cryptocurrencies etc.) of blockchain 1.0, the smart contracts have the wide range of implementations that begin from simple payments to complex transactions. Such applications include smart contracts such as an electronic bill of lading or an electronic letter of credit. The most well-known platforms that run smart contract is Ethereum. Ethereum aims to provide a platform where anyone can create applications for change of data and value in a secure way. Some of the remarkable applications that can be built on Ethereum include identity management such as black stack and civil projects, trust and transparency, crowdfunding, marketplaces, copyright and ownership repositories, and governance. From the year of 2015 and under the terms of blockchain 2.0, the scholars began to search the advantages of smart contracts and they examined the industries of food, security, banking, finance, corporate governance, real estate, education, and logistics.

Although radical changes are occurring in blockchain technology, there is limited empirical studies to focus on the logistics industry. On the other hand, the majority of the studies include the manufacturing, banking, and education but it is important to address that they are not focused on business fields about transportation technology. Hence, the study is designed to address the mentioned shortcomings in the literature.

METHODOLOGY

At the first stage of this study, the literature review of blockchain technology and smart contracts has been performed. In order to develop the algorithm of the blockchain based electronic bill of lading, the block process diagram of issuance of bill lading has been carefully implemented as a conceptual model. Conceptual modeling is known to be essential in simulation development to provide a better understanding of the system in early stages of development, and in this way to increase quality of requirements, enhance communication between users and developers and help in verification and validation of software products. (Bozlu and DemirOrz, 2008) Regarding Stewart et al. (2001), modeling is the purposeful abstraction of a real or a planned system with the objective of reducing it to a limited, but representative, set of components and interactions that allow the qualitative and quantitative description of its properties. Strictly speaking, modeling is a methodological aspect of science. Conceptual models can be stated in different ways. A text and block diagrams specify how a system is constructed from a bunch of components in a model. Some commonly used conceptual modeling techniques and methods include workflow modeling, workforce modeling, rapid application development, object-role modeling, and the Unified Modeling Language (UML). In this study, data-modelling technique is used to conceptualize the electronic bill of lading. Data flow modeling (DFM) is a basic conceptual modeling technique that graphically represents elements of a system. DFM is a simple technique, however, like many conceptual modeling techniques, it is possible to construct higher and lower level representative diagrams.

At the second stage of the study, the implementation of the framework for researches, which include software, bundles like Node.js and blockchain platforms (such as Microsoft Azure), has been explained under a proposed system and create APIs to connect their application with the Azure Platform easily without worrying of the server-side coding. Hence, this study also consists of pseudo codes, which easily understand how blockchain based electronic bill of lading works.

DEVELOPING A BLOCK PROCESS DIAGRAM: BLOCKCHAIN BASED ELECTRONIC BILL OF LADING

A process block diagram is a simple flowchart that represents an overview of the process or system. Process block diagram is used to simplify a complex process. As opposed to a program flowchart, a process block diagram does not show inputs and outputs to the process. This section explains how blockchain based electronic bill of lading is modeled on a process block diagram. The process block diagram consists of connectors, routes, conditional routing, and jobs.

The Issuance of Blockchain Based Electronic Bill of Lading

Blockchain based Electronic Bill of Lading process is commenced that logistics service to Logistics Company is demanded via either consignee or consignor. Meanwhile, many of operation process in logistics is carried out by both Consignor and Carrier (means a logistic company having authorization for issuing Bill of Lading in accordance with international related regulations, not the main carrier), also including consignee if it is needed. To provide an instruction of bill of lading, it should be requested from consignor by the carrier. The digital transportation request from consignor is the booking note, which normally incorporates the provisions of the carrier's electronic bill of lading, adding only the cargo and shipment details such as cargo weight, load and discharge ports, rates, etc. The booking note facilitates to issue electronic hash data of consignor bill of lading. The hash data should consist of items (B/L fields) listed in Table 1. Afterward, consignor is to check and control in case of any correction on it. If any change on the draft electronic bill of lading for the correction is needed denoted by *Yes*, it is corrected and reissued by the carrier and then it is sent to consignor in order to check and control finally.

Table 1. Literature review on blockchain based smart contracts

Author	Year	Topics
Kosba et al.	2015	Smart Contract Applications based on Blockchain Cryptography and Privacy-Preserving Model
Norta	2015	Smart-Contracting Cooperations in Decentralized Autonomous Organizations
Takahashi	2016	Blockchain based Electronic Bill of lading in terms of UNCITRAL Model Law
Yuan	2016	Intelligent Transportation Systems in Terms of Blockchain
Huckle et al.	2016	IoT and Blockchain based Economy Applications
Hou	2017	The Application of Blockchain Technology in E-government in China
Weernink et al.	2017	The Blockchain Potential for Port Logistics
Hackius and Petersen	2017	The research on blocktechnology how effects the supply chain industry.
Lei et al.	2017	Intelligent Transportation Systems Dynamic Key Management in the Perspective of Blockchain
Turkanović et al.	2018	Higher Education Credit Platform with Blockchain Technology
Vos et al.	2018	DEFEND: A Secure and Privacy-Preserving Decentralized System for Freight Declaration
Niranjanamurthy et. al.	2018	Analysis of Blockchain technology with SWOT analysis.

Source: Authors

In addition, it is confirmed that the form is the final draft for issuance. After leaving of vessel from the port of loading, an electronic bill of lading is issued by the carrier as an electronic bill of lading.

The method of electronic payment is based on token but not the coin. It is to understand that coins or tokens are accepted as cryptocurrencies, even if a great number of coins are not a function as a currency or medium of exchange. The essential distinction between the coins and tokens is in their structure; coins are distinct currencies with their own separate blockchain while tokens operate on top of a blockchain that facilitates the creation of decentralized applications (Aziz, 2018). Token is acting as an important asset or utility, which is generally located on top of another blockchain. Tokens may illustrate any fungible or tradeable assets, which have advantage from commodities to loyalty points. While the researcher does not change the codes of blockchain, the creation of a token is very easy process. Blockchain may allow creating your own tokens on the platforms, for example Ethereum or Waves platform. The feature of creating own tokens gives a functionality which let to create an self-executing codes and there is no longer to require any third-party softwares to use. Accordingly, token is attached to the identity of the user with the title or the right to possess. An electronic bill of lading token has a digital signature with the transfer of an electronic bill of lading taking place by hashing the consignor's electronic bill of lading and the consignee public key, and digitally signing the consignee's electronic bill of lading using the consignee's private key. If freight of the shipment is paid by consignor denoted by *Yes*, the freight is to paid and carrier is confirmed after the payment so, electronic bill of lading is sent to consignee and carrier's agent (as of here, in following sentences carrier means carrier's agent at destination) at destination by using the consignor's private key. This technology cannot per se ensure the existence of a unique authoritative copy that cannot be altered.

After arrival notification of vessel to the consignee by the carrier, consignee applies to the carrier for taking delivery of delivery order of the shipment. If freight is needed to be paid by consignee denoted by *Yes*, the consignee is to pay the freight of the shipment upon carrier's requesting for the payment. Upon the carrier's confirmation the payment of the freight, at the destination with origin agent, carrier checks bill of lading is issued as an electronic bill of lading. While carrier can use the consignee's public key to verify whether the consignee has used its private key to digitally sign the transfer of the bill of lading, the consignee could already signed the hash data of bill of lading and the public key of a third party with its private key without consignee being able to verify this.

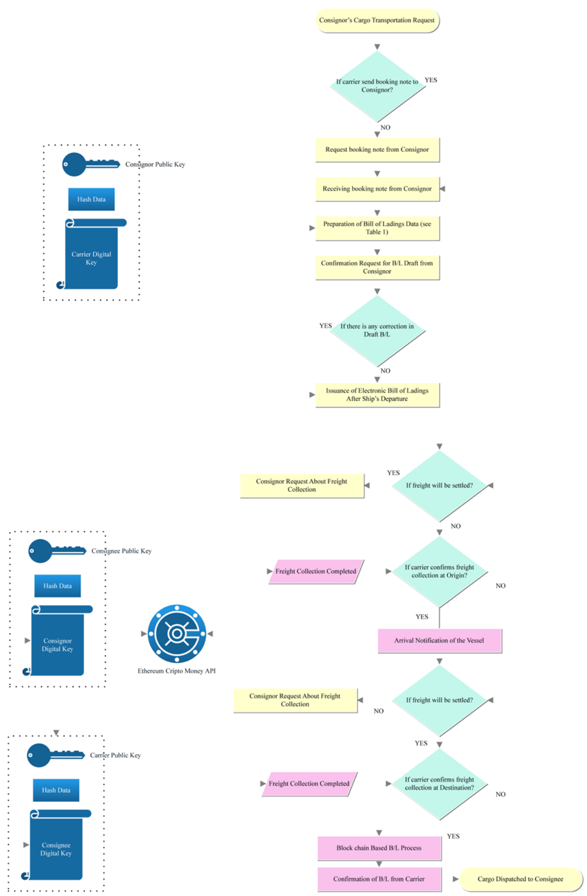
When the blockchain based electronic bill of lading is issued, the handling process over of the goods is that electronic bill of lading on consignee's hand, is delivered to carrier and then carrier confirms the original bill of lading and there is no problem of releasing of the goods to consignee by the carrier. Therefore, the goods are delivered to consignee. All the process of blockchain based electronic bill of lading is over.

A Proposed System

This section reveals the outlines of a blockchain based bill of lading platform. An abstract representation of the platform is presented in Figure 2. This platform is designed for creating, handling and managing blockchain based electronic bill of lading tokens as the payment of the freight and bill of lading's issuance on a distributed peer to peer network where peers are consignors/consignees and carriers.

The platform has two types of tokens: utility and security. Utility tokens refers to credit value for the value of the cargo, amount of freight and the issuance of the bill of lading, as with the consignor buys the tokens. Each consignee will hold a dedicated wallet for collecting tokens. The consignee will send a

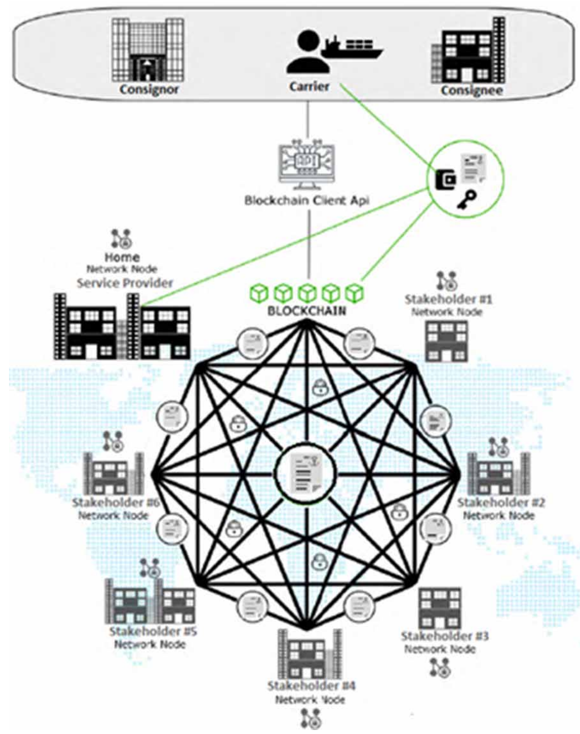
Figure 1. Blockchain electronic bill of lading process
Source: Authors



great number of tokens to another blockchain address. The transfer data is stored: (1) the official sender name (consignee) is identified, (2) the receiver (consignor) – he is anonymously presented, (3) a credit value (utility token), and (4) bill of lading identification. Moreover, the payment verification will be done by consignor tokens. For the blockchain security, stakeholders will be nominated a 2/2 multi-signature address by their carriers. The bill of lading process of consignor with utility tokens and their ability to prove the possession of security token, which will be held the information of electronic bill of lading. The data structure of a security token is already explained in Table 1.

Any accredited platform members may login to the blockchain network. While trying to login to the blockchain network, the service supplier will able to install a node on the network (see the fig.2) so that they may construct a globally secure network. A node publishes all messages across the network, which

Figure 2. The proposed blockchain based electronic bill of lading platform
Source: Authors



is the initial stage in the blockchain process that makes in a block verification, hence the verification of security token can be send for completed shipment. The platform node has a core blockchain client, which has own server instance with duplicate copy of the whole blockchain ledger. This situation makes the system more secure. The platform nodes will not have to mine transactions since it will be based on delegated-proof-of-stake consensus protocol. Therefore, there is no longer to require computing power by the platform node. This approach is also convenient from the security view for the electronic bill of lading network, since random peers cannot login to the network and create new utility tokens by mining them. Each new member may join the network and may reviewed by other members, might be assigned with utility tokens and asked to install a network node. Since a delegated-proof-of-stake distributed consensus version is designed for this platform, each member will register as a nominee in the blockchain platform and the electronic bill of lading community will vote for a nominee so that they will confirm transactions and seal blocks. It means that the members will vote for the member, which will be the most confirmatory and steady in its work.

Data Structure of Block

Block is the essential part of Blockchain technology. This is data structure of the B/L item, which will be connected in a chain inside Blockchain structure. All data will be stored inside of Blockchain objects illustrated in Figure 3.

Block data structure consists of:

Figure 3. Block data structure

```
class Block {
...
   constructor_bill(index_no, timestamp_bl, nonce_bl, prevBlockHash_bl, hash_bl, transactions_bl)
{
      this.index_bl = index_bl;
      this.timestamp_bl = timestamp_bl;
      this.transactions_bl = transactions_bl;
      this.nonce_bl = nonce_bl;
      this.hash_bl = hash_bl;
      this.prevBlockHash_bl = prevBlockHash_bl;
   }
```

1) **Index_no:** It defines a property, which is basically the number in the block chain.
2) **Timestamp_bl:** It refers to creation date of data.
3) **Transactions_bl:** Once a block is created, it stores new transactions that will be inside of block in a blockchain and they cannot be changed anymore.
4) **Nonce_bl:** It refers to the small information for the content of block, which creates a hash output. While a nonce value is inserted in the hashing algorithm, the output (signature) will be a string that will show with 5-zeros: '00000fc87…e0').
5) **Hash_bl:** It is defined as a string, which consists of all transactions, and small information that is basically compressed.
6) **PrevBlockHash_bl:** A prior blockchain hash data.

Blockchain Object

The blockchain object is a class, which has a various features to handle block chain.

1) Create a new block,
2) Access the content of the last block,
3) Build new transaction and hash block,
4) Run "Proof of Work",
5) Handle pending transactions that should be stored when the new block is created.

Block constructor consists of:

1) **Chain_bl:** It is an array where to keep all block in the chain.
2) **Transaction_bl:** It is an array where to keep all of the new transactions before inserting into new block.
3) **A Genesis Block:** It is the first block in the chain. Every blockchain requires proceeding with one block.

Figure 4. The structure of block constructor

```
class Blockchain {
    constructor() {
        this.chain_bl = [];
        this.pendingTransactions_bl = [];
        this.createNewBlock(10, '0', 'Genesis_block');
    }
}
```

Figure 5. Algorithm for creating a block

```
class Blockchain {
    ...
    createNewBlock(nonce_bl, prevBlockHash_bl, hash_bl) {
        const newBlock = new Block(
            this.chain.length + 1,
            Date.now(),
            Nonce_bl,
            prevBlockHash_bl,
            hash_bl,
            this.pendingTransactions
        );

        this.pendingTransactions = [];
        this.chain.push(newBlock);

        return newBlock;
    }
}
```

Creating a Block

The block object should be created so that the data may inserted into the all transaction. The method consists of three parameters: nonce_bl, prevBlockHash_bl, hash_bl. In the first step, the block object is created and then set "pendingTransactions" equal to an empty array. Once a new block is generated, all data may be stored into the new transaction. To remove all data in the entire array may facilitate to start over for the next block. Afterward, all data will be pushed into the block and returned to the new block.

Creating a New Bill of Lading Transaction

This is the main method to be used for all operations of the electronic bill of lading. The coder can use it for confirmation for issuance of the electronic bill of lading between shipper and carrier. The functions of every transaction are described in the next section of this study.

Proof of Work For Electronic Bill Of Lading

Proof-of-Work, or PoW, is the original consensus algorithm which can be used to confirm transactions and produce new blocks in the blockchain network. With the PoW, users vote each other in order to complete transactions on the block chain network. In this platform, all users send digital tokens to other users. A decentralized ledger collects all the transactions into blocks with the below source code in Figure 7.

Figure 6. Creating a new bill of lading transaction

```
class Blockchain {
...
 fetchLatestBlock() {
      return this.chain[this.chain.length - 1];
}
...
 hashBlock(prevBlockHash_bl, currentBlock_bl, nonce_bl) {
     const bl_data = prevBlockHash_bl + JSON.stringify(currentBlock_bl) + nonce_bl;
     const bl_hash = sha256(bl_data);
     return bl_hash;
}
...
makeNewTransaction(container_id, voyage_id, bl_id, master_bl_id, cargo_id, cargo_type, hs_code, coo, precarriage_by, prp,
weight, carrier, nvocc_code,  master_carrier, vocc_code, shipper, notifier, consignee, agent, pod, poa, conttype, contsize, fcllcl,
ifcontarized, charges, hazardous, hazardousclass, hazardousUNNumber, hazardousFlashpoint, prepaid, collect, operation, location,
time
) {
      const transaction = {
            container_id:container_id,
            voyage_id:voyage_id,
            bl_id:bl_id,
            master_bl_id:master_bl_id,
            cargo_id:cargo_id,
            cargo_type:cargo_type,
            hs_code:hs_code
            coo:coo
            precarriage_by:precarriage_by,
            prp:prp,
            weight:weight,
            carrier:carrier,
            nvocc_code:nvocc_code,
            master_carrier: master_carrier,
            vocc_code: vocc_code,
            master_carrier: master_carrier,
            vocc_code: vocc_code,
            shipper:shipper,
            notifier: notifier,
            consignee:consignee,
            agent_name:agent,
            port of departure: pod,
            port of arrival: poa,
            container type: conttype,
            container size:contsize,
            container fcl/lcl, fcllcl,
            containerized: ifcontarized,
            charges:charges,
            hazardous: hazardous,
            hazardousclass: hazardousclass,
            hazardousUNNumber: hazardousUNNumber,
            hazardousFlashpoint: hazardousFlashpoint,
            prepaid_freight:prepaid,
            collect_freight: collect,
            operation: operation,
            location: location,
            time: time
      }
      this.pendingTransactions.push(transaction);
      return this.getLatestBlock().index + 1;
   }
}
```

Figure 7. Proof of work

```
class Blockchain {
   ...
   PoW(prevBlockHash_bl, currentBlockData_bl) {  //Proof of Work
      let nonce_bl = 0;
      let bl_hash = this.hashBlock(prevBlockHash_bl, currentBlockData_bl, nonce_bl);

      while (hash.substring(0, 2) !== '00') {
         nonce_bl++;
         hash = this.hashBlock(prevBlockHash_bl, currentBlockData_bl, nonce_bl);
      };

      return nonce_bl;
   }
}
```

The Data Fields of Electronic Bill Of Lading

The method takes 35 parameters which transaction of the bill of lading is used in Table 2 at Appendix. This function pushes this transaction into our pending transactions array. Of course, there are many stakeholders to perform many transactions in the blockchain. Once a new transaction is created, it will be inserted into our new transactions array.

MANAGERIAL IMPLICATIONS

This research reveals the important managerial implications for managers and software programmers. A great amount of the existing literature about the blockchain technology is practitioner-oriented and gives an expectation for a huge impact of the technology. Most of them focus on specific industries such as education, supply chain, health and finance. In spite of the emerging studies in this field, only few study work on the paperwork in logistics industry.

In the light of this study, the logistics community can build upon long open source research by adopting their documentation needs. Because of the increased information transparency, this study guides container carriers, for example, in redesigning their transportation structures for reducing the documentation costs. In addition to that, this study provides benefits for open source coders. Because, the current blockchain based bill of lading platforms does not offer any open source support in coding, yet.

On the other hand, managers might deduce that a strategic reorganization and delegation of responsibilities is needed to cope with blockchain-induced changes. The changes may include positive impacts (such as new payment methods between consignor and consignee for cargo value, the issuance of bill of lading etc.).

Building a blockchain based electronic bill of lading network might develop information transparency so that managers may be substituted by increased control by the blockchain. Additionally, the ease with which new business relationships can be established might change substantially because of “trustless systems” that enforce contractual compliance without any need for personal relationships (Kiviat, 2015).

DISCUSSION

Blockchain-based bill of lading is a smart contract application that is a computer protocol intended to digitally facilitate, verify, or enforce the negotiation or performance of a bill of lading. In the literature of smart contracts, there are several studies examined the different fields: education, law, manufacturing, medical and transportation. This study observed that only 5 of the 12 found use cases are considered to the context of the Internet of Things. Three of them (Hou, 2017; Turkanović et al, 2018; Vos et al., 2018) use the blockchain for trading data collected by sensors of IoT devices and other goods.

This study observed that in some papers data are inserted in the blockchain, employing the 80 bytes of transactions reserved for arbitrary data; in other papers, a customized blockchain is used to store the data. The mining techniques reported are all less computationally expensive alternatives to PoW. However, PoW requires very high computational power, and so IoT devices with limited capabilities would not be able to add blocks in the blockchain. Therefore, the nodes should have a great computational power.

In this study, the algorithm aims to create the electronic bill of lading and the search was limited to published studies reported in English this field. For example, Vos et al. (2018) suggested a blockchain based freight declaration platform. Its key contribution is a data partitioning scheme and several protocols that enable such a system to utilize blockchain and its powerful validation principle, while also preserving the privacy of the involved economic operators. Maintaining privacy on the blockchain based electronic bill of lading is a complicated issue. Recall that their public key (or its hash) identifies each node. A node does not need to know everybody else’s key; they just need the key of their transacting counterparty (Eris, 2016).

CONCLUSION AND FUTURE RESEARCH

Blockchain-based bill of lading was proposed as a global blockchain-based electronic bill of lading platform. This platform has a distinct advantage of the blockchain over traditional electronic bill of lading platforms. With proof of concept, this study presents a prototype platform, which is based on the open-source coding. It addresses a globally unified viewpoint for consignors, consignees and container carriers. Carriers benefit from a single and transparent view of their completed shipments, while service providers have access to up-to-date data regardless of consignee origins. Other beneficiaries of the proposed system are potential customers, who can directly validate the information provided by carriers. This proposed platform eliminates risk on delayed delivery or loss of document and ensures confidence on time delivery. In addition to that, it can be redesigned for other transportation modes such as air transportation, road transportation etc.

A distributed peer-to-peer network system aims to transfer the title of ownership of the cargo from the consignors to the consignee in order to ensure an efficient, simplified, ubiquitous, based on blockchain technology. It is seen that this platform may potentially evolve into a unified, simplified and globally ubiquitous open source-based platform.

For the future research, researchers plan to test the prototype in a real-life environment, which would include the service provider, cargo owners and container carriers. In this way, the presented concept could be further validated. Additionally, the future study plan to adopt the electronic bill of lading blockchain so that each bill of lading would be nominated with a unique blockchain address and a pool of tokens. After completing shipment of the cargo, the consignee would get tokens from the consignor's address and not directly from the service provider. The service provider address would be a multi-signature address between a service provider and a container carrier.

This study further plan to extend this work and the blockchain based electronic bill of lading platform to be based on smart contracts and an appropriate version of the blockchain technology.

REFERENCES

Aziz. (2019, Jan. 12). Coins, Tokens, & Altcoins: What's the difference? Retrieved from https://masterthecrypto.com/differences-between-Cryptocurrency-coins-and-tokens/ ?cv=1

Bozlu, B., & Demirörs, O. (2008, June). A conceptual modeling methodology: from conceptual model to design. In *Proceedings of the 2008 Summer Computer Simulation Conference* (p. 30). Society for Modeling & Simulation International. Eris Industries DocumentationBlockchains. Available at https://docs.erisindustries.com/explainers/ blockchains/

Hackius, N., & Petersen, M. (2017). Blockchain in logistics and supply chain: trick or treat? In *Proceedings of the Hamburg International Conference of Logistics (HICL)* (pp. 3-18). epubli.

Hou, H. (2017, July). The application of blockchain technology in E-government in China. In *Proceedings 2017 26th International Conference on Computer Communication and Networks (ICCCN),* (pp. 1-4). IEEE.

Huckle, S., Bhattacharya, R., White, M., & Beloff, N. (2016). Internet of things, blockchain and shared economy applications. *Procedia Computer Science*, *98*, 461–466. doi:10.1016/j.procs.2016.09.074

Kiviat, T. I. (2015). Beyond Bitcoin: Issues in regulating blockchain transactions. *Duke Law Journal*, *65*(3), 569–608.

Kosba, A., Miller, A., Shi, E., Wen, Z., & Papamanthou, C. (2016, May). Hawk: The blockchain model of cryptography and privacy-preserving smart contracts. In *Proceedings 2016 IEEE symposium on security and privacy (SP)*, (pp. 839-858). IEEE.

Lei, A., Cruickshank, H., Cao, Y., Asuquo, P., Ogah, C. P. A., & Sun, Z. (2017). Blockchain-based dynamic key management for heterogeneous intelligent transportation systems. *IEEE Internet of Things Journal*, *4*(6), 1832–1843. doi:10.1109/JIOT.2017.2740569

Niranjanamurthy, M., Nithya, B. N., & Jagannatha, S. (n.d.). Analysis of blockchain technology: Pros, cons, and SWOT. *Cluster Computing,* 1-15.

Norta, A. (2015, August). Creation of smart-contracting collaborations for decentralized autonomous organizations. In *Proceedings International Conference on Business Informatics Research* (pp. 3-17). Springer, Cham. 10.1007/978-3-319-21915-8_1

Ølnes, S., & Jansen, A. (2017, September). Blockchain technology as a support infrastructure in e-government. In *Proceedings International Conference on Electronic Government* (pp. 215-227). Cham, Switzerland: Springer. 10.1007/978-3-319-64677-0_18

Takahashi, K. (2016). Implications of the blockchain technology for the UNCITRAL Works. Retrieved from http://www.uncitral.org/pdf/english/congress/Papers_for_ Programme/30-TAKAHASHI-Implications_of_the_Blockchain_Technology_and_UNCITRAL_ works.pdf

Turkanović, M., Hölbl, M., Košič, K., Heričko, M., & Kamišalić, A. (2018). EduCTX: A blockchain-based higher education credit platform. *IEEE access: Practical Innovations, Open Solutions*, *6*, 5112–5127. doi:10.1109/ACCESS.2018.2789929

Vos, D., Overweel, L., Raateland, W., Vos, J., Bijman, M., Pigmans, M., & Erkin, Z. (2018). DEFenD: A secure and privacy-preserving decentralized system for freight declaration. arXiv preprint arXiv:1803.09257.

Weernink, M., Engh, W., Francisconi, M., & Thorborg, F. (2017). The blockchain potential for port logistics. Retrieved from http://smart-port.nl/wp-content/uploads/2017 /06/Bijlage-6_White-Paper-Blockchain.pdf

Yuan, Y., & Wang, F. Y. (2016, November). Towards blockchain-based intelligent transportation systems. In *Proceedings 2016 IEEE 19th International Conference on Intelligent Transportation Systems (ITSC),* (pp. 2663-2668). IEEE. 10.1109/ITSC.2016.7795984

APPENDIX

Table 2. Fields stored in BL data in electronic bill of lading

B/L Field	Type of Data	Visibility	Field Definition for Container	Field Definition for Cargo
Container ID	Text	Visible	The ISO 6346 container identification number	
Voyage ID	Text	Visible	Concatination of the ship's IMO number and date of departure in ISO 8601 format	
BL ID	Text	Visible	Bill of lading Number for NVOCC	
Order No	Text	Visible	Customer Purchase Order Number	
Master BL ID	Text	Hidden	Bill of lading Number for VOCC	
Cargo ID	Text	Visible		This cargo's identification number, defined by the shipper
Cargo Type	Text	Visible		Description of this cargo's contents
HS Code	Text	Visible		The harmonized commodity description and coding system code for cargo
Country of Origin	Text	Visible		The country where a cargo shipped from.
Precarriage By	Text	Visible	A company who organize pre-carriage	
Place of Receipt of Precarriage	Text	Visible		The place where shipper handed over the goods to the carrier
Weight	Number	Visible	Weight of this container, in kilograms	Weight of this cargo, in kilograms
Measurement	Text	Visible		Measurement of this cargo, meters
Carrier	Text	Visible	A non-vessel operating carrier	
NVOCC Code	Text	Visible	A non-vessel operating carrier code	
Master Carrier	Text	Hidden	A vessel operating common carrier	
VOCC Code	Text	Hidden	A vessel operating common carrier code	
Shipper	Text	Visible	Person / company who sends this cargo	
Notifier	Text	Visible	Person / company who notified for this cargo	
Consignee	Text	Visible	Person / company who receives this cargo	
Agent Name	Text	Visible		A Shipper's Agent Name
Port of Departure	Text	Visible	Geographical coordinates of the loading port	
Port of Arrival	Text	Visible	Geographical coordinates of the discharging port	
Container Type	Text	Visible	Standart/High Cube/Hard-Top/Open-Top/Flatracks/Plats/ Tanks/Bulk/ Ventilated/Refrigerated	
Container Size	Text	Visible	Dimensions of conteiner box	
Container FCL/LCL	Text	Visible	Full Container Load/Less Container Load	
Containerized	Boolean	Visible	YES/NO	
Hazardous	Boolean	Visible	YES/NO	
Hazardous Class	Text	Visible	IMDG Class	
Hazardous UNNumber	Text	Visible	UN Number	
Hazardous Flashpoint	Text	Visible	Centigrade	

continued on the following page

Table 2. Continued

B/L Field	Type of Data	Visibility	Field Definition for Container	Field Definition for Cargo
Charges	Text	Hidden	Description of Charges	
Prepaid Freight	Text	Hidden	A freight paid already	
Collect Freight	Text	Hidden	A freight paid at destination	
Operation	Text	Visible	INSERT if package was inserted into container; REMOVE if it was removed”	
Standarts	Text	Visible	Bill of Lading Standard Terms & Conditions	
Location	Text	Visible	Place of BL claim	
Time	DateTime	Visible	Time of BL claim in ISO format	

Source: Authors

Chapter 25
Artificial Intelligence in Supply Chain Management

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ABSTRACT

This chapter develops a method proposal regarding digitisation of variables in road, maritime, and airline transport, and makes parameters machinable, output-producing algorithms methods. Results regarding which artificial intelligence is proper to be used in storage, distribution, stock, and order tracking, supply chain architecture, and third- and fourth-party logistical practices are sought. For this, artificial neural nets, software techniques, artificial intelligent philosophy, and the reflections on the business world are analysed.

INTRODUCTION

This study aims to develop a method proposal regarding digitisation of variables in road, maritime and airline transport and making parameters machinable, output producing algorithms methods. Results regarding which artificial intelligent is proper to be used in storage, distribution, stock and order tracking, supply chain architecture, third- and fourth-party logistical practices are sought. For this, today artificial neural nets, software techniques, artificial intelligent philosophy and the reflections on the business world are analysed.

In road transport, the problem of cost controlling, optimal route selection, and decision regarding proper loading selection are enabled with the supporting systems, artificial intelligence applications and fuzzy logic method. In the maritime transport, artificial intelligence techniques can take charge in port combinations, tonnage of thousands of containers to be shipped, the balance of ship, safety and port of discharge as both a software and hardware. Ports can carry out stuffing of empty and full containers in a rapid and safe way with the help of unmanned, autonomous systems. Airway companies have started to benefit from artificial intelligence algorithms in both passenger and cargo transportations. In fact, when all components are analysed one by one, they constitute one big whole that can speak the same language.

DOI: 10.4018/978-1-7998-1397-2.ch025

ARTIFICIAL INTELLIGENCE

Artificial intelligence is defined as the comprehension of human's mentality and trying to develop computer operations, which can present similar mentality. In other words, it is the thinking attempt of programmed computer. According to more broad definition, artificial intelligence is the computer, equipped with capacities unique to human intelligence such as knowledge acquisition, perception, vision, thinking and making decisions (Yapay Zeka, 2012). Even though artificial intelligence is generally associated with the computer units, it is also closely related to mathematics, biology, psychology, philosophy and other different sciences. The combination of information gathered from all of these sciences will eventually depend on the developments regarding artificial intelligence (Keleş, 2015).

Today, Siri, the artificial intelligence application, developed to help people on their mobile devices by Apple Corp., gives hundreds of answers to the millions of users regarding tens of thousands different issues at the same time. Siri is a product of an at least 20-year artificial intelligence research. It can be referred as an algorithm symphony or mathematical poem which hundreds of engineers wrap them up in voices and images. From this point of view, artificial intelligence is the field of computer sciences, which deals with the designing intelligent computer systems, i.e. systems having linguistic performance, learning, reasoning, solving problem abilities (Barr & Feigenbaum, 1981:3).

The concept of artificial intelligence as medium that shapes the change is a benefit centre with its all risks, and points, which are open to discussion and improvement. Today, Uber has become the biggest taxi company, which does not have a single taxi and has an organizational culture, benefitting from artificial intelligence applications in an effective way (Osborne, 2017:1). On the other hand, AirBnb, the biggest accommodation company in the world, has a service network which is in compliance with the millions of people's location, price range and quality choices without having a single accommodation. AirBnb makes system sustainable by analysing the consumption tendencies, choice criteria, personal expectations of users and updating the business processes according to the obtained results due to the algorithms of artificial intelligence (Grewali 2017). In addition to this, Google, Facebook and Twitter, the most popular media companies of the world, have their genuine artificial intelligence algorithms. Structures such as B2B (Busines to Business), Amazon, Alibaba, Hepsiburada, and C2C (Consumer to Consumer), B2C (Business to Computer) do not have their own stocks. They only mediate billions of dollars shopping and provide necessary technology, credibility, arbitration, easy payment for this shopping. Digital platforms considerably reduce the operation and dispute costs of people or institutions, arising during the mutual usage of a product or providing services (Schwab, 2016).

Artificial intelligence is not accepted as only an integration of software and hardware. Today, it is known that there is a bound between artificial intelligence and law, philosophy, sociology and anthropology. John McCharty says, "Artificial Intelligence cannot ignore the philosophy. Because then, its philosophy will be bad" in the conference, held in Stanford University (Topal, 2017).

In summary, the artificial intelligence applications, artificial systems, robotics and technological peripherals have more importance and rooted in human's culture, socio-economical perception and habits, scientific, political and intellectual lives day by day. Artificial intelligence is not the devilish structure that spells the death of us, deprives us from our personal rights and freedoms, economical freedoms as well as it is not a final and certain miracle that will save the future of human being. Artificial Intelligence is a field of computer sciences that deals with the designing of computer systems which have qualifications like linguistic performance, reasoning, problem solving. The history of artificial intelligence is briefly summarized as follows:

1920 The play, Rossum's Universal Robots, written by Czech author Karel Capek brought the robot word in the literature. In the play, synthetic human-looking robots, working for people, are used (Dağ, 2018).

1950 In the Mind, a philosophy journal, the article, "Accounting Machines and Intelligence", is referred as a cornerstone (http://tektasi.net/ retrieved on 04.06.2019).

1956 Machines that have learned and play games like chess, checkers, black jack, which engineers accepted as conformable with intelligence setup at the beginner level, emerged (http://tektasi.net/ retrieved on 04.06.2019).

1962 IBM 701 Checkers AI managed to beat a human for the first time (http://incompleteideas.net/book/first/ebook/node109.html retrieved on 05.05.2019).

1964 In the Artificial Intelligence laboratory of MIT, Joseph Weizenbaum developed the first artificial intelligence Chatbot application, named ELIZA is the first example of chatbots suchlike today's artificial intelligence wonder Siri or Cortana, developed for the human-machine activity (Weizenbaum, 1966).

1967 In 1967, an artificial intelligence application, Mac Hack is the first artificial system that participated in the intelligent games tournament against a human and gained a victory (https://www.chess.com/article/view/machack-attack retrieved on 14.06.2019).

1968 SHRDLU, the artificial intelligence application, prepared by Terry Winograd is a simple chatbot, coded with LISP. SHRDLU, coming to life in the PDP-6 operation system is designed as making contact with its users in English (Winograd, 1980).

1968 The application named Zobrist's AI, managed to win an amateur in the GO game, which has more possibilities, counting and moves than chess does (https://www.chess.com/article/view/machack-attack retrieved on 14.06.2019).

1988 Judea Pearl, an IT specialist and philosopher, brought out the theory regarding bringing possibility assessment and decision-making abilities in the artificial intelligence organisms in his book named "Probabilistic Reasoning in Intelligent Systems", published in 1988 (Vamos, 1992).

1989 Artificial ıntelligence researches met with the CNN (Convolutional Neural Network) technology, which is accepted as the basis of researches such as data mining and cryptocurrency. With this, which is named as ConvNet, they started to be tested in numeric expressions of virtual reality applications (Arel et al., 2010).

1997 The artificial intelligence programme of IBM named Deep Blue beat Garry Kasparov; the world chess champion (Hsu, 1999).

2000 Gripping successes have achieved because companies like Google, Facebook, Amazon, Twitter, the giant companies of today, find their rational solutions, required for data analyses, in artificial intelligence and artificial systems, and support financially the researches regarding them.

2004 DARPA (Defence Advanced Research Projects Agency) held the first unmanned automobile race, Darpa Grand Challenge in Mojave desert, USA (Yalçın et al., 2014).

2013 For the first time, an artificial intelligence application, simulating a 13-year old Ukrainian boy named Eugene Goostman, managed to pass the Turing test and convince 33% of the jury itself as a human. (Sample & Hern, 2014).

2013 Carnegie Mellon University (the leader institution of the world in the researches regarding internet and artificial intelligence) produced the artificial intelligence application named NEIL (Never Ending Image Learner). NEIL is unique with its ability to analyse the link between different images and figures. This development leaded to the algorithm of Google Image Search (Mitchel et al., 2018).

2016 The most rapid super computer of the world, developed by Chinese scientists, broke the speed record with Sunway Taihulight (Fu et al., 2016).

Today, more rapid and efficient data processing mean deeper analysis, coding, learning and memory. Sunway Taihulight operated with 93-petaflop while its second opponent Tşanhe-2 (also produced in Chine) operated with 34-petaflop performance. In a short time, facing with systems, as three times intelligent as today's systems, depends on the similar developments in all fields of informatics world. In order not to be stuck in traffic, your road assistant interprets and presents alternative routes by filtering similar data, gathered from the same area (Mitchel et al., 2018). There are billions of digital and artificial decisions such as from finding your lost mobile device to kitchen shopping, from electronic games that you want to play to unmanned cars made according to mathematic formulas, analysed data decisions and results.

Artificial intelligence systems, within the TYPE 1 category by 2000s, are named as "Purely Reactive". They have more limitations than recent artificial intelligence systems do. It has the simplest qualifications of its most-developed type. They perceive their environment as are, the simplest way and at the most basic level (Firby, 1987). Artificial intelligence systems, categorized as TYPE 2, are named as "Limited Memory". In these systems that have limited-memory definition, the perception of environment shows similarity with the environment perception of a living organism. These systems can carry some information, experienced in the past, to present and re-interpret depending on the capacity of programmed learning software. The most proper example of TYPE 2 is unmanned automobiles (Xiao et al., 2008). Artificial intelligence systems, categorized as TYPE 3, are named as "Theory of Mind". These creations can perceive the thoughts and feelings of human. They can develop socially relation networks, communicate with other people and intelligent synthetic systems, make different emotional expressions and perceive its current environment with its all distances and extensions (Moses, 2001). Artificial intelligence livings, categorized as TYPE 4, are "Self-Aware" individuals. They are aware of their own being. Synthetic organisms at this level can state their existence and have fictional souls named "internal states" (Kouvnev et al., 2010).

Institutions that use artificial intelligence applications within themselves in an effective way gain these favours (Şekkeli et al., 2018):

- 48% Automatic Communication and Decision Making: Chatbots, Customer Services artificial intelligence applications, Stock and Order Management Systems, Asset Management, Financial Markets Selling-Purchasing Decisions etc.
- 14% Automatic Feedback to Customers: E-Commerce Consumer Messages, Cargo Status Reports, Delivery Information, Order, Production, Distribution Information etc.
- 6% Preventing Repeated Processes: Supervision of Work-flows, Performance Analyses, Multi-centred Purchasing Coordination (Chain Markets and Diners)
- 5% Reports regarding the Course of Business: Predictive Analytics, Providing Data on Market Risks etc.
- 4% Advanced Reports
- 20% All of the above-mentioned points
- 3% other.

The idea that today's algorithms are significantly different from Fortran, LISP based productions in terms of rational way and software is common. However, the fictional structure has been protected. Algorithms, used in artificial intelligence applications, are classified between each other (Özer, 2015).

SUPPLY CHAIN MANAGEMENT AND LOGISTICS

Supply Chain Management

The relationship between the concepts of Supply Chain Management and Logistics is debatable. Supply chain management is the umbrella of a big family in terms of its meaning, duty fields, job descriptions, methodology. Supply Chain Management is the general meaning of a process. This circular process has fractions, which consist of sub-units and sub-processes. It is the whole process in which material, information and source flow, providing the proper product at proper time at proper place, at proper price and at proper cost, possible in the supply network to the customers, are integrated (Babacan, 2003).

Supply chain management is a circle management that provides added value. Customer, product, storage, transportation, customs clearance, value-added services, informatics, distribution and gathering, operational researches, supplier(s) that provide services and sub-contractors can be shown as the components of this circle (Bali et al., 2014).

Logistics

The logistics word with its known meaning today arose and became widespread in the literature in 1800s. Word meaning of logistics can be seen in the French dictionaries of 17th century. Even though *logistique* is a French word, logistics word can also be seen in English sources at similar period (Paker et al., 2017). Its origin is known as logos (logicalness) in ancient Greek. In its derived form, logistics is built upon the meanings of rationale, reasonable computing. Travelling Salesman Problem helped the concept of supply chain management become scientific and gain a place in business and academic world as from 1911 (Tanyaş, 2014). The idea of "Postponement", put forward by Wroe Alderson, included recommendations regarding the re-shaping of the supply chain with marketing networks (Alderson, 2006). Alderson is one of the first researchers by stating the linear bond between the supply chain and profitability by putting forward that the success of marketing can be achieved by planning properly the steps of transportation of the product from the field to the final customer in his work named "Marketing Behaviour and Executive Action", published in 1957 (Calonius, 2006). In 1952, Norman Woodland and Bernard Silver registered their barcode systems with the patent number 2612994. Today, it is almost impossible to think a supply chain management without barcode. (Woodland & Bernard, 1952). 50s were a period of time in which several breakthroughs were made. It played an effective role in order to bring an institutional roof organization in operational researches on behalf of APICS (American Production and Inventory Control Society) and supply chain management (Cox et al., 1998).

Kurt Salmon Associates, management consultation company, having a righteous reputation and reliability in the retailer sector, made first detailed supply chain management analysis regarding textile and ready-made clothing sector in 1985 (Lummus et al., 2001). With his article named "Triumph of the Lean Production", regarding his studies on Toyoto Production System in 1988, John Krafcik put forward the definition of Lean Production (Krafcik, 1988). Lean Production is accepted as the first intellectual step of Lean Procurement function. Desert Storm Operation, carried out in Iraq in 1991, is the first full-scale military operation in which the results of modern organizational researches were put in the practice (Kavak, 2013).

Mapping of seas leaded to open new lines of merchandise and not only products but also the information were started to be shared with the help of these lines. Aviation was rapidly accepted in not only the defence industry but also the transport sector. Today, three sub-headings as road, airline and maritime transport come to mind when said transportation. Apart from these, however, there are important sub-headings such as multimodal and intermodal transport, pipeline transport and other (passenger, electric, Hyperloop, space) (Deveci & Çavuşoğlu, 2013).

The evolutionary structure of logistic services is grouped as 3rd Party Logistics, 4th Party Logistics and 5th Party Logistics (Selvardis & Spring, 2007). These groups are used to refer the integration levels, the diversity and scope of services in the process of supply chain management. In time, it evolved from the structure, referred as "In House" and shaping its supply processes of customers with its internal sources to 2PL, 3PL, 4PL, 5PL (Vasiliauskas & Jakubauskas, 2007). It can also be accepted as an indirect indicator that expresses the usage rates of external sources of institutions during the business flow of supply chain management. "Party" is used as "partner". First party is the partner of decision-maker that produces the business order and trade. In addition, this is the customer that buys the service of supply chain management. 1st party covers not only customer but also the real and legal persons, the customers of supply chain management. Second Party is the group that refers to the direct transporters. Ownership can be as not only the relevant companies' having legally all commercial vehicles but also their operation with leasing contracts. Business partners of supply chain management are referred as 3rd Party (3PL) (Erkan, 2014).

ARTIFICIAL INTELLIGENCE AND SOLUTION MODELS DEPENDING ON THE INTEGRATION WITH SUPPLY CHAIN MANAGEMENT

Today's Models

Today, all of the learning-based models are an imitation of learning processes of human. The applications of today's artificial intelligence systems on the industry of supply chain management are nothing more than undertaking the duties, carried out by people earlier, by mechanical systems. Nevertheless, it can be said that it is too early to refer today's artificial intelligence as fully independent. These synthetic creatures, made become learner and decision-maker by algorithms and codes, are still highly human-dependent structures (Uğur & Kınacı, 2006).

Simultaneous Airway Tariff System

Participation of an artificial system in the process is faster its results are gotten in a shorter time than the industries, acting little data because almost all of the critical decision points in the airway services are digitalized. Tobias Grosche, from Airconomy Gmbh, and Franz Rothlauf, from the University of Mainz, built a system that develops answer with artificial intelligence algorithms to the process, optimizing the timetable (Fink & Rothlauf, 2015).

Travelling Salesman Problem and Artificial Intelligence Algorithms

Information regarding Travelling Salesman Problem (TSP) was given in the previous chapters. TSP does not appear at the visiting plan limitation of one salesman. Same problem is frequently encountered in the business flows of supply chain management. Especially during the process of Reverse Logistics, it is necessary the acceptance of faulty and idle products from the necessary sales centres and discharging them to the most proper factory or storehouse, appealing that product. In a delivery process accepted as simple, there are hundreds of variables such as sales centre, main storehouse, cross dock, factory, parts warehouse, delivery time, places of every unit, working time, product loading and unloading competences, transport vehicles, their types, their capacities, the possible empty locations suitable for the load for every shipment and the planning of this empty space at the least road, fuel and work time. This number decreases and increases depending on the scale of the network of supply chain management (Alaykıran & Engin, 2005).

Online Transportation and Load Optimization Programmes

Online platforms that bring together the owner of load and transporter companies have provided services since 1990s. Most of these platforms perform on the basis that the owner logs the information of load to be transported and the transporter company logs the details of the vehicle, proper for the load into the system. These structures, which provide simple database services and do not have artificial intelligence add-ons at the beginning, have turned into smart and learner systems today. The transport frequency of load, the empty space of vehicle, and the transport demands of the city, where the current cargo is delivered, have become proactive structures that unite the supply and demand. Online cargo platforms, which use actively the artificial intelligence applications, handle this concept at two simultaneous channels. The first one is searching and association algorithms. These mathematical clusters, referred as Search and Ranking Algorithms, have turned into structures that make breakthrough in the association of mathematical clusters with the transporters (Agichtein et al., 2006). There are tens of different algorithms, which help the owner of load and transporters find the proper load for themselves. In fact, they take place of the biggest freight forward companies of today because the number of organizational and individual customers, provided services by online systems, is referred as hundreds of millions. No doubt, the customer satisfaction arises during the process of after sales support in such a knowledge-intensive business flow (Yurtay et al., 2014).

Smart Storehouse Systems

The practices of Pattern Matching, Validation, Prediction, Selection are the terms, used in the definition of robotic systems, constitute the backbone of Artificial Intelligence of autonomous, unmanned logistic storehouses (Coffey et al., 2004). Companies such as Amazon, Hitachi, Gap, Samsung, Apple, Walmart, which need large-scaled storehouse management, benefit from artificial intelligence system in the units within their supply management network and lead them to improve. In the storehouse in Manchester, Amazon uses robots, acting dependently on the artificial intelligence system that read barcode, put products on the shelf, pick the ordered product from the shelf and prepare them for the shipping. With the unmanned storehouse model, storehouse manages the two hundred thousand orders daily at the error rate of 0.00002. The contributions of artificial intelligence system and robots to the process is the going away human-centred problems such as speed, non-stop working hours, cancelling out the accident risk, taking out the salary and salary-related costs (Kocaman & Kocaman, 2013).

Freight Vehicles Integrated with Artificial Intelligence Systems

Since Lawrence Sperry invented the first autopilot in 1912, airplanes have flown with the mechanic and artificial decision systems through the sky (Usta et al., 2011). Today's planes have had the technology, which can take off and land on without pilot, since the late of 1980s. There is no need for an existence of an organic pilot in the cockpit during the processes, including taking off, endurance, landing and parking processes. The only reason for the existence of pilots in the cockpit creates an assuring image that enables passengers to have a journey without panic. This process has developed more rapidly in aviation, railway and waterage than motor vehicles, carrying load on the highway. Undoubtedly, the reason of it, the perception of the unpredictable behaviours of other people, driving on the highway by the artificial intelligence systems takes time. Unmanned vehicles within this issue refer freight vehicles that have gained autonomous mobility without driver, pilot, shipmaster, machinist (Ayşe & Kurnaz, 2009).

SWOT Analysis of the Integration of Artificial Intelligence Systems and Supply Chain Management

Artificial intelligence is a multi-disciplinary research field. It shapes its life by cooperating with several independent fields such as mathematics, informatics, manufacturing and services industry, retailer sector, public institutions, law. Due to this multi-dimensional feeding structure, one of which makes artificial intelligence the dynamic of change, it shows continuity as a positive solution mean rather than a fashion concept. While artificial intelligence algorithms are benefitting from the all resources of mathematics, they cover even technology, software engineering, processor architecture, the contracting of supply chain management. SWOT analysis is as follows:

Strengths: Artificial intelligence applications provide the companies of supply chain management with the effectiveness, efficiency, competition superiority. By recommending new problem-solving methods, artificial intelligence applications facilitate to open new solutions of chronic problems within the business processes. ML programmes and robots minimize the human errors in the storehouse and transfer centres in which they are used. Due to the artificial intelligence applications, big data analyses are possible and large-scaled databases produce usable results by real-time analysing before the data wears off. Artificial intelligence systems comply with the decision support systems that help companies perform with low cost and high profit.

***Weaknesses (Open to Improve)*:**The awareness of managements regarding the benefits gained by artificial intelligence systems and technological developments to the companies is not at the desired level. The integration process of artificial intelligence systems into the business processes are still not among the projects that realize in a short time (less than 1 year). Because the development costs of artificial intelligence systems have bigger budget rather than unintelligent systems, they are under the category of investment projects that can be funded by only large-scaled companies.

Threats: Competitors also develop similar technological investments at different scales. The possibility to invest on a wrong system means both loss of reputation and high cost for the company. The change rate of artificial intelligence systems and related structures is very high. The possible and speed for expiration and being old-technology of hardware, software and business model, participating in the inventory, are higher rather than other types of investment are. Because the registration of artificial intelligence systems is a difficult process, the opponents can easily copy. Highly technology-intensive business designs can affect negatively the organic relation between the business partner of supply chain management and its customer.

Opportunities: Businesses of supply chain management, which handle artificial intelligence systems in an efficient way, can get the returns on their investment in a 2-5-year mid-term period. Artificial intelligence systems enable businesses of supply chain management to analyse their organizational values and continue their lives without losing corporate identity, culture, process and critical advantage points by producing solutions that support the organizational memory setup. The market image of pioneer supply chain management, which have artificial intelligence, machine learning, robotic, autonomous structures, will shape as leader, innovative and positive. The development of artificial intelligence and its integration into the supply chain management processes will create a know-how for companies and pave the for them to get new customers.

CONCLUSION

It is observed that artificial intelligence applications have evolved into a commercial requirement for supply chain management, logistics, transport, storehouse management, customs services and businesses depending on these industries. There are companies, which are aware of this issue and already make necessary preparations for the future in Turkey. Artificial intelligence applications are not the products that consist of only codes. Its relationship with mathematics and philosophy should be accepted. In order to reach the number of adequate and experienced developers in our country, a curriculum in which the positive sciences outweigh should be applied before too late. Tomorrow's people, developing technology, designing, and thinking, will be competent within the bounds of today's education system. In Turkey, it should be focused on philosophy education that support the proper analyses of the relationship between the courses of positive sciences, primarily mathematic and concepts in order not to be foreign-dependent.

Artificial intelligence is not a magic wand to be expected to create a miracle. There is not a "master key", which opens all locks, or "master algorithm", which answers all these problems with the same formula. Companies of Supply Chain Management should be seen as tailors that produce special solutions to the special problems. Every customer, every market, every product group, and combination is different and single. Therefore, the demands, came from customers, would be unique. Supply Chain Management refers a big family from logistic companies, customs services, and transportation companies to port operators. Every business group has their own business sub-groups. When examined in a broader sense, keeping this network, seemed as complicated, operational and adding value, has become impossible without the support of technology, especially software technology. Companies have to get into market with new services, lines and price lists every day in order to turn increasing competitive pressure and decreasing profitability into an advantage. In countries, in which inflationary economies are intense, the only way of logistic companies to gain a right to live is to make a difference when included the ambiguity in the economic conditions. At several levels, the answers of the problem regarding providing more rapid, more comprehensive, lower prices and qualified services intersect artificial intelligence systems. It is seen that artificial intelligence systems are inevitable in meeting the demands of today's logistic companies, with all sub-branches, such as automation, efficiency, low cost, high profit, speed, timely, safely production. It is presumed that the safest solution of the problem, which obliges the logistic companies to renovate themselves administratively and organizationally against the demands regarding the products which need to be stored in hundreds of different codes, distribution, packing, customs clearance, repair, is to use more intensely the means of informatics in the business flows. It is thought that current situation leads logistic companies to become transparent, integrated and digital companies.

By considering that technology triggers learning, learning triggers change, change triggers competition advantage and superior benefit, it is predicted that the investment budgets of logistic companies, to be used for software and hardware in the future, have bigger share in their existing budget. Artificial intelligence applications are tools in which software, hardware or both, equipped with problem solving techniques, are used. A problem eventually arises and it remains idle after the solution. In this sense, humanizing the mechanic problem solving tools are presumed as unnecessary due to abstract thinking, features such as giving unusual reactions to usual conditions, keeping up with changes, working as a team, taking initiative that human-being has.

REFERENCES

Agichtein, E., Brill, E., & Dumais, S. (2006, August). Improving web search ranking by incorporating user behavior information. In *Proceedings of the 29th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval* (pp. 19-26). ACM. 10.1145/1148170.1148177

Akbulut, İ., Aydın, S., & Eleren, A. (2016). *Gri İlişkisel Analiz İle Tedarik Zinciri Performansının Değerlendirilmesi; Otomotiv Sektöründe Bir Uygulama. Uluslararası Katılımlı 16* (pp. 33–37). Üretim Araştırmaları Sempozyumu.

Aksoy, R., & Kurnaz, S. (2009). İnsansız Kara Araçları Ve Muharebe Gereksinimleri. *Journal of Aeronautics and Space Technol.*

Alaykıran, K., & Engin, O. (2005). Ant colony metaheuristic and an application on traveling salesman problem. *Gazi Üniversitesi Mühendislik-Mimarlık Fakültesi Dergisi, 20*(1).

Alderson, W. (2006). Marketing efficiency and the principle of postponement. In *A twenty-first century guide to Aldersonian marketing thought* (pp. 109–113). Boston, MA: Springer. doi:10.1007/0-387-28181-9_8

Arel, I., Rose, D. C., & Karnowski, T. P. (2010). Deep machine learning-a new frontier in artificial intelligence research. *IEEE Computational Intelligence Magazine*, *5*(4), 13–18. doi:10.1109/MCI.2010.938364

Babacan, M. (2003). Lojistik sektörünün ülkemizdeki gelişimi ve rekabet vizyonu. *Ege Akademik Bakış Dergisi*, *3*(1), 8–15.

Bali, Ö., Tutun, S., Pala, A., & Çörekçi, C. (2014). A MCDM approach with fuzzy dematel and fuzzy topsis for 3 pl provider selection. *Journal of Engineering and Natural Sciences*, *32*, 222–239.

Barr, A., & Feigenbaum, E. A. (1981). The handbook of artificial intelligence. Los Altos, CA: William Kaufmann, 163-171.

Calonius, H. (2006). Contemporary research in marketing: A market behaviour framework. *Marketing Theory*, *6*(4), 419–428. doi:10.1177/1470593106069936

Coffey, C. S., Hebert, P. R., Ritchie, M. D., Krumholz, H. M., Gaziano, J. M., Ridker, P. M., ... Moore, J. H. (2004). An application of conditional logistic regression and multifactor dimensionality reduction for detecting gene-gene interactions on risk of myocardial infarction: The importance of model validation. *BMC Bioinformatics*, *5*(1), 49. doi:10.1186/1471-2105-5-49 PMID:15119966

Cox, J. F., Blackstone, J. H., & Spencer, M. S. (1998). American production and inventory control society. *Publisher APICS, Dictionary, 9*.

Dağ, A. (2018). Transhumanism in cinema and novel: The samples of the film "Blade Runner" and novel of "Neuromancer". *RumeliDE Dil ve Edebiyat Araştırmaları Dergisi*, (11), 89-98.

Deveci, D. A., & Çavuşoğlu, D. (2013). Intermodal rail transport: Opportunities and threats for Turkey. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, *5*(1), 93–120.

Erkan, B. (2014). The importance and determinants of logistics performance of selected countries. *Journal of Emerging Issues in Economics*, *Finance, and Banking*, *3*(6), 1237–1254.

Filiz, E., Karaboğa, H. A., & Akoğul, S. (2017). BIST-50 index change values classification using machine learning methods and artificial neural networks. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 26*(1), 231-241.

Fink, A., & Rothlauf, F. (Eds.). (2008). *Advances in computational intelligence in transport, logistics, and supply chain management* (Vol. 144). Springer. doi:10.1007/978-3-540-69390-1

Firby, R. J. (1987, July). *An investigation into reactive planning in complex domains* (Vol. 87, pp. 202–206). AAAI.

Fu, H., Liao, J., Yang, J., Wang, L., Song, Z., Huang, X., ... Zhao, W. (2016). The Sunway TaihuLight supercomputer: System and applications. *Science China. Information Sciences*, *59*(7), 072001. doi:10.100711432-016-5588-7

Grewal, E. (2017, 4). Airbnb & machine learning. Retrieved from https://www.techemergence.com/airbnb-machine-learning-how-data-and-socialscience-make-it-all-work/

Hsu, F. H. (1999). IBM's deep blue chess grandmaster chips. *IEEE Micro*, *19*(2), 70–81. doi:10.1109/40.755469

http://tektasi.net/wp-content/uploads/2014/01/yapay-zeka-teknolojilerinin-end%C3%BCstrideki-uygulamalari.pdf

http://incompleteideas.net/book/first/ebook/node109.html

https://www.chess.com/article/view/machack-attack

Kavak, G. (2013). Birinci Körfez Savaşı Sonrası Irak'tan Türkiye'ye Göç ve Sonuçları. *II. Türkiye Lisansüstü Çalışmalar Kongresi*, 435-444.

Keleş, N. (2015, 9). Yapay Zeka ve Uygulama Alanları. Retrieved from http://www.bilgiustam.com/yapay-zeka-nedir-uygulama-alanlari-nelerdir/

Kocaman, B., & KOCAMAN, B. (2013). The technologies of energy storage on smart grids and microgrids. *Bitlis Eren Üniversitesi Fen Bilimleri Dergisi*, *2*(1), 119–127.

Kounev, S., Brosig, F., Huber, N., & Reussner, R. (2010, July). Towards self-aware performance and resource management in modern service-oriented systems. In *2010 IEEE International Conference on Services Computing* (pp. 621-624). IEEE. 10.1109/SCC.2010.94

Krafcik, J. F. (1988). Triumph of the lean production system. *MIT Sloan Management Review*, *30*(1), 41.

Lummus, R. R., Krumwiede, D. W., & Vokurka, R. J. (2001). The relationship of logistics to supply chain management: Developing a common industry definition. *Industrial Management & Data Systems*, *101*(8), 426–432. doi:10.1108/02635570110406730

Mitchell, T., Cohen, W., Hruschka, E., Talukdar, P., Yang, B., Betteridge, J., ... Krishnamurthy, J. (2018). Never-ending learning. *Communications of the ACM*, *61*(5), 103–115. doi:10.1145/3191513

Moses, L. J. (2001). Executive accounts of theory-of-mind development. *Child Development*, *72*(3), 688–690. doi:10.1111/1467-8624.00306 PMID:11405573

OsborneC. (2017). Uber uses AI. Retrieved from http://www.zdnet.com/article/uber-uses-artificial-intelligence-to-figure-out-yourpersonal-price-hike/

Özer, M. C. (2015). Bilgisayar Müziği Dillerinin Tarihçesi. *Devlet Türk Musikisi Konservatuvarı Dergisi*, 47.

Paker, S., Çullu, B., Paker, N., & Çiçek, S. Yelken Yarış. Organizasyonlarının Lojistik Süreçleri Üzerine Keşifsel Bir Araştırma. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, 27-50.

Sample, I., & Hern, A. (2014). Scientists dispute whether computer 'Eugene Goostman' passed Turing test. *The Guardian, 9*.

Schwab, K. (2016). *Dördüncü Sanayi Devrimi* (Z. Dicleli, Trans.). İstanbul, Turkey: Optimist Yayıncılık.

Şekkeli, Z. H., & Bakan, İ. (2018). Smart FActories. *Journal of Life Economics*, *5*(4), 203–220.

Selviaridis, K., & Spring, M. (2007). Third party logistics: A literature review and research agenda. *International Journal of Logistics Management*, *18*(1), 125–150. doi:10.1108/09574090710748207

Tanyaş, M. (2014). *İstanbul lojistik sektör analizi raporu*. Müstakil Sanayici ve İşadamları Derneği Loder Dergisi.

Topal, Ç. (2017). Sociological imagination of Alan Turing: Artificial intelligence as social imaginary. *Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Dergisi, 57*(2).

Uğur, A., & Kınacı, A. C. (2006). Yapay zeka teknikleri ve yapay sinir ağları kullanılarak web sayfalarının sınıflandırılması. *XI. Türkiye'de İnternet Konferansı Bildirileri*, 362.

Usta, M. A., Akyazi, Ö., & Akpinar, A. S. (2011, June). Aircraft roll control system using LQR and fuzzy logic controller. In *Proceedings 2011 International Symposium on Innovations in Intelligent Systems and Applications* (pp. 223-227). IEEE. 10.1109/INISTA.2011.5946069

Vámos, T. (1992). Judea pearl: Probabilistic reasoning in intelligent systems. *Decision Support Systems*, *8*(1), 73–75. doi:10.1016/0167-9236(92)90038-Q

Vasiliauskas, A. V., & Jakubauskas, G. (2007). Principle and benefits of third-party logistics approach when managing logistics supply chain. *Transport*, *22*(2), 68–72. doi:10.3846/16484142.2007.9638101

Weizenbaum, J. (1966). ELIZA---a computer program for the study of natural language communication between man and machine. *Communications of the ACM*, *9*(1), 36–45. doi:10.1145/365153.365168

Winograd, T. (1980). What does it mean to understand language? *Cognitive Science*, *4*(3), 209–241. doi:10.120715516709cog0403_1

Woodland, N. J., & Bernard, S. (1952). *U.S. Patent No. 2,612,994*. Washington, DC: U.S. Patent and Trademark Office.

Xiao, Y., Wei, Z., & Wang, Z. (2008). A limited-memory BFGS-type method for large-scale unconstrained optimization. *Computers & Mathematics with Applications (Oxford, England)*, *56*(4), 1001–1009. doi:10.1016/j.camwa.2008.01.028

Yalçın, Ö., Topcu, N., Arar, Ö. F., Akpınar, S., & Gürbüz, A. (2014, April). Akay02 driverless vehicle architecture for campus environment. In *Proceedings 2014 22nd signal processing and communications applications conference (SIU)* (pp. 2257-2260). IEEE. 10.1109/SIU.2014.6830715

Yapay Zeka. (2012). Retrieved from http://www.turkcebilgi.com/yapay_zeka

Yurtay, Y., Yurtay, N., Akçetin, E., & Kılıç, A. (n.d.). Freight optimization in container loading: Case study. *Yönetim ve Ekonomi Araştırmaları Dergisi, 12*(23), 228-247.

Chapter 26
Blockchain Technology in Maritime Transportation and Management

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ABSTRACT

This chapter discusses using blockchain technology in maritime transportation and management. Blockchain technology is less than 10 years old. With a lot of its features, the new technology has the potential to solve many problems in many sectors. Nowadays, this potential attracts many companies and organizations to try the blockchain technology in their sector to find the solution to their problems, to increase their profit, and to decrease the time spent for doing their jobs. Like other sectors, there are many works in maritime transportation and management for using blockchain technology. This chapter introduces blockchain technology and examines current and future uses and applications of it in maritime transportation and management.

DOI: 10.4018/978-1-7998-1397-2.ch026

INTRODUCTION

The transportation of goods from one place to another within the world trade constitutes an important link of the logistics system. In addition, transportation constitutes the largest activity of the logistics system, which accounts for one third of the logistic costs. As it is known, two thirds of the world is covered by oceans and seas. The fact that seas and oceans constitute a physical obstacle necessitates transportation by either maritime or airway. Compared to the maritime transportation by air transportation, it is seen that transportation costs are very low in maritime transportation and the amount of cargo carried by a ship at one time is hundreds of times higher. Therefore, maritime transportation is unrivaled as the best method of transportation.

According to 2018 figures (Worldbank, 2019a), the gross domestic product of the world is approximately US $ 85,791 trillion. Considering the monetary value of the products exported in world trade, it is seen that the figure is US $ 19.6 trillion (Worldbank, 2019b). It is known that seventy five percent of this trade is carried out by sea. The continuation of commercial transactions in maritime transportation, which have such a size, requires the operation of many mechanisms. Due to the international nature of maritime transportation, although transportation is based on certain standards in the historical process, differences in language, system and law between countries cause the use of many intermediaries and many commercial documents. This causes loss of time and money. In some cases, the transportation may cause the cargo to arrive late due to bureaucracy problems. In order to solve the problems created by this complex system in maritime transportation, it is inevitable to use a system other than classical methods. Thanks to envisaged system, it is considered that costs can be reduced while increasing the amount of goods transported, that is, making maritime transportation much more effective. Considering the studies conducted in recent years, it is appreciated that blockchain technology can bring practical solutions to many problems of maritime transportation.

It has been almost ten years since blockchain technology was first introduced by Satoshin Nakamoto with his article “Bitcoin: A Peer-to-Peer Electronic Cash System” (Nakamoto, 2008). During this time, blockchain technology has started to attract the attention of the whole world. Because the system was first introduced to the world by electronic money system concept, blockchain technology was mostly semantically mixed with virtual money. For this reason, blockchain technology is thought to be just an electronic money system. Today, it is understood that the system is a reliable recording system rather than electronic money. Previously, it was seen that the institutions approaching this system with suspicion started to find ways to understand this system more closely and benefit from it.

Blockchain technology consists of computers connected to each other in a decentralized structure. Data is recorded by encrypting all computers in the chain. In this way, it is not possible to change the data illegally and the data is stored in a safe manner. Due to the accuracy of the data, there is no need for intermediaries which are known as Trusted Third Parties in international trade. The elimination of these intermediaries reduces costs. In addition, in blockchain technology, all kinds of records are open to everyone, so transparency is in the foreground. Thanks to these features, blockchain technology has been used in maritime sector as in many other sectors. In this chapter, the current applications of blockchain technology in maritime transportation and management in the world have been determined by the literature review method and it has been evaluated that blockchain technology can find solutions to problems in this sector in the future. The study is important in terms of compiling blockchain technology’s usage areas in maritime transportation and management and offering solutions to current problems.

Maritime transportation and management starts with the acquisition of a ship. Ship acquisition becomes either by purchasing the ship or by chartering the ship. The price of the ship, the daily charter rate or the freight rate is determined by the economic market conditions in the world. The shrinking of production in the world in some periods and consequently the decrease of world trade causes less supply of goods to be transported by sea. This leads to a decrease in the demand for ships, resulting in a supply-demand imbalance. The long-term continuity of this imbalance causes the ships to be scrapped before their useful life expires, to be sold at low prices or to be laid up for a while. By means of the transparency that it creates, the use of blockchain technology in ship purchase and sale and ship chartering is considered to provide accurate values that are far from speculation in determining the ship's valuation, daily charter rate or freight rate of the ship. Due to its complex and bureaucratic structure, numerous commercial documents are used in maritime transportation. There are also many institutions and intermediaries in this trade. Thanks to the characteristics of the blockchain technology, many studies for creating many documents used in maritime trade such as the bill of lading have been started by using blockchain technology. In addition, today in many maritime companies, network-based computer systems have a wide range of uses. This makes maritime companies risky against cyber-attacks. For this reason, every company in this sector must take measures against cyber-attacks. Considering the characteristics of blockchain technology, it is observed that there are great advantages against network based classical computer systems. Blockchain technology, which is impossible to decode as well as the fact that the encrypted structure and information stored on all computers that make up the blockchain technology, will be useful in preventing cyber-attacks.

The aim of this section is to introduce the potential uses of blockchain technology in maritime transportation and management and to give an idea about how blockchain technology will create an opportunity to solve the problems in this sector. First of all, in the study, a description of maritime transportation and management and blockchain technology is made and the usage areas of blockchain technology in different sectors are introduced. Then, the applications of blockchain technology in maritime transportation and management are explained under the headings of ship purchase and sale, bill of lading, container weight verification, ship registration process, port and terminal operations, cyber security. In the last part of the study, results and evaluations are stated.

BACKGROUND

Importance and Development of Maritime Transportation

Gross Domestic Product (GDP) is a monetary measure of the market value of all final goods and services produced in a period. GDP varies due to changes in the economic situation of countries. In general, GDP increases with technological and economic developments and GDP decreases in periodic economic crises. The sum of the GDPs of all countries of the world shows the monetary value of all goods and services produced in the world. In global economic crises, a decrease in world production is observed as the production of all countries is generally reduced. There is an inseparable relationship between GDP and world trade. As world GDP increases, world trade volume increases, as GDP decreases, world trade is adversely affected and world trade volume decreases. The effect of increasing and decreasing trade volume is seen most rapidly in the world maritime transportation. Because almost all the goods transported in the world are transported by sea. With the increase in trade volume, the demand for maritime transportation increases and with the decrease, the demand for maritime transportation decreases. Therefore, maritime trade volume is also increasing or decreasing. The increase or decrease in the demand for maritime transportation causes the freight rates of the goods transported by ships to change. When the demand is high, freight rates increase and when the demand is low, freight rates decrease. As a result of the increase in trade volume and therefore the demand for maritime transportation, the maritime transportation sector develops and benefits from this situation. Otherwise, the demand for maritime transportation decreases and the maritime transportation sector suffers from this situation.

Table 1 shows the GDP, World Merchandise Exports and Total Cargo in maritime transportation between 2008 and 2017. When the table is examined, it is clear that there is a linear relationship between GDP and the quantity of goods exported and the amount of goods transported in maritime transportation. Due to the increase in GDP, trade and consequently the amount of maritime transportation increases. The table also shows the dramatic decreases in World Merchandise Exports and Total Cargo's decrease in maritime transportation in 2008, when the world economy went into crisis. In 2008, 5 percent decline in world GDP was seen to correspond to 22.3 percent drop in World Merchandise Exports and a percent drop in goods transported by sea.

Blockchain Technology

The blockchain is a chain of information that is formed as a block of information entered into a network system consisting of computers connected to each other. In other terms, a blockchain is a distributed network that is shared via a computer network between the agreed parties. The blockchain consists of a number of linked blocks secured by encryption and holding the time information of operations verified by the network community. When an element is added to the blockchain, it cannot be changed; a blockchain converts it into a constant record of past activity (Seebacher & Schüritz, 2017: 14).

In almost all commercial systems, there are intermediaries who make the work continue and earn money from this business. In complex commercial systems, the number of these intermediaries is so many that sometimes this situation can rise to uncontrollable levels. This situation causes the costs to

Table 1. World GDP, World Merchandise Exports and Total Cargo in maritime transportation

Year	World GDP (trillion US$)	World Merchandise Exports (trillion US$)	Total Cargo (billion tons) in maritime transportation
2008	63,61	16,27	8,229
2009	60,34	12,64	7,858
2010	66,03	15,40	8,409
2011	73,35	18,46	8,785
2012	75,05	18,63	9,197
2013	77,19	19,07	9,514
2014	79,30	19,11	9,843
2015	75,00	16,63	10,024
2016	76,10	16,13	10,289
2017	80,89	17,85	10,702

Data Source**:** (Worldbank, 2019a), (Worldbank, 2019b), (UNCTAD, 2018, p.5) increase more than necessary. For example, a lot of intermediaries are needed such as trusting banks, accountants, notaries in order to carry out an international trade transaction. All of these intermediaries help the operation of the system and cause the costs to be increased. The common feature of these intermediaries is that they are reliable. These agents are called Trusted Third Parties. The traders pay money not because of the complexity of the work of the intermediaries, but because they are reliable. In blockchain technology, Trusted Third Parties is a network of interconnected computers. Each computer connected to the system stores all records by creating a chain. Since data are recorded on thousands of networked computers, Trusted Third Parties are computers. One of the most important features of blockchain technology is to eliminate intermediaries. The system has data entry from various points. Management is controlled by a single system, while the storage point is all computers that make up the system. Unlike centralized record-based closed systems, all computers are interconnected within a decentralized structure. When an operation is performed on this system, the operation is shared with each node connected to the network, in other words all computers. Each data is added to the data before it. The process is copied to all computers in the chain. For this reason, it is not possible to make unlawful changes on the data. In addition, the information recorded is encrypted. This ensures that information is kept securely. Since the information is encrypted with tens of thousands of computers that make up the system and is in the form of information blockchains, it is impossible to change the recorded information and therefore is a highly reliable system. In commercial systems, all records are kept under the control of traders and are generally kept as a trade secret. There is no obligation of the traders except for public disclosure of the company reports when they are obliged to do so. Moreover, they see their public disclosure of each transaction as both unnecessary and time-consuming. In blockchain technology, such records are open to everyone, so that transparency is in the forefront. Payments or money transfers within blockchain technology can be realized without the need of any bank or intermediary. This event is made possible by virtual money which has been created on blockchain technology. This money is purely virtual money, independent of the central banks of the countries. The real money value of virtual money is determined within the scope of the relationship between supply and demand for virtual money. Nowadays, with the increase in trust in blockchain technology, it is appreciated and it is deprived because of shaking of trust. Spending is possible with virtual money. With the help of blockchain technology, the money can be kept in personal wallets created by individuals in their brokerage houses or on their computers. Owing to the reliable structure of the blockchain, more than one spending cannot be made with the same money. In his article "Bitcoin: A Peer-to-Peer Electronic Cash System" is considered the beginning of the blockchain literature. Nakamoto has proposed a virtual currency composed of digital signatures and under the control of the owner. In this system, to prevent the same money from being used for more than one expenditure, a person-to-person network has been foreseen, which keeps a notebook controlled by the nodes formed from computers and records the history of the transactions (Nakamoto, 2008: 8).

When the studies about blockchain technology are examined; it is stated that the most important features of blockchain technology are the transparency of all information. As a result of being open to the public and the creation of a reliable environment, the data becomes unchangeable (Seebacher & Schüritz, 2017: 11). The decentralization, persistence, anonymity and traceability characteristics of the blockchain have a potential for transformation of the traditional industry (Zheng vd. 2017: 563). As a result of the combination of distributed recordability and security, blockchain technology provides an attractive environment for the solution of existing problems in the financial and non-financial industries (Crosby vd. 2016: 17-18). Blockchain technology, although having some limitations, can be considered as a long-term solution for keeping reliable digital records as a public record-keeping and digital protection solution (Lemieux, 2016: 110). Blockchain technology differs with the concept of trust in the sharing economy, and it is suitable to some extent to replace the currently used reliable technologies and can only be done with reliable interfaces (Hawlitschek vd. 2018: 50). Blockchain technology has an infinite number of uses and it has penetrated into all areas of our lives and therefore our life (Efanov ve Roschin, 2018: 119). Development of blockchain applications for use in government applications will be useful (Hou, 2017: 4). Blockchain technology provides the opportunity to trade among people who do not know each other by providing the necessary environment of trust without the need of intermediaries (Aste, 2017: 26). Blockchain-based transactions can be monitored easily, so that they can play a key role in particular in supply chains for addressing crisis situations such as product recall after safety and security vulnerabilities, in addition to monitoring sources of insecurity (Kshetri, 2017: 71-72). Blockchain technology has great potential to facilitate complex financial transactions and cross-border money transfers (Beck vd. 2017: 383); introducing bitcoin and blockchain technology to financial infrastructures will be useful in solving existing financial problems (Cocco, Pinna, & Marchesi, 2017, p.18); Blockchain technology will provide effective and effective convenience to measure the performance and output of supply chain activities (Kshetri, 2018). When the above-mentioned studies are examined, it is seen that with the features of blockchain technology, it will be a life saver for the solution of problems in many sectors.

BLOCKCHAIN TECHNOLOGY IN MARITIME TRANSPORTATION AND MANAGEMENT

Blockchain applications have started to be used in maritime transportation and management as well as in all sectors and positive feedbacks have been taken. With the existing features of the blockchain, many problems of the sector can be solved which in turn will decrease the time, intermediaries and costs in the transactions, increase transparency, security and reliability. When the studies regarding the use of blockchain technology in the maritime transportation sector are examined; it is stated that blockchain technology for the maritime industry has the potential to transform industry to promote international trade (Loklindt vd. 2018: 197). Blockchain technology will stimulate the digital transformation of the global maritime industry, and the ability of the blockchain to remain competitive with the unceasing progress of technology, which will lead to the change of the maritime transportation industry (Ong, 2018: 30). The blockchain technology can be used as an essential component of the maritime cargo management system, considering its potential for information exchange and registration (Xu et al., 2018: 4). The maritime industry relies on a broad information infrastructure, including applications between transportation companies, ports, liner lines and other actors. For this reason, it is not possible to insert blockchain technology directly into this sector where there is a need for an interface application to ensure compliance (Jabbar &Bjørn, 2018: 297).

Nowadays, blockchain technology has the potential to provide cargo tracking and end-to-end supply chain visibility, record ship-related information, integrate marine insurance policies with smart contracts and digitize transactions on paper (UNCTAD, 2018: 87). However, the lack of electronic information exchange standards and the need for a common format for information exchange (Buchhorn-Roth, 2016) remain a problem in the maritime sector in the face of blockchain technology. However, it is evaluated that the appetite created by the benefit and trust of blockchain applications will solve these and similar questions in a short time and all obstacles to digitalization will be removed. In the following part, a framework of the current applications of blockchain technology in maritime transportation and management has been drawn in sub-headings and its future uses are examined.

Supply chain management in maritime transportation is the planning and management of the processes of delivering the handed goods to the buyers from the moment of their receipt. The biggest expectation of the shippers is to transport their goods at the lowest cost and in a safe way. Reducing costs without reducing the quality and safety of transportation in today's increasingly competitive environment requires correct decisions at every stage of the carriage. For this reason, it is necessary to observe each stage of transportation successfully. Thanks to the transparency of blockchain technology, supply chain transparency can be ensured in the maritime transportation sector. Furthermore, with this technology, costs can be reduced considerably by reducing bureaucratic procedures, transactions on paper and intermediaries. As other sectors in the world, companies dealing with maritime transportation have to reduce their costs by reducing their intermediaries and inefficient transactions with regard to documentation processes. It is a well-known fact that one of the most important features of the blockchain technology is the elimination of intermediaries. Below, pilot studies on the use of the blockchain in the supply chain are included.

An example of this is the joint venture of IBM and Maersk. The aim of the initiative is to develop an open digitization platform designed to be used by the entire industry to ensure that the goods are digitally tracked. In this way, it will be ensured that all actors, a very simple exchange of information, can follow the goods moving within the supply chain and a paperless trade will be achieved. In this way, time and costs will be reduced (UNCTAD, 2018: 88). IBM and Maersk's joint venture are expanding because of IBM's signing a memorandum of understanding with Pacific International Lines, one of Singapore's leading companies and a port group PSA International. With the use of blockchain, Maersk's supply chain solutions company, Damco, sent flowers from Kenya, orange from California and pineapple from Colombia to the Port of Rotterdam (Diordiiev, 2018: 59). As another example, the Hyundai Merchant Marine Company and other consortium members in September 2017 may be given pilot studies for shipment reservation and cargo delivery, for blockchain applications using safe paperless processes; in this study, it was aimed to monitor and manage the reefer containers on board in real time (Kang, 2017). The fact that blockchain technology eliminates intermediaries, reduces transactions on paper, and can easily follow the movement of goods within the supply chain owing to its transparency feature, and the successful completion of plotting applications show that blockchain applications can be used effectively in future supply chain applications.

Ship Sale and Purchase

There are generally four markets in the maritime transportation system. These are the freight market, the sale and purchase market, the shipbuilding market and the demolition market (Stopford, 2003: 77). There is a strong link among the four markets and the supply and demand balance of each market is based on the economies of scale. The sale and purchase market is a volatile and risky market. In times of crisis, the fact that the buyer and seller cannot come together at the right time and at the right place causes the ships not to be sold at their actual value. The sale and purchase of a ship usually carried out through brokers. It is the cornerstones of the ship sales process that the ship is brought to the market, the price and conditions are negotiated, an agreement is announced to announce the conditions of sale, the necessary controls are performed and the ship is delivered to the new owners.

When the ship is placed on the market for sale, a broker is appointed or the shipowner carries out the sales. However, when price negotiations for sales are made, time pressure and the need to make quick decisions often do not allow the ships to be bought and sold at the value they need (Pineus, 1986). When determining the price of the second hand ships, the age of the ship, cargo carrying capacity, attributes, and compliance with international standards, class, inspection and survey reports and sea and load conditions must be taken into consideration. When determining the ship value, it is mandatory to use one of the models or mixed models as opinion survey, trend analysis, mathematical models or probability analysis.

Considering that the estimation of the market value is not always correct in the second hand ship valuations; firstly, a reasonable price determination of the ship with a regression analysis, calculation of the long-term asset value (LTAV) and a price adjustment based on the distinguishing features will be appropriate. Blockchain's ability to store big data and processing these data using artificial intelligence applications will minimize unforeseen uncertainties in the calculation of long-term asset value. In this way, speculation will be prevented and accurate information will be provided to the decision makers. By the inclusion of data into the system with blockchain technology and banks' integration into this system using financial technologies (FINTECH), the institutionalization of the blockchain will increase, and many costs will be eliminated from taxation practices to commission costs, which will bring ship values closer to real values. Because blockchain is a transparent technology that enables people who do not know each other to trust shared information and records, the need for a third party to verify the information will be eliminated. With the digitization of the ship information, everyone will be able to access this information easily, the information will be transmitted and stored more quickly, documents requiring wet signature will be eliminated. Thus, the sale and purchase processes will be more transparent and fast. By converting, the sales contracts, which are widely used in sale and purchase processes to blockchain based intelligent contracts, automation of the processes will be provided and online audits can be made easily. Unlike written contracts, processes in intelligent contracts are resolved automatically, and the blockchain system guarantees that smart contracts will work similarly for all participants. As the system is subject to constant control, the risk of error in intelligent contracts is greatly reduced. Smart contracts continue their obligations and reporting, minimize operational errors, and accelerate the process. Loan financing can be facilitated without the need of intermediaries through smart contracts. It may also benefit from the creation of risk rating frameworks for selection of syndicated loans, standardization, providing access to financial details.

Bill of Lading

The Bill of Lading is unarguably the single most important document in the shipping industry, since it acts as a cargo receipt, contract of carriage, as well as a document of title across the stages of the supply chain (Jabbar & Bjørn, 2018: 301). According to Article 1228 of the Turkish Commercial Code (TCC); the Bill of Lading is a bill that proves that a carriage contract has been made, shows that the item has been received or loaded to ship by the carrier and however and only in return for its submission the carrier is obliged to deliver the goods. As understood from this article, the carrier is obliged to deliver the goods to the person who brings the bill of lading in the port of destination. Bill of Ladings often come to discharging ports after ships (Diordiiev, 2018: 58). One of the reasons why the bill of lading does not reach the buyer of the goods in time is the postal delays or there may be a delay in the inter-bank transactions in a foreign trade with letter of credit transactions. Due to this and other reasons, the bill of lading may not be delivered to the buyer on time by the buyer's bank.

In addition, bill of lading is one of the documents that may be subject to commercial fraud. In the "Recognizing and Preventing Commercial Fraud" published by United Nations Commission on International Trade Law (UNCITRAL) in 2013, the bill of lading is shown in "the forged or fraudulent documents group" that covers the documents that may be used in connection with commercial frauds (UNCITRAL, 2013). In other words, the commission defines the bill of lading as a widely forged or fraudulent document.

It is foreseen that blockchain technology can be used in order to prevent the delay of the bill of lading to the unloading port and to prevent the forgeries mentioned above on the bill of lading. Due to the fact that the transactions made via blockchain technology are completely digital and electronically transmitted, any delays in the post or banks can be prevented. In addition, the elimination of intermediaries will eliminate the need for letter of credit transactions and banks serving as a reliable intermediary institution. With distributed structure of the system, all the information added to the blockchain by encrypting and because the original can be always seen on the blockchain, it will not be possible to counterfeit on the bill of lading (Morley, 2017). It will also eliminate the human error (Takahashi, 2016: 206). Thanks to the fact that everyone can see records, all parties will be able to track the goods being transported. In addition, freight payments can also be made with virtual money. Since the trade will be done through blockchain technology, which has a completely reliable recording system, it may not need the bill of lading anymore. However, in order to achieve these advantages, the international legal structure should be made suitable for the blockchain-based bill of lading.

Blockchain applications in the maritime industry are the first and the most advanced research applications (Czachorowski et al., 2019). As a matter of fact, in 2017, two logistics companies, Sparx Logistics and Wave Limited, together with a container ship operating company named Zim Integrated Shipping Services, completed a pilot project on blockchain based paperless bills of lading; with this system, containers sent from China to Canada have been delivered to buyers successfully (Blenkey, 2017). The Israel-based Logchain Company has completed shipment of goods from Belgium using a pilot blockchain application using electronic bill of lading and letter of credit; the company expects that shipping costs will be reduced by between 7% and 9%, and that the two weeks work will be reduced by one to two minutes in terms of documentation (Chambers, 2019a). Singapore's Pacific International Lines (PIL) has sent mandarin oranges from China to Singapore using an electronic bill of lading built on the IBM Blockchain Platform; with the plot application, it is stated that a 5-7 day documentation period is reduced to the size of seconds (Chambers, 2019b).

In many countries, such as the above-mentioned applications, blockchain-based bill of lading pilot applications are available. Although the blockchain-based bill of lading is currently in pilot application level, it is inevitable that it will be used all over the world in a very short time due to its numerous advantages. By using the blockchain, it is evaluated that classical systems will gradually disappear and a digital structure will be used. It is clear that the bill of ladings created by using blockchain will lead to positive results in efficiency, productivity, security, transparency and speed, and to eliminate the analog systems in global cargo and port operations (Ong, 2018: 31). The digital bill of lading will accelerate the process, reduce costs and risks, and eliminate large amounts of paper (Lehmacher, 2017). In addition, it is stated that blockchain technology can guarantee the uniqueness of bill of lading by preventing double expenditure; however, the legal structure should be made suitable for the creation of blockchain based bill of lading (Takahashi, 2016: 210-211). Furthermore, by way of smart contracts that can be created by blockchain technology, it is possible to connect the charter party contracts and the bill of lading with each other and a change that can be made on them can be made unanimously by all parties (Diordiiev, 2018: 59).

Container Weight Verification Requirement

For the safer implementation of maritime transportation, the International Maritime Organization (IMO) on the verification and reporting of the gross weights of the containers to be loaded on the ships has imposed some obligations. These obligations entered into force as of July 01, 2016. The intention behind this initiative is to prevent accidents due to improper loading, and to prevent loss of life at sea and in the harbor. The factor that caused the IMO to take action in this regard was the accidents caused by overloading the containers or not knowing their weights correctly. Here, three major accidents can be given as examples.

The 4419 TEU container ship, MSC Napoli, passed through the English Channel on the morning of January 18, 2007, faced heavy seas, broke down from the hull and began to sink. In the investigation conducted by the Marine Accident Investigation Branch (MAIB) after the accident, 660 containers loaded on the deck were weighed and 137 of them (20%) were found to be approximately 3 tons more than their declared weight. In total, it was seen that it was 312 tons more than the declared weight. In the report, it was stated that the inconsistencies in the container weights did not cause this accident to be on its own but contributed to it. (MAIB, 2008) In February 2011, in Australia's Darwin port, it was reported that the loading limits of the crane were exceeded and that the container fell next to two harbor workers, since a 40-foot container, which was declared as 4 tons, was actually 28 tons (Middleton, 2011). On June 11, 2011, the container ship named Demeb in the port of Algeciras was loaded with 163 containers and the vessel was in danger of capsized by heeling. Because of the investigation carried out by the Accident and Incident Investigations (CIAIM) after the accident, it was stated that the actual weights of the containers did not correspond to the declared weights and therefore caused the error in the stowage plan and caused the ship to be capsized. (CIAIM, 2012)

Due to these and similar accidents, IMO decided to take a precaution in this regard and the regulation was put into effect in 2016. According to this new regulation, a full container will be weighed before arriving at the port and this information will be transferred to the loading port. The information required to be transferred includes the container number, the maximum load capacity of the container, the gross weight and the weight measurement unit, the weighing date, the identity of the weighing instrument (registration no / serial no / authorization number, etc.), the method of weighing, the trade name of the coastal facility, the trade name of the weighing device operator and the certificate of authorization, the trade name and contact information of the shipper or its representative, and the name, surname and title of the approvator of the weighing document. It is clear that the most secure tool is the blockchain technology, given its superior features, to ensure that all of this information is fully transferred to the port, then forwarded to the carrier, and stored in records for a certain period of time, so that the information is not accidentally or intentionally changed or erased.

For example, in the United Kingdom, it was found that information transfer was not possible with the existing information technology infrastructure regarding the transfer of the weight information of the containers to the port and this created a new starting opportunity. Marine Transport International (MTI), a shipping broker and technology solutions provider, has launched a blockchain-based application. With this application, it will be ensured that the weights of the containers will be transferred to the ports without any problem, the sea transportation infrastructure will be extended to the landside and the actors not previously integrated into the system will be integrated into the maritime transportation infrastructure. (Jabbar ve Bjørn, 2018: 303)

As a result of the transparency to be achieved by using blockchain applications, it will be ensured that all parties within the container transportation will see the weights of the containers as soon as they are entered into the system, and the necessary preparations will be made by the port and the carrier before the containers arrive at the port. In this way, the overloaded containers are even prevented from going to the port and the certification process will be accelerated (Splash, 2017).

Ship Registration Process

According to international agreements, each merchant ship must be registered in a country. The country where the ship is registered is called the flag state. The flag state of a ship carries out the regulatory control of the ship. It regularly inspects the ship, certifies the equipment and crew of the ship, and publishes safety and environmental protection documents. A flag state carries out many transactions to certify its ship, to follow up its documents continuously, and to carry out these complex operations on paper. For this reason, operations can cause time loss and errors.

Blockchain applications in the world began to attract the attention of flag states. For example, the Danish Maritime Authority has begun operations to try to digitize the entire ship registration process. With a project that they are conducting, they are trying to provide a clear, safe and more efficient approach by using blockchain technology in ship registration processes (Chambers, 2017c). Lloyd's Register has developed a block-chain based prototype to make ship registration processes more efficient and faster. Lloyd's marine and offshore director, Nick Brown, says that blockchain technology has a lot of potential because of its stability and controllability, its ability to use information more efficiently than existing systems, and its ability to transfer information quickly (De, 2018). With the use of blockchain technology in ship registration processes, the system's distributed structure will eliminate the risks such as deleting or replacing the records, thanks to its transparency, the records can be observed by everyone and this can be done very easily when the records need to be updated.

Port and Terminal Operations

Ports or terminals are the starting or ending points of maritime transportation. Both ship and cargo related services are provided here. These services include many complex processes within the port or terminal. The ability to provide port and terminal services effectively depends on the most efficient planning of these complex operations. With a good planning, the efficiency of the port or terminal can be increased, while a bad planning can result in a loss of money. In the planning of many activities in ports and terminals, it was foreseen that blockchain technology would bring useful solutions and started to be used as pilot applications.

For example, in April 2015, the construction of a fully automatic and environmentally sustainable container terminal in the port of Rotterdam was completed and in September 2017 a field laboratory named Block Lab, which aims to develop applications and solutions based on blockchain, was launched (UNCTAD, 2018: 88). Port of Antwerp, along with T-mining, a logistics company, has launched a blockchain-based initiative to reduce paper handling (Tan, 2017). The Malaysia Institute of Supply Chain Innovation (MISI) and Shanghai Jiaotong University are conducting a joint research project to develop a platform using blockchain technology to address the complexity and inefficiency of less than container load (LCL) processes in Chinese ports. In this way, thanks to the transparency to be created, a trust can be created between the actors within the process, the flow of information will be accelerated through blockchain technology, and the transactions on paper and cost will be reduced by eliminating intermediaries (A. Tan, 2017). By using blockchain technology in port and terminal operations, it is considered that efficient planning of port and terminal operations can be achieved and thus the productivity of the port or terminal can be increased.

Cyber Security

Every system working on computer networks in the world is vulnerable to cyber attacks. In general terms, the cyber-attack is defined as: Deliberate attempts by unauthorized persons to access ICT (information and communications technology) systems, usually with the goal of theft, disruption, damage, or other unlawful actions (Fischer, 2016: 1). Every day, software developers try to take action against malicious hackers and the viruses they produce. In fact, the SANS Institute report estimated that a ransom attack occurred approximately every 20 seconds in early 2016, and the frequency of attacks increased to 10 seconds in September of the same year (SANS, 2017: 3). Because of its international character, network-based computer systems in the maritime transportation sector have a wide range of uses. For this reason, every company doing business in this sector must take measures against cyber attacks.

As regards the issue, the International Maritime Organization (IMO) initiated a study and adopted the Maritime Safety Committee's Decision No. 248 (98) on "administrations to ensure that cyber risks are appropriately addressed in safety management systems no later than the first annual verification of the company's Document of Compliance after 1 January 2021". This is the first mandatory term for cyber risks in the maritime industry, and is an important step in protecting the maritime transportation system and the entire maritime industry from increasing cyber security threats. (UNCTAD, 2018: 85)

The ransom attack on 27 June 2017 caused disruption in the computer systems in the world. This ransom attack, also affecting Maersk, has made it clear that cyber security threats are everywhere in the maritime industry (Baker, 2017). Maersk, which handles one-seventh of the world's transported containers, stated that this cyber attack, affecting Europe and India, affected all its units, including ship transport, port and tugboat operations, oil and gas production, drilling services and oil tankers. In addition, 17 container terminals operated by APM, the port operator of Maersk, were also attacked. Two of these terminals are in the port of Rotterdam. In the examination, it has been reported that computers in APM Terminals are infected with ransomware that encodes hard disks. (Gronholt-Pedersen, 2017) Maersk reported that cyber attacks caused $ 300 million in damage and that different and more protective measures had been put in place to protect their system from cyber attacks that might happen thereafter (Novet, 2017). This would not have happened if Maersk had used the blockchain on computer systems (Diordiiev, 2018: 59).

Considering the features of blockchain technology, it is observed that there are great advantages over network based classical computer systems. The only way to capture networks in blockchain technology is to penetrate the blockchain. The cryptic structure of the blockchain, which cannot be solved, can prevent this kind of penetration. In addition, it is not possible to delete the information or keep the hostage for ransom because the information is stored on all computers connected to the blockchain.

CONCLUSION

The public has increasingly supported the perception that the blockchain technology can provide solutions to unresolved problems in many sectors with its superior features. The biggest contribution to this support is the success in test applications with blockchain technology. When the studies with blockchain are examined, it is seen that both state and private institutions are starting to try blockchain technology and get successful results for solving the existing problems in many sectors. Maritime transportation and management is one of the fields that contain many problems and where blockchain technology can be used in order to find solutions to these problems. In fact, blockchain technology has been started to be tested in this field with many pilot applications and successful results have been started.

The superior features of blockchain technology can be listed as follows. It is impossible to change and delete the information as a result of encrypting and saving the information to all computers connected to the system. The transparency obtained due to the fact that the recorded information can be seen by all users so that the transactions can be easily controlled and the intermediaries are eliminated. The expenditures can be made easily with the virtual money generated by the blockchain technology. With these features of blockchain technology, it is envisaged that blockchain technology has the potential to transform the traditional industry into a modern structure, provides an environment for the solution of existing problems. It can be used as record keeping and protection of digital information, increases the possibility of safe trade among people who do not know each other, facilitates trading with virtual money, and provides a valid and effective environment for measuring the performance and outputs of the activities.

In maritime transportation and management, blockchain technology can be used in many areas such as ship purchase and sale, bill of lading, container weight verification, ship registration process, port and terminal operations, cyber security. Thus, many intermediaries and commercial documents can be eliminated; it can be used as a basic component of maritime cargo management system with the ease of cargo tracking and ability to provide end-to-end supply chain visibility. In addition, all records related to ships can be kept without error, the contracts can be turned into smart contracts and in this way time and money can be saved. With the use of blockchain technology in ship purchase and sale transactions, it is considered that unpredictable uncertainties in the calculation of long-term asset value of second-hand vessels can be reduced. Thereby preventing speculations on ship prices and providing accurate information to decision-makers, with the integration of financial technologies of banks into this system, institutionalization of blockchain technology may increase, the costs may decrease and this situation can bring the ship values closer to the real values. With the use of blockchain technology in bill of lading, it is considered that the delay of the bill of lading to the discharge port and counterfeiting on the bill of lading can be prevented, with the elimination of intermediaries. It can eliminate the need for letter of credit transactions and banks that serve as reliable intermediary institutions, it can eliminate human errors, thanks to the transparency, all parties can follow the goods transported and freight payments can be made with virtual money. By using blockchain technology in the container weights verification, it is considered that the weight of the containers and other cargo related information can be reported to the ports without any problem. As a result of the transparency to be obtained, all parties involved in the transportation of the container shall be able to see the weight of the containers as soon as they are entered into the system, it may contribute to the reduction of accidents due to overloading of the containers or the inaccuracy of their weight. With the use of blockchain technology in ship registration operations, it is considered that the system can eliminate the risks of deletion or modification of records with the distributed structure of the system. Thanks to transparency, everyone can easily observe records. By means of the fact that the information can be used and transferred quickly, these transactions can be performed very easily and without errors when records need to be updated. By using blockchain technology in port and terminal operations, it is considered that efficient planning of port, terminal operations can be achieved, and thus the efficiency of the port or terminal can be increased. It is considered that the use of blockchain technology can provide great improvements in cyber security. By using powerful blockchain technology instead of network-based computer technology, which is vulnerable to cyber attacks and partially protected, it is possible to increase the resistance of companies engaged in maritime transport and operation against cyber attacks, and to prevent the financial damages. However, it is a fact that blockchain applications are currently in need of development and that reliable interfaces, electronic information exchange standards, a common format and a legal infrastructure are needed to integrate with existing classical systems.

REFERENCES

Aste, T., Tasca, P., & Di Matteo, T. (2017). Blockchain technologies: The foreseeable impact on society and industry. *Computer*, *50*(9), 18–28. doi:10.1109/MC.2017.3571064

Baker, J. (2017). Maersk cyber attack should serve as a timely warning to others. Lloyd's List. Retrieved from https://lloydslist.maritimeintelligence.informa.com/LL108941/Maersk-cyber-attack-should-serve-as-a-timely-warning-to-others

Beck, R., Avital, M., Rossi, M., & Thatcher, J. B. (2017). Blockchain technology in business and information systems research. *Business & Information Systems Engineering*, *59*(6), 381–384. doi:10.100712599-017-0505-1

Blenkey, N. (2017). Zim completes pilot of blockchain based paperless Bills of Lading. Retrieved from https://www.marinelog.com/news/zim-completes-pilot-of-blockchain-based-paperless-bills-of-lading/

Buchhorn-Roth, M. (2016). Secure data exchange across supply chains: Blockchain and electronic data interchange. *Combined Transport Magazine.* Retrieved from https://combined-transport.eu/blockchain-edi-for-supply-chains

Chambers, S. (2017c). Denmark trials blockchain to register ships. Splash 247. Retrieved from http://splash247.com/denmark-trials-blockchain-register-ships/

Chambers, S. (2019a). Israeli start-up heralds blockchain shipment from Belgium. Splash 247. Retrieved from https://splash247.com/israeli-start-up-heralds-blockchain-shipment-from-belgium/

Chambers, S. (2019b). Mandarins arrive in Singapore ahead of Lunar New Year thanks to landmark blockchain shipment. Splash 247. Retrieved from https://splash247.com/mandarins-arrive-in-singapore-ahead-of-lunar-new-year-thanks-to-landmark-blockchain-shipment/

CIAIM. (2012). *Technical report a-20/2012*. Retrieved from https://madden-maritime.com/wp-content/uploads/2019/03/CIAIM-Deneb-Capsize-during-cargo-operations-June-2011.pdf

Cocco, L., Pinna, A., & Marchesi, M. (2017). Banking on blockchain: Costs savings thanks to the blockchain technology. *Future Internet*, *9*(3), 1–20. doi:10.3390/fi9030025

Crosby, M., Nachiappan, P., Verma, S., & Kalyanaraman, V. (2016). BlockChain technology: Beyond Bitcoin. *Applied Innovation Review*, (2), 6–19. doi:10.1515/9783110488951

Czachorowski, K., Solesvik, M., & Kondratenko, Y. (2019). *Green IT engineering: Social, business, and industrial applications* (Vol. 171). Springer International. doi:10.1007/978-3-030-00253-4

De, N. (2018). British maritime society builds blockchain tool for ship registration. Retrieved from https://www.coindesk.com/british-maritime-society-builds-blockchain-tool-for-ship-registration

Diordiiev, V. (2018). Blockchain technology and its impact on financial and shipping services. *Економіка. Екологія. Соціум, 2*(1), 51–63. Retrieved from https://ees-journal.com/index.php/journal/article/view/48/21

Efanov, D., & Roschin, P. (2018). The all-pervasiveness of the blockchain technology. *Procedia Computer Science*, *123*, 116–121. doi:10.1016/j.procs.2018.01.019

Fischer, E. A. (2016). Cybersecurity issues and challenges: In brief. *Congressional Research Service*, 1–12. Retrieved from https://fas.org/sgp/crs/misc/R43831.pdf

Gronholt-Pedersen, J. (2017). Maersk says global IT breakdown caused by cyber attack. Retrieved from https://www.reuters.com/article/us-cyber-attack-maersk/maersk-says-global-it-breakdown-caused-by-cyber-attack-idUSKBN19I1NO

Hawlitschek, F., Notheisen, B., & Teubner, T. (2018). The limits of trust-free systems: A literature review on blockchain technology and trust in the sharing economy. *Electronic Commerce Research and Applications*, *29*, 50–63. doi:10.1016/j.elerap.2018.03.005

Hou, H. (2017). The application of blockchain technology in E-government in China. In *Proceedings 2017 26th International Conference on Computer Communications and Networks, ICCCN 2017*. doi:10.1109/ICCCN.2017.8038519

Jabbar, K., & Bjørn, P. (2018). Infrastructural grind: Introducing blockchain technology in the shipping domain. *Proceedings of the 2018 ACM Conference on Supporting Groupwork - GROUP '18*, 297–308. Retrieved from 10.1145/3148330.3148345

Kang, T. J. (2017). HMM completes pilot blockchain voyage with reefer-laden boxship. Retrieved from https://lloydslist.maritimeintelligence.informa.com/LL111275/HMM-completes-pilot-blockchain-voyage-with-reeferladen-boxship

Kshetri, N. (2017). Can blockchain strengthen the internet of things? *IT Professional*, *19*(4), 68–72. doi:10.1109/MITP.2017.3051335

Kshetri, N. (2018). Blockchain's roles in meeting key supply chain management objectives. *International Journal of Information Management, 39*(June 2017), 80–89. doi:10.1016/j.ijinfomgt.2017.12.005

Lehmacher, W. (2017). Why blockchain should be global trade's next port of call. World Economic Forum. Retrieved from https://www.weforum.org/agenda/2017/05/blockchain-ports-global-trades/

Lemieux, V. L. (2016). Trusting records: Is blockchain technology the answer? *Records Management Journal*, *26*(2), 110–139. doi:10.1108/RMJ-12-2015-0042

Loklindt, C., Moeller, M.-P., & Kinra, A. (2018). How blockchain could be implemented for exchanging documentation in the shipping industry. In *Proceedings of the 6th International Conference on Dynamics in Logistics LDIC*, 194–198. doi:10.1007/978-3-319-74225-0_27

MAIB. (2008). *Napoli Report No 9/2008*. Retrieved from https://assets.publishing.service.gov.uk/media/547c703ced915d4c0d000087/NapoliReport.pdf

Middleton, A. (2011). 'Near miss' at wharf as 28-tonne container falls. Retrieved from https://www.abc.net.au/news/2011-02-21/near-miss-at-wharf-as-28-tonne-container-falls/1951486

Morley, H. R. (2017). Container weight blockchain shows tech's potential. *Journal of Commerce.* Retrieved from https://www.joc.com/technology/container-weight-blockchain-shows-tech%E2%80%99s-potential_20170830.html. Erişim Tarihi: 09.04.2019.

Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system.* doi:10.100710838-008-9062-0

Novet, J. (2017). Shipping company Maersk says June cyberattack could cost it up to $300 million. Retrieved from https://www.cnbc.com/2017/08/16/maersk-says-notpetya-cyberattack-could-cost-300-million.html

Ong, E. (2018). Blockchain bills of lading. *NUS Centre for Maritime Law Working Paper*, (17).

Pineus, K. (1986). *Ship's value*. London, UK: LLP Professional Publishing.

SANS. (2017). Cyber security trends: Aiming ahead of the target to increase security in 2017. Retrieved from https://www.sans.org/webcasts/2017-cybersecurity-trends-aiming-target-increase-security-103517

Seebacher, S., & Schüritz, R. (2017). Blockchain technology as an enabler of service systems: A structured literature review. In *Proceedings 8th International Conference on Exploring Service Science, IESS 1.7, 143*(April), 12–23. 10.1007/978-3-319-56925-3_2

Splash. (2017). Health, safety, and the blockchain. 24/7 Splash. Retrieved from https://splash247.com/health-safety-blockchain/

Stopford, M. (2003). *Maritime economics*. New York: Taylor & Francis Group.

Takahashi, K. (2016). Blockchain technology and electronic bills of lading. *The Journal of International Maritime Law, 22*(March), 202–211. Retrieved from https://www1.doshisha.ac.jp/~tradelaw/PublishedWorks/BlockchainTechnologyElectronicBL.pdf

Tan, A. (2017). A blockchain model for LCL operations in China. MIT Center for Transportation and Logistics. Retrieved from https://ctl.mit.edu/pub/newsletter/supply-chain-frontiers-64-blockchain-model-lcl-operations-china

Tan, W. Z. (2017). Antwerp to use blockchain technology in container handling operations. Lloyd's List. Retrieved from https://lloydslist.maritimeintelligence.informa.com/LL108882/Antwerp-to-use-blockchain-technology-in-container-handling-operations

Turkish Commercial Code. (2011). Retrieved from www.mevzuat.gov.tr/MevzuatMetin/1.5.6102.pdf

UNCTAD. (2018). *Review of maritime transport*. doi:10.18356/fd502c06-en

United Nations Commission on International Trade Law. (2013). Recognizing and preventing commercial fraud. Retrieved from http://www.uncitral.org/pdf/english/texts/fraud/Recognizing-and-preventing-commercial-fraud-e.pdf

Worldbank. (2019a). Databank. Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

Worldbank. (2019b). Databank. Retrieved from https://data.worldbank.org/topic/trade

Xu, L., Chen, L., Gao, Z., Chang, Y., Iakovou, E., & Shi, W. (2018). Binding the physical and cyber worlds: A blockchain approach for cargo supply chain security enhancement. In *Proceedings 2018 IEEE International Symposium on Technologies for Homeland Security, HST 2018*, 1–5. 10.1109/THS.2018.8574184

Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2017). An overview of blockchain technology: Architecture, consensus, and future trends. *Proceedings - 2017 IEEE 6th International Congress on Big Data, BigData Congress 2017*, 557–564. doi:10.1109/BigDataCongress.2017.85

Compilation of References

Aaker, A. D. (2002). *Building strong brand*. UK: Free Press Business.

Aaker, D. A. (1991). *Managing brand equity: Capitalizing on the value of a brand name New York*. Free Press.

Aaker, D. A. (1996). Measuring brand equity across products and markets. *California Management Review*, *38*(3), 102–120. doi:10.2307/41165845

Abbasi, M., & Nilsson, F. (2012). Themes and challenges in making freight transport sustainable: A logistics service providers' perspective. *TRF Annual Forum, Tampa Sweden*, 1–16.

Abduaziz, O., Cheng, J. K., Tahar, R. M., & Varma, R. (2015). A hybrid simulation model for green logistics assessment in automotive industry. *Procedia Engineering*, *100*, 960–969. doi:10.1016/j.proeng.2015.01.455

Abdulrahman, M., Gunasekaran, A., & Subramanian, N. (2014). Critical barriers in implementing reverse logistics in the Chinese manufacturing sectors. *International Journal of Production Economics*, *147*, 460–471. doi:10.1016/j.ijpe.2012.08.003

Abuelenin, A. H. M. (2017). The impact of shortage implementation of the international regulations on maritime safety. *Cogent Social Sciences*, *3*(1). doi:10.1080/23311886.2017.1335499

Abuja MoU. (2018). *Annual Report 2017*. Retrieved from http://www.abujamou.org/assets/annual_report_2017.pdf

Acar, A. Z., Önden, İ., & Kara, K. (2015). Evaluating the location of regional return centers in reverse logistics through integration of GIS, AHP and integer programming. *International Journal of Industrial Engineering*, *22*(4), 399–411.

Acar, Z. (2010). *Depolama ve Depo Yönetimi, 1.b*. Ankara, Turkey: Nobel Yayın Dağıtım.

Adefolalu, A. A. (1977). Significance of transportation in rural development in environmental and spatial factors. *In Proceedings of the 20th Annual Conference of Nigeria Geographical Association, University of Ife*, Ile Ife.

Agbesi, K. (2013). The impact of ICT on the clearing of goods at Ghana ports: A study of Tema and Takoradi ports. *SAVAP International Part I: Natural and Applied Sciences*, *4*(3), 87–95.

Agency for Environmental Protection. (2015). *State of the environment in the republic of Serbia* - a brief overview, ministry of agriculture and environmental protection, Belgrade. Retrieved from http://www.sepa.gov.rs/index.php?menu=5005&id=19&akcija=showExternal

Agenda for Development. (1997). New York, NY: United Nations.

Agichtein, E., Brill, E., & Dumais, S. (2006, August). Improving web search ranking by incorporating user behavior information. In *Proceedings of the 29th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval* (pp. 19-26). ACM. 10.1145/1148170.1148177

Agrawal, S., Singh, R. K., & Murtaza, Q. (2015). A literature review and perspectives in reverse logistics. *Resources, Conservation, and Recycling*, *97*, 76–92. doi:10.1016/j.resconrec.2015.02.009

AIMU Technical Services Committee. (n.d.). *High speed craft. AIMU Technical Services Committee Reports*. Retrieved from http://www.aimuedu.org/aimupapers/hsc.pdf

Ajiboye, A. O. (2007). Opportunities and challenges in the field of transport and logistics management in Nigeria. In K. U. Nnadi, & I. C. Ogwude (Eds.), *Transport in Nigeria - Economics, management policy* (pp. 49–73). Owerri: Reliable Publishers.

Ajiboye, A. O., & Afolayan, O. (2009). A study of the transportation factors militating against agricultural production in a developing country: The case of Nigeria. *Africa Journal of Technology Policy*, *5*(1), 263–271.

Ajiboye, A. O., & Afolayan, O. (2009). The impact of transportation on agricultural production in a developing country: A case study kolanut production in Nigeria. *International Journal of Agricultural Economics and Rural Development*, *2*(2), 49–57.

Ajiboye, A. O., & Ayantoyinbo, B. B. (2009). Analysis of transportation and distribution problems of agricultural products marketing in Sub-Saharan region: An application to kolanut. *Journal of Technology*. *Entrpreneurship and Rural Development*, *4*(1), 188–200.

Akat, Ö. (2003). *Uluslararası Pazarlama Karması ve Yönetimi (4. baskı)*. Bursa, Turkey: Ekin Kitabevi.

Akbulut, İ., Aydın, S., & Eleren, A. (2016). *Gri İlişkisel Analiz İle Tedarik Zinciri Performansının Değerlendirilmesi; Otomotiv Sektöründe Bir Uygulama. Uluslararası Katılımlı 16* (pp. 33–37). Üretim Araştırmaları Sempozyumu.

Aksen, D., Aras, N., & Karaarslan, A. G. (2009). Design and analysis of government subsidized collection systems for incentive-dependent returns. *International Journal of Production Economics*, *119*(2), 308–327. doi:10.1016/j.ijpe.2009.02.012

Aksoy, Ç. (2013). *A scale proposal for sustainability performance assessment and its implementation*. (Doctoral Thesis), Turkey.

Aksoy, R., & Kurnaz, S. (2009). İnsansız Kara Araçları Ve Muharebe Gereksinimleri. *Journal of Aeronautics and Space Technol.*

Aktan, C. C. (1999). *Globalleşme, Ekonomik Kriz ve Türkiye, TOSYÖV Yayını Ekonomik, Sosyal ve Siyasal Araştırmalar Serisi*. Ankara, Turkey: Kasım.

Akyuz, E., & Celik, M. (2015). Application of Cream human reliability model to cargo loading process of LPG tankers. Elsevier, 39-48. doi:10.1016/j.jlp.2015.01.019

Akyuz, E., & Celik, M. (2016). A hybrid human error probability determination approach: The case of cargo loading operation in oil/chemical tanker ship. Elsevier, 424-431.

Alaykıran, K., & Engin, O. (2005). Ant colony metaheuristic and an application on traveling salesman problem. *Gazi Üniversitesi Mühendislik-Mimarlık Fakültesi Dergisi, 20*(1).

Albadvi, A., Keramati, A., & Razmi, J. (2007). Assessing the impact of information technology on firm performance considering the role of intervening variables: Organizational infrastructures and business processes reengineering. *International Journal of Production Research*, *45*(12), 2697–2734. doi:10.1080/00207540600767780

Albareda-Sambola, M., Alonso-Ayuso, A., Molina, E., & De Blas, C. S. (2009). Variable neighborhood search for order batching in a warehouse. *Asia-Pacific Journal of Operational Research*, *26*(5), 655–683. doi:10.1142/S0217595909002390

Albasini, F. (2018). Le e-commerce et l'emballage: à la recherche de l'optimisation. *Emballages Digest (Machines & Technologies), 633* (November), 11–14.

Alderson, W. (2006). Marketing efficiency and the principle of postponement. In *A twenty-first century guide to Aldersonian marketing thought* (pp. 109–113). Boston, MA: Springer. doi:10.1007/0-387-28181-9_8

Alexandridis, G., Kavussanos, M. G., Kim, C. Y., Tsouknidis, D. A., & Visvikis, I. D. (2018). A survey of shipping finance research: Setting the future research agenda. *Transportation Research Part E, Logistics and Transportation Review*, *115*(February), 164–212. doi:10.1016/j.tre.2018.04.001

Alfalla-Luque, R., Marin-Garcia, J. A., & Medina-Lopez, C. (2014). An analysis of the direct and mediated effects of employee commitment and supply chain integration on organisational performance. *International Journal of Production Economics*.

Al-Ghandoor, A., Jaber, J., Al-Hinti, I., & Abdallat, Y. (2013). Statistical assessment and analyses of the determinants of transportation sector gasoline demand in Jordan. *Transportation Research Part A, Policy and Practice*, *50*, 129–138. doi:10.1016/j.tra.2013.01.022

Alkan, M. ve Erdal, M. (2004). Lojistik ve Dış Ticaret Sözlüğü (1. baskı). İstanbul, Turkey: UTİKAD Yayınları.

Alkhatib, S. F. R., Darlington, Z. Y., & Nguyen, T. T. (2015). A novel technique for evaluating and selecting logistics service providers based on the logistics resource view. *Expert Systems with Applications*, *42*(20), 6976–6989. doi:10.1016/j.eswa.2015.05.010

Allen, C., & Clouth, S. (2012). *A guide book to the green economy;* ıssue 1: green economy, green growth, and low-carbon development – history, definitions and a guide to recent publications. UN Division for Sustainable Development, UNDESA.

Alvarez, J. F., Longva, T., & Engebrethsen, E. S. (2010). A methodology to assess vessel berthing and speed optimization policies. *Maritime Economics & Logistics*, *12*(4), 327–346. doi:10.1057/mel.2010.11

Ambrosini, V., Bowman, C., & Collier, N. (2009). Dynamic capabilities: An exploration of how firms renew their resource base. *British Journal of Management*, *20*(1), 9–24. doi:10.1111/j.1467-8551.2008.00610.x

Ambrosino, D., & Scutella, M. G. (2005). Distribution network design: new problems and related models. *European Journal of Operational Research*, *165*(3), 610–624. doi:10.1016/j.ejor.2003.04.009

American Bureau of Shipping. (2003). *Guidance notes on dynamic load approach and direct analysis for high speed craft. ABS American Bureau for Shipping*. Houston, TX. Retrieved from https://ww2.eagle.org/content/dam/eagle/rules-and-guides/archives/design_and_analysis/113_dlaanddirectanalhighspeedcraft/pub113_hsc_dla.pdf

American Production and Inventory Control Society. (2013). *APICS Dictionary (14. Bs.)*. Chicago, IL: APICS.

AMERIPEN. (2017). *Optimizing packaging for an e-commerce world*. Saint-Paul, MN: White Paper - American Institute for Packaging and Environment.

Amit, R., & Schoemaker, J. P. (1993). Strategic assets and organizational rent. *Strategic Management Journal*, *14*(1), 33–46. doi:10.1002mj.4250140105

Anand, N., & Grover, N. (2015). Measuring retail supply chain performance: Theoretical model using key performance indicators (KPIs). *Benchmarking: An International Journal*, *22*(1), 135–166. doi:10.1108/BIJ-05-2012-0034

Anderson, E. W., & Sullıvan, M. W. (1993). The antecedents and consequences of customer satisfaction for firms. *Marketing Science*, *12*(2), 125–143. doi:10.1287/mksc.12.2.125

Andersson, P. (1992). Analysing distribution channel dynamics: Loose and tight coupling in distribution networks. *European Journal of Marketing*, *26*(2), 47–68. doi:10.1108/03090569210010031

Andina (2019). *Chancay port terminal to boost economic development in Peru.* Retrieved from: Internet Source: https://andina.pe/agencia/noticia-chancay-port-terminal-to-boost-economic-development-in-peru-740184.aspx

Anonymous. (2017). Retrieved from https://lojistikplatform.blogspot.com/2017/04/4pl-dorduncu-parti-lojistik-nedir.html

Antão, P., & Soares, C. G. (2003). Analysis of high speed craft accidents. In T. Bedford, & P. van Gelder (Eds.), *Safety and reliability: Proceedings of the ESREL 2003 Conference*, *Maastricht, the Netherlands* (Vol. 1, pp. 37–44). Boca Raton, FL: CRC Press.

Antão, P., & Soares, C. G. (2008). Causal factors in accidents of high-speed craft and conventional ocean-going vessels. *Reliability Engineering & System Safety*, *93*(9), 1292–1304. doi:10.1016/j.ress.2007.07.010

Arel, I., Rose, D. C., & Karnowski, T. P. (2010). Deep machine learning-a new frontier in artificial intelligence research. *IEEE Computational Intelligence Magazine*, *5*(4), 13–18. doi:10.1109/MCI.2010.938364

Arif, M., Gupta, A., & Williams, A. (2013). Customer service in the aviation industry An exploratory analysis of UAE airports. *Journal of Air Transport Management*, *32*, 1–7. doi:10.1016/j.jairtraman.2013.05.001

Arı, K. (2014). İzmir'de Deniz Ulaşımı ve Ticaretinin Kent Kimliğinin Oluşumu Üzerindeki Etkileri. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, *3*(1), 1–18.

Arslan, O. (2009, March). Quantitative evaluation of precautions on chemical tanker operations. (S. Direct, Dü.) Elsevier (Vol. 2), 113-120.

Arslan, O., & Er, I. D. (2008, June). SWOT analysis for safer carriage of bulk liquid chemicals in tankers. Elsevier, 1-3(154), 901-913.

Artan, S., & Kalaycı, C. (2009). The effect of the internet on international trade: the case of OECD countries. *Journal of Doğuş University*, *10*(2), 175–187.

Arvis, J. F., Mustra, M., Ojala, L., Shepherd, B., & Saslavsky, D. (2016). Connecting to compete: Trade logistics in the global economy. Washington: World Bank.

Arvis, J. F., Saslavsky, D., Ojala, L., Shepherd, B., Busch, C., Raj, A., & Naula, T. (2007). Connecting to compete: Trade logistics in the global economy. The Logistics Performance Index and Its Indicators. Worldbank Press, Washington, DC. Retrieved from http://siteresources.worldbank.org/INTTLF/Resources/lpireport.pdf

Arvis, J. F., Mustra, M., Ojala, L., Shepherd, B., & Saslavsky, D. (2014). *Connecting to compete: Trade logistics in the global economy*. Washington: World Bank.

Asdecker, B., & Felch, V. (2018). Development of an Industry 4.0 maturity model for the delivery process in supply chains. *Journal of Modelling in Management*, *13*(4), 840–883. doi:10.1108/JM2-03-2018-0042

Ash, L., & Waters, C. D. J. (1991). Simulating the transport of coal across Canada - Strategic route planning. *The Journal of the Operational Research Society*, *42*(3), 195–203.

Aste, T., Tasca, P., & Di Matteo, T. (2017). Blockchain technologies: The foreseeable impact on society and industry. *Computer*, *50*(9), 18–28. doi:10.1109/MC.2017.3571064

Atabaş, H. (2018). *Blockchain technology and the new place of crypto coins in our lives*. İstanbul, Turkey: Ceres Publisher.

Attia, T. M. (2016). Importance of communication and information technology and its applications in the development and integration of performance in seaports. *Renewable Energy and Sustainable Development.*, *2*(2), 137–146. doi:10.21622/resd.2016.02.2.137

Auestad, Ø. F., Gravdahl, J. T., Sørensen, A. J., & Espeland, T. H. (2013). Simulator and control system design for a free floating surface effect ship at zero vessel speed. *IFAC Proceedings Volumes, 46*(10), 67–72. doi:10.3182/20130626-3-AU-2035.00064

August, R. (2004). *International Business Law* (4th ed.). New Jersey: Pearson.

Autry, C. W., & Griffis, S. E. (2008). Supply chain capital: The impact of structural and relational linkages on firm execution and innovation. *Journal of Business Logistics*, *29*(1), 157–174. doi:10.1002/j.2158-1592.2008.tb00073.x

Avrupa Birliği Türkiye İş Geliştirme Merkezi. (2014). *Dış Ticarette Kullanılan Belgeler*.28.04.2019. Retrieved from http://www.abigem.org/appmanager/tr/portal?_nfpb=true&_pageLabel=pag eKobiUluslararasi&nodeName=KobiUluslararasi_02.

Aydin, N., Lee, H., & Mansouri, S. A. (2017). Speed optimization and bunkering in liner shipping in the presence of uncertain service times and time windows at ports. *European Journal of Operational Research*, *259*(1), 143–154. doi:10.1016/j.ejor.2016.10.002

Ayers, J. B. (2006). *Handbook of supply chain management*. Florida: Auerbach Publications.

Aykaç, S. Ö., & Bayraktar, D. (2007). Proposing Snell's Law approach for service-level requirements in supply chain management. In D. Bayraktar, F. Çebi, & B. Bolat (Eds.), *Sıtkı Gözlü'ye armağanı* (pp. 37–48). Istanbul, Turkey: Çağlayan Basımevi.

Aziz. (2019, Jan. 12). Coins, Tokens, & Altcoins: What's the difference? Retrieved from https://masterthecrypto.com/differences-between-Cryptocurrency-coins-and-tokens/ ?cv=1

Azzi, A., Battini, D., Persona, A., & Sgarbossa, F. (2012). Packaging design: General framework and research agenda. *Packaging Technology & Science*, 1–22.

Babacan, M. (2003). Lojistik sektörünün ülkemizdeki gelişimi ve rekabet vizyonu. *Ege Akademik Bakış Dergisi*, *3*(1), 8–15.

Babicz, J. (2015). *Wärtsilä Encyclopedia of Ship Technology* (2nd ed.). Helsinki: Wärtsilä Corporation.

Bağrıaçık, A. ve Yıldırım, M. (2008). Dış Ticaret Mevzuatı ve Muhasebe Uygulamaları (1. baskı). Ankara, Turkey: Yaklaşım Yayıcılık.

Bai, C., & Sarkis, J. (2014). Determining and applying sustainable supplier key performance indicators. *Supply Chain Management*, *19*(3), 275–291. doi:10.1108/SCM-12-2013-0441

Bailey, N., Housley, W., & Belcher, P. (2006). Navigation, interaction, and bridge team work. *The Sociological Review*, *54*(2), 342–362. doi:10.1111/j.1467-954X.2006.00617.x

Baker, J. (2017). Maersk cyber attack should serve as a timely warning to others. Lloyd's List. Retrieved from https://lloydslist.maritimeintelligence.informa.com/LL108941/Maersk-cyber-attack-should-serve-as-a-timely-warning-to-others

Bali, Ö., Tutun, S., Pala, A., & Çörekçi, C. (2014). A MCDM approach with fuzzy dematel and fuzzy topsis for 3 pl provider selection. *Journal of Engineering and Natural Sciences*, *32*, 222–239.

Baltacioglu, T., Ada, E., Kaplan, M. D., Yurt, O., & Kaplan, Y. C. (2007). A new framework for service supply chains. *Service Industries Journal*, *27*(2), 105–124. doi:10.1080/02642060601122629

Barbero J A (2010). Freight logistics in Latin America and the Caribbean: An agenda to improve performance. *Inter-American Development Bank Infrastructure and Environment Department*, Technical Notes No. IDB-TN-103

Bari, G. S., & Matveev, K. I. (2016). Hydrodynamic modeling of planing catamarans with symmetric hulls. *Ocean Engineering*, *115*, 60–66. doi:10.1016/j.oceaneng.2016.01.035

Bari, G. S., & Matveev, K. I. (2017). Hydrodynamics of single-deadrise hulls and their catamaran configurations. *International Journal of Naval Architecture and Ocean Engineering*, *9*(3), 305–314. doi:10.1016/j.ijnaoe.2016.11.001

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *7*(1), 99–120. doi:10.1177/014920639101700108

Barney, J. B. (1986). Types of competetion and the theory of strategy: Toward an integrative framework. *Academy of Management Review*, 11.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. doi:10.1037/0022-3514.51.6.1173 PMID:3806354

Barr, A., & Feigenbaum, E. A. (1981). The handbook of artificial intelligence. Los Altos, CA: William Kaufmann, 163-171.

Barreto, L., Amaral, A., & Pereira, T. (2017). Industry 4.0 implications in logistics: An overview. *Procedia Manufacturing*, *13*, 1245–1252. doi:10.1016/j.promfg.2017.09.045

Barrios, K. (2017). *Global container shipping alliances.* Retrieved from https://www.xeneta.com/blog/shipping-alliances

Bartholdi, J. J., & Hackman, S. T. (2014). *Warehouse & Distribution Science Release 0.96 (0*.96th ed.). Atlanta, GA: Georgia Institute of Technology, School of Industrial and Systems Engineering, The Supply Chain and Logistics Institute.

Bartholdi, J. J., Jarumaneeroj, P., & Ramudhin, A. (2016). A new connectivity index for container ports. *Maritime Economics & Logistics*, *18*(3), 231–249.

Bascetin, A., & Kesimal, A. (1999). The study of a fuzzy set theory for the selection of an optimum coal transportation system from pit to the power plant. *International Journal of Surface Mining, Reclamation, and Environment*, *13*(3), 97–101.

Başkol, M. (2010). Logistics and logistics management, Bartın University IIBF. *Journal of Faculty of Economics and Administrative Sciences*, *1*(2), 47–63.

Basturk, H. I., & Krstic, M. (2013). Adaptive wave cancelation by acceleration feedback for ramp-connected air cushion-actuated surface effect ships. *Automatica*, *49*(9), 2591–2602. doi:10.1016/j.automatica.2013.05.017

Baykal, R. (2011). *Gemiler ve Açık Deniz Yapıları* (1st ed.). İstanbul, Turkey: Birsen Yayınevi Ltd. Şti.

Baykal, R. (2012). *Karma Taşımacılık Yaklaşımıyla Limanlar ve Terminaller* (1st ed.). İstanbul, Turkey: Birsen Yayınevi Ltd. Şti.

Beamon, B. M. (1999). Measuring supply chain performance. *International Journal of Operations & Production Management*, *19*(3), 275–292. doi:10.1108/01443579910249714

Beck, R., Avital, M., Rossi, M., & Thatcher, J. B. (2017). Blockchain technology in business and information systems research. *Business & Information Systems Engineering*, *59*(6), 381–384. doi:10.100712599-017-0505-1

Beena, V. I., & Subramanian, V. A. (2003). Parametric studies on seaworthiness of SWATH ships. *Ocean Engineering*, *30*(9), 1077–1106. doi:10.1016/S0029-8018(02)00101-4

Behar, A., & Manners, P. (2008). Logistics and exports. CSAE (Centre for The Study of African Economies) Working Paper Series, CSAE-WPS/2008-13. Retrieved from http://www.csae.ox.ac.uk/ workingpapers/pdfs/2008-13text.pdf

Bemis Company. (2016). *Packaging for a new era of Ecommerce - How e-commerce will transform the role of consumer packaging*. Neenah, WI. Retrieved from http://www.bemis.com/Bemis/media/ Library/pdf/restricted/Bemis-eBook-eCommerce.pdf

Bendall, H. B., & Stent, A. F. (2001). A scheduling model for a high-speed containership service: a hub and spoke short-sea application. *International Journal of Maritime Economics*, *3*(3), 262–277. doi:10.1057/palgrave.ijme.9100018

Bengi, B.S. (2013). *Lojistik merkezlerde yönetim ve organizasyon: Trakya master plan örneği.* T.C. Namık Kemal Üniversitesi Fen Bilimleri Enstitüsü Yüksek Lisans Tezi Birdoğan Baki, (2004). *Lojistik Yönetimi Ve Lojistik Sektör Analizi,* Lega Kitabevi, Trabzon, 2004, 9-11, 10.

Bennett, J. (2018). Trimarans make waves in the fast ferry sector. Retrieved from https://www.passengership.info/news/view,trimarans-make-waves-in-the-fast-ferry-sector_50510.htm

Bentzen, K., Laugesen, M., & Cerneckyte, V. (2007). Transport and Logistics Centres, FDT. (Association of Danish Transport Centres) - The consolidated WP 3 Final Report, Aalborg, Denmark. Retrieved from http://www.porteconomics.nl/docs/Interreg%20report.pdf

Bentzen-Laugesen-Cerneckyte, e. p. 21; MappletreeLog, Overview of Mapletree Logistics Trust, Mapletree Logistics Trust Management Ltd Presentation April 2010. Retrieved from http://www.mapletreelogisticstrust.com/data/resources/docs/newsfiles/ PR/Intro%20slides%20on%20MLOG_Apr%202010.pdf

Berlin Forum COAL Working Group Meeting. (2006). Brussels.

Bernhardt, K. L., Donthu, N., & Kennett, P. A. (2000). A longitudinal analysis of satisfaction and profitability. *Journal of Business Research*, *47*(2), 161–171. doi:10.1016/S0148-2963(98)00042-3

Berry, T. D., Johnson, K. L., & Porter, B. E. (2011). Speed(ing). In Handbook of traffic psychology (pp. 249–265). Elsevier. doi:10.1016/B978-0-12-381984-0.10018-9

Bese, E., & Kalayci, S. (2019). Environmental Kuznets Curve (EKC): Empirical relationship between economic growth, energy consumption, and CO2 emissions: evidence from 3 developed countries. *Panoeconomicus*, 1–26.

Bharadwaj, S. G., Varadarajan, P. R., & Fahy, J. (1993). Sustainable competitive advantage in service industries: A conceptual model and research propositions. *Journal of Marketing*, *57*(4), 83–99. doi:10.1177/002224299305700407

Bhat, A. A., & Mishra, P. P. (2018). The Kyoto Protocol and CO2 emission: Is India still hibernating? *Indian Growth and Development Review*, *11*(2), 152–168. doi:10.1108/IGDR-10-2017-0080

Bilir, H., & Cay, S. (2016, April). A relation between electronic money and financial markets. *Niğde University Journal of Faculty of Economics and Administrative Sciences*, *9*(2), 21–31.

BillerudKorsnäs. (2018). *How packaging can add value in e-commerce*. Solna, Sweden. Retrieved from https://www.billerudkorsnas.com

Bistline, J., & Rai, V. (2010). The role of carbon capture technologies in greenhouse gas emissions-reduction models: A parametric study for the U.S. power sector. *Energy Policy*, *38*(2), 1177–1191. doi:10.1016/j.enpol.2009.11.008

Bjärnemo, R., Jönson, G., & Johnsson, M. (2000). *Packaging logistics in product development*. Paper presented at the 5th International Conference on Computer Integrated Manufacturing (ICCIM 2000), March, Singapore.

Black Sea MoU. (2009). Pre-press release CIC on safety of navigation. Retrieved from http://www.bsmou.org/2009/01/pre-press-release-cic-on-safety-of-navigation-2/

Black Sea MoU. (2018a). *Annual report for 2017*. Retrieved from http://www.bsmou.org/downloads/annual-reports/BSMOU-AR-2017.pdf

Black Sea MoU. (2018b). Report of the 2017 CIC on safety of navigation-including ECDIS. Retrieved from http://www.bsmou.org/2018/06/report-of-the-2017-cic-on-the-saferty-of-navigation-including-ecdis/

Blenkey, N. (2017). Zim completes pilot of blockchain based paperless Bills of Lading. Retrieved from https://www.marinelog.com/news/zim-completes-pilot-of-blockchain-based-paperless-bills-of-lading/

Bloemer, J. M. M., de Ruyter, K., & Peeters, P. (1998). Investigating drivers of bank loyalty: The complex relationship between image, service quality and satisfaction. *International Journal of Bank Marketing*, *16*(7), 276–286. doi:10.1108/02652329810245984

BMZ - Federal Ministry for Economic Cooperation and Development. (2012). *Economic instruments in solid waste management* - Case study Bulgaria. Retrieved from http://www.giz.de/de/downloads/giz2013-en-economic-instruments-bulgaria.pdf

Bolaji, B. (2014). Theoretical analysis of the energy performance of three low global warming potential hydro-fluorocarbon refrigerants as R134a alternatives in refrigeration systems. In *Proceedings of the institution of mechanical engineers Part A journal of power and energy*, 56-63. 10.1177/0957650913507252

Bolat, H. B., Bayraktar, D., Öztürk, M., & Turan, N. (2011). *A model proposal for the vehicle routing problem in the green logistics chain*. XI. Research Symposium of Production (pp. 536-548). June.

Bostel, N., Dejax, P., & Lu, Z. (2005). The design, planning, and optimization of reverse logistics network. In A. Langevin, & D. Riopel (Eds.), *Logistics systems: design and optimization* (pp. 171–212). New York: Springer. doi:10.1007/0-387-24977-X_6

Boujelben M.(2013). Modeling and solving a distribution network design problem with multiple operational constraints. Application to a case-study in the automotive industry. Operations Research. Ecole Centrale Paris, 2013.

Boult, M. (2000). Risk management of LPG transport activities in Hong Kong. Hazardous Materials, 85-100.

Bouzon, M., Augusto Cauchick Miguel, P., & Manuel Taboada Rodriguez, C. (2014). Managing end of life products: A review of the literature on reverse logistics in Brazil. *Management of Environmental Quality*, *25*(5), 564–584. doi:10.1108/MEQ-04-2013-0027

Bowersox, D. J., Closs, D. J., & Cooper, M. B. (2002). Supply chain logistics management, McGraw-Hill Companies Inc. Series, New York.

Bowersox, D., Closs, D., & Cooper, M. B. (2002). Supply chain logistics management, McGraw-Hill Companies Inc. Series, New York.

Bowersox, D. J., & Daugherty, P. J. (1995). Logistics paradigms: The impact of information technology. *Journal of Business Logistics*, *16*(1), 65–80.

Bozer, Y. A., & Kile, J. W. (2008). Order batching in walk-and-pick order picking systems. *International Journal of Production Research*, *46*(7), 1887–1909. doi:10.1080/00207540600920850

Bozlu, B., & Demirörs, O. (2008, June). A conceptual modeling methodology: from conceptual model to design. In *Proceedings of the 2008 Summer Computer Simulation Conference* (p. 30). Society for Modeling & Simulation International. Eris Industries DocumentationBlockchains. Available at https://docs.erisindustries.com/explainers/ blockchains/

Bozoklu, Ş., & Yılancı, V. (2013). The causality relation between financial development and economic growth: an analysis for emerging economies. *Dokuz Eylül University Journal of Economics and Administrative Sciences Faculty*, *28*(2), 161–187.

BP statistical review of world energy. (2013). Retrieved from http://www.bp.com/content/dam/bp/pdf/statisticalreview/statistical_review_of_world_energy_2013.pdf

Brandon, P., Frykman, N., & Roge, P. (2019). Free and unfree labor in Atlantic and Indian ocean port cities (Seventeenth-Nineteenth Centuries). *International Review of Social History*, *64*(S27), 1–18. doi:10.1017/S0020859018000688

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies*, *47*(1), 239–253. doi:10.2307/2297111

Brewer, A. M., & Button, K. J. ve Henser, D. A. (2001). Logistics and supply chain management (1st ed.). Oxford, UK: Pergamon.

Brito, M. P., Dekker, R., Flapper, S. D. (2002). Reverse logistics: A review of case studies. *Econometric Institute Report,* EI-21.

Britton, L. G. (1999). *Avoiding static ignition hazard in chemical operations*. New York: American Institute of Chemical Engineers. doi:10.1002/9780470935408

Brodie, P. (1999). *Commercial shipping handbook* (1st ed.). London, UK: LLP.

Brooks, C. (2002). *Introductory econometrics for finance*. Cambridge, UK: Cambridge University Press.

Brouer, B. D., Karsten, C. V., & Pisinger, D. (2017). Optimization in liner shipping. *4OR, 15*(1), 1–35. doi:10.100710288-017-0342-6

BTRE. (2001). Logistics in Australia: A preliminary analysis. *Bureau of Transport and Regional Economics, Canberra*. Retrieved from http://www.btre.gov.au/docs/wp49_contents.htm

Buchhorn-Roth, M. (2016). Secure data exchange across supply chains: Blockchain and electronic data interchange. *Combined Transport Magazine.* Retrieved from https://combined-transport.eu/blockchain-edi-for-supply-chains

Bulian, G., & Francescutto, A. (2008). Large amplitude rolling and strongly nonlinear behaviour of multihull ships in moderate beam waves. In E. Kreuzer (Ed.), *IUTAM Symposium on Fluid-Structure Interaction in Ocean Engineering* (pp. 25–36). Dordrecht, The Netherlands: Springer Netherlands. 10.1007/978-1-4020-8630-4_3

Bulian, G., Francescutto, A., & Zotti, I. (2008). Stability and roll motion of fast multihull vessels in beam waves. *Ships and Offshore Structures*, *3*(3), 215–228. doi:10.1080/17445300801990913

Bullock, J. A., Haddow, G. D., & Coppola, D. P. (2018). Transportation safety and security. In *Homeland Security* (pp. 169–188). Elsevier; doi:10.1016/B978-0-12-804465-0.00007-8

Bulut, Ö. (2007). Türkiye'de Taşımacılık Sektörünün Lojistik Olgusu İçerisinde İncelenmesi, Kadir Has Üniversitesi SBE, (Yayınlanmamış Yüksek Lisans Tezi), İstanbul, Turkey. 4458 s. Gümrük Kanunu, md.3 (5911. S.K. ile Değişiklik Yapılmış Hali)

Burgess, P. (2016). Consumers' mindset: expectations, experience, and satisfaction. In P. Burgess (Ed.), Integrating the packaging and product experience in food and beverages - a road-map to consumer satisfaction (pp. 161–182). Cambridge, MA: Elsevier - Woodhead Publishing.

Burmaoğlu, S. (2012). Ulusal İnovasyon Göstergeleri ile Ulusal Lojistik Performansı Arasında İlişki:AB Ülkeleri Üzerine Bir Araştırma . *Ege Akademik Bakı*ş, 193-208.

Burns, L. R. (2002). *The healthcare value chain: producers, purchasers, and providers*. San Francisco, CA: Jossey Bass, A Wiley Company Print.

Bustillos, M. (2013, Sept. 7). The Bitcoin Boom, *The New Yorker*. Retrieved from http://btcworldnews.com/new-yorkers-maria-bustillos-the-bitcoin-boom/

Butterworth, J., Atlar, M., & Shi, W. (2015). Experimental analysis of an air cavity concept applied on a ship hull to improve the hull resistance. *Ocean Engineering*, *110*, 2–10. doi:10.1016/j.oceaneng.2015.10.022

Büyükkalkan, B. (2013). Gümrük İdarelerinde Ticaretin Kolaylaştırılması Çalışmaları ile Risk Analizi Çalışmaları Arasındaki Korelasyon. *Gümrük ve Ticaret Uzmanları Derneği Gümrük ve Ticaret Dergisi*, *35*, 15–20.

Çağlar, V. (2016). Sustainable container terminal operations: challenges and enhancements, *Journal Of The Black Sea Studies*, (49), 141-156.

Çalış, A. (2007). *İhracatta Teslim Şekilleri ve Nakliyat (1. baskı)*. Ankara, Turkey: İhracatı Geliştirme Etüd Merkezi Yayınları.

Calonius, H. (2006). Contemporary research in marketing: A market behaviour framework. *Marketing Theory*, *6*(4), 419–428. doi:10.1177/1470593106069936

Çam, E. (2014). E-commerce with yesterday, today, and tomorrow: Problems and solution proposals, (Master's thesis), Inönü University Institute Of Social Sciences.

Canadian Association of Logistics Management. (1998). Retrieved from http://www.calm.org/calm/AboutCALM/AboutCALM.html

Çancı, M. (2003). *Murat Erdal, Uluslararası Taşımacılık Yönetimi* (p. 24). İstanbul, Turkey: UTİKAD Yayını.

Çancı, M., & Erdal, M. (2003). *Lojistik Yönetimi: Freight Forwarder El Kitabı 1*. İstanbul, Turkey: UTİKAD.

Çancı, M., & Güngören, M. (2013). İktisadi Yaşamda Taşımacılık Sektörü. *Elektronik Sosyal Bilimler Dergisi*, *12*(45), 198–213.

Caner, O. (2012). Incoterms 2010. *İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi*, 22(11), 223-262.

Canıtez, M. (2009). *Uluslararası Pazarlamada Lojistik ve Uygulamalar*. Ankara, Turkey: Gazi Yayınevi.

Canıtez, M., & Tümer, G. (2005). *İhracat ve İthalatta Lojistik. Uygulamalı İhracat-İthalat İşlemleri ve Dokümantasyon (Editörler: KARAHAN Kasım, CANITEZ Murat)*. Ankara, Turkey: Gazi Kitabevi.

Cano, J. A., Correa-Espinal, A. A., & Gómez-Montoya, R. A. (2017). An evaluation of picking routing policies to improve warehouse efficiency. *International Journal of Industrial Engineering and Management*, *8*(4), 229–238.

Cano, J. A., Correa-Espinal, A. A., & Gómez-Montoya, R. A. (2018a). A review of research trends in order batching, sequencing, and picker routing problems. *Espacios*, *39*(4), 3.

Cano, J. A., Correa-Espinal, A. A., & Gómez-Montoya, R. A. (2019). Mathematical programming modeling for joint order batching, sequencing and picker routing problems in manual order picking systems. *Journal of King Saud University - Engineering and Science*.

Cano, J. A., Correa-Espinal, A. A., Gómez-Montoya, R. A., & Cortés, P. (2019). Genetic algorithms for the picker routing problem in multi-block warehouses. In W. Abramowicz, & R. Corchuelo (Eds.), *Lecture notes in business information processing* (Vol. 353, pp. 313–322). Cham, Switzerland: Springer.

Cano, J. A., Correa-Espinal, A., & Gómez-Montoya, R. A. (2018b). Solución del problema de conformación de lotes en almacenes utilizando algoritmos genéticos. *Información Tecnológica*, *29*(6), 235–244. doi:10.4067/S0718-07642018000600235

Cano, J. A., Gomez, R. A., & Salazar, F. (2017). Routing policies in multi-parallel warehouses: An analysis of computing times. *Espacios*, *38*(51), 23.

Cao, C., & Chen, J. (2011). An empirical analysis of the relationship among service quality, customer satisfaction, and loyalty of high-speed railway based on structural equation model. *Canadian Social Science*, *7*(4), 67–73.

Caribbean MoU. (2018). *2017 annual report*. Retrieved from http://www.caribbeanmou.org/sites/default/files/annual_report_2017.pdf

Carlan, V., Sys, C., Vanelslander, T., & Roumboutsos, A. (2017). Digital innovation in the port sector: Barriers and facilitators. *Competition and Regulation in Network Industries*, *18*(1-2), 71–93. doi:10.1177/1783591717734793

Carter, C. R., & Ellram, L. M. (1998). Reverse logistics: A review of the literature and framework for future investigation. *Journal of Business Logistics*, *19*, 85–102.

Carter, C., & Easton, P. (2011). Sustainable supply chain management: Evolution and future directions. *International Journal of Physical Distribution & Logistics Management*, *41*(1), 46–62. doi:10.1108/09600031111101420

Caschili, S., & Medda, F. (2015). The port attractiveness index: Application on African ports. *Région et Développment*, Nr. 41-2015. 41, 47-82

Castro, A., & Matarrollo, Y. (2009). *Strategic distribution network design (DND)*. Politecnico Di Milano, Italy: Model and Case Studies in the Consumer Electronics Industry.

Celik, M. (2010, February). Enhancement of occupational health and safety requirements in chemical tanker operations: The case of cargo explosion. Elsevier, 195-203.

Çelik, M., & Süral, H. (2016). Order picking in a parallel-aisle warehouse with turn penalties. *International Journal of Production Research*, *54*(14), 4340–4355. doi:10.1080/00207543.2016.1154624

Centeno, M. A., & Sundaram, R. (2004). Considering due time in manual order picking operations. In *IIE Annual Conference and Exhibition 2004* (pp. 1215–1220). Houston, TX.

Çetinkaya, Ş. (2018). Development of Crypto Coins and investigation of the place in money markets by swot analysis. *International Journal of Economics and Political Sciences*, *2*(5), 11–21.

Cetin, V. R., Yilmaz, H. H., & Erkan, V. (2018). The impact of increasing speed limit in Turkey: The case of Ankara-Sivrihisar road section. *Case Studies on Transport Policy*, *6*(1), 72–80. doi:10.1016/j.cstp.2017.11.004

Chambers, S. (2017c). Denmark trials blockchain to register ships. Splash 247. Retrieved from http://splash247.com/denmark-trials-blockchain-register-ships/

Chambers, S. (2019a). Israeli start-up heralds blockchain shipment from Belgium. Splash 247. Retrieved from https://splash247.com/israeli-start-up-heralds-blockchain-shipment-from-belgium/

Chambers, S. (2019b). Mandarins arrive in Singapore ahead of Lunar New Year thanks to landmark blockchain shipment. Splash 247. Retrieved from https://splash247.com/mandarins-arrive-in-singapore-ahead-of-lunar-new-year-thanks-to-landmark-blockchain-shipment/

Chan, F. T. S., Chan, H. K., & Choy, K. L. (2006). A systematic approach to manufacturing packaging logistics. *International Journal of Advanced Manufacturing Technology*, *29*(9–10), 1088–1101. doi:10.100700170-005-2609-x

Chang, C.-H., Miles, R. D., & Sinha, K. C. (1981). A regional network optimization model for coal transportation. *Transportation Research Part B: Methodological*, *15*(4), 227–238. doi:10.1016/0191-2615(81)90009-6

Chang, Y. H. (1998). *Logistical management*. Taiwan: Hwa-Tai Bookstore Ltd.

Chanintrakul, P., Mondragon, A., Lalwani, C., & Wong, C. (2009). Reverse logistics network design: A state-of-the-art literature review. *International Journal of Business Performance and Supply Chain Modelling*, *1*(1), 61–81. doi:10.1504/IJBPSCM.2009.026266

Chapman, R., Soosay, C., & Kandampully, J. (2003). Innovation in logistic services and the new business model: A conceptual framework. *International Journal of Physical Distribution & Logistics Management*, *33*(7), 630–650. doi:10.1108/09600030310499295

Chauhan, P., & Chaddah, J. K. (2017). Role of social media in influencing sustainability practices among Indian Organizations. *Sansmaran Research Journal*; Mumbai, 7, 1: 12-18.

Chen, C. F., & Chang, Y. Y. (2008). Airline brand equity, brand preference and purchase intentions - the moderating effects of switching costs. *Journal of Air Transport Management*, *14*(1), 40–42. doi:10.1016/j.jairtraman.2007.11.003

Chen, Ch., & Lam, J. S. L. (2018). Sustainability and interactivity between cities and ports: A two-stage data envelopment analysis (DEA) approach. *Maritime Policy & Management*, *45*(7), 944–961. doi:10.1080/03088839.2018.1450528

Chen, D., Ignatius, J., Sun, D., Zhan, S., Zhou, S., Marrad, M., & Demirbag, M. (2018). Reverse logistics pricing strategy for a green supply chain: A view of customers' environmental awareness. *International Journal of Production Economics*, 1–13.

Cheng, C.-Y., Chen, Y.-Y., Chen, T.-L., & Yoo, J. J.-W. (2015). Using a hybrid approach based on the particle swarm optimization and ant colony optimization to solve a joint order batching and picker routing problem. *International Journal of Production Economics*, *170*, 1–10. doi:10.1016/j.ijpe.2015.03.021

Cheng, H., & Karimi, I. (2006). Scheduling trans-shipment operations in maritime chemical transportation. *Industrial & Engineering Chemistry Research*, 1955–1973.

Chen, M.-C., Huang, C.-L., Chen, K.-Y., & Wu, H.-P. (2005). Aggregation of orders in distribution centers using data mining. *Expert Systems with Applications*, *28*(3), 453–460. doi:10.1016/j.eswa.2004.12.006

Chen, T. L., Cheng, C. Y., Chen, Y. Y., & Chan, L. K. (2015). An efficient hybrid algorithm for integrated order batching, sequencing and routing problem. *International Journal of Production Economics*, *159*, 158–167. doi:10.1016/j.ijpe.2014.09.029

Chi, H., Pedrielli, G., Ng, S. H., Kister, T., & Bressan, S. (2018). A framework for real-time monitoring of energy efficiency of marine vessels. *Energy*, *145*, 246–260. doi:10.1016/j.energy.2017.12.088

Chintoan-Uta, M., & Silva, J. R. (2017). Global maritime domain awareness: A sustainable development perspective. *WMU Journal of Maritime Affairs*, *16*(1), 37–52. doi:10.100713437-016-0109-5

Cho, H.-S. (2014). Determinants and effects of logistics costs in container ports: The transaction cost economics perspective. *The Asian Journal of Shipping and Logistics*, *30*(2), 193–215. doi:10.1016/j.ajsl.2014.09.004

Chopra, K. (2016, July 21). Specifications and requirements for LPG and LNG ships to sail in international waters. Retrieved from https://www.marineinsight.com/maritime-law/specifications-and-requirements-for-lpg-and-lng-ships-to-sail-in-international-waters/

Chopra, S., ve Meindl, P. (2007). Supply chain management: strategy, planning, and organization (3rd ed.). New Jersey: Pearson.

Chopra, S., & Meindl, K. (2016). *Supply chain management, strategy, planning, and operation* (6th ed.). USA: Pearson Education

Chopra, S., & Meindl, P. (2007). *Supply chain management strategy, planning, and operation*. New Jersey: Pearson Education. doi:10.1007/978-3-8349-9320-5_22

Choudhary, P., Imprialou, M., Velaga, N. R., & Choudhary, A. (2018). Impacts of speed variations on freeway crashes by severity and vehicle type. *Accident; Analysis and Prevention*, *121*, 213–222. doi:10.1016/j.aap.2018.09.015 PMID:30265907

Chow, C. K. W. (2014). Customer satisfaction and service quality in the Chinese airline industry. *Journal of Air Transport Management*, *35*, 102–107. doi:10.1016/j.jairtraman.2013.11.013

Chow, G., Heaver, T. D., & Henriksson, L. E. (1993). Logistics performance: Definition and measurement. *International Journal of Physical Distribution & Logistics Management*, *24*(1), 17–28. doi:10.1108/09600039410055981

Cho, Y., Han, J., & Kim, J. (2018). Intent inference of ship maneuvering for automatic ship collision avoidance. *IFAC-PapersOnLine*, *51*(29), 384–388. doi:10.1016/j.ifacol.2018.09.457

Christopher, M. (2011). *Logistics and supply chain management: Creating value adding networks*. London, UK: Pearson Education Limited.

Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *International Journal of Logistics Management*, *15*(2), 1–14. doi:10.1108/09574090410700275

CIAIM. (2012). *Technical report a-20/2012*. Retrieved from https://madden-maritime.com/wp-content/uploads/2019/03/CIAIM-Deneb-Capsize-during-cargo-operations-June-2011.pdf

Çiçek, E., & Bay, M. (2017). Strategic global supply chain management and logistics, Selçuk University IIBF. *Journal of Social and Economic Research*, *7*(13), 91–117.

CILM. (1998). Opportunities in logistics management: A publication of the council of logistics management of United States of America. Retrieved from http://www.clm1.org/mission.html

CILT. (2003). *The chartered institute of logistics and transport, international royal charters and bye laws*. London, UK.

CIPS. (2007). *How to develop a waste management and disposal strategy CIPS The chartedred İnstitute of Purchasing Supply knowledge,* works 1-27. Retrieved from https://www.cips.org/Documents/About%20CIPS/Develop%20Waste%20v3%20-%2020.11.07.pdf

Cleveland, C. J., & Morris, C. (2014). Transportation, Water. In *Handbook of energy* (Vol. II, pp. 623–632). Elsevier; doi:10.1016/B978-0-12-417013-1.00035-2

Clinton, S. R., & Closs, D. J. (1997). Logistics strategy: Does it exist? *Journal of Business Logistics*, *18*(1), 19–44.

Closs, D. J., Thomas, J. G., & Steven, R. C. (1997). Information technology influences on world class capability. *International Journal of Physical Distribution & Logistics Management*, *27*(1), 4–17. doi:10.1108/09600039710162259

CMA CGM Corporate Social Responsibility Report. (2018). Retrieved from https://www.cmacgm-group.com/en/csr/social

CNE. (2014). *Packaging and circular economy*. Paris, France: Conseil National de l'Emballage.

CNE. (2015). *Packaging as key element in product logistics*. Paris, France: Conseil National de l'Emballage.

CNE. (2016). *Packaging the development of consumption patterns and distribution channels*. Paris, France: Conseil National de l'Emballage.

CNN. (2019). *The shipping industry must go carbon neutral to survive*. Retrieved from: https://edition.cnn.com/2019/08/08/perspectives/climate-shipping-sustainable-green/index.html

CNUCED. (2017). *Étude sur les transports maritimes 2016*. United Nation Publication.

Coal sector report, Turkish coal institute. (2014). Retrieved from http://www.taskomuru.gov.tr/file//duyuru/TTKGM_Sektor_Raporu_2016.PDF

Cocco, L., Pinna, A., & Marchesi, M. (2017). Banking on blockchain: Costs savings thanks to the blockchain technology. *Future Internet*, *9*(3), 1–20. doi:10.3390/fi9030025

Coelho, E. K. F., & Mateus, G. R. (2017). A capacitated plant location model for reverse logistics activities. *Journal of Cleaner Production*, *167*, 1165–1177. doi:10.1016/j.jclepro.2017.07.238

Coffey, C. S., Hebert, P. R., Ritchie, M. D., Krumholz, H. M., Gaziano, J. M., Ridker, P. M., ... Moore, J. H. (2004). An application of conditional logistic regression and multifactor dimensionality reduction for detecting gene-gene interactions on risk of myocardial infarction: The importance of model validation. *BMC Bioinformatics*, *5*(1), 49. doi:10.1186/1471-2105-5-49 PMID:15119966

Cohen, C., & Zéau, P. (2019). Une pénurie de palettes en bois menace le Royaume-Uni en cas de "Brexit dur". Retrieved from http://www.lefigaro.fr/conjoncture/2019/02/27/20002-20190227ARTFIG00253-une-penurie-de-palettes-de-bois-menace-le-royaume-uni-en-cas-de-brexit-dur.php

Cohen, M. W., & Levinthal, A. D. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1).

Collins, D. J., & Montgomery, C. A. (2008). *A corporate strategy: A resource-based approach* (2nd ed.). New York, NY: McGraw-Hill.

Collis, D. J. (1994). Research note: How valuable are organizational capabilities? *Strategic Management Journal*, *15*, 143–152.

COM. (2012). 60 final (2012) *Innovating for sustainable growth: A bioeconomy for Europe;* published on Feb. 13, 2012. Retrieved from https://ec.europa.eu/research/bioeconomy/pdf/official-strategy_en.pdf

COM. (2014). 0398 final (2014) *Towards a circular economy: A zero waste programme for Europe;* published on July 2, 2014. Retrieved from http://www.ipex.eu/IPEXL-WEB/dossier/document/COM20140398.do

Control regulation of electrical and electronic waste products (AEEE) . (2012). Official newspaper. Retrieved from http://www.resmigazete.gov.tr/eskiler/2012/05/20120522-5.htm

Control regulation of electrical and electronic waste products municipal application guide. (2016). Retrieved from https://recturkey.files.wordpress.com/2016/11/aeee_rehberi.pdf

Control regulation of herbal waste oil, RG . (2005). Number 25791. Retrieved from http://www.resmigazete.gov.tr/eskiler/2005/04/20050419-4.htm

Control regulation of medical waste RG. (2005). Number 25883. Retrieved from http://www.vertic.org/media/National%20Legislation/Turkey/TR_By-law_Medical_Waste_Control.pdf

Control regulation of packaging wastes . (2011). Number 28235. Retrieved from http://www.resmigazete.gov.tr/eskiler/2011/08/20110824-6.htm

Control regulation of waste battery and accumulator. (2004). Number 25569. Retrieved from http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.7118&sourceXmlSearch=&MevzuatIliski=0

Cooper, M. C., Lambert, D. M., & Pagh, J. D. (1997). Supply chain management: More than a new name for logistics. *International Journal of Logistics Management*, *8*(1), 1–14. doi:10.1108/09574099710805556

Council of Supply Chain Management Professionals (CSCMP). (2013). *Supply chain management definitions and glossary.* Retrieved from https://cscmp.org/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx?hkey=60879588-f65f-4ab5-8c4b-6878815ef921)

Cox, J. F., Blackstone, J. H., & Spencer, M. S. (1998). American production and inventory control society. *Publisher APICS, Dictionary, 9*.

Craig, V. (2004). *Global logistics management* (1st ed.). Lansdowne, South Africa: Juta and Company.

Cretu, A. E., & Brodie, R. J. (2007). The influence of brand image and company reputation where manufacturers market to small firms: A customer value perspective. *Industrial Marketing Management*, *36*(2), 230–240. doi:10.1016/j.indmarman.2005.08.013

Cronin, J., Brady, M. K., & Hult, G. T. M. (2000). Assessing the effects of quality, value, and customer satisfaction on consumer behavioral intentions in service environments. *Journal of Retailing, 76*(2), 193–218.

Crosby, M., Nachiappan, P., Verma, S., & Kalyanaraman, V. (2016). BlockChain technology: Beyond Bitcoin. *Applied Innovation Review*, (2), 6–19. doi:10.1515/9783110488951

CSCMP. (n.d.). Council of Supply Chain Management Professionals. Retrieved from http://www.cscmp.org

Cucinotta, F., Nigrelli, V., & Sfravara, F. (2017). A preliminary method for the numerical prediction of the behavior of air bubbles in the design of Air Cavity Ships (pp. 509–516). doi:10.1007/978-3-319-45781-9_51

Cullinane, K. (2012). An international dimension: Shipping. In T. Ryley & L. Chapman (Eds.), *Transport and sustainability* (Vol. 2, pp. 65–104). Emerald Group. doi:10.1108/S2044-9941(2012)0000002007

Czachorowski, K., Solesvik, M., & Kondratenko, Y. (2019). *Green IT engineering: Social, business, and industrial applications* (Vol. 171). Springer International. doi:10.1007/978-3-030-00253-4

Czarniawska, B. (2013). Is speed good? *Scandinavian Journal of Management*, *29*(1), 7–12. doi:10.1016/j.scaman.2012.11.007

da Conceição, V. P., Dahlman, J., & Navarro, A. (2017). What is maritime navigation? Unfolding the complexity of a sociotechnical system. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *61*(1), 267–271. doi:10.1177/1541931213601549

Dağ, A. (2018). Transhumanism in cinema and novel: The samples of the film "Blade Runner" and novel of "Neuromancer". *RumeliDE Dil ve Edebiyat Araştırmaları Dergisi*, (11), 89-98.

Daily Mail Online. (2013). Meet Francisco: The fastest ferry on the planet with jet engines that propel over 1000 passengers and 150 cars at 67 MPH. *Daily Mail Online.* Retrieved from http://www.dailymail.co.uk/news/article-2351454/Meet-Francisco-The-fastest-ferry-planet-jet-engines-propel-1000-passengers-150-cars-67-MPH.html

Dallari, F., Marchet, G., & Melacini, M. (2009). Design of order picking system. *International Journal of Advanced Manufacturing Technology*, *42*(1-2), 1–12. doi:10.100700170-008-1571-9

Danish, & Wang, Z. (2018). Dynamic relationship between tourism, economic growth, and environmental quality. *Journal of Sustainable Tourism, 26*(11), 1928-1943.

Daugherty, P., & Pittman, P. H. (1995). Utilization of time-based strategies: Creating distribution flexibility/responsiveness. *International Journal of Operations & Production Management*, *4*, 60.

Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of Marketing*, *58*(4), 37–52. doi:10.1177/002224299405800404

Dayi, O., & Mascle, C. (2015). *Méthodologie d'amélioration leagile de la chaîne logistique*. Paper presented at the 11e CIGI2015 – Congrès International de Génie Industriel, October, Québec, Canada.

De Koster, R., Le-Duc, T., & Roodbergen, K. J. (2007). Design and control of warehouse order picking: A literature review. *European Journal of Operational Research*, *182*(2), 481–501. doi:10.1016/j.ejor.2006.07.009

De Koster, R., Van Der Poort, E. S., & Wolters, M. (1999). Efficient orderbatching methods in warehouses. *International Journal of Production Research*, *37*(7), 1479–1504. doi:10.1080/002075499191094

De Langen, P., Turró, M., Fontanet, M., & Caballé, J. (2018). *The infrastructure investment needs and financing challenge of European ports, Report prepared for the European Seaports Organisation (ESPO).* Retrieved from: https://www.espo.be/publications/the-infrastructure-investment-needs-and-financing-

de Melo Rodriguez, G., Echevarrieta, I., & Serra, J. M. (2015). Improving the efficiency of a high speed catamaran through the replacement of the propulsion system. *TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 9*(4), 531–535. doi:10.12716/1001.09.04.09

De Santis, R., Montanari, R., Vignali, G., & Bottani, E. (2018). An adapted ant colony optimization algorithm for the minimization of the travel distance of pickers in manual warehouses. *European Journal of Operational Research*, *267*(1), 120–137. doi:10.1016/j.ejor.2017.11.017

De, N. (2018). British maritime society builds blockchain tool for ship registration. Retrieved from https://www.coindesk.com/british-maritime-society-builds-blockchain-tool-for-ship-registration

Debjani, G. (2008). Logistics services under Indo-EU TIA, ICRIER (Indian Council For Research on International Ecoomic Relations, 2008. Retrieved from http://wtocentre.iift.ac.in/EU%20BTIA/EU%20BTIA/Report%20on%20Logistic%20Services%20-%20India-EU%20BTIA.pdf

del Águila Ferrandis, J., Brizzolara, S., & Chryssostomidis, C. (2018). Influence of large hull deformations on the motion response of a fast catamaran craft with varying stiffness. *Ocean Engineering*, *163*, 207–222. doi:10.1016/j.oceaneng.2018.05.038

Delfman, W. (2004). Logistics service providers market view, University of Cologne. Retrieved from http://www.spl.uni. koeln.de

Delfman, W., & Albers, S. (2000). Supply chain management in the global context, Universitat zu Köln Working Paper, WP-No.102, Köln, Germany.

Delfman, W., & Albers, S. (2000). Supply chain management in the Global Context, Universitat zu Köln Working Paper, WP-No.102, Köln, Germany.

Deligiannis, P. (2017). Ship performance indicator. *Marine Policy*, *75*, 204–209. doi:10.1016/j.marpol.2016.02.027

Deloitte. Türkiye Gayrimenkul Sektörü Raporu, TC Başbakanlık Yatırım Destek ve Tanıtım Ajansı Yayını, Ocak 2010. Retrieved from http://www.invest.gov.tr/tr-TR/infocenter/publications/Documents/GAYRIMENKUL.SEKTORU.pdf

Demirbas, A. (2017). Fuel properties of hydrogen, liquefied petroleum gas (LPG), and compressed natural gas (CNG) for transportation. *Energy Sources*, 601–610.

Dempsey, M. E. (2010). *Eyes of the army–U.S. army roadmap for unmanned aircraft systems roadmap 2010-2035. U.S. Army UAS Center of Excellence*, *9*, 1–140.

Deutsche Post – DHL. Retrieved from http://www.dp-dhl.com/reports/2009/gb/en/group-management-report/ employees.html

Deveci, D. A., & Çavuşoğlu, D. (2013). Intermodal rail transport: Opportunities and threats for Turkey. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, *5*(1), 93–120.

Devon, R. (2019). The waste hierarchy. Available at https://www.recycledevon.org/at-work/resource-efficiency

DHL. (2008). DHL Hub Leipzig/Halle, Deutsche Post World Net Corporate Communications/Public Relations Publications, Germany. Retrieved from http://www.dp-dhl.com/content/dam/logistik_populaer/leipzig_hub/hub-leipzig_en.pdf

Dianwei, Q. (2006). The research on logistics cost accounting and management in China. In *Proceedings of 2006 International Conference on Management of Logistics and Supply Chain*, Sept. 20-22, 2006, Sydney, Australia.

DiDomenico, A., & Nussbaum, M. A. (2011). Effects of different physical workload parameters on mental workload and performance. *International Journal of Industrial Ergonomics*, *41*(3), 255–260. doi:10.1016/j.ergon.2011.01.008

Diericks, I., Cool, K., & Barney, J. B. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management Science*, *35*(12).

Ding, J.-F., Kuo, J.-F., Shyu, W.-H., & Chou, C.-C. (2019). Evaluating determinants of attractiveness and their cause-effect relationships for container ports in Taiwan: Users' perspectives. *Maritime Policy & Management*, *46*(4), 466–490. doi:10.1080/03088839.2018.1562245

Diordiiev, V. (2018). Blockchain technology and its impact on financial and shipping services. *Економіка. Екологія. Соціум, 2*(1), 51–63. Retrieved from https://ees-journal.com/index.php/journal/article/view/48/21

Directive 2001/81/EC of the European Parliament and of the Council. Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:309:0022:0030:EN:PDF

discover. (2019). Retrieved from https://discover.dhl.com/business/business-ethics/parcelcopter-drone-technology)

Djavareshkian, M. H., & Esmaeili, A. (2013). Neuro-fuzzy based approach for estimation of Hydrofoil performance. *Ocean Engineering*, *59*, 1–8. doi:10.1016/j.oceaneng.2012.10.015

Dnv. (2008). Liquified gas carriers. Hovik: Det Norske Veritas.

Dobrzykowski, D. D., & Vonderembse, M. A. (2009). Healthcare supply chain and IS strategies for improved outcomes In *Proceedings of Production and Operations Management Society 20th Annual Conference*, Florida.

Doğan, Ö. İ., Marangoz, M., & Topoyan, M. (2003). Factors affecting the competitiveness of enterprises in internal and external markets and an application. *Dokuz Eylül Üniversity Journal of Social Sciences*, *5*(2), 114–139.

Dölek, A. (1999). *Mevzuat Işığında Dış Ticaret İşlemleri ve Piyasa Uygulamaları*. İstanbul, Turkey: Beta Basım Yayım Dağıtım.

Dominic, C. (2010). Packaging logistics, functional demands, transport testing (Innventia document). Retrieved from https://www.kth.se/polopoly_fs/1.220326.1550158571!/Menu/general/column-content/attachment/Föreläsning%203.pdf

Dominic, C., Johansson, K., Lorentzon, A., Olsmats, C., Tiliander, L., & Weström, P. (2000). *Förpackningslogistik* (2nd ed.). Kista, Sweden: PACKFORSK.

Dominici, G., & Guzzo, R. (2010). Customer satisfaction in the hotel industry: A case study from Sicily. *International Journal of Marketing Studies*, *2*(2), 3–12.

Dowlatshahi, S. (2010). A cost-benefit analysis for the design and implementation of reverse logistics systems: Case studies approach. *International Journal of Production Research*, *48*(5), 1361–1380. doi:10.1080/00207540802552642

Drobetz, W., & Johns, M. (2018). The evolution of modern ship finance. In *Finance and risk management for international logistics and the supply chain* (pp. 85–108). Elsevier; doi:10.1016/B978-0-12-813830-4.00004-6

Dudek, G. (2009). *Collaborative planning in supply chains: A negotiation-based approach*. Heidelberg, Germany: Springer Dordrecht.

Dukic, G., & Oluic, C. (2007). Order-picking methods: Improving order-picking efficiency. *International Journal of Logistics Systems and Management*, *3*(4), 451–460. doi:10.1504/IJLSM.2007.013214

Dulebenets, M. A., & Ozguven, E. E. (2017). Vessel scheduling in liner shipping: Modeling transport of perishable assets. *International Journal of Production Economics, 184*(November, 2016), 141–156. doi:10.1016/j.ijpe.2016.11.011

Dumitrecsu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, *29*(4), 1450–1460. doi:10.1016/j.econmod.2012.02.014

Dyllick, T., & Hockerts, K. (2002). Beyond the business case for corporate sustainability. *Business Strategy and the Environment*, (11): 131–132.

Eckert, J. A., & Fawcett, S. J. (1996). Critical capability for logistics excellence: People, quality, and time. *Proceedings of the Council of Logistics Management*, 183-197.

Edrissi, A., Nourinejad, M., & Roorda, M. J. (2015). Transportation network reliability in emergency response. *Transportation Research Part E, Logistics and Transportation Review*, *80*, 56–73. doi:10.1016/j.tre.2015.05.005

Efanov, D., & Roschin, P. (2018). The all-pervasiveness of the blockchain technology. *Procedia Computer Science*, *123*, 116–121. doi:10.1016/j.procs.2018.01.019

Eggemeier, F. T. (1988). Properties of workload assessment techniques. In Advances in Psychology (Vol. 52, pp. 41–62). doi:10.1016/S0166-4115(08)62382-1

Ehmer, P., & Heymann, E. (2010, Dec. 9). German logistics sector back on growth track, Deutsche Bank Research, Research Briefing, Frankfurt, Germany.

EIA. (2017). Retrieved from https://www.eia.gov/outlooks/ieo/table4-3.php

EIA. International Energy Outlook, Energy Information Administration report, USA. (2009). Available at http://www.eia.doe.gov/oiaf/ieo/electricity.html

Ek, Å., Runefors, M., & Borell, J. (2014). Relationships between safety culture aspects – A work process to enable interpretation. *Marine Policy*, *44*, 179–186. doi:10.1016/j.marpol.2013.08.024

Elbert, R. M., Franzke, T., Glock, C. H., & Grosse, E. H. (2016). The effects of human behavior on the efficiency of routing policies in order picking: The case of route deviations. *Computers & Industrial Engineering*, *111*(1), 537–551.

Elia, S., Maggi, E., & Mariotti, I. (2009). Does the logistics sector gain from manufacturing internalisation? An empirical investigation on the Italian case, Economic and Statistics Discussion Papers No.52/09, Universita Studiorum Molise, Italy. Retrieved from http://web.unimol.it/progetti/repec/mol/ecsdps/ ESDP09052.pdf

Ellen MacArthur Foundation. (2013). *Towards the circular economy: opportunities for the consumer goods sector*. Retrieved from https://www.ellenmacarthurfoundation.org

Ellinger, A., Ellinger, D., & Keller, S. B. (2002). Logistics managers' learning environments and firm performance. *Journal of Business Logistics*, *23*(1), 19–37. doi:10.1002/j.2158-1592.2002.tb00014.x

Emory, L., & Kerr, C. N. (1967). USA Patent No. 3,453,836.

Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *37*(1), 32–64. doi:10.1518/001872095779049543

Environmental Law, RG. (1983). Number 18132. Retrieved from http://www.mevzuat.gov.tr/MevzuatMetin/1.5.2872.pdf

Erdal, M., & Çancı, M. (2009). Lojistik Yönetimi, 3. Baskı, İstanbul: UTİKAD Yayınları.

Eren, E. (2012). *Örgütsel davranış ve yönetim psikolojisi*. İstanbul, Turkey: Beta Yayıncılık.

Erkan, B. (2014). The importance and determinants of logistics performance of selected countries. *Journal of Emerging Issues in Economics*, *Finance, and Banking*, *3*(6), 1237–1254.

Ernstsen, J., & Nazir, S. (2018). Consistency in the development of performance assessment methods in the maritime domain. *WMU Journal of Maritime Affairs*, *17*(1), 71–90. doi:10.100713437-018-0136-5

Ertuğrul, M. U. (2014). *Seyir (1. Baskı)*. İstanbul, Turkey: Akademi Denizcilik.

Ertürk, T. (2018). Türkiye denizlerini kaybetmek üzere. Retrieved from https://odatv.com/turkiye-denizlerini-kaybetmek-uzere-01111813.html

Esmailian, E., Farzanegan, B., Menhaj, M. B., & Ghassemi, H. (2018). A robust neuro-based adaptive control system design for a surface effect ship with uncertain dynamics and input saturation to cargo transfer at sea. *Applied Ocean Research*, *74*, 59–68. doi:10.1016/j.apor.2018.02.010

Esper, F., Fugate, B. S., & Davis-Sramek, B. (2007). Logistics learning capability: Sustaining the competitive advantage through logistics leverage. *Journal of Business Logistics*, *28*(2), 57–81. doi:10.1002/j.2158-1592.2007.tb00058.x

EU climate action. Retrieved from http://ec.europa.eu/climateaction/eu_action/index_en.htm

EU Emission Trading Scheme website. Retrieved from http://ec.europa.eu/environment/climat/emission/index_en.htm

EU. The market for solid fuels in the community in 2007 and the Outlook for 2008, Commission of the European Communities Working Document, 2009. Retrieved from http://ec.europa.eu/energy/observatory/coal/report_solid_fuels_market_eu_en.htm

European Commission, Directorate-General Regional Policy . (2004). Resource book on PPP case studies.

European Commission. (2011) *A roadmap for moving to a competitive low carbon economy in 2050.* Communication. European Commission European Commission, Brussels, Belgium. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1560718490833&uri=CELEX:52012IP0086

European Parliament. Council. (2008). *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives.* Directive. European Parliament European Parliament, Brussels, Belgium. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1560718830307&uri=CELEX:32008L0098

Evangelista, P., Colicchia, C., & Creazza, A. (2017). Is environmental sustainability a strategic priority for logistics service providers? *Journal of Environmental Management*, *198*(1), 353–362. doi:10.1016/j.jenvman.2017.04.096 PMID:28494424

Eyres, D. J., & Bruce, G. J. (2012). Development of ship types. In *Ship construction* (pp. 17–33). Elsevier; doi:10.1016/B978-0-08-097239-8.00003-9

Ezel, H. (2013). *Uluslararası Ticarette Teslim Şekilleri (Incoterms)*. Yayınlanmamış Yüksek Lisans Tezi, Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü.

FAA, Summary of Small Unmanned Aircraft Rule (Part 107). (2017). Retrieved from https://goo.gl/vLMToL

Fabbe-Costes, N., Jahre, M., & Roussat, C. (2008). Supply chain integration: the role of logistics service providers. *International Journal of Productivity and Performance Management*, *58*(1), 71–91. doi:10.1108/17410400910921092

Fagerholt, K., Gausel, N. T., Rakke, J. G., & Psaraftis, H. N. (2015). Maritime routing and speed optimization with emission control areas. *Transportation Research Part C, Emerging Technologies*, *52*, 57–73. doi:10.1016/j.trc.2014.12.010

Fagundes, L. D., Amorim, E. S., & Da Silva Lima, R. (2017). Action research in reverse logistics for end-of-life tire recycling. *Systemic Practice and Action Research*, *30*(5), 553–568. doi:10.100711213-016-9408-1

Falkland Islands Government. (2013). *Call for Expression of Interest.* Retrieved from: https://www.falklands.gov.fk/home/call-for-expression-of-interest/

Faltinsen, O. M. (2006). Hydrodynamic features of high-speed vessels. *Ships and Offshore Structures*, *1*(1), 13–23. doi:10.1533aos.2005.0010

Fang, C. C., & Chan, H. S. (2007). An investigation on the vertical motion sickness characteristics of a high-speed catamaran ferry. *Ocean Engineering*, *34*(14–15), 1909–1917. doi:10.1016/j.oceaneng.2007.04.001

Fan, L., Zhang, S., & Yin, J. (2018). Structural analysis of shipping fleet capacity. *Journal of Advanced Transportation*, *2018*, 1–11. doi:10.1155/2018/3854090

Farahani, R. Z., Asgari, N., & Davarzani, H. (2009) *Supply chain and logistics in national, international and governmental environment – concepts and models*. Berlin, Germany: Physiga-Verlag.

Farkas, A., Degiuli, N., & Martić, I. (2017). Numerical investigation into the interaction of resistance components for a series 60 catamaran. *Ocean Engineering*, *146*, 151–169. doi:10.1016/j.oceaneng.2017.09.043

Fast Ferry International. (2018). Fast Ferry Vessel Database. Retrieved from http://www.fastferryinfo.com/fastferries/

Fawcett, S. E., Magnan, G., & M. ve McCarter, M. W. (2008). Benefits, barriers and bridges to effective supply chain management. *Supply Chain Management*, *13*(1), 35–48. doi:10.1108/13598540810850300

Fawcett, S., Stanley, S., & Smith, S. (1997). Developing logistics capabilities to improve the performance of international operations. *Journal of Business Logistics*, *18*(2), 101–127.

Fayol, H. (1916). *General and Industrial Management*. Paris, France: Institute of Electrical and Electronics Engineering.

Fedi, L., Lavissiere, A., Russell, D., & Swanson, D. (2019). The facilitating role of IT systems for legal compliance: the case of port community systems and container verified gross mass (VGM). *Supply Chain Forum: An International Journal*. 20(1): 29-42

Fehr, M. (2014). The management challenge for household waste in emerging economies like Brazil: Realistic source separation and activation of reverse logistics. *Waste Management & Research*, *32*(9), 32–39. doi:10.1177/0734242X14541985 PMID:24990590

Feibert, D. C., Hansen, M. S., & Jacobsen, P. (2017). An integrated process and digitalization perspective on the shipping supply chain – a literature review. In *2017 IEEE International Conference on Industrial Engineering and Engineering Management IEEE*. Pages 1-5 10.1109/IEEM.2017.8290113

Fernández-Macho, J., González, P., & Virto, J. (2016). An index to assess maritime importance in the European Atlantic economy. *Marine Policy*, *64*, 72–81. doi:10.1016/j.marpol.2015.11.011

Filiz, E., Karaboğa, H. A., & Akoğul, S. (2017). BIST-50 index change values classification using machine learning methods and artificial neural networks. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 26*(1), 231-241.

Finder, V. (2019, Oct. 15). Marianne - LPG tanker. Retrieved from https://www.vesselfinder.com/vessels/MARIANNE-IMO-9474539-MMSI-477612300

Fink, A., & Rothlauf, F. (Eds.). (2008). *Advances in computational intelligence in transport, logistics, and supply chain management* (Vol. 144). Springer. doi:10.1007/978-3-540-69390-1

FintechtimeD. (n.d.). Retrieved from http://fintechtime.com/tr/?s=p2p

Firby, R. J. (1987, July). *An investigation into reactive planning in complex domains* (Vol. 87, pp. 202–206). AAAI.

Fischer, E. A. (2016). Cybersecurity issues and challenges: In brief. *Congressional Research Service*, 1–12. Retrieved from https://fas.org/sgp/crs/misc/R43831.pdf

Fiske, S. T., & Taylor, S. E. (1991). *Social cognition*. New York: McGraw-Hill.

Fleischmann, M., Bloemhof-Ruwaard, J. M., Dekker, R., Van, L., Van, N., & Van, W. (1997). Quantitative models for reverse logistics: A review. *European Journal of Operational Research*, *103*(1), 1–17. doi:10.1016/S0377-2217(97)00230-0

Fleischmann, M., Van Nunen, J. A., & Gräve, B. (2003). Integrating closed-loop supply chains and spare-parts management at IBM. *Interfaces*, *33*(6), 44–56. doi:10.1287/inte.33.6.44.25189

Flint, D., Larsson, E., Gammelgaard, B., & Mentzer, J. T. (2005). Logistics innovation: A customer value-oriented social process. *Journal of Business Logistics*, *26*(1), 113–147. doi:10.1002/j.2158-1592.2005.tb00196.x

Forozia, A., Zadeh, M. S., & Gilani, M. H. (2013). Customer satisfaction in hospitality industry: Middle East tourists at 3-star hotels in Malaysia. *Research Journal of Applied Sciences, Engineering, and Technology*, *5*(17), 4329–4335. doi:10.19026/rjaset.5.4425

Fotis, P. N., & Pekka, V. (2017). The effect of renewable energy use and economic growth on pollution in the EUROZONE. *Economics and Business Letters*, *6*(3), 88–99. doi:10.17811/ebl.6.3.2017.88-99

Frazelle, E. (2002). Supply chain strategy: the logistics of supply chain management. McGraw Hill, 258-261.

Fredendall, L. D., & Hill, E. (2001). *Basics of supply chain management*. Boca Raton, FL: CRC Press.

Freidinger-Legay, A. (2018). La recyclabilité a le vent en poupe. *La Revue des Marques*, *104*(October), 62–66.

French, M. L. (2008). Improving sustainability through effective reuse of product returns: Minimizing waste in a batch blending process environment. *Journal of Cleaner Production*, *16*(15), 1679–1687. doi:10.1016/j.jclepro.2008.01.006

Friederiszick, H., Gantumur, T., Jayaraman, R., Röller, L. H., & Weinmann, J. (2009). Railway alliances in EC long-distance passenger transport: A competitive assessment post-liberalization 2010. ESMT White Paper No. Wp-109-01, ESMT European School of Management and Technology. Retrieved from http://www.esmt.org/fm/292/WP-109-01.pdf

Fruth, M., & Teuteberg, F. (2017). Digitization in maritime logistics – What is there and what is missing? *Cogent Business & Management.*, *4*(1), 1–40. doi:10.1080/23311975.2017.1411066

Fugate, B. S., Mentzer, J. T., & Stank, T. P. (2010). Logistics performance: efficiency, effectiveness, and differentiation. *Journal of Business Logistics*, *31*(1), 43–62. doi:10.1002/j.2158-1592.2010.tb00127.x

Fugazza, M. & Hoffmann, J. (2017). Liner shipping connectivity as determinant of trade. *Journal of Shipping and Trade*, 1–18.

Fu, H., Liao, J., Yang, J., Wang, L., Song, Z., Huang, X., ... Zhao, W. (2016). The Sunway TaihuLight supercomputer: System and applications. *Science China. Information Sciences*, *59*(7), 072001. doi:10.100711432-016-5588-7

Fulconis, F., & Philipp, B. (2018a). Packaging scorecard for closed-loop logistics systems: A sustainable development perspective. *Procedia - social and behavioral sciences*, Elsevier Editor, March, *238*, 19–28. doi:. doi:10.1016/j.sbspro.2018.03.003

Fulconis, F., & Philipp, B. (2016). Packaging et chaîne logistique en boucle fermée: Contribution au passage d'une économie linéaire à une économie circulaire. *Logistique & Management*, *24*(3/4), 186–198. doi:10.1080/12507970.2016.1268936

Fulconis, F., & Philipp, B. (2018b). Quels packagings pour les supply chains du e-commerce. *Supply Chain Magazine*, *13*, 104–105.

Fulconis, F., & Philipp, B. (2019). La supply chain face aux défis de la livraison E-commerce: Entre intégration et flexibilité, quelles solutions packaging? *Logistique & Management*, *27*(2), 132–147. doi:10.1080/12507970.2018.1546127

Gabay, G., Moskowitz, H. R., Beckley, J., & Ashman, H. (2009). Consumer centered "brand value" of foods: Drivers and segmentation. *Journal of Product and Brand Management*, *18*(1), 4–16. doi:10.1108/10610420910933326

Gademann, N., & van de Velde, S. (2005). Order batching to minimize total travel time in a parallel-aisle warehouse. *IIE Transactions*, *37*(1), 63–75. doi:10.1080/07408170590516917

Gang, D., Chuanwang, S., & Jinxian, W. (2016). Liner shipping fleet deployment with sustainable collaborative transportation. *Sustainability*, *8*(2), 165. doi:10.3390u8020165

Gang, L., Wang, Y., Sun, Y., Zhou, L., & Zhang, M. (2016). Estimation of vessel collision risk index based on support vector machine. *Advances in Mechanical Engineering*, *8*(11). doi:10.1177/1687814016671250

Garbatov, Y., Rudan, S., & Guedes Soares, C. (2010). Fatigue assessment of welded trapezoidal joints of a very fast ferry subjected to combined load. *Engineering Structures*, *32*(3), 800–807. doi:10.1016/j.engstruct.2009.12.007

García-Arca, J., & Prado Prado, J. C. (2008). Packaging design model from a supply chain approach. *Supply Chain Management: An International Journal*, *13*(5), 375–380. doi:10.1108/13598540810894960

García-Arca, J., Prado-Prado, J. C., & Gonzalez-Portela Garrido, A. T. (2014). Packaging logistics: Promoting sustainable efficiency in supply chains. *International Journal of Physical Distribution & Logistics Management*, *44*(4), 325–346. doi:10.1108/IJPDLM-05-2013-0112

García-Espinosa, J., Di Capua, D., Serván-Camas, B., Ubach, P.-A., & Oñate, E. (2015). A FEM fluid–structure interaction algorithm for analysis of the seal dynamics of a surface-effect ship. *Computer Methods in Applied Mechanics and Engineering*, *295*, 290–304. doi:10.1016/j.cma.2015.07.010

García-Olivares, A., Solé, J., & Osychenko, O. (2018). Transportation in a 100% renewable energy system. *Energy Conversion and Management, 158*(August 2017), 266–285. doi:10.1016/j.enconman.2017.12.053

Garme, K., Rosén, A., Stenius, I., & Kuttenkeuler, J. (2014). Rough water performance of lightweight high-speed craft. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, *228*(3), 293–301. doi:10.1177/1475090212460456

Gehin, A., Zwolinski, P., & Brissaud, D. (2008). A tool to implement sustainable end-of-life strategies in the product development phase. *Journal of Cleaner Production*, *16*(5), 566–576. doi:10.1016/j.jclepro.2007.02.012

Gehling, R. (2007). International safety standards for high-performance marine vehicles–the DSC Code, HSC Codes and the WIG Craft Guidelines. *Australian Journal of Mechanical Engineering*, *4*(2), 101–110. doi:10.1080/14484846.2007.11464519

Genç, N. (2007). *Yönetim ve Organizasyon*. Ankara, Turkey: Seçkin Yayıncılık.

Genç, R. (2009). *Çağımızın Mesleği Lojistik ve Tedarik Zinciri Yönetiminin Yöntem ve Kavramları (1. baskı)*. Ankara, Turkey: Detay Yayıncılık.

General principles of waste management, RG . (2008). Number 26927. Retrieved from http://www.resmigazete.gov.tr/eskiler/2008/07/20080705-7.htm

Gestión (2019). *Primera fase del puerto de Chancay de Cosco Shipping y Volcan demandará US$1,300 millones.* Retrieved from https://gestion.pe/economia/empresas/primera-fase-puerto-chancay-cosco-shipping-volcan-demandara-us-1-300-millones-256546

Ghandoor, A. (2013). An approach to energy savings and improved environmental impact through restructuring Jordan's transport sector. *Renewable & Sustainable Energy Reviews*, *18*, 31–42. doi:10.1016/j.rser.2012.09.026

Ghassemi, H. (2009). Hydrodynamic characteristics of the surface-piercing propellers for the planing craft. *Journal of Marine Science and Application*, *8*(4), 267–274. doi:10.100711804-009-8076-2

Ghiani, G., Laporte, R., & Musmanno, R. (2004). *Introduction to logistics systems planning and control*. Wiley.

Giannetti, C. (2015). Unit roots and the dynamics of market shares: An analysis using an Italian banking micro-panel. *Empirical Economics*, *48*(2), 537–555. doi:10.100700181-013-0795-1

Gilanli, E., Altuğ, N., & Oğuzhan, A. (2012). Comparison of forward and reverse logistics in enterprises. *Trakya University Journal of Social Science, 14*(1).

Giuffrida, N., Ignaccolo, M., Inturri, G., Rofè, Y., & Calabrò, G. (2017). Investigating the correlation between transportation social need and accessibility: The case of Catania. *Transportation Research Procedia*, *27*, 816–823. doi:10.1016/j.trpro.2017.12.122

Gledić, I., Parunov, J., Prebeg, P., & Ćorak, M. (2019). Low-cycle fatigue of ship hull damaged in collision. *Engineering Failure Analysis*, *96*, 436–454. doi:10.1016/j.engfailanal.2018.11.005

Global Reporting Initiative (GRI). (2018). Retrieved from https://www.globalreporting.org/information/about-gri/what-is-GRI/Pages/

Gohomene, D. A., Yang, Z. L., Bonsal, S., Maistralis, E., Wang, J., & Li, K. X. (2016). The attractiveness of ports in West Africa: Some lessons from shipping lines' port selection. *Growth and Change*, *47*(3), 416–426. doi:10.1111/grow.12133

Golombek, R., Kittelsen, S. A., & Maestad, O. 2005. Coal transport demand in Western Europe and Japan: Imports of energy market liberalisation and climate policy. Working paper, Center of International Economics and Shipping, Bergen, Norway.

Golrizgashti, S. (2014). Supply chain value creation methodology under BSC approach. *Journal of Industrial Engineering International*, 10, 67(1)–67(15).

Gómez-Montoya, R. A., Cano, J. A., & Campo, E. A. (2018). Efficient slotting management in an agribusiness distribution center. *Espacios*, *39*(16), 23.

Gómez-Montoya, R. A., Correa-Espinal, A. A., & Hernández-Vahos, J. D. (2016). Picking routing problem with K homogenous material handling equipment for a refrigerated warehouse. *Revista de la Facultad de Ingeniería*, (80): 9–20.

Gonzalez-Torre, P. L., Adenso-Diaz, B., & Artiba, H. (2004). Environmental and reverse logistics policies in European bottling and packaging firms. *International Journal of Production Economics*, *88*(1), 95–104. doi:10.1016/S0925-5273(03)00181-6

goo.gl. (2019). Retrieved from https://goo.gl/i9AKGh

goo.gl. (2019). Retrieved from https://goo.gl/J6a6WK

Görçün, Ö. F. (2013). *Örnek Olay ve Uygulamalarla Tedarik Zinciri Yönetimi*. İstanbul, Turkey: Beta Basım A. Ş.

Gould, K. S., Røed, B. K., Saus, E. R., Koefoed, V. F., Bridger, R. S., & Moen, B. E. (2009). Effects of navigation method on workload and performance in simulated high-speed ship navigation. *Applied Ergonomics*, *40*(1), 103–114. doi:10.1016/j.apergo.2008.01.001 PMID:18295184

Gourdin, K. (2006). *Global logistics management: a competitive advantage for the 21st century* (2nd ed.). New York: Wiley-Blackwell Publishing.

Govindan, K., & Bouzon, M. (2018). From a literature review to a multi-perspective framework for reverse logistics barriers and drivers. *Journal of Cleaner Production*, *187*, 319–327. doi:10.1016/j.jclepro.2018.03.040

Grant, M. R. (1991). *The resource-based theory of competitive advantage: Implication for strategy formulation*, California Management Review, Spring.

Gray, R. (2004, Sept. 13). Bulk liquefied gas by sea. Retrieved from http://www.sigtto.org/media/7210/supplement-lng-history.pdf

Grazia Speranza, M. (2018). Trends in transportation and logistics. *European Journal of Operational Research*, *264*(3), 830–836. doi:10.1016/j.ejor.2016.08.032

Grewal, E. (2017, 4). Airbnb & machine learning. Retrieved from https://www.techemergence.com/airbnb-machine-learning-how-data-and-socialscience-make-it-all-work/

GRI Standards Download Center. (n.d.). Retrieved from https://www.globalreporting.org/standards/gri-standards-download-center/

Gronholt-Pedersen, J. (2017). Maersk says global IT breakdown caused by cyber attack. Retrieved from https://www.reuters.com/article/us-cyber-attack-maersk/maersk-says-global-it-breakdown-caused-by-cyber-attack-idUSKBN19I1NO

Grosse, E. H., Glock, C. H., & Ballester-Ripoll, R. (2014). A simulated annealing approach for the joint order batching and order picker routing problem with weight restrictions. *International Journal of Operations and Quantitative Management*, *20*(2), 65–83.

Grosse, E. H., Glock, C. H., & Neumann, W. P. (2017). Human factors in order picking: A content analysis of the literature. *International Journal of Production Research*, *55*(5), 1260–1276. doi:10.1080/00207543.2016.1186296

Grossman, G. M., & Krueger, A. B. (1991). Environmental impacts of a North American Free Trade Agreement. NBER. Working Paper 3914.

Gruchmann, T., Melkonyan, A., & Krumme, K. (2018). Logistics business transformation for sustainability: Assessing the role of the lead sustainability service provider (6PL). *Logistics*, *2*(25), 1–19. doi:10.3390/logistics2040025

Guasch, J. L., & Kogan, J. (2006). Inventories and logistic costs in developing countries: levels and determinants—a red flag for competitiveness and growth. *Policy Research Working Paper* 2552. Washington DC: World Bank.

Gudehus, T., & Kotzab, H. (2012). *Comprehensive logistics*. Berlin, Germany: Springer Berlin Heidelberg; doi:10.1007/978-3-642-24367-7

Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management (New York, N.Y.)*, *33*(1), 220–232. doi:10.1016/j.wasman.2012.09.008 PMID:23098815

Guide to Ocean Alliances. (n.d.). Retrieved from https://www.flexport.com/blog/what-are-ocean-alliances

Guide, V. D. R. Jr, Jayaraman, V., Srivastava, R., & Benton, W. C. (2000). Supply-chain management for recoverable manufacturing systems. *Interfaces*, *30*(3), 125–142. doi:10.1287/inte.30.3.125.11656

Gu, J., Goetschalckx, M., & McGinnis, L. F. (2007). Research on warehouse operation: A comprehensive review. *European Journal of Operational Research*, *177*(1), 1–21. doi:10.1016/j.ejor.2006.02.025

Gu, J., Goetschalckx, M., & McGinnis, L. F. (2010). Research on warehouse design and performance evaluation: A comprehensive review. *European Journal of Operational Research*, *203*(3), 539–549. doi:10.1016/j.ejor.2009.07.031

Güner, S., & Coşkun, E. (2013). Environmental perceptions of small and medium-sized enterprises and the effects of buyer supplier relations on environmental practices. *Ege Akademik Bakış*, *12*(2), 151–167.

Guo, J., Ji, X., Wen, Y., & Cui, X. (2017). A new shock factor of SWATH catamaran subjected to underwater explosion. *Ocean Engineering*, *130*, 620–628. doi:10.1016/j.oceaneng.2016.12.017

Gürdeniz, C. (2013). *Hedefteki Donanma* (M. Tanaydın, Ed.). (1st ed.). İstanbul, Turkey: Kırmızı Kedi Yayınevi.

Gürdeniz, C. (2015). *Mavi Uygarlık-Türkiye Denizcileşmelidir* (T. Arslan, Ed.). 1st ed.). İstanbul, Turkey: Kırmızı Kedi Yayınevi.

Gürsoy, Y. (2010). *Dış Ticaret İşlemleri Yönetimi (6. baskı)*. Bursa, Turkey: Ekin Yayınevi.

Güven, Ö. (2002). *İhracat ve İthalatçının El Kitabı (4. baskı)*. İzmir, Turkey: Kardeşler Basımevi.

Hackius, N., & Petersen, M. (2017). Blockchain in logistics and supply chain: trick or treat? In *Proceedings of the Hamburg International Conference of Logistics (HICL)* (pp. 3-18). epubli.

Hafeez, K., & Essmail, E. A. (2007). evaluating organization core competences and associated personal competences using analytical hierarchy process. *Management Research News*, *8*(30), 530–547. doi:10.1108/01409170710773689

Hafeez, K., Zhang, Y., & Malak, N. (2002). Core competence for sustainable competitive advantage: A structured methodology for identifying core competence. *IEEE Transactions on Engineering Management*, *49*(1), 28–35. doi:10.1109/17.985745

Hai Lu - Yirong Su. (2002). An approach towards overall supply chain efficiency. (Master Thesis), Göteburg University, Sweden. pp. 26-27.

Hajiabadi, A., Shafaghat, R., & Kazemi Moghadam, H. (2018). A study into the effect of loading conditions on the resistance of asymmetric high-speed catamaran based on experimental tests. *Alexandria Engineering Journal*, *57*(3), 1713–1720. doi:10.1016/j.aej.2017.03.045

Håkansson, H., & Persson, G. (2004). Supply chain management: The logic of supply chains and networks. *International Journal of Logistics Management*, *15*(1), 11–26. doi:10.1108/09574090410700202

Ha, M.-H., Yang, Z., Notteboom, T., Ng, A. K. Y., & Heo, M.-W. (2017). Revisiting port performance measurement: A hybrid multi-stakeholder framework for the modelling of port performance indicators. *Transportation Research Part E, Logistics and Transportation Review*, *103*, 1–16. doi:10.1016/j.tre.2017.04.008

Hamzeie, R., Savolainen, P. T., & Gates, T. J. (2017). Driver speed selection and crash risk: Insights from the naturalistic driving study. *Journal of Safety Research*, *63*, 187–194. doi:10.1016/j.jsr.2017.10.007 PMID:29203018

Han, H., & Ponce-Cueto, E. (2016). Formalization of reverse logistics programs: A theoretical framework. *Brazilian Journal of Operations & Production Management*, *13*(2), 160–172. doi:10.14488/BJOPM.2016.v13.n2.a3

Hao, W. U., & Yongpeng, O. U. (2018). Numerical simulation of air layer morphology on flat bottom plate with air cavity and evaluation of the drag reduction effect. *International Journal of Naval Architecture and Ocean Engineering*. doi:10.1016/j.ijnaoe.2018.09.005

Hareide, O. S., Mjelde, F. V., Glomsvoll, O., & Ostnes, R. (2017). Developing a high-speed craft route monitor window BT - Augmented cognition, enhancing cognition, and behavior in complex human environments. In D. D. Schmorrow, & C. M. Fidopiastis (Eds.), (pp. 461–473). Cham, Switzerland: Springer International Publishing.

Hartmann, E., & De Grahl, A. (2011). The flexibility of logistics service providers and its impact on customer loyalty: An empirical study. *The Journal of Supply Chain Management*, *47*(3), 63–85. doi:10.1111/j.1745-493X.2011.03228.x

Haşimoğlu, Z. (2015). *Seyir*. İstanbul, Turkey: Birsen Yayın Dağıtım Ltd.Şti.

Håvold, J. I. (2005). Safety-culture in a Norwegian shipping company. *Journal of Safety Research*, *36*(5), 441–458. doi:10.1016/j.jsr.2005.08.005 PMID:16310804

Hawlitschek, F., Notheisen, B., & Teubner, T. (2018). The limits of trust-free systems: A literature review on blockchain technology and trust in the sharing economy. *Electronic Commerce Research and Applications*, *29*, 50–63. doi:10.1016/j.elerap.2018.03.005

Hayes, R. H., Wheelwright, S., & Clark, K. (1988). *Dynamic manufacturing: Creating the learning organization*. New York: Free Press.

Hazra, T., & Goel, S. (2009). Solid waste management in Kolkata, India: Practices and challenges. *Waste Management (New York, N.Y.)*, *29*(1), 470–478. doi:10.1016/j.wasman.2008.01.023 PMID:18434129

Heilig, L., Stahlbock, R., & Voss, S. (2019). From digitalization to data-driven decision making in container terminals. *Computing Research Repository (CoRR)*. Preprint. International Maritime Organization (IMO). *Introduction to IMO*. Retrieved from http://www.imo.org/en/About/Pages/Default.aspx

Heilig, L., & Voss, S. (2016). Information systems in seaports: A categorization and overview. *Information Technology Management*, *18*(3), 179–201. doi:10.100710799-016-0269-1

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal*, *24*(10), 889–1068. doi:10.1002mj.332

Hellström, D., & Saghir, M. (2007). Packaging and logistics interactions in retail supply chains. *Packaging Technology and Science, 20*(3), 197–216. doi: 1099-1522. doi:10.1002/(ISSN)

Helsinki, F. I. (1996). *What is logistics?* Logistics Partners Oyo. JSC.

Henderson, R., & Cockburn, I. (1994). Measuring competence: exploring firm-effects in pharmaceutical research. *Strategic Management Journal*, Winter Special Issue 15, 63–84.

Henderson, R., & Mitchell, W. (1997). The interactions of organizational and competitive influences on strategy and performance. *Strategic Management Journal*, Summer Special Issue 18, 5–15.

Henn, S. (2012). Algorithms for on-line order batching in an order picking warehouse. *Computers & Operations Research*, *39*(11), 2549–2563. doi:10.1016/j.cor.2011.12.019

Henn, S., Koch, S., Doerner, K. F., Strauss, C., & Wäscher, G. (2010). Metaheuristics for the order batching problem in manual order picking systems. *Business Research*, *3*(1), 82–105. doi:10.1007/BF03342717

Henn, S., & Schmid, V. (2013). Metaheuristics for order batching and sequencing in manual order picking systems. *Computers & Industrial Engineering*, *66*(2), 338–351. doi:10.1016/j.cie.2013.07.003

Henry, R. K., Yongsheng, Z., & Jun, D. (2006). Municipal solid waste management challenges in developing countries – Kenyan case study. *Waste Management (New York, N.Y.)*, *26*(1), 92–100. doi:10.1016/j.wasman.2005.03.007 PMID:16006111

Hersch, G., & Pettigrew, P. (2002). Reenergizing the supply chain. *SSM*, *8*(6), 41–47.

Hesse, M., & Rodrigue, J. P. (2004). The transport geography of logistics and freight distribution, *Journal of Transport Geography, 12*(3).

Hilmi Yüksel, “Tedarik Zinciri Yönetiminde Bilgi Sistemlerinin Önemi”, Dokuz Eylül Üniversitesi, Sosyal Bilimler Enstitüsü Dergisi, Cilt 4 Sayı 3, 2002, s. 262.

Hitt, M. A., Bierman, L., Shimizu, K., & Kochhar, R. (2001). Direct and moderating effects of human capital on strategy and performance in professional service firms: A resource-based perspective. *Academy of Management Journal*, *44*(1), 13–28.

Hitt, M. A., Duane, I. R., & Robert, E. H. (2005). *Strategic management competitiveness and globalization: Concepts* (6th ed.). Ohio: Thomson South Western Publishing.

HMSO. (1990) *Circular 11/94 department of the environment HMSO,* pp. 41-42. Retrieved from http://products.ihs.com/Ohsis-SEO/107325.html

Hobbs, R. R. (1981). *Marine navigation 1: Piloting*. Dordrecht, The Netherlands: Springer Netherlands; doi:10.1007/978-94-011-7370-4

Hofmann, E., & Rüsch, M. (2017). Industry 4.0 and the current status as well as future prospects on logistics. *Computers in Industry*, *89*, 23–34. doi:10.1016/j.compind.2017.04.002

Hoppe, H. (2005). International regulations for high-speed craft an overview. In *International Conference on Fast Sea Transportation FAST 2005*. St. Petersburg.

Hou, H. (2017). The application of blockchain technology in E-government in China. In *Proceedings 2017 26th International Conference on Computer Communications and Networks, ICCCN 2017*. doi:10.1109/ICCCN.2017.8038519

Hou, H. (2017, July). The application of blockchain technology in E-government in China. In *Proceedings 2017 26th International Conference on Computer Communication and Networks (ICCCN),* (pp. 1-4). IEEE.

Hsieh, L.-F., & Huang, Y.-C. (2011). New batch construction heuristics to optimise the performance of order picking systems. *International Journal of Production Economics*, *131*(2), 618–630. doi:10.1016/j.ijpe.2011.02.006

Hsu, C.-M., Chen, K.-Y., & Chen, M.-C. (2005). Batching orders in warehouses by minimizing travel distance with genetic algorithms. *Computers in Industry*, *56*(2), 169–178. doi:10.1016/j.compind.2004.06.001

Hsu, F. H. (1999). IBM's deep blue chess grandmaster chips. *IEEE Micro*, *19*(2), 70–81. doi:10.1109/40.755469

Hsu, W. K. K. (2015). Assessing the safety factors of ship berthing operations. *Journal of Navigation*, *68*(03), 576–588. doi:10.1017/S0373463314000861

http://incompleteideas.net/book/first/ebook/node109.html

http://tektasi.net/wp-content/uploads/2014/01/yapay-zeka-teknolojilerinin-end%C3%BCstrideki-uygulamalari.pdf

https://www.chess.com/article/view/machack-attack

Huang, C. J., & Huang, K. P. (2012). The logistics capabilities scale for logistics service providers. *Journal of Information and Optimization Sciences*, *33*(1), 135–148. doi:10.1080/02522667.2012.10700139

Huckle, S., Bhattacharya, R., White, M., & Beloff, N. (2016). Internet of things, blockchain and shared economy applications. *Procedia Computer Science*, *98*, 461–466. doi:10.1016/j.procs.2016.09.074

Hugos, M. (2011). *Essentials of supply chain management*. Hoboken, NJ: John Wiley & Sons. doi:10.1002/9781118386408

Hult, T., Closs, D., & Frayer, D. (2014). How global should your supply chains be? *Global Edge Business Review*, *8*(2), 1–12.

Hülya, Z. (2007). *Ulaşım Sektöründe İntermodalite ve Lojistik Alanındaki Gelişmeler ve Türkiye'ye Yansımaları*. Ankara, Turkey: Gazi Üniversitesi SBE, Yayınlanmamış Doktora Tezi.

Hwang, H., Oh, Y. H., & Lee, Y. K. (2004). An evaluation of routing policies for order-picking operations in low-level picker-to-part system. *International Journal of Production Research*, *42*(18), 3873–3889. doi:10.1080/00207540410001696339

Iansiti, M., & Clark, K. (1994). Integration and dynamic capability: Evidence from product development in automo-biles and mainframe computers. *Industrial and Corporate Change*, *3*(3), 557–605. doi:10.1093/icc/3.3.557

İGEME (İhracatı Geliştirme ve Etüd Merkezi), Türkiye'nin Hizmet Sektörü İhracatı ve Geliştirilmesine Yönelik Öneriler. İGEME Yayınları, Ankara, Turkey. Retrieved from http://www.igeme.org.tr/KKS/Arastirmalar

İGEME. (2006). *100 Soruda Dış Ticaret* (p. 166). Ankara, Turkey: DTM Yayınları.

Imamoglu, H. (2019). The role of financial sector in energy demand and climate changes: Evidence from the developed and developing countries. *Environmental Science and Pollution Research International*, 1–18. PMID:31175568

İMEAK Chamber of Shipping. (2018a). *Deniz Sektör Raporu 2017*. İstanbul, Turkey. Retrieved from http://www.denizticaretodasi.org.tr/Shared Documents/sektorraporu/2017_sektor_tr.pdf

İMEAK Chamber of Shipping. (2018b). Türk Deniz Ticaret Filosu. Retrieved from http://www.denizticaretodasi.org.tr/Shared Documents/filo-verileri/kasim2018.pdf

IMO. (2007). *International code for the construction and equipment*. London, UK: International Maritime Organization.

IMO-IMDG. (2016). *International maritime dangerous goods*. London, UK: International Maritime Organization.

IMO-Marpol. (1978). *Marine pollution*. London, UK: International Maritime Organization.

IMO-SOLAS. (1974). *International Convention for the Safety Life at Sea*. London, UK: International Maritime Organization.

Indian Ocean MoU. (2018). *Annual report - 2017*. Retrieved from http://www.iomou.org/php/iomoudoc2/annrep17.pdf

Insight, M. (2017). 4 types of high performance marine vehicles. Retrieved from https://www.marineinsight.com/naval-architecture/types-of-high-performance-marine-vehicles/

INSINNA, V. (2014). Start-up debuts sense-and-avoid system for quadcopters. *National Defense*, *99*(728), 14–15.

Institut Montaigne. (2016). *Économie circulaire, réconcilier croissance et environnement. Rapport Novembre*. Paris, France: Institut Montaigne.

International Chamber of Commerce. (2014). *History of Incoterms.* Retrieved from http://iccwbo.org/products-and-services/trade-facilitation/incoterms- 2010/history-of-the-incoterms-rules/

International Chamber of Shipping (ICS). (2006). International oil tanker and terminal safety guide. London, UK: International Chamber of Shipping (ICS).

International Chamber of Shipping. (2016). *Bridge procedures guide. Release 9.1.3. (Fifth)*. London, UK: Marisec Publications.

International Chamber of Shipping. (n.d). Shipping and World Trade. Retrieved from http://www.ics-shipping.org/shipping-facts/shipping-and-world-trade

International Maritime Organization. (2014). *SOLAS, Consolidated Edition 2014: Consolidated Text of the International Convention for the Safety of Life at Sea, 1974, and Its Protocol of 1988: Articles, Annexes, and Certificates*. International Maritime Organization.

International Maritime Organization. (2018a). GISIS: Marine casualties and incidents. Retrieved from https://gisis.imo.org/Public/MCI/Search.aspx?Mode=Advanced

International Maritime Organization. (2018b). High-speed craft (HSC). Retrieved from http://www.imo.org/en/OurWork/Safety/Regulations/Pages/HSC.aspx

International Maritime Organization. (2018c). IMO and the safety of navigation. Retrieved from http://www.imo.org/en/OurWork/Safety/Navigation/Pages/Default.aspx

International Maritime Organization. (2018d). IMO and the sustainable development goals. Retrieved from http://www.imo.org/en/MediaCentre/HotTopics/Pages/SustainableDevelopmentGoals.aspx

International Maritime Organization. (2018e). Introduction to IMO. Retrieved from http://www.imo.org/About/Pages/Default.aspx

International Maritime Organization. (2018f). Short history of IMO. Retrieved from http://www.imo.org/en/About/HistoryOfIMO/Pages/Default.aspx

International Maritime Organization. (2018g). Vision, principles, and goals. Retrieved from http://www.imo.org/en/OurWork/HumanElement/VisionPrinciplesGoals/Pages/Default.aspx

International Monetary Fund (IMF). World Economic Outlook April (2019). Growth slowdown, precarious recovery. International Monetary Fund, Publication Services, Washington, DC

International Monetary Fund (IMF). World Economic Outlook October (2018). Challenges to steady growth, International Monetary Fund, Publication Services, Washington, DC.

Ioannou, M., & Rusu, O. (2012). Consumer-based brand equity: a cross-cultural perspective. *Journal of Promotion Management*, *18*(3), 344–360. doi:10.1080/10496491.2012.696462

Islam, M. S., Tseng, M. L., Karia, N., & Lee, C. H. (2018). Assessing green supply chains practices in Bangladesh using fuzzy importance and performance approach, *Resources, Conservations, and Recycling,* pp. 131, 134-145.

Istanbul Fast Ferries Co. Inc. (2018). Filomuz. Retrieved from https://www.ido.com.tr/services-new#filomuz

Itami, H., & Numagami, T. (1992). Dynamic interaction between strategy and technology. *Strategic Management Journal*, *13*(Special Issue), 119–135. doi:10.1002mj.4250130909

Itami, H., & Roehl, T. (1987). *Mobilizing invisible assets*. Cambridge, MA: Harvard University Press.

İTO (İstanbul Ticaret Odası). (2006). Türkiye Lojistik Sektörü Altyapı Analizi, Yayın No: 2006-14, İstanbul, Turkey, s. 15.

IyibozkurtE. (1994). *Türkiye-Avrupa Topluluğu Gümrük Birliği*. Bursa, Turkey: Ezgi Kitabevi.

Jabbar, K., & Bjørn, P. (2018). Infrastructural grind: Introducing blockchain technology in the shipping domain. *Proceedings of the 2018 ACM Conference on Supporting Groupwork - GROUP '18*, 297–308. Retrieved from 10.1145/3148330.3148345

Jack, E. P., & Raturi, A. (2002). Sources of volume flexibility and their impact on performance. *Journal of Operations Management*, *20*(5), 519–548. doi:10.1016/S0272-6963(01)00079-1

Jack, E., Thomas, L. P., & Beitelspacher, L. (2010). Reverse logistics capabilities: Antecedents and cost savings. *International Journal of Physical Distribution & Logistics Management*, *40*(3), 228–246. doi:10.1108/09600031011035100

Jacobs, F. R., & Chase, B. (2013). *Operations and supply chain management: The core*. New York: McGraw-Hill/Irwin.

Jadoul, A. (2019). De la consigne dans l'e-commerce. *Emballages Magazine,* (1003: January/ February) 16.

Jahre, M., & Hatteland, C. J. (2004). Packages and physical distribution. *International Journal of Physical Distribution & Logistics Management*, *34*(2), 123–139. doi:10.1108/09600030410526923

Janiç, M. (2017). *Transport systems modeling, planning, and evaluation*. Boca Raton, FL: CRC Press, Taylor & Francis Group.

Jantzen, N. R., & Alexander, M. (1969). A logistical view of packaging. In J. Schorr, M. Alexander, & R.-J. Franco (Eds.), *Logistics in Marketing* (pp. 129–155). New York: Pitman Publishing.

Janvier-James, A. M. (2012). A new introduction to supply chains and supply chain management: definitions and theories perspective. *International Business Research*, *5*(1), 194.

Jari, G. (n.d.). Formulation of Logistics Policies, Transforum: 3rd Forum Meeting. Amsterdam, The Netherlands. Retrieved from http://www.transforum-eu.net/IMG/pdf/Logistixs.pdf

Jayaraman, V. (1998). Transportation, facility location and inventory issues in distribution network design: An investigation. *International Journal of Operations & Production Management*, *18*(5), 471–494. doi:10.1108/01443579810206299

Jayaraman, V., & Luo, Y. (2007). Creating competitive advantages through new value creation: A reverse logistics perspective. *The Academy of Management Perspectives*, *21*(2), 56–73. doi:10.5465/amp.2007.25356512

Jercea, A. D. (2012). The importance of international transportation as part of the world economy after the end economic crisis. *Metalurgia International*, *17*(8), 85–89.

Jiang, H., & Zhnag, Y. (2016). An investigation of service quality, customer satisfaction and loyalty in China's airline market. *Journal of Air Transport Management*, *57*, 80–103. doi:10.1016/j.jairtraman.2016.07.008

Jiang, J., Lee, L. H., Chew, E. P., & Gan, C. C. (2015). Port connectivity study: An analysis framework from a global container liner shipping network perspective. *Transportation Research Part E, Logistics and Transportation Review*, *73*, 47–64. doi:10.1016/j.tre.2014.10.012

Jiang, Y., Sun, H., Zou, J., Hu, A., & Yang, J. (2017). Experimental and numerical investigations on hydrodynamic and aerodynamic characteristics of the tunnel of planing trimaran. *Applied Ocean Research*, *63*, 1–10. doi:10.1016/j.apor.2016.12.009

Joel, D. (2009). *Wisner - Keah-Choon Tan – G. Keong Leong, Principles of supply chain management* (2nd ed., p. 16). Mason, OH: South Western Cengage Learning.

Johansson, K., & Weström, P. (2000). Measurement of packaging logistics parameters. In K. Sjöström (Ed.), *Packaging logistics review* (pp. 17–28). Econpap, Finland.

Johnson, P. F., Leenders, M., & Flynn, A. (2011). *Purchasing and supply management*. Columbus: McGraw-Hill.

Johnsson, M. (1998). *Packaging logistics - A value-added approach*. Engineering Logistics Lund.

Joung, H., Choi, E., & Wang, E. (2016). Effects of perceived quality and perceived value of campus foodservice on customer satisfaction: Moderating role of gender. *Journal of Quality Assurance in Hospitality & Tourism*, *17*(2), 101–113. doi:10.1080/1528008X.2015.1042620

Jovanovic, M. M., & Vracarevic, B. R. (2016). Challenges ahead: Mitigating air transport carbon emissions. *Polish Journal of Environmental Studies*, *25*(5), 1975–1984. doi:10.15244/pjoes/62700

Jurdzinski, M. (2018). Changing the model of maritime navigation. *TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 12*(1), 35–41. doi:10.12716/1001.12.01.03

Kacar, A. Y. (2014*). Customer satısfactıon and Rfıd technology in the logistics sector.* Retrieved from https://www.paranomist.com/lojistik-sektorunde-musteri-memnuniyeti-ve-rfid-teknolojisi.html

Kache, F., & Seuring, S. (2017). Challenges and opportunities of digital information at the intersection of Big Data analytics and supply chain management. *International Journal of Operations & Production Management*, *37*(1), 10–36. doi:10.1108/IJOPM-02-2015-0078

Kahn, K. B., & Mentzer, J. T. (1996). Logistics and interdepartmental integration. *International Journal of Physical Distribution & Logistics Management*, *26*(8), 6–14. doi:10.1108/09600039610182753

Kalaycı, C. (2013). Dıgıtal division, digital poverty and international trade, Atatürk University. *Journal of Economics and Administrative Sciences*, *27*(3), 145–162.

Kalayci, S. (2017). Dışsal Faktörlerin Ulaşım Sektörüne Etkisi: Lojistik Firmalarından Kanıtlar. *Finans Politik & Ekonomik Yorumlar*, *54*(633), 41–59.

Kalayci, S., & Koksal, C. (2015). The relationship between China's airway freight in terms of carbon-dioxide emission and export volume. *International Journal of Economic Perspectives*, *9*(4), 60–68.

Kalayci, S., & Yazici, S. (2016). The impact of export volume and GDP on USA's civil aviation in between 1980-2012. *International Journal of Economics and Finance*, *8*(1), 229–235. doi:10.5539/ijef.v8n1p229

Kang, T. J. (2017). HMM completes pilot blockchain voyage with reefer-laden boxship. Retrieved from https://lloydslist.maritimeintelligence.informa.com/LL111275/HMM-completes-pilot-blockchain-voyage-with-reeferladen-boxship

Kang, D., & Woo, S. (2017). Liner shipping networks, port characteristics and the impact on port performance. *Maritime Economics & Logistics*, *19*(2), 274–295. doi:10.105741278-016-0056-2

Kannan, G., Pokharel, S., & Kumar, P. S. (2009). A hybrid approach using ISM and fuzzy TOPSIS for the selection of reverse logistics provider. *Resources, Conservation, and Recycling*, *54*(1), 28–36. doi:10.1016/j.resconrec.2009.06.004

Kaplan, S. M. (2007). Rail transportation of coal to power plants: Reliability issues, CRS Report for Congress RL34186, Retrieved from http://ncseonline.org/nle/crs/abstract.cfm?NLEid=1916

Karaca, Ş. (2013). Investigation of consumers' attitudes towards green products. *Ege Academic Review*, *13*(1), 99–111.

Kara, M. A., & Ciğerlioğlu, O. (2018). Türkiye Ekonomisinde Ulaşım Altyapısının Ekonomik Büyümeye Etkisi. *Gaziantep University Journal of Social Sciences*, *17*(2), 577–591. doi:10.21547/jss.382949

Karamolla, T. (2015). *Structure of logistics industry and solutions for the problems in the sector,* (Master's thesis), Celal Bayar University.

Kara, S., Rugrungruang, F., & Kaebernick, H. (2007). Simulation modelling of reverse logistics networks. *International Journal of Production Economics*, *106*(1), 61–69. doi:10.1016/j.ijpe.2006.04.009

Karásek, J. (2013). An overview of warehouse optimization. *Journal of Advances in Telecommunications, Electrotechnics, Signals, and Systems*, *2*(3), 7.

Kardeş, İ. (2011). *Effects of environmentally friendly applications of brands on consumer brand preference,* Ege Akademik Bakış 11(1), pp. 165 -177

Karimpour, R., Ballini, F., & Ölcer, A. I. (2019). Circular economy approach to facilitate the transition of the port cities into self-sustainable energy ports – a case study in Copenhagen-Malmö Port (CMP). *WMU Journal of Maritime Affairs*, *18*(2), 225–247. doi:10.100713437-019-00170-2

Kartoğlu, C., & Kum, S. (2017). Assessment of electronic navigation equipment's effect to mental workload by utilising revised NASA task load index. In A. Weintrit (Ed.), *Marine navigation: Proceedings of the 12th International Conference on Marine Navigation and Safety of Sea Transportation (TransNav 2017)* (pp. 23–28). Gdyinia Maritime University, Gdynia, Poland, June 21-23. Boca Raton, FL: CRC Press. 10.1201/9781315099132-1

Katircioglu, S., Cizreliogullari, M. N., & Katircioglu, S. (2019). Estimating the role of climate changes on international tourist flows: Evidence from Mediterranean Island States. *Environmental Science and Pollution Research International*, 1–7. PMID:30868454

Katircioğlu, S., & Katircioğlu, S. (2018). Testing the role of urban development in the conventional environmental Kuznets curve: Evidence from Turkey. *Applied Economics Letters*, *25*(11), 741–746. doi:10.1080/13504851.2017.1361004

Katircioglu, S., Katircioglu, S., & Kilinc, C. C. (2018). Investigating the role of urban development in the conventional environmental Kuznets curve: Evidence from the globe. *Environmental Science and Pollution Research International*, *25*(15), 15029–15035. doi:10.100711356-018-1651-9 PMID:29552719

Kavak, G. (2013). Birinci Körfez Savaşı Sonrası Irak'tan Türkiye'ye Göç ve Sonuçları. *II. Türkiye Lisansüstü Çalışmalar Kongresi*, 435-444.

Kavcı, R. (2016). *Inspectıon of inspection crimes example*, Workıng Paper Serıes, Foreıgn Trade Instıtute, Wps No/43/2016-06.

Kazgan, G. (1997). *Globalization and the new economic order: What brings? What is it taking? Where is it going?* İstanbul, Turkey: Altın Books Press.

Keleş, N. (2015, 9). Yapay Zeka ve Uygulama Alanları. Retrieved from http://www.bilgiustam.com/yapay-zeka-nedir-uygulama-alanlari-nelerdir/

Keller, K. L. (1993). Conceptualizing, measuring, and managing customer-based brand equity. *Journal of Marketing*, *57*(1), 1–22. doi:10.1177/002224299305700101

Keller, K. L. (2008). *Strategic brand management: Building, measuring, and managing brand equity*. Upper Saddle River, NJ: Pearson Prentice-Hall.

Keller, K. L. (2009). Building strong brands in a modern marketing communications environment. *Journal of Marketing Communications*, *15*(2–3), 139–155. doi:10.1080/13527260902757530

Kengpol, A., & Tuammee, S. (2015). The development of decision support framework for a quantitative risk assessment in multimodal green logitics: An empirical study. *International Journal of Production Research*. doi:10.1080/00207543.2015.1041570

Kenne, J. P., Dejax, P., & Gharbi, A. (2012). Production planning of a hybrid manufacturing–remanufacturing system under uncertainty within a closed-loop supply chain. *International Journal of Production Economics*, *135*(1), 81–93. doi:10.1016/j.ijpe.2010.10.026

Kersten, W., Hohrath, P. & Böger, M. (2007). An empirical approach to supply chain risk management: Development of a strategic framework.

Keskin, M. H. (2006). *Lojistik*. Ankara, Turkey: Tedarik Zinciri Yönetimi, Nobel Yayın Dağıtım.

Khan, B., Khan, F., Veitch, B., & Yang, M. (2018). An operational risk analysis tool to analyze marine transportation in Arctic waters. *Reliability Engineering & System Safety*, *169*, 485–502. doi:10.1016/j.ress.2017.09.014

Khedmati, M. R., & Keivanfar, I. (2010). Crushing response of bow structure of aluminium high-speed crafts at the event of inclined collisions: Numerical simulation. *International Journal of Crashworthiness*, *15*(5), 469–479. doi:10.1080/13588261003703726

Kherbash, O., & Mocan, M. L. (2015). A review of logistics and transport sector as a factor of globalization. *Procedia Economics and Finance*, *27*(15), 42–47. doi:10.1016/S2212-5671(15)00969-7

Khor, K. S., Udin, Z. M., Ramayah, T., & Hazen, B. T. (2016). Reverse logistics in Malaysia: The contingent role of institutional pressure. *International Journal of Production Economics*, *175*, 96–108. doi:10.1016/j.ijpe.2016.01.020

Kihara, H., Dobashi, J., Hibi, S., & Uemura, M. (2018). Fundamental studies on the influence of wave loads on a trimaran's cross-deck structure. *Journal of Marine Science and Technology*. doi:10.100700773-018-0548-0

Kılcı, H. (2017). Taşımacılık Faaliyetlerinin Rekabet Üstünlüğü Oluşturmada İşletmecilikte Yeri ve Önemi: Türkiye Örneği ve Türkiye'de Taşımacılığın Gelişimi. *Balkan Sosyal Bilimler Dergisi, ICOMEP*(Özel Sayı), 74–86.

Kilibarda, M., Zečević, S., & Vidović, M. (2012). Measuring the quality of logistic service as an element of the logistics provider offering. *Total Quality Management & Business Excellence*, *23*(11-12), 1345–1361. doi:10.1080/14783363.2012.704279

Kılıç, C., Bayar, Y., & Özekicioğlu, H. (2014). Effect of research and development expenditures on high technology export: a panel data analysis for G8 countries. *Erciyes University Journal of Economic and Administrative Sciences*, *44*, 115–130.

Kim, J., Hwang, Y., & Park, K. (2009). *An assessment of the recycling potential of materials based on environmental and economic factors*; Case study in South Korea. *Journal of Cleaner Production 17,* pp. 1264-1271.

Kim, D. J., & Kim, S. Y. (2017). Turning characteristics of waterjet propelled planing boat at semi-planing speeds. *Ocean Engineering*, *143*, 24–33. doi:10.1016/j.oceaneng.2017.07.034

Kim, S. H., & Yamato, H. (2004). An experimental study of the longitudinal motion control of a fully submerged hydrofoil model in following seas. *Ocean Engineering*, *31*(5–6), 523–537. doi:10.1016/j.oceaneng.2003.10.003

Kim, Y. G., Lee, S. M., & Seong, P. H. (2017). A methodology for a quantitative assessment of safety culture in NPPs based on Bayesian networks. *Annals of Nuclear Energy*, *102*, 23–36. doi:10.1016/j.anucene.2016.08.023

Kinobe, J. R., Gebresenbet, G., & Vinneras, B. (2012). Reverse logistics related to waste management with emphasis on developing countries – a review paper. *Journal of Environmental Science and Engineering B*, *1*(9), 1104–1118.

Kiraga, R. (2014). *Transport management practices and logistics performance of humanitarian organizations in Kenya*. (Unpublished Thesis), University of Nairobi.

Kirstein, L. (2018). Information sharing for efficient maritime logistics. International Transport Forum, Case-Specific Policy Analysis, OECD/ITF. Pages 1-34.

Kiviat, T. I. (2015). Beyond Bitcoin: Issues in regulating blockchain transactions. *Duke Law Journal*, *65*(3), 569–608.

Koban, E. ve Yıldırır Keser, E. (2010). Dış Ticarette Lojistik (3. baskı). Bursa, Turkey: Ekin Basın Yayın Dağıtım.

Kocaman, B., & KOCAMAN, B. (2013). The technologies of energy storage on smart grids and microgrids. *Bitlis Eren Üniversitesi Fen Bilimleri Dergisi*, *2*(1), 119–127.

Koçel, T. (2005). *İşletme Yöneticiliği: Yönetim ve Organizasyon, Organizasyonlarda Davranış, Klasik Modern-Çağdaş ve Güncel Yaklaşımlar, Genişletilmiş 10. Baskı*. İstanbul, Turkey: Beta Yayınları.

Koch, S., & Wäscher, G. (2016). A grouping genetic algorithm for the order batching problem in distribution warehouses. *Journal of Business Economics*, *86*(1), 131–153. doi:10.100711573-015-0789-x

Kock, C. (2008). *Malt distribution network design for the South African Breweries. Submitted Bachelors of industrial engineering Faculty of Engineering*. University of Pretoria.

Köksal, Ş. (2013). TRAFİKTE HIZ VE KAZA RİSKİ. Retrieved from http://www.trafik.gov.tr/Sayfalar/AsiriHiz.aspx

Korinek, J., & Sourdin, P. (2011) To what extent are high-quality logistics services trade facilitating? *OECD Trade Policy Working Papers* 108. OECD Publishing.

Korkmaz, O. (2012). Türkiye'de Gemi Taşımacılığının Bazı Ekonomik Göstergelere Etkisi. *Business and Economics Research Journal*, *3*(2), 97–109.

Kosba, A., Miller, A., Shi, E., Wen, Z., & Papamanthou, C. (2016, May). Hawk: The blockchain model of cryptography and privacy-preserving smart contracts. In *Proceedings 2016 IEEE symposium on security and privacy (SP)*, (pp. 839-858). IEEE.

Köseoğlu, B. (2015). Limanlarda Tasarım, Planlama ve Modelleme Süreçlerinde Kulanılan Yöntem ve Teknikler Üzerine Bir Literatür Araştırması. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, *7*(1), 1–20.

Kotler, P. (1997). *Marketing management: Analysis, planning, implementation, and control*. Upper Saddle River, NJ: Prentice-Hall.

Kotler, P., & Keller, K. L. (2009). *Marketing management, New Jersey*. Upper Saddle River, NJ: Pearson Education.

Kounev, S., Brosig, F., Huber, N., & Reussner, R. (2010, July). Towards self-aware performance and resource management in modern service-oriented systems. In *2010 IEEE International Conference on Services Computing* (pp. 621-624). IEEE. 10.1109/SCC.2010.94

Kowalski, J. C. (2009). Needed: A strategic approach to supply chain management. *Healthcare Financial Management*, *63*(6), 90. PMID:19526824

Kozan, E., & Liu, S. Q. (2012). A demand-responsive decision support system for coal transportation. *Decision Support Systems*, *54*(1), 665–680. doi:10.1016/j.dss.2012.08.012

KPI Association Ltd. (n.d.). Retrieved from https://www.shipping-kpi.org/book/pages/introduction#?kpiProfileId=1

Krafcik, J. F. (1988). Triumph of the lean production system. *MIT Sloan Management Review*, *30*(1), 41.

Kritchanchai, D. (2012). A framework for healthcare supply chain improvement in Thailand. *Operations and Supply Chain Management*, *5*(2), 103–113.

Krystosik-Gromadzińska, A. (2018). Ergonomic assessment of selected workstations on a merchant ship. *International Journal of Occupational Safety and Ergonomics*, *24*(1), 91–99. doi:10.1080/10803548.2016.1273589 PMID:27997306

Kshetri, N. (2018). Blockchain's roles in meeting key supply chain management objectives. *International Journal of Information Management, 39*(June 2017), 80–89. doi:10.1016/j.ijinfomgt.2017.12.005

Kshetri, N. (2017). Can blockchain strengthen the internet of things? *IT Professional*, *19*(4), 68–72. doi:10.1109/MITP.2017.3051335

Küçük, O. (2012). *Uluslararası Lojistik (1. baskı)*. Ankara, Turkey: Detay Yayımcılık.

Küçükşahin, F. (2003). *Ansiklopedik Bilimsel ve Teknik Denizcilik Sözlüğü: İngilizce-Türkçe* (1st ed.). İstanbul, Turkey: Akademi Denizcilik.

Kuhlman, T., & Farrington, J. (2010). What is sustainability? *Sustainability, 2*. Retrieved from www.mdpi.com/journal/sustainability

Kujawa, B. J. (2003). An investigation into logistics outsourcing practices, trends and issues within the manufacturing sector in South Africa. (Doctorate Thesis), Rand Afrikaans University, South Africa. Retrieved from http://ujdigispace.uj.ac.za:8080/dspace/ bitstream/10210/2430/1/TITLE%20PAGE.pdf

Kulak, O., Sahin, Y., & Taner, M. E. (2012). Joint order batching and picker routing in single and multiple-cross-aisle warehouses using cluster-based tabu search algorithms. *Flexible Services and Manufacturing Journal*, *24*(1), 52–80. doi:10.100710696-011-9101-8

Kularatne, R. K. A. (2015). Case study on municipal solid waste management in Vavuniya township: Practices, issues and viable management options. *Journal of Material Cycles and Waste Management*, *17*(1), 51–62. doi:10.100710163-013-0225-7

Kumagai, I., Takahashi, Y., & Murai, Y. (2015). Power-saving device for air bubble generation using a hydrofoil to reduce ship drag: Theory, experiments, and application to ships. *Ocean Engineering*, *95*, 183–194. doi:10.1016/j.oceaneng.2014.11.019

Kurochkin, D. (2012). *Logistics: (Transport, procurement, manufacturing, distribution, warehousing, info): Lectures* (p. 268). Minsk: FUA Inform.

Kusadasi Chamber of Commerce. (2013). *E-commerce and tourism sector.* Retrieved from https://translate.google.com/#view=home&op=translate&sl=tr&tl=en&text=Ku%C5%9Fadas%C4%B1%20Ticaret%20odas%C4%B1

Kutluk, E. (2018). İstanbul Boğazı'ndan Geçen Gemilerin Oluşturduğu Trafik Yükünün Çevresel Etkileri: Ro-Ro Gemileri Özelinde Bir İnceleme. *Marmara Üniversitesi Siyasal Bilimler Dergisi*, *6*(1), 285–310.

Kuznets, S. (1955). Economic growth and income inequality. *The American Economic Review*, *65*, 1–28.

Kwun, D. J. W. (2011). Effects of campus foodservice attributes on perceived value, satisfaction, and consumer attitude: A gender-difference approach. *International Journal of Hospitality Management*, *30*(2), 252–261. doi:10.1016/j.ijhm.2010.09.001

Lai, C.-S., Chiu, C.-J., Yang, C.-F., & Pai, D.-C. (2010). The effects of corporate social responsibility on brand performance: The mediating effect of industrial brand equity and corporate reputation. *Journal of Business Ethics*, *95*(3), 457–469. doi:10.100710551-010-0433-1

Lai, F., Griffin, M., & Babin, B. J. (2009). How quality, value, image, and satisfaction create loyalty at a Chinese telecom. *Journal of Business Research*, *62*(10), 980–986. doi:10.1016/j.jbusres.2008.10.015

Lai, F., Li, D., Wang, Q., & Zhao, X. (2008). The information technology capability of third-party logistics providers: A resource-based view and empirical evidence from China. *The Journal of Supply Chain Management*, *44*(3), 22–38. doi:10.1111/j.1745-493X.2008.00064.x

Lai, K. H. (2004). Service capability and performance of logistics service providers. *Transportation Research Part E, Logistics and Transportation Review*, *40*(5), 385–399. doi:10.1016/j.tre.2004.01.002

Lai, K., Wu, S. J., & Wong, C. W. Y. (2013). Did reverse logistics practices hit the triple bottom line of Chinese manufacturers? *International Journal of Production Economics*, *146*(1), 106–117. doi:10.1016/j.ijpe.2013.03.005

Lam, J. S. L., & Yap, W. Y. (2011). Dynamics of liner shipping network and port connectivity in supply chain systems: Analysis on East Asia. *Journal of Transport Geography*, *19*(6), 1272–1282. doi:10.1016/j.jtrangeo.2011.06.007

Lam, S. Y., Shankar, V., & Murthy, E. M. K. B. (2004). Customer value, satisfaction, loyalty, and switching costs: An illustration from a business-to-business service context. *Journal of the Academy of Marketing Science*, *32*(3), 293–311. doi:10.1177/0092070304263330

Langer, H., Gehrke, J. D., Hammer, J., Lorenz, M., Timm, I. J., & Herzog, O. (2006). A framework for distributed knowledge management in autonomous logistic processes. *International Journal of Knowledge-Based and Intelligent Engineering Systems*, *10*(4), 277–290. doi:10.3233/KES-2006-10404

Langley, C., J. Coyle, B. Gibson, R. Novak, & E. Bardi. (2008). *Managing supply chain: A logistics approach*. South-Western Cengage Learning (8th ed.).

Last, P., Kroker, M., & Linsen, L. (2017). Generating real-time objects for a bridge ship-handling simulator based on automatic identification system data. *Simulation Modelling Practice and Theory*, *72*, 69–87. doi:10.1016/j.simpat.2016.12.011

Lau, K., & Wang, Y. (2009). Reverse logistics in the electronic industry of China: A case study, Supply Chain Management. *International Journal (Toronto, Ont.)*, *14*, 447–465.

Le Moigne, R. (2014). *L'Économie circulaire - Comment la mettre en œuvre dans l'entreprise grâce à la reverse supply chain*. Paris, France: Dunod.

Lean, H. H., & Jinghi, S. (2010). Logistics development and economic growth in China, Institute of China Studies. (University of Malaya), ICS Working Paper Series, WP No: 2010-5, Malaysia. Retrieved from http://www.iadb.org/intal/intalcdi/ PE/2010/05814.pdf

Lee, J. A., Chang, Y. S., Shim, H.-J., & Cho, S.-J. (2015). A study on the picking process time. In *6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015* (Vol. 3, pp. 731–738). Las Vegas, NV: Elsevier B.V. 10.1016/j.promfg.2015.07.316

Lee, C. F., Lee, J. C., & Lee, A. C. (2000). *Statistics for business and financial economics*. Singapore: World Science Publishing.

Lee, C. K. M., & Chan, T. M. (2009). Development of RFID-based reverse logistics system. *Expert Systems with Applications*, *36*(5), 9299–9307. doi:10.1016/j.eswa.2008.12.002

Lee, C., & Lam, L. (2012). Managing reverse logistics to enhance sustainability of industrial marketing. *Industrial Marketing Management*, *41*(4), 589–598. doi:10.1016/j.indmarman.2012.04.006

Lee, P. T.-W., Kwon, O. K., & Ruan, X. (2019). Sustainability challenges in maritime transport and logistics industry and its way ahead. *Sustainability*, *11*(5), 1–9. doi:10.3390u11051331

Lee, S. M., Lee, D., & Kang, C. Y. (2012). The impact of high-performance work systems in the health-care industry: Employee reactions, service quality, customer satisfaction, and customer loyalty. *Service Industries Journal*, *32*(1), 17–36. doi:10.1080/02642069.2010.545397

Lehmacher, W. (2017). Why blockchain should be global trade's next port of call. World Economic Forum. Retrieved from https://www.weforum.org/agenda/2017/05/blockchain-ports-global-trades/

Lei, A., Cruickshank, H., Cao, Y., Asuquo, P., Ogah, C. P. A., & Sun, Z. (2017). Blockchain-based dynamic key management for heterogeneous intelligent transportation systems. *IEEE Internet of Things Journal*, *4*(6), 1832–1843. doi:10.1109/JIOT.2017.2740569

Lemieux, V. L. (2016). Trusting records: Is blockchain technology the answer? *Records Management Journal*, *26*(2), 110–139. doi:10.1108/RMJ-12-2015-0042

Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, *13*(S1), 111–125. doi:10.1002mj.4250131009

Leung, A. W. S., Chan, C. C. H., Ng, J. J. M., & Wong, P. C. C. (2006). Factors contributing to officers' fatigue in high-speed maritime craft operations. *Applied Ergonomics*, *37*(5), 565–576. doi:10.1016/j.apergo.2005.11.003 PMID:16368069

LGC. (2009, July 7). Planning cargo operation. Retrieved from http://www.liquefiedgascarrier.com/cargo-planning.html

Liang, H., & Zong, Z. (2011). A lifting line theory for a three-dimensional hydrofoil. *Journal of Marine Science and Application*, *10*(2), 199–205. doi:10.100711804-011-1038-5

Li, J., Huang, R., & Dai, J. B. (2017). Joint optimisation of order batching and picker routing in the online retailer's warehouse in China. *International Journal of Production Research*, *55*(2), 447–461. doi:10.1080/00207543.2016.1187313

Li, L., & Dingti, L. (2019). Effects of logistics capabilities on performance in manufacturing firms. *Proceedings of The 3rd International Conference on Logistics and Supply Chain Management*, 50-58.

Lin, C. J., Hsieh, T. L., & Lin, S. F. (2013). Development of staffing evaluation principle for advanced main control room and the effect on situation awareness and mental workload. *Nuclear Engineering and Design*, *265*, 137–144. doi:10.1016/j.nucengdes.2013.08.056

Lin, C.-C., Kang, J.-R., Hou, C.-C., & Cheng, C.-Y. (2016). Joint order batching and picker Manhattan routing problem. *Computers & Industrial Engineering*, *95*, 164–174. doi:10.1016/j.cie.2016.03.009

Lindner, E. (1997). *Chemie für Ingenieure*. Lindner Verlag Karlsruhe.

Lirn, T. C., Thanopoutou, H. A., Beynon, M. J., & Beresford, A. K. C. (2004). An application of AHP on transshipment port selection: A global perspective. *Maritime Economics & Logistics*, *6*(1), 70–91. doi:10.1057/palgrave.mel.9100093

Litke, A., Anagnostopoulos, D., & Varvarigou, D. (2019). Blockchains for supply chain management: architectural elements and challenges towards a global scale deployment, MDPİ. *Logistics*, *3*(1), 1–17. doi:10.3390/logistics3010005

Liu, S. (2009, July). A research on the relationship of logistics industry development and economic growth of China. *International Business Research, 2*(3), pp. 197-200.

Liu, B., Wu, W., & Guedes Soares, C. (2018). Ultimate strength analysis of a SWATH ship subjected to transverse loads. *Marine Structures*, *57*, 105–120. doi:10.1016/j.marstruc.2017.10.006

Liu, C. M. (2008). A Blending and Inter-Modal Transportation Model for the Coal Distribution Problem. *International Journal of Operations Research*, *5*(2), 107–116.

Li, Y., Wu, X., Ma, Y., & Wang, J. (2008). A method based on potential theory for calculating air cavity formation of an air cavity resistance reduction ship. *Journal of Marine Science and Application*, *7*(2), 98–101. doi:10.100711804-008-7077-x

Li, Y., Xu, L., & Li, D. (2013). Examining relationships between the return policy, product quality, and pricing strategy in online direct selling. *International Journal of Production Economics*, *144*(2), 451–460. doi:10.1016/j.ijpe.2013.03.013

Logsdon, T. (1992). *The Navstar global positioning system*. Boston, MA: Springer US; doi:10.1007/978-1-4615-3104-3

Loklindt, C., Moeller, M.-P., & Kinra, A. (2018). How blockchain could be implemented for exchanging documentation in the shipping industry. In *Proceedings of the 6th International Conference on Dynamics in Logistics LDIC*, 194–198. doi:10.1007/978-3-319-74225-0_27

Long, D. (2003). *International logistics: Global supply chain management* (1st ed.). New York: Springer.

Lotz, A. (2015). Drones in logistics: A feasible future or a waste of effort.

Louro, J., Vazquez, P., & de la Campa, R. M. (2012). Accident risk factors in conventional and high speed ferry ships in Spain. *Journal for Maritime Research*, *9*(1), 3–8.

Lu, C. S., & Tsai, C. L. (2010). The effect of safety climate on seafarers' safety behaviors in container shipping. *Accident; Analysis and Prevention*, *42*(6), 1999–2006. doi:10.1016/j.aap.2010.06.008 PMID:20728654

Lu, C. S., & Yang, C. C. (2006). Evaluating key logistics capabilities for international distribution center in Taiwan. *Transportation Journal*, *45*(4), 9–27.

Lu, C. S., & Yang, C. C. (2010). Logistics service capabilities and firm performance of international distribution center operators. *Service Industries Journal*, *30*(2), 281–298. doi:10.1080/02642060802123392

Lummus, R. R., Krumwiede, D. W., & Vokurka, R. J. (2001). The relationship of logistics to supply chain management: Developing a common industry definition. *Industrial Management & Data Systems*, *101*(8), 426–432. doi:10.1108/02635570110406730

Lun, Y. H. V., & Hoffmann, J. (2016). Connectivity and trade relativity: The case of ASEAN. *Journal of Shipping and Trade*, 1–11.

Lundström, A. (2009). *An approach for innovative packaging development*. (Master Thesis), Luleå University of Technology, Sweden.

Luo, M., & Shin, S. H. (2016). Half-century research developments in maritime accidents: Future directions. *Accident; Analysis and Prevention*. doi:10.1016/j.aap.2016.04.010 PMID:27106054

Lu, Z., & Bostel, N. (2007). A facility location model for logistics systems including reverse flows: The case of remanufacturing activities. *Computers & Operations Research*, *34*(2), 299–323. doi:10.1016/j.cor.2005.03.002

Lynch, C. F. (2000). Logistics outsourcing: A management guide, Illinois, Council of Logistics Management Publications, IL.

Lynch, D., Keller, S., & Ozment, J. (2000). The effects of logistics capabilities and strategy on firm performance. *Journal of Business Logistics*, *21*(2), 47–67.

Maas, S., Schuster, T., & Hartmann, E. (2014). Pollution prevention and service stewardship strategies in the third-party logistics industry: Effects on firm differentiation and the moderating role of environmental communication. *Business Strategy and the Environment*, *23*(1), 38–55. doi:10.1002/bse.1759

Magge, J. F., Copacino, W. C., & Rosenfield, D. B. (1985). Modern logistics management: Integrating marketing, manufacturing, and physical distribution (1st ed.). Canada: John Wiley & Sons.

Magoga, T., Aksus, S., Cannon, S., Ojeda, R., & Thomas, G. (2017). Identification of slam events experienced by a high-speed craft. *Ocean Engineering*, *140*, 309–321. doi:10.1016/j.oceaneng.2016.07.017

Mahoney, J. T., & Pandian, J. R. (1992). The resource-based view within the conversation of strategic management. *Strategic Management Journal*, *13*(5), 363–380. doi:10.1002mj.4250130505

MAIB. (2008). *Napoli Report No 9/2008*. Retrieved from https://assets.publishing.service.gov.uk/media/547c703ced915d4c0d000087/NapoliReport.pdf

Majdalani, F., Koegler, U., & Kuge, S. (2007). Middle East transport and logistics at a crossroads. World Economic Forum's Arab World Competitiveness Report 2006-2007. New York: Oxford Press. Retrieved from http://www.boozallen.com/media/file/ME_Transport_Logistics_Crossroads.pdf

Makkonen, H., Heino, J., Laitil, L., Hiltunen, A., Pöyliö, E., & Harkki, J., (2002). *Optimisation of steel plant recycling in Finland: dusts, scales and sludge*, Resources, Conservation and Recycling 35, pp. 77-84

Mandal, N. R. (2017). *Ship construction and welding* (Vol. 2). Singapore: Springer Singapore; doi:10.1007/978-981-10-2955-4

Mangiaracina, R., Song, G., & Perego, A. (2015). Distribution network design: a literature review and a research agenda. *International Journal of Physical Distribution & Logistics Management*, *45*(5), 506–531. doi:10.1108/IJPDLM-02-2014-0035

Manzini, R., Bozer, Y., & Heragu, S. (2015). Decision models for the design, optimization and management of warehousing and material handling systems. *International Journal of Production Economics*, *170*(1), 711–716. doi:10.1016/j.ijpe.2015.08.007

Marcotullio, P. J., Williams, E., & Marshall, J. D. (2005). Faster, sooner, and more simultaneously: How recent road and air transportation CO_2 emission trends in developing countries differ from historic trends in the United States. *Journal of Environment & Development*, *14*(1), 125–148. doi:10.1177/1070496504273716

Marine Accident Investigation Branch. (2018). *MAIB ANNUAL REPORT 2017*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/720443/MAIB_Annual_Report_2017.pdf

MarineTraffic. (2018). MarineTraffic Data | Vessels. Retrieved from https://www.marinetraffic.com/en/data/?asset_type=vessels&columns=shipname:asc,flag,photo,recognized_next_port,reported_eta,reported_destination,current_port,imo,ship_type,show_on_live_map,time_of_latest_position,lat_of_latest_position,lon_of_latest_posit

Marr, A.-K. (2018). Onlinehandel führt zu mehr Papiermüll. Retrieved from https://www.spiegel.de/wissenschaft/natur/altpapier-und-pappe-online-handel-sorgt-fuer-immer-mehr-papiermuell-a-1234506.html

Martí, M. L., Puertas, R., & García, L. (2014). Relevance of Trade facilitation in Emerging Countries Export. *The Journal of International Trade & Economic Development*, *23*(2), 202–222. doi:10.1080/09638199.2012.698639

Martin, J. C., Roman, C., & Espino, R. (2011). Evaluating frequent flyer programs from the air passengers' perspective. *Journal of Air Transport Management*, *17*(6), 364–368. doi:10.1016/j.jairtraman.2011.02.008

Martin, J.-L. (2016). *Entreprise et environnement – Les achats d'emballages*. Paris, France: Éditions Campus Ouvert.

Martyn, R. (2017, April 20). Cargo handling and emergency shutdown. Retrieved from http://braemartechnical.com/files/Lecture-100-LNG-Cargo-Vessels-Handling-System.pdf

Massaroni, E., Cozzolino, A., & Wankowicz, E. (2014). *Sustainable supply chain management needs sustainable packaging - An exploratory study*. Paper presented at the Atti del XXVI Convegno annuale di Sinergie, Cassino: Università de Cassino.

Matsumoto, M. (2010). Development of a simulation model for reuse businesses and case studies in Japan. *Journal of Cleaner Production*, *18*(13), 1284–1299. doi:10.1016/j.jclepro.2010.04.008

Matusiak, M. (2014). *Optimizing warehouse order batching when routing is precedence constrained and pickers have varying skills.*

McCollum, D. L. (2007). Future Impacts of Coal Distribution Constraints on Coal Cost, Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-07-26, 2007.

McLeod, F. N., & Cherrett, T. J. (2007). Maximising efficiency in domestic waste collection through improved fleet management. In *Proceedings of the Logistics Research Network Annual Conference,* September, Hull, UK.

Mediterranean MoU. (2017). *Annual report 2016*. Retrieved from http://www.medmou.org/

Mehmet Tanyaş, "Tedarik Zinciri Yönetimi ve KALDER Kıyaslama Grup Projesi", 14. Kalite Kongresi, KALDER, İstanbul, Turkey, 16.11.2005, s.4

Mehmet Tanyaş, "Tedarik Zinciri-Değer Zinciri Farkı", Lojistik Dergisi (LODER-Lojistik Derneği Süreli Yayını), Kasım 2004, Sayı: 3, s. 13.

Meixell, M. J., & Gargeya, V. B. (2005). Global supply chain design: A literature review and critique. *Transportation Research Part E, Logistics and Transportation Review*, *41*(6), 531–550. doi:10.1016/j.tre.2005.06.003

Mena, C., Christopher, M., Johnson, M., & Jia, F. (2007). Innovation in Logistics Services, NESTA (National Endowment for Science, Technology and the Arts), Cranfield. p. 3.

Mena, C., Christopher, M., Johnson, M., & Jia, F. (2007). Innovation in logistics services, NESTA. Cranfield, UK: National Endowment for Science, Technology and the Arts.

Mentzer, J. T., Daniel, J. E., & Tomas, M. H. (2001). Logistics service quality as a segment- customized process. *Journal of Marketing*, *65*(4), 82–104. doi:10.1509/jmkg.65.4.82.18390

Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining supply chain management. *Journal of Business Logistics*, *22*(2), 1–25. doi:10.1002/j.2158-1592.2001.tb00001.x

Mentzer, J. T., & Konrad, B. P. (1991). An efficiency/effectiveness approach to logistics performance analysis. *Journal of Business Logistics*, *12*(1), 33–62.

Mentzer, J. T., Min, S., & Bobbitt, L. M. (2004). Toward a unified theory of logistics. *International Journal of Physical Distribution & Logistics Management*, *34*(8), 606–627. doi:10.1108/09600030410557758

Merico, E., Dinoi, A., & Contini, D. (2019). Development of an integrated modelling-measurement system for near-real-time estimates of harbour activities impact to atmospheric pollution in coastal cities. *Transportation Research Part D, Transport and Environment*, *73*, 108–119. doi:10.1016/j.trd.2019.06.009

Metin, C., & Erdal, M. (2003). *Uluslararasi taşimacilik yönetimi*. Istanbul, Turkey: Utikad Yayını.

Middleton, A. (2011). 'Near miss' at wharf as 28-tonne container falls. Retrieved from https://www.abc.net.au/news/2011-02-21/near-miss-at-wharf-as-28-tonne-container-falls/1951486

Mikayilov, J. I., Mukhtarov, S., Mammadov, J., & Azizov, M. (2019). Re-evaluating the environmental impacts of tourism: Does EKC exist? *Environmental Science and Pollution Research International*, 1–14.

Mikulic, J., & Prebezac, D. (2011). What drives passenger loyalty to traditional and lowcost airlines? A formative partial least squares approach. *Journal of Air Transport Management*, *17*(4), 237–240. doi:10.1016/j.jairtraman.2010.09.005

Miles, M. P., & Covin, J. C. (2000). Environmental marketing: A source of reputational, competitive, and financial advantage. *Journal of Business Ethics*, *23*(3), 299–311. doi:10.1023/A:1006214509281

Milla, L. (2010). Railway freight markets' mergers and acquisitions–comparing European Union and Russia. In *Proceedings International Manufacturing Symposium,* Cambridge, UK. Retrieved from http://www.ifm.eng.cam.ac.uk/cim/symposium2010/ proceedings/13_laisi.pdf

Miller, D., Eisenstat, R., & Foote, N. (2002). Strategy from the inside out. *California Management Review*, *44*(3), 37–54. doi:10.2307/41166131

Mimouni, F., Abouabdellah, A., & Mharzi, H. (2015). Study of the reverse logistics' break-even in a direct supply chain. *International Review on Modelling and Simulations*, *8*(2), 277–283. doi:10.15866/iremos.v8i2.4901

Ministry of Development Electronic Working Group Report. (2015). *10th Development Plan 2014-2018.* Retrieved from http://www.kalkinma.gov.tr/Pages/OzelIhtisas

Ministry of Development, Iron-Steel Working Group Report, Ankara, Turkey . (2014). *Ministry of Development, Tenth Development Plan (2014-2018),* Ankara, Turkey. 2013. Retrieved from http://www.cka.org.tr/dosyalar/Ozel%20Ihtisas%20Komisyonu%20Raporlar%C4%B1/Demir-%C3%87elik%20%C3%87al%C4%B1%C5%9Fma%20Grubu%20Raporu.pdf

Mitchell, T., Cohen, W., Hruschka, E., Talukdar, P., Yang, B., Betteridge, J., ... Krishnamurthy, J. (2018). Never-ending learning. *Communications of the ACM*, *61*(5), 103–115. doi:10.1145/3191513

Moghadam, M. R. A., Mokhtarani, N., & Mokhtarani, B. (2009). Municipal solid waste management in Rasht City, Iran. *Waste Management (New York, N.Y.)*, *29*(1), 485–489. doi:10.1016/j.wasman.2008.02.029 PMID:18448322

Molina-Besch, K., & Pålsson, H. (2016). A supply chain perspective on green packaging development – Theory vs. practice. *Packaging Technology & Science*, *29*(1), 45–63. doi:10.1002/pts.2186

Moraes, H. B., Vasconcellos, J. M., & Latorre, R. G. (2004). Wave resistance for high-speed catamarans. *Ocean Engineering*, *31*(17–18), 2253–2282. doi:10.1016/j.oceaneng.2004.03.012

Morash, E. A., Droge, C. M., & Shawnee, K. V. (1996). Strategic logistics capabilities for competitive advantage and firm success. *Journal of Business Logistics*, *17*(1), 1–22.

Morash, E. A., & Lynch, D. F. (2002). Public policy and global supply chain capabilities and performance: A resource-based view. *Journal of International Marketing*, *10*(1), 25–51. doi:10.1509/jimk.10.1.25.19529

Morley, H. R. (2017). Container weight blockchain shows tech's potential. *Journal of Commerce.* Retrieved from https://www.joc.com/technology/container-weight-blockchain-shows-tech%E2%80%99s-potential_20170830.html. Erişim Tarihi: 09.04.2019.

Moses, L. J. (2001). Executive accounts of theory-of-mind development. *Child Development*, *72*(3), 688–690. doi:10.1111/1467-8624.00306 PMID:11405573

Mourits, J., & Evers, M. (1995). Distribution network design: an integrated planning support framework. *International Journal of Physical Distribution & Logistics Management*, *25*(5), 43–57. doi:10.1108/09600039510089703

Mousaviraad, S. M., Wang, Z., & Stern, F. (2015). URANS studies of hydrodynamic performance and slamming loads on high-speed planing hulls in calm water and waves for deep and shallow conditions. *Applied Ocean Research*, *51*, 222–240. doi:10.1016/j.apor.2015.04.007

Mukhopadhyay, S. K., & Setoputro, R. (2004). Reverse logistics in e-business: Optimal price and return policy. *International Journal of Physical Distribution & Logistics Management*, *34*(1), 70–89. doi:10.1108/09600030410515691

Muller-Rostin, C. (2008). Airport entry and exit: A European analysis, GAP (German Airport Performance) Research Project. Retrieved from http://userpage.fu-berlin.de/~jmueller/gapprojekt/downloads/ gap_papers/Muel_Rost_Nie_Ivan_Han_Ehm_Airport%20Entry%20and%20Exit_jul_08.pdf

Murat, E., & Küresel Lojistik, U. (2005). *Uluslararası Taşımacılık ve Lojistik Hizmet Üretenler Derneği*. İstanbul, Turkey: Yayınları.

Mustaffa, N. H., & Potter, A. (2009). Healthcare supply chain management in Malaysia: A case study. *Supply Chain Management*, *14*(3), 234–243. doi:10.1108/13598540910954575

Nachtmann, H. & Pohl, E. A. (2008). The state of healthcare logistics cost and quality improvement opportunities.

Nævestad, T. O., Hesjevoll, I. S., & Phillips, R. O. (2018). How can we improve safety culture in transport organizations? A review of interventions, effects and influencing factors. *Transportation Research Part F: Traffic Psychology and Behaviour*, *54*, 28–46. doi:10.1016/j.trf.2018.01.002

Najafi, A., Aliakbari, T., & Hashemi, S. A. (2018). Experimental optimization of hydrodynamic performance of catamarans using hydrofoil element. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, 1–14. doi:10.1177/1475090218761415

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system [online], BitCoin. Retrieved from https://bitcoin.org/bitcoin.pdf

Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system.* doi:10.100710838-008-9062-0

Nardi, L., Silva, R., Ribeiro, E., Valle, S., & Oliveira, W. (2017). Proposal for a methodology to monitor sustainability in the production of soft drinks in ref PET. *Journal of Cleaner Production*, *151*, 218–234. doi:10.1016/j.jclepro.2017.02.181

Nas, A. (2017). Türkiye'de 4.5G Reklamlarında Hızın Kültürel Temsili. İstanbul Üniversitesi İletişim Fakültesi Dergisi | Istanbul University Faculty of Communication Journal, (52), 67–87. doi:10.17064/iuifd.333135

Nas, S. (2015). The definitions of safety and security. *Journal of ETA Maritime Science*, *3*(2), 53–54. doi:10.5505/jems.2015.42713

NBG ship management. (2015, March 03). LPG fleet. Retrieved from http://www.nbgship.com/index.html: http://www.nbgship.com/lpgfleet.html

Nebol, E., Uslu, T., & Uzel, E. (2013). *Tedarik Zinciri ve Lojistik Yönetimi*. İstanbul, Turkey: Beta Basım A.Ş.

Nelson, R. R., & Sidney, G. W. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Belknap Press/Harvard University Press.

Ng, K. Y. A. (2006). Assessing the attractiveness of port in the north European container transshipment market: An agenda for future research in port competition. *Maritime Economics & Logistics*, *8*, 234–250. doi:10.1057/palgrave.mel.9100158

Nilsson, F., Olsson, A., & Wikström, F. (2011). *Toward sustainable goods flows: A framework from a packaging perspective*. Paper presented at the 23rd Nofoma Conference, Harstad, Norway.

Nilsson, R., Gärling, T., & Lützhöft, M. (2009). An experimental simulation study of advanced decision support system for ship navigation. *Transportation Research Part F: Traffic Psychology and Behaviour*, *12*(3), 188–197. doi:10.1016/j.trf.2008.12.005

Niranjanamurthy, M., Nithya, B. N., & Jagannatha, S. (n.d.). Analysis of blockchain technology: Pros, cons, and SWOT. *Cluster Computing,* 1-15.

Noorliza, K. (2011). Resource-based logistics and logistics performance (Thesis), Business School, The University of Hull. Retrieved from https://hydra.hull.ac.uk/resource/hull:5299

Noorliza, K., & M.-Hasmi A. H. A. (2016c). Transforming green logistics practice into benefits: a case of third-party logistics (3PLs). In *Proceedings of the International Conference on Industrial Engineering and Operations Management (IEOM)*, March, 2016, p. 178.

Noorliza, K., & M.-Hasmi, A. H. A. (2013). Green innovations in logistics industry: sustainability and competitive advantage. In K. S. Soliman (Ed.), *Entrepreneurship vision 2020: Innovation, development sustainability, and economic growth, international business information management association,* Jakarta, pp. 456-462.

Noorliza, K., & M.-Hasmi, A. H. A. (2016a). Halal business and sustainability: strategies, resources, and capabilities of Halal third-party logistics (3PL). *Progress in Industrial Ecology, an International*, 10(2-3), 286-299.

Noorliza, K. (2016b). Halal value creation: Its role in adding value and enabling logistics service. *Production Planning and Control: The Management of Operations*, *27*(9), 677–685. doi:10.1080/09537287.2016.1166276

Noorliza, K. (2018a). Knowledge resources, technology resources and competitive advantage of logistics service providers. *Knowledge Management Research and Practice*, *16*(4), 451–463. doi:10.1080/14778238.2018.1521541

Noorliza, K. (2018b). How knowledge resource does matter in technology and cost advantages of a firm? Evidence from Malaysian logistics sector. *Asian Journal of Technology Innovation*, *26*(3), 346–368. doi:10.1080/19761597.2018.1555002

Noorliza, K., Wong, C. Y., Mhah, A., & Lai, K.-H. (2015). The effects of resource bundling on third-party logistics providers' performance. *International Journal of Engineering Business Management*, *7*(9), 1–14.

Noorliza, K., & Wong, C. Y. (2013). The impact of logistics resources on the performance of Malaysian logistics service providers. Production Planning & Control. *The Management of Operations*, *24*(7), 589–606.

Norta, A. (2015, August). Creation of smart-contracting collaborations for decentralized autonomous organizations. In *Proceedings International Conference on Business Informatics Research* (pp. 3-17). Springer, Cham. 10.1007/978-3-319-21915-8_1

Novet, J. (2017). Shipping company Maersk says June cyberattack could cost it up to $300 million. Retrieved from https://www.cnbc.com/2017/08/16/maersk-says-notpetya-cyberattack-could-cost-300-million.html

Nuroğlu, E., & Nuroğlu, H. H. (2018). Industry 4.0 as an opportunity window for Turkey's Foreıgn Trade. *Journal of Management and Economics Research*, *16*(Special Issue), 329–346. doi:10.11611/yead.458090

O'Cass, A., & Sok, P. (2012). Examining the role of within functional area resource-capability complementarity in achieving customer and product-based performance outcomes. *Journal of Strategic Marketing*, *20*(4), 345–363. doi:10.1080/0965254X.2011.643918

Öcal, Y. (2014). *Waste management in iron and steel industry*. (Specialization Thesis). General Directorate of Economic Sectors and Coordination T. C. Ministry of Development, Publishing Numer: 2911

Oda, S. (2008). *Logistics sector in Turkey and its effects on foreign*, (Master's thesis). Trakya Üniversity Social Sciences Institute.

OdaS, . (2008). *Türkiye'de Lojistik Sektörü ve Dış Ticaret Üzerine Etkileri*. Trakya Üniversitesi SBE, Yayınlanmamış Yüksek Lisans Tezi.

OECD ENV/EPOC. (2011). *Working group on waste prevention and recycling, policy principles for sustainable materials management,* Paris, France. Retrieved from http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/EPOC/WPIEEP(2011)20/FINAL&docLanguage=En

OECD. (2002). Transport logistics, shared solutions to common challenges. OECD Publication, Paris, France. Retrieved from http://www.cemt.org/pub/pubpdf/JTRC/ 02LogisticsE.pdf

OECD. (2002). *Transport logistics, shared solutions to common challenges.* OECD Publication, Paris, France. Retrieved from http://www.cemt.org/pub/pubpdf/JTRC/02LogisticsE.pdf

Oh, J., Park, S., & Kwon, O. S. (2016). Advanced navigation aids system based on augmented reality. *International Journal of E-Navigation and Maritime Economy*, *5*, 21–31. doi:10.1016/j.enavi.2016.12.002

Ojala, L., & Celebi, D. (2015). The World Bank's Logistics Performance Index (LPI) and Drivers of Logistics Performance. *Paper prepared for the International Trade Forum Roundtable on Logistics Development Strategies and their Performance Measurements*, Queretaro, Mexico, March 9–10. Forum and Chief Executives Meeting.

Okasha, N. M., Frangopol, D. M., Saydam, D., & Salvino, L. W. (2011). Reliability analysis and damage detection in high-speed naval craft based on structural health monitoring data. *Structural Health Monitoring: An International Journal*, *10*(4), 361–379. doi:10.1177/1475921710379516

Oksay, S. (1998). Çokuluslu Şirketler Teorileri Çerçevesinde, Yabancı Sermaye Yatırımlarının İncelenerek, Değerlendirilmesi, Dış Ticaret Müsteşarlığı Dergisi, Sayı 8, Ocak 1998. Retrieved from http://www.econturk.org/ Turkiyeekonomisi/oksay3.pdf

Oliver, R. K., & Weber, M. D. (1982). Supply-chain management: logistics catches up with strategy. In R. K. Oliver, & M. D. Weber (Eds.), *The roots of logistics: a reader of classical contributions to the history and conceptual foundations of the science of logistics* (pp. 183–194). Berlin, Germany: Springer.

Olivier, D., & Slack, B. (2006). Rethinking the port. *Environment and Planning A. Economy and Space*, *38*(8), 1409–1427.

Ølnes, S., & Jansen, A. (2017, September). Blockchain technology as a support infrastructure in e-government. In *Proceedings International Conference on Electronic Government* (pp. 215-227). Cham, Switzerland: Springer. 10.1007/978-3-319-64677-0_18

Olsmats, C., & Dominic, C. (2003). Packaging scorecard - A packaging performance evaluation method. *Packaging Technology & Science*, *16*(1), 9–14. doi:10.1002/pts.604

Olsson, E., & Jansson, A. (2006). Work on the bridge – studies of officers on high-speed ferries. *Behaviour & Information Technology*, *25*(1), 37–64. doi:10.1080/01449290500066711

Ong, E. (2018). Blockchain bills of lading. *NUS Centre for Maritime Law Working Paper*, (17).

Onur, G., & Bektas, B. (n.d.). Dünya Hizmet Ticaretinde Gelişmeler ve Türkiye Açısından Yarattığı Fırsatlar, Güneydoğu ve Doğu Kalkınma Projesi. Retrieved from http://www.gapdogukalkinma.org

Orhan, O. Z. (2003). Dünyada ve Türkiye'de Lojistik Sektörünün Gelişimi, İ.T.O. (İstanbul Ticaret Odası) Yayınları, Yayın No: 2003-39. İstanbul, Turkey.

Orhan, O. Z. (2003). Dünyada ve Türkiye'de Lojistik Sektörünün Gelişimi, Marmara Üniversitesi İktisadi ve İdari Bilimler Fakültesi, *İstanbul Ticaret Odası Yayınları*, İstanbul, 2003, 26.

Orłowski, M., Bastien, C., Razmkhah, O., & McCartan, S. (2017). Design methodology for crash occupant protection in cabin design of the high speed vessel. *Marine Structures*, *51*, 1–20. doi:10.1016/j.marstruc.2016.10.001

OsborneC. (2017). Uber uses AI. Retrieved from http://www.zdnet.com/article/uber-uses-artificial-intelligence-to-figure-out-yourpersonal-price-hike/

Osleeb, J. P., & Ratick, S. J. (1983). A mixed integer and multiple objective programming model to analyze coal handling in New England. *European Journal of Operational Research*, *12*(3), 302–313. doi:10.1016/0377-2217(83)90200-X

Osleeb, J. P., Ratick, S. J., Buckley, P., Lee, K., & Kuby, M. (1986). Evaluating dredging and offshore loading locations for U.S. coal exports using the local logistics system. *Annals of Operations Research*, *6*(6), 161–180. doi:10.1007/BF02026823

Osman Z. Orhan, Dünyada ve Türkiye'de Lojistik Sektörünün Gelişimi, İ.T.O (İstanbul Ticaret Odası) Yayınları, Yayın No: 2003-39. İstanbul, 2003, s.10

Ostlin, J., Sundin, E., & Bjoerkman, M. (2009). Product life-cycle implications for remanufacturing strategies. *Journal of Cleaner Production*, *17*(11), 999–1009. doi:10.1016/j.jclepro.2009.02.021

Özalp, A. (2018). *International trade finance, principles, and blockchain*. İstanbul, Turkey: Türkmen Publisher.

Özdoğan, B., & Karğın, S. (2018). Blockchain technology's reflections on accounting and finance fields and expectations, *The Journal of Accounting and Finance*, October/2018, 161-175.

Özer, M. C. (2015). Bilgisayar Müziği Dillerinin Tarihçesi. *Devlet Türk Musikisi Konservatuvarı Dergisi*, 47.

Özkan, Ö. (2012). Incoterms 2010 ile Getirilen Yenilikler. *Akademik Bakış Uluslararası Hakemli Sosyal Bilimler E-Dergisi*, 31, 01-15.

Ozkan, T., Yanginlar, G., & Kalayci, S. (2018). Testing the transportation-induced environmental Kuznets curve hypothesis: evidence from eight developed and developing countries. *International Journal of Energy Economics and Policy*, *9*(1), 174–183.

Öztürk, N., & Koç, A. (2006). Electronıc money, with other types of money comparison and potential effects. *Selçuk Universityi Journal of Social and Economic Research*, *11*, 207–243.

Pagliara, F., Mauriello, F., & Garofalo, A. (2017). Exploring the interdependences between High Speed Rail systems and tourism: Some evidence from Italy. *Transportation Research Part A, Policy and Practice*, *106*, 300–308. doi:10.1016/j.tra.2017.09.022

Pahl, J., & Kaiser, B. (2018). Arctic port development. In I. N. Verstergaard, B. A. Kaiser, L. Fernandez, & J. Nymand Larsen. (Eds.), *Arctic Marine Resource Governance and Development* (s. 139-184). Springer. Springer Polar Sciences.

Pahl, J., & Voss, S. (2017). Maritime load dependent lead times – An analysis. In *Proceedings of the International Conference on Computational Logistics* (vol. 10572, pp. 300-305). Cham, Switzerland: Springer. 10.1007/978-3-319-68496-3_20

Paine, F. (1981). *Fundamentals of packaging*. Leicester, UK: Brookside Press.

Paker, S., Çullu, B., Paker, N., & Çiçek, S. Yelken Yarış. Organizasyonlarının Lojistik Süreçleri Üzerine Keşifsel Bir Araştırma. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, 27-50.

Pålsson, H. (2018). *Packaging logistics. Understanding and managing the economic and environmental impacts of packaging in supply chains*. London, UK: Kogan Page.

Pålsson, H., & Hellström, D. (2018). *Linking the packaging innovation process to logistics and supply chain performance in the food industry*. Paper presented at the 23rd Logistics Research Network (LRN) Annual Conference Proceedings, September, Plymouth, UK.

Pålsson, H., & Hellström, D. (2016). Packaging logistics in supply chain practice – current state, trade-offs and improvement potential. *International Journal of Logistics Research and Applications*, *19*(5), 351–368. doi:10.1080/13675567.2015.1115472

Paltrinieri, N., Gabriele, L., Molag, M., Bonvicini, S., Spadoni, G., & Cozzani, V. (2009). Risk reduction in road and rail LPG transportation by passive fire protection. *Hazardous Materials,* 332-344.

Panayotou, T. (1993). Empirical tests and policy analysis of environmental degradation at different stages of economic development. World Employment Programme Working Paper Number WP238. Geneva, Switzerland: International Labor Office.

Pan, J. C. H., & Wu, M. H. (2012). Throughput analysis for order picking system with multiple pickers and aisle congestion considerations. *Computers & Operations Research*, *39*(7), 1661–1672. doi:10.1016/j.cor.2011.09.022

Papanikolaou, A. (2002). Developments and potential of advanced marine vehicles concepts. *Bulletin of the KANSAI Society of Naval Architects*, *55*, 50–54.

Papanikolaou, A. (2005). Review of advanced marine vehicles concepts. In *Proceedings of the Seventh International Symposium on High speed marine vehicles (HSMV 2005), Naples, Italy* (pp. 21–23).

Paris MoU. (2018a). *2017 Paris MoU Annual Report. Safeguarding responsible and sustainable shipping*. Retrieved from https://www.parismou.org/sites/default/files/2017 Annual ParisMoU_0.pdf

Paris MoU. (2018b). Concentrated inspection campaign. Retrieved from https://www.parismou.org/inspections-risk/inspection-types/concentrated-inspection-campaign

Paris MoU. (2018c). Concentrated inspection campaign (CIC) on safety of navigation, including ECDIS (2017). Retrieved from https://www.parismou.org/concentrated-inspection-campaign-cic-safety-navigation-including-ecdis-2017

Park, H. J., Tasaka, Y., & Murai, Y. (2018). Bubbly drag reduction accompanied by void wave generation inside turbulent boundary layers. *Experiments in fluids*, *59*(11), 166. doi:10.100700348-018-2621-1

Park, S. H., & Lee, I. (2018). Optimization of drag reduction effect of air lubrication for a tanker model. *International Journal of Naval Architecture and Ocean Engineering*, *10*(4), 427–438. doi:10.1016/j.ijnaoe.2017.09.003

Paul, F. (2015). 10 reasons Amazon's drone delivery plan still won't fly. *Techwatch.* Retrieved from http://www.networkworld.com/article/2900317/wireless/10-reasons-amazons-drone-delivery-plan-still-wont-fly

Payne, P. R. (1997). The response of a hydrofoil to wave orbital velocity fields. *Ocean Engineering*, *24*(3), 235–263. doi:10.1016/S0029-8018(96)00011-X

Peder, M., & Pruzan-Jorgensen, A. F. (2010). *Sustainability trends in the container shipping industry*. Retrieved from https://www.bsr.org/en/our-insights/report-view/sustainability-trends-in-the-container-shipping-industry

Pedroni, P. (2000). Fully modified OLS for heterogeneous co-integrated panels. *Advances in Econometrics*, *15*, 93–130. doi:10.1016/S0731-9053(00)15004-2

Pedroni, P. (2001). Purchasing power parity tests in co-integrated panels. *The Review of Economics and Statistics*, *83*(4), 727–731. doi:10.1162/003465301753237803

Penrose, E. G. (1959). *The theory of the growth of the firm*. New York: Wiley.

Perl, J., & Sirisoponsilp, S. (1988). Distribution networks: facility location, transportation and inventory. International Journal of Physical Distribution & Materials Management, 18(6), pp. 18-26.

Perrin, A., & Joly, C. (2018). Élaboration du cahier des charges fonctionnel et du cahier des charges achats. In P. Dole (Ed.), *Dans Les 7 fonctions de l'emballage* (pp. 405–410). Paris, France: Lavoisier.

Persson, G. (1991). Achieving competitiveness through logistics. *International Journal of Logistics Management*, *2*(1), 1–11. doi:10.1108/09574099110804625

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. IZA Discussion Paper No. 1240.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross section dependence. *Journal of Applied Econometrics*, *22*(2), 265–312. doi:10.1002/jae.951

Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal*, *14*(3), 179–192. doi:10.1002mj.4250140303

Peteraf, M. A., & Barney, J. B. (2003). Unraveling the resource-based tangle. *Managerial and Decision Economics*, *24*(4), 309–323. doi:10.1002/mde.1126

Petersen, C. G., & Aase, G. (2004). A comparison of picking, storage, and routing policies in manual order picking. *International Journal of Production Economics*, *92*(1), 11–19. doi:10.1016/j.ijpe.2003.09.006

Petersen, C. G. II. (1997). An evaluation of order picking routeing policies. *International Journal of Operations & Production Management*, *17*(11), 1098–1111. doi:10.1108/01443579710177860

Petersen, C. G. II. (1999). The impact of routing and storage policies on warehouse efficiency. *International Journal of Operations & Production Management*, *19*(10), 1053–1064. doi:10.1108/01443579910287073

Piaralal, S. K., Nair, S. R., Yahya, N., & Karim, J. A. (2015). An integrated model of the likelihood and extent of adoption of green practices in small and medium sized logistics firms. *American Journal of Economics*, *5*(2), 251–258.

Piasecki, T. (2018, May 1). Preparation of the cargo system for LNG discharge from a membrane steam turbine LNG vessel at an offshore LNG terminal. Researched from https://www.researchgate.net/publication/325202953_PREPARATION_OF_THE_CARGO_SYSTEM_FOR_LNG_DISCHARGE_FROM_A_MEMBRANE_STEAM_TURBINE_LNG_VESSEL_AT_AN_OFFSHORE_LNG_TERMINAL

Piecyk, M. I., & McKinnon, A. C. (2010). Forecasting the carbon footprint of road freight transport in 2020. *International Journal of Production Economics*, *128*(1), 31–42. doi:10.1016/j.ijpe.2009.08.027

Pike, D. (1993). Fast-ferry navigation. *Journal of Navigation*, *46*(02), 282–286. doi:10.1017/S0373463300011632

Pineus, K. (1986). *Ship's value*. London, UK: LLP Professional Publishing.

Plomaritou, E., & Papadopoulos, A. (2017). Shipbroking and chartering practice. London, UK: e-publish.

Popadiuk, S., Rivera, E., & Bataglia, W. (2014). Heterogeneity of isomorphic pressures: Intertwining the resource-based view and the neoinstitutional approach. *Brazilian Administration Review*, *11*(4), 456–475. doi:10.1590/1807-7692bar2014130003

Poppa, B., & Woratschek, H. (2017). Consumers' relationships with brands and brand communities' roles of identification and satisfaction. *Journal of Retailing and Consumer Services*, *35*, 46–56. doi:10.1016/j.jretconser.2016.11.006

popsci. (2019). Retrieved from https://www.popsci.com/chinas-new-drone-company-has-big-plans)

Porter, M. E. (1990). *Competitive advantage of nation*. New York: The Free Press.

Porter, M. (1998). *Competitive advantage - creating and sustaining superior performance*. New York: The Free Press.

Portstrategy a. (2019). *BPA urges 'grown-up' scrubbers conversation.* Retrieved from https://www.portstrategy.com/news101/world/europe/scrubber-clarity-call-at-uk-parliament

Portstrategy b. (2019). *DP world to operate new Russian ports.* Retrieved from https://www.portstrategy.com/news101/world/europe/dp-world-to-operate-new-russian-ports

Portstrategy c. (2019). *CAD$47.5M to improve Halifax efficiency.* Retrieved from https://www.portstrategy.com/news101/world/americas/cad$47.5m-to-improve-halifax-efficiency

Portstrategy d. (2019). *From fuel to food.* Retrieved from https://www.portstrategy.com/news101/insight-and-opinion/the-analyst/from-fuel-to-food

Portstrategy e. (2019). *Cross-port benefits of geospatial technology.* Retrieved from https://www.portstrategy.com/news101/port-operations/planning-and-design/Cross-port-benefits-of-geospatial-technology

Poundra, G. A. P., Utama, I. K. A. P., Hardianto, D., & Suwasono, B. (2017). Optimizing trimaran yacht hull configuration based on resistance and seakeeping criteria. *Procedia Engineering*, *194*, 112–119. doi:10.1016/j.proeng.2017.08.124

Prahalad, C. K., & Hamel, G. (1990). *The core competence of the corporation. Harvard Business Review*. May-June.

Prajapati, H., Kant, R., & Shankar, R. (2019). Bequeath life to death: State-of-art review on reverse logistics. *Journal of Cleaner Production*, *211*, 503–520. doi:10.1016/j.jclepro.2018.11.187

Prasse, C., Nettstraeter, A., & Ten Hompel, M. (2014). How IoT will change the design and operation of logistics systems. *2014 International Conference on the Internet of Things, IOT 2014*, 55–60. 10.1109/IOT.2014.7030115

Premuda. (2013, March 12). Cargo operations. Retrieved from http://sqems.premuda.net/cargo%20ops.pdf

Prokhoroval, V. V., Kolomyts, O. N., Nenasheva, A. I., Sholukha, N. A., & Vashchenko, P. G. (2016). Logistics management as a tool to achieve competitive advantages of the enterprise trade. [Special Issue on "Management of Systems of Socio-Economic and Legal Relations in Modern Conditions of Development of Education and Society".]. *International Review of Management and Marketing*, *6*(6), 32–37.

Provost, P. (2010). Élaboration d'un cahier des charges fonctionnel - Méthodologie et informatisation. *Techniques de l'Ingénieur*, Réf.: AG6060-V1, 10 Janvier, 1-19.

Puertas, R., Marti, L. & García, L. (2013). Logistics performance and export competitiveness: European experience. *Empirica Journal of European Economics*, on line, doi:10.100710663-013-9241-z

Pujo, P., Ounnar, F., Power, D., & Khader, S. (2016). Wireless holon network for job shop isoechoic control. *Computers in Industry*, *83*, 12–27. doi:10.1016/j.compind.2016.08.005

Pustoshnyi, A. V. (2013). Prospects for high-speed water transport in Russia. *Herald of the Russian Academy of Sciences*, *83*(6), 506–512. doi:10.1134/S1019331614010043

Qingyu, Z., Vonderembse, M. A., & Lim, J. (2005). Logistics flexibility and its impact on customer satisfaction. *International Journal of Logistics Management*, *16*(1), 71–95. doi:10.1108/09574090510617367

Ramberg, J. (2011). *ICC Guide to Incoterms 2010: Understanding and Practical Use* (1st ed.). Paris, France: ICC Services.

Rani, D., & Gulati, T. R. (2017). Time optimization in totally uncertain transportation problems. *International Journal of Fuzzy Systems*, *19*(3), 739–750. doi:10.100740815-016-0176-y

Rantasila, K. (2010). *Measuring national logistics costs: designing a generic model for assessing national logistics costs in global context,* Turku School of Economics, (Master's Thesis). Retrieved from http://info.tse.fi/julkaisut/Thesis2010/12927.pdf

Rantasila, K., & Ojala, L. (2012). Measurement of national-level logistics costs and performance, *Discussion Paper* No. 2012–4, International Transport Forum, Paris.

Ravi, V. (2012). Evaluating overall quality of recycling of e-waste from end-of-life computers. *Journal of Cleaner Production*, *20*(1), 145–151. doi:10.1016/j.jclepro.2011.08.003

Rawson, K. J., & Tupper, E. C. (2001). Particular ship types. In *Basic ship theory* (pp. 655–694). Elsevier; doi:10.1016/B978-075065398-5/50019-4

Razzaque, M. A. (1997). Challenges to logistics development: The case of a Third World country - Bangladesh. *International Journal of Physical Distribution & Logistics Management*, *27*(1), 18–38. doi:10.1108/09600039710162268

realclearpolitics. (2019). Retrieved from https://www.realclearpolitics.com/video/2013/12/01/amazons_jeff_bezos_unveils_plan_to_deliver_packages_using_drones_on_60_minutes.html

Regulation on control of excavation soil, construction, and demolition wastes, RG. (2004). Number 25406. Retrieved from http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.5401&sourceXmlSearch=&MevzuatIliski=0

Regulation on control of solid wastes RG. (1991). Number 20814. Retrieved from http://www.resmigazete.gov.tr/arsiv/20814.pdf

ReportM. S. (2018). Retrieved from https://www.maersk.com/sustainability

ResearchGate. A prescriptive process flowchart for waste management. Available at https://www.researchgate.net/figure/A-prescriptive-process-flowchart-for-waste-management_fig2_276535861

Resources, capabilities and competencies. (1996). InNanda, A. (Ed.), *B. Boingeon, & A. Edmondson, Organisational Learning and Competitive Advantage*. London, UK: Sage.

Reza Kohansal, A., & Ghassemi, H. (2010). A numerical modeling of hydrodynamic characteristics of various planing hull forms. *Ocean Engineering*, *37*(5–6), 498–510. doi:10.1016/j.oceaneng.2010.01.008

Rezaei, J., Roekel, W. S., & Tavasszy, L. (2018). Measuring the relative importance of the logistics performance index indicators using best worst method. *Transport Policy*, *68*, 158–169. doi:10.1016/j.tranpol.2018.05.007

Reza, M., Suthiwartnarueput, K., & Pornchaiwiseskul, P. (2015). Liner shipping connectivity and international trade in maritime southeast Asian countries. *Journal of International Logistics and Trade*, *13*(3), 43–74. doi:10.24006/jilt.2015.13.3.003

Richey, R. G., Chen, H., Genchev, S. E., & Daugherty, P. J. (2005). Developing effective reverse logistics programs. *Industrial Marketing Management*, *34*(8), 830–840. doi:10.1016/j.indmarman.2005.01.003

Rivard-Royer, H., Landry, S., & Beaulieu, M. (2002). Hybrid stockless: a case study: Lessons for health-care supply chain integration. *International Journal of Operations & Production Management*, *22*(4), 412–424. doi:10.1108/01443570210420412

Riyadh MoU. (2018). *2017 Riyadh MoU annual report*. Retrieved from https://riyadhmou.org/public_html/assets/uploads/images/3b4b3362fb82d3a92acd2fdb2ee02d15.pdf

RobinsonA. (2013). Retrieved from https://cerasis.com/2013/08/13/transportation-and-logistics-management/

Robotis, A., Bhattacharya, S., & Van Wassenhove, L. (2005). The effect of remanufacturing on procurement decisions for resellers in secondary markets. *European Journal of Operational Research*, *163*(3), 688–705. doi:10.1016/j.ejor.2004.01.013

Rodrigue, J. P. (2006). Challenging the derived transport-demand thesis: geographical issues in freight distribution. *Environment and Planning A, 38*(8), pp. 1449-1462. Retrieved from http://people.hofstra.edu/jean-paul_rodrigue/downloads/Derived%20Demand.pdf

Rodrigue, J. P. (n.d.). GEOG 80-Trasport Geography. Retrieved from http://www.umsl.edu/~naumannj/Geography%20PowerPoint%20Slides/transportation%20geog/Geog%2080%20Topic%205_B.ppt

Rodrigue, J. P., Comtois, C., & Slack, B. (2009). *The geography of transport system* (2nd Ed.). New York: Routledge. Retrieved from http://www.people.hofstra.edu/geotrans/eng/ch5en/conc5en/ worldlogisticscosts.html

Rodrigue, J. P., Comtois, C., & Slack, B. (2017). *The geography of transport systems*, Hofstra University, Department of Global Studies & Geography. Retrieved from https://transportgeography.org

Rodrigue, J. P., Comtois, C., & Slack, B. (2013). *The geography of transport systems, Routledge*. New York, NY: Taylor & Francis Group. doi:10.4324/9780203371183

Rodrigue, J.-P. (2017). Maritime transport. In *International encyclopedia of geography: People, the earth, environment, and technology* (pp. 1–7). Oxford, UK: John Wiley & Sons; doi:10.1002/9781118786352.wbieg0155

Rodrigues, A. M., Bowersox, D. J., & Calantone, R. J. (2005). Estimation of global and national logistics expenditures: 2002 data update. *Journal of Business Logistics, 26*(2). Retrieved from https://www.msu.edu/~rodri205/CV/Documents/ISL2005%20Article.pdf

Rodriguez, A. C., Lee, D. A. Jr, & Makic, M. B. F. (2017). Situational awareness in critical care: an aviation approach to reduce error. *Journal of Perianesthesia Nursing*, *32*(6), 650–652. doi:10.1016/j.jopan.2017.08.001 PMID:29157771

Rogers, D. S., Rogers, Z. S., & Lembke, R. (2010). Creating value through product stewardship and take-back. *Sustainability Accounting*, *Management, and Policy Journal*, *1*(2), 133–160.

Rogers, D. S., & Tibben-Lembke, R. (1999). *Going backwards: Reverse logistics trends and practices*. Pittsburgh, PA: Reverse Logistics Executive Council.

Rogers, D. S., & Tibben-Lembke, R. (2001). An examination of reverse logistics practices. *Journal of Business Logistics*, *22*(2), 129–148. doi:10.1002/j.2158-1592.2001.tb00007.x

Rojas, M., Guisao, E., & Cano, J. A. (2011). *Logística Integral: Una propuesta práctica para su negocio*. Medellín: Universidad de Medellín.

Roodbergen, K. J., & Vis, I. (2006). A model for warehouse layout. [Institute of Industrial Engineers]. *IIE Transactions*, *38*(10), 799–811. doi:10.1080/07408170500494566

Roodbergen, K. J., & Vis, I. F. A. (2009). A survey of literature on automated storage and retrieval systems. *European Journal of Operational Research*, *194*(2), 343–362. doi:10.1016/j.ejor.2008.01.038

Roodbergen, K. J., Vis, I. F. A., & Taylor, G. D. Jr. (2015). Simultaneous determination of warehouse layout and control policies. *International Journal of Production Research*, *53*(11), 3306–3326. doi:10.1080/00207543.2014.978029

Rossi, C., & Russo, F. (2017). *Ancient engineers' inventions* (Vol. 33). Cham, Switzerland: Springer International Publishing; doi:10.1007/978-3-319-44476-5

Ross, S. D., James, J. D., & Vargas, P. (2006). Development of a scale to measure team brand associations in professional sport. *Journal of Sport Management*, *20*(2), 260–279. doi:10.1123/jsm.20.2.260

Rousselle, L. (2018). L'emballage ne manque pas d'air. *L'Usine Nouvelle*, *3583*(November), 48–50.

Rubin, J., & Leiby, P. N. (2013). Tradable credits system design and cost savings for a national low carbon fuel standard for road transport. *Energy Policy*, *56*, 16–28. doi:10.1016/j.enpol.2012.05.031

Ruggiero, V., & Morace, F. (2018). Methodology to study the comfort implementation for a new generation of hydrofoils. *International Journal on Interactive Design and Manufacturing (IJIDeM)*. doi:10.100712008-018-0511-7

Rundh, B. (2005). The multi-faceted dimension of packaging. *British Food Journal*, *107*(9), 670–684. doi:10.1108/00070700510615053

Rushton, A., Oxley, J., & Croucher, P. (2000). *The handbook of logistics and distribution management* (2nd ed., p. 18). London, UK: Kogan Page Publishers.

Saavedra, Y. M., Barquet, A. P., Rozenfeld, H., Forcellini, F. A., & Ometto, A. R. (2013). Remanufacturing in Brazil: Case studies on the automotive sector. *Journal of Cleaner Production*, *53*, 267–276. doi:10.1016/j.jclepro.2013.03.038

Saban, M., & Güğercin, G. (2009). Deniz Taşımacılığı İşletmelerinde Maliyetleri Etkileyen Faktörler ve Sefer Maliyetleri. *Dokuz Eylül Üniversitesi Denizcilik Dergisi*, *1*(1), 1–16.

Sabır, H. (2013). Competition policy and developing countries in the globalized world, international. *Journal of Political Science & Urban Studies*, *1*(1), 121–133.

Sadowski, P. (2010). *Green logistics - Foundations, approaches and background for optimizing energy efficiency in logistics* (pp. 4–53). Saarbrücken, Germany: Müller.

Saghir, M. (2004). The concept of packaging logistics. In *Proceedings of the 2nd World Conference on POM Production and Operations Management & 15th Annual POM Conference,* April, Cancun.

Saghir, M. (2002). *Packaging logistics evaluation in the Swedish retail supply chain*. Lund: Lund University.

Salazar, F., Gomez, R. A., & Cano, J. A. (2017). Pallet loading problem in distribution centers using mixture experiments. *Espacios*, *38*(2), 2.

Saleem, H., Jiandong, W., Zaman, K., Elashkar, E. E., & Shoukry, A. M. (2018). The impact of air-railways transportation, energy demand, bilateral aid flows, and population density on environmental degradation: Evidence from a panel of next-11 countries. *Transportation Research Part D, Transport and Environment*, *62*, 152–168. doi:10.1016/j.trd.2018.02.016

Sample, I., & Hern, A. (2014). Scientists dispute whether computer 'Eugene Goostman' passed Turing test. *The Guardian, 9*.

Sánchez, R. J., Hoffmann, J., Micco, A., Pizzolitto, G. V., Sgut, M., & Wilmsmeier, G. (2003). Port efficiency and international trade: Port efficiency as a determinant of maritime transport costs. *Maritime Economics & Logistics*, *5*(2), 199–218. doi:10.1057/palgrave.mel.9100073

Sánchez, R. J., & Mouftier, L. (2016). Reflections on the future of ports: From current strains to the changes and innovation of the future. *ECLAC United Nations, ISU Infrastructure Service Unit*. *Natural Resources and Infrastructure Divison*, *352*(8), 1–9.

Sánchez, R. J., Ng, A. K. Y., & Garcia-Alonso, L. (2011). Port selection factors and attractiveness: the service providers' perspective. *Transportation Journal*, *50*(2), 141–161. doi:10.5325/transportationj.50.2.0141

SANS. (2017). Cyber security trends: Aiming ahead of the target to increase security in 2017. Retrieved from https://www.sans.org/webcasts/2017-cybersecurity-trends-aiming-target-increase-security-103517

Santini, F. D. O., Ladeira, W. J., & Sampaio, C. H. (2018). The role of satisfaction in fashion marketing: A meta-analysis. *Journal of Global Fashion Marketing*, *9*(4), 1–17. doi:10.1080/20932685.2018.1503556

Santos, F. M., Temarel, P., & Guedes Soares, C. (2009). Modal analysis of a fast patrol boat made of composite material. *Ocean Engineering*, *36*(2), 179–192. doi:10.1016/j.oceaneng.2008.09.013

Santos, M. (2014). Neuro-fuzzy modeling and fuzzy control of a fast ferry. In F. Matía, G. N. Marichal, & E. Jiménez (Eds.), *Fuzzy modeling and control: Theory and applications* (pp. 191–204). Paris, France: Atlantis Press; doi:10.2991/978-94-6239-082-9_10

Sarıer, B. (2016). Günlük hayatta temassız ödemenin yeri | Bankalararası Kart Merkezi. Retrieved from https://bkm.com.tr/gunluk-hayatta-temassiz-odemenin-yeri/

Savaresi, S. M., Bertin, D., & Bittanti, S. (2000). Non-linear design of an IGV-FAN servo system for surface effect ships. *IFAC Proceedings Volumes, 33*(9), 601–606. doi:10.1016/S1474-6670(17)38210-1

Schneider, T.H., (2006). The future of coal-fired power generation in Europe,

Schneller, E. S., & Smeltzer, L. R. (2006). Strategic management of the health care supply chain. San Francisco, CA: Jossey-Bass, A Wiley Print.

Scholz, A., & Wäscher, G. (2017). Order batching and picker routing in manual order picking systems: The benefits of integrated routing. *Central European Journal of Operations Research*, *25*(2), 491–520. doi:10.100710100-017-0467-x

Schramm-Klein, H., & Morschett, D. (2006). The relationship between marketing performance, logistics performance and company performance for retail companies. *International Review of Retail, Distribution and Consumer Research*, *16*(2), 277–296. doi:10.1080/09593960600572399

Schrotenboer, A. H., Wruck, S., Roodbergen, K. J., Veenstra, M., & Dijkstra, A. S. (2017). Order picker routing with product returns and interaction delays. *International Journal of Production Research*, *55*(21), 6394–6406. doi:10.1080/00207543.2016.1206982

Schütze, G. (2019). An analysis of MSC Zoe's container loss. Retrieved from https://www.maritime-executive.com/editorials/an-analysis-of-msc-zoe-s-container-loss

Schwab, K. (2016). *Dördüncü Sanayi Devrimi* (Z. Dicleli, Trans.). İstanbul, Turkey: Optimist Yayıncılık.

Seebacher, S., & Schüritz, R. (2017). Blockchain technology as an enabler of service systems: A structured literature review. In *Proceedings 8th International Conference on Exploring Service Science, IESS 1.7, 143*(April), 12–23. 10.1007/978-3-319-56925-3_2

Segetlija, Z., Mesarić, J., & Dujak, D. (2012). Importance of distribution channels-marketing channels-for national economy. In Pavlović, D. K., & Benazić, D. (Eds.), Marketing Challenges in New Economy (pp. 785-810). Juraj Dobrila University of Pula.

Şeker, S. E. (2014). Digitalization, management. *Information Systems*, *1*(1), 6–7.

Şekkeli, Z. H., & Bakan, İ. (2018). Smart FActories. *Journal of Life Economics*, *5*(4), 203–220.

Selviaridis, K., & Spring, M. (2007). Third party logistics: A literature review and research agenda. *International Journal of Logistics Management*, *18*(1), 125–150. doi:10.1108/09574090710748207

Selznick, P. (1957). *Leadership and administration*. New York: Harper and Row.

Seo, J., Choi, H. K., Jeong, U. C., Lee, D. K., Rhee, S. H., Jung, C. M., & Yoo, J. (2016). Model tests on resistance and seakeeping performance of wave-piercing high-speed vessel with spray rails. *International Journal of Naval Architecture and Ocean Engineering*, *8*(5), 442–455. doi:10.1016/j.ijnaoe.2016.05.010

Sequenzia, G., Rizzuti, S., Martorelli, M., & Ingrassia, T. (2018). Advances on mechanics, design engineering and manufacturing. *International Journal on Interactive Design and Manufacturing*, 575–584. doi:10.100712008-018-0509-1

Serena, N., & Perron, P. (2001). Lag length selection and the construction of unit root tests with good size and power. *Econometrica*, *69*(6), 1519–1554. doi:10.1111/1468-0262.00256

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, *16*(15), 1699–1710. doi:10.1016/j.jclepro.2008.04.020

Seyidoğlu, H. (2002). *Ekonomik Terimler Ansiklopedik Sözlük* (3rd ed.). İstanbul, Turkey: Güzem Can Yayınları.

Shafiee, M., Lotfi, F. H., & Saleh, H. (2014). Supply chain performance evaluation with data envelopment analysis and balanced scorecard approach. *Applied Mathematical Modelling*, *38*(21-22), 5092–5112. doi:10.1016/j.apm.2014.03.023

Shafiul, A. A., & Ali, M. (2004). Partnerships for solid waste management in developing countries: Linking theories to realities. *Habitat International*, *28*(3), 467–479. doi:10.1016/S0197-3975(03)00044-4

Shang, K. C., & Marlow, P. (2008). The effects of logistics competency on performance. *Journal of International Logistics and Trade*, *5*(2), 45–66. doi:10.24006/jilt.2007.5.2.003

Shang, K., & Marlow, P. (2005). Logistics capabilities and performance in Taiwan's major manufacturing firms. *Transportation Research Part E, Logistics and Transportation Review*, *41*(3), 217–234. doi:10.1016/j.tre.2004.03.002

Sherali, H. D., & Puri, R. (1993). Models for a coal blending and distribution problem. *Omega*, *21*(2), 235–243. doi:10.1016/0305-0483(93)90056-Q

Shih, L. H. (1997). Planning of fuel coal imports using a mixed integer programming method. *International Journal of Production Economics*, *51*(3), 243–249. doi:10.1016/S0925-5273(97)00078-9

Shipyards' & Maritime Equipment Association. (2017). *2017 Market forecast report*. Retrieved from https://maritimetechnology.nl/media/2017-Market-Forecast-Report-finaal.pdf

Sigtto. (2017). Liquifed gas handling princibles on ships and on terminals. London, UK: Witherby & Company Limited.

Silva, I. S., Campopiano, F., Lopes, G. S. V., Uenojo, A. K., Silva, H. T., Pellini, E. L., ... Barros, E. A. (2018). Development of a Trimaran ASV. *IFAC-PapersOnLine*, *51*(29), 8–13. doi:10.1016/j.ifacol.2018.09.461

Simms, C., & Trott, P. (2010). Packaging development: A conceptual framework for identifying new product opportunities. *Marketing Theory*, *10*(4), 397–415. doi:10.1177/1470593110382826

Simone, C., Francesca, M., Francesco, P., & Claudio, F. (2014). An analysis of shipping agreements: the cooperative container network [Springer Science+Business Media New York.]. *Networks and Spatial Economics*, *14*(3-4), 357–377. doi:10.100711067-014-9230-1

Si, S.-L., You, X.-Y., Liu, H.-C., & Zhang, P. (2018). DEMATEL Technique: A systematic review of the state-of-the-art literature on methodologies and applications. *Mathematical Problems in Engineering*, *2018*, 1–33. doi:10.1155/2018/3696457

Smith, B. K. (2011). *An empirical investigation of supply chain excellence in healthcare*. (Unpublished Doctoral Dissertation). University of Arkansas.

Smith-Forbes Insights, D. S. (2018). *L'Économie de l'espace vide*. Jersey City, NJ: Forbes Insights.

Snow, C. C., & Hrebiniak, L. G. (1980). Strategy, distinctive competence and organizational performance. *Administrative Science Quarterly*, 25.

Sorkun, M. F., & Onay, M. (2016). Effect of product modularity on supply chain strategies through reverse logistics processes. *Journal of Social Sciences and Humanities*, *8*(2), 41–57.

Soumya, C. (2017, Sept. 30). Understanding the design of liquefied gas carriers. Retrieved from https://www.marineinsight.com/naval-architecture/understanding-design-liquefied-gas-carriers/

Splash. (2017). Health, safety, and the blockchain. 24/7 Splash. Retrieved from https://splash247.com/health-safety-blockchain/

Srivastava, R. K., Fahey, L., & Christensen, H. K. (2001). The resource-based view and marketing: The role of market-based assets in gaining competitive advantage. *Journal of Management*, *27*(6), 777–802. doi:10.1177/014920630102700610

Srivastava, S. K., & Srivastava, R. (2006). Managing product returns for reverse logistics. *International Journal of Physical Distribution & Logistics Management*, *36*(7), 524–546. doi:10.1108/09600030610684962

Stadtler, H., & Kilger, C. (2005). *Supply chain management and advanced planning: Concepts, models, software, and case studies*. Heidelberg, Germany: Springer Dordrecht.

Stank, T. J., Daugherty, P., & Ellinger, A. (1999). Marketing/Logistics integration and firm performance. *International Journal of Logistics Management*, *10*(1), 11–24. doi:10.1108/09574099910805905

Stank, T. P., Davis, B. R., & Fugate, B. S. (2005). A strategic framework for supply chain-oriented logistics. *Journal of Business Logistics*, *26*(2), 27–46.

Statistics, C. World Coal Association. (2014). Available at http://www.worldcoal.org/resources/coal-statistics/

Staudt, F. H., Alpan, G., Di Mascolo, M., & Rodriguez, C. M. T. (2015). warehouse performance measurement: A literature review. *International Journal of Production Research*, *53*(18), 5524–5544. doi:10.1080/00207543.2015.1030466

Stock, J. R. (1997). Applying theories from other disciplines to logistics. *International Journal of Physical Distribution & Logistics Management*, *27*(9/10), 515–539. doi:10.1108/09600039710188576

Stojanović, D., & Knežević, V. (2017). *Logıstıcs operators ın waste management ın the republıc of Serbıa.* See discussions, stats, and author profiles for this publication at https://www.researchgate.net/publication/314949050

Stopford, M. (2003). *Maritime economics*. New York: Taylor & Francis Group.

Stosic, N., Kovacevic, A., & Smith, I. K. (2019, May 27). An investigation of liquid injection in refrigeration screw compressors. Retrieved from https://www.researchgate.net/profile/Ahmed_Kovacevic/publication/237659424_An_Investigation_of_Liquid_Injection_in_Refrigeration_Screw_Compressors/links/0f317539340c57deae000000.pdf

Stout, E. G. (1950). Development of high-speed water-based aircraft. *Journal of the Aeronautical Sciences*, *17*(8), 457–480. doi:10.2514/8.1698

Sügen, Y. (1996). *Kaptanın Kılavuzu* (3rd ed.). İstanbul, Turkey: Beta Basım Yayım Dağıtım A.Ş.

Sumalee, A., & Ho, H. W. (2018). Smarter and more connected: Future intelligent transportation system. *IATSS Research*, *42*(2), 67–71. doi:10.1016/j.iatssr.2018.05.005

Sun, L., Zhang, H., Liu, W., & Chen, F. (2018). Research on risk assessment and control of inland navigation safety. *International Journal of System Assurance Engineering and Management*, *9*(3), 729–738. doi:10.100713198-017-0694-5

Sustainability Reporting Guidelines, G. R. I. (2011). Version 3.1. Retrieved from https://www.globalreporting.org/resourcelibrary/G3.1-Guideline.pdf

Sustainability ReportM. S. C. (2017). Retrieved from https://www.msc.com/sustainability

Sustainable Shipping Initiative Vision 2040. (2011). Retrieved from https://www.ssi2040.org/about-the-ssi/the-case-for-action

Svanes, E., Vold, M., Möller, H., Pettersen, M. K., Larsen, H., & Hanssen, O.-J. (2010). Sustainable packaging design: A holistic methodology for packaging design. *Packaging Technology & Science*, *23*(3), 161–175.

Svenson, G. (2002). The theoretical foundation of supply chain management: A functionalist theory of marketing. *International Journal of Physical Distribution & Logistics Management*, *32*(2), 734–754. doi:10.1108/09600030210452422

Szaky, T. (2019). *The future of packaging – from linear to circular*. Oakland, CA: Berrett-Koehler Publishers.

Szymanskı, D. M., & Henard, D. H. (2001). Customer satisfaction: A meth-analysis of the empirical evidence. *Journal of the Academy of Marketing Science*, *29*(1), 16–35. doi:10.1177/0092070301291002

TaeChang, Y., Roh, Y., & Park, H. (2014). Assessing noxious gases of vessel operations in a potential Emission Control Area. Elsevier, 91-97.

Taha, E., Tokur, İ., & Gülbahar, F. (2016). *Sustainability in logistics sector green logistics*. Istanbul, Turkey: MUSIAD.

Takahashi, K. (2016). Blockchain technology and electronic bills of lading. *The Journal of International Maritime Law, 22*(March), 202–211. Retrieved from https://www1.doshisha.ac.jp/~tradelaw/PublishedWorks/BlockchainTechnology-ElectronicBL.pdf

Takahashi, K. (2016). Implications of the blockchain technology for the UNCITRAL Works. Retrieved from http://www.uncitral.org/pdf/english/congress/Papers_for_Programme/30-TAKAHASHI-Implications_of_the_Blockchain_Technology_and_UNCITRAL_ works.pdf

Talaat, W. M., Hafez, K. A., & Banawan, A. A. (2017). A CFD presentation and visualization for a new model that uses interceptors to harness hydro-energy at the wash of fast boats. *Ocean Engineering*, *130*, 542–556. doi:10.1016/j.oceaneng.2016.12.014

Talay, İ. (1997). A research on the concept and application of sustainability: Şanlıurfa example. (Doctoral Thesis), University of Ankara, Turkey.

Talley, W. K., & Ng, M. (2013). Maritime transport chain choice by carriers, ports and shippers. *International Journal of Production Economics*, *142*(2), 311–316. doi:10.1016/j.ijpe.2012.11.013

Tan, A. (2017). A blockchain model for LCL operations in China. MIT Center for Transportation and Logistics. Retrieved from https://ctl.mit.edu/pub/newsletter/supply-chain-frontiers-64-blockchain-model-lcl-operations-china

Tan, W. Z. (2017). Antwerp to use blockchain technology in container handling operations. Lloyd's List. Retrieved from https://lloydslist.maritimeintelligence.informa.com/LL108882/Antwerp-to-use-blockchain-technology-in-container-handling-operations

Tanishita, M., & van Wee, B. (2017). Impact of vehicle speeds and changes in mean speeds on per vehicle-kilometer traffic accident rates in Japan. *IATSS Research*, *41*(3), 107–112. doi:10.1016/j.iatssr.2016.09.003

Tanyaş, R. ve Hazır, M. (2011). Lojistik Temel Kavramlar (1. baskı). Mersin: Çağ Üniversitesi Yayınları.

Tanyaş, M. (2009). *Akademi Lojistik: Lojistik Kavram ve Terimleri Rehber Kitabı* (p. 8). Mersin Ticaret ve Sanayi Odası Yayını.

Tanyaş, M. (2014). *İstanbul lojistik sektör analizi raporu*. Müstakil Sanayici ve İşadamları Derneği Loder Dergisi.

Taşkın, E. (2012). *Uluslararası Pazarlama: Güncel Örnek Uygulamalar Yaklaşımlar (1. baskı)*. İstanbul, Turkey: Türkmen Kitabevi.

Tavakoli Dakhrabadi, M., & Seif, M. S. (2018). Hydro-aerodynamic mathematical model and multi-objective optimization of wing-in-ground effect craft in take-off. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, *232*(4), 421–433. doi:10.1177/1475090217708478

Tavakoli, S., Najafi, S., Amini, E., & Dashtimanesh, A. (2018). Performance of high-speed planing hulls accelerating from rest under the action of a surface piercing propeller and an outboard engine. *Applied Ocean Research*, *77*, 45–60. doi:10.1016/j.apor.2018.05.004

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533. doi:10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Teece, D., & Pisano, G. (1994). The dynamic capabilities of firms: An introduction. *Industrial and Corporate Change*, *3*(3), 537–556. doi:10.1093/icc/3.3.537-a

Tejesh, B. S. S., & Neeraja, S. (2018). Warehouse inventory management system using IoT and open source framework. *Alexandria Engineering Journal*, *57*(4), 3817–3823. doi:10.1016/j.aej.2018.02.003

Teodorović, D., & Janić, M. (2017). Transport economics. In *Transportation engineering* (pp. 635–717). Elsevier; doi:10.1016/B978-0-12-803818-5.00010-X

Tezdogan, T., Incecik, A., & Turan, O. (2014). Operability assessment of high-speed passenger ships based on human comfort criteria. *Ocean Engineering*, *89*(0), 32–52. doi:10.1016/j.oceaneng.2014.07.009

The Asia Foundation. (2008). The cost of moving goods, road transportation, regulations, and charges in Indonesia. The Asia Foundation Publication, Indonesia. Retrieved from http://asiafoundation.org/resources/pdfs/movinggoodslightenglish.pdf

The International Society of Logistics. (2014). *Your window into logistics*. Retrieved from http://www.sole.org/info.asp

The Maritime and Coastguard Agency. (2008). International code of safety for high-speed craft (2000-2008 Edition. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282657/msis34_hsc_code_2000_2008_itos_rev1.01-full-2.pdf

The Material Handling Institute. (2014). *History of material handling*. Retrieved from http://www.mhi.org/about

Theys, C., Bräysy, O., Dullaert, W., & Raa, B. (2010). Using a TSP heuristic for routing order pickers in warehouses. *European Journal of Operational Research*, *200*(3), 755–763. doi:10.1016/j.ejor.2009.01.036

Thomas, B. S., & Sclavounos, P. D. (2007). Optimal-control theory applied to ship maneuvering in restricted waters. *Journal of Engineering Mathematics*, *58*(1–4), 301–315. doi:10.100710665-006-9130-6

Thompson A. A., & Strickland, A. A. (1999). *Strategic management: concepts and cases*. (11th Ed.) Singapore: McGraw-Hill Comp.

Tiao, W. C. (2010). Practical approach to investigate the statistics of nonlinear pressure on a high-speed ship by using the Volterra model. *Ocean Engineering*, *37*(8–9), 847–857. doi:10.1016/j.oceaneng.2010.02.019

Tilanus, B. (1997). *Information systems in logistics and transportation*. London, UK: Elsevier Science Ltd.

Timur, M. C., & Çekerol, G. S. (2013). *Tedarik Zinciri Yönetimi* (1st ed.). Eskişehir: Anadolu University.

Tokyo MoU. (2017). Launch of joint concentrated inspection campaign on safety of navigation (Solas Ch. V). Retrieved from http://www.tokyo-mou.org/doc/Press Release on CIC on Safety of Navigation.pdf

Tokyo MoU. (2018). *Annual report on Port State Control in the Asia-Pacific Region*. Retrieved from http://www.tokyo-mou.org/doc/ANN17.pdf

Tompkins, J. A., White, J. A., Bozer, Y. A., & Tanchoco, J. M. A. (2010). *Facilities planning* (4th ed.). Hoboken, NJ: Wiley.

Tongzon, J. (2002). Port choice determinants in a competitive environment. *The International Association of Maritime Economists Annual Conference 2002 Conference Proceedings*, Panama.

Tongzon, J. (2009). Port choice and freight forwarders. *Transportation Research Part E, Logistics and Transportation Review*, *45*(1), 186–195. doi:10.1016/j.tre.2008.02.004

Tongzon, J., & Heng, W. (2005). Port privatization, efficiency and competitiveness: Some empirical evidence from container ports (terminals). *Transportation Research Part A, Policy and Practice*, *39*(5), 405–424. doi:10.1016/j.tra.2005.02.001

Tongzon, J., & Sawant, L. (2007). Port choice in a competitive environment: From the shipping lines' perspective. *Applied Economics*, *39*(4), 477–492. doi:10.1080/00036840500438871

Topal, Ç. (2017). Sociological imagination of Alan Turing: Artificial intelligence as social imaginary. *Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Dergisi, 57*(2).

Torsvik, T. (2009). Modelling of ship waves from high-speed vessels. In E. Quak, & T. Soomere (Eds.), *Applied wave mathematics: Selected topics in solids, fluids, and mathematical methods* (pp. 229–263). Berlin, Germany: Springer Berlin Heidelberg; doi:10.1007/978-3-642-00585-5_13

Trab, S., Bajic, E., Zouinkhi, A., Abdelkrim, M. N., Chekir, H., & Ltaief, R. H. (2015). Product allocation planning with safety compatibility constraints in IoT-based warehouse. *Procedia Computer Science*, *73*, 290–297. doi:10.1016/j.procs.2015.12.033

Tsai, C.-Y., Liou, J. J. H., & Huang, T.-M. (2008). Using a multiple-GA method to solve the batch picking problem: Considering travel distance and order due time. *International Journal of Production Research*, *46*(22), 6533–6555. doi:10.1080/00207540701441947

Tsao, Y., Zhang, O., & Chen, T. (2016). Multi-item distribution network design problems under volume discount on transportation cost. *International Journal of Production Research*, *54*(2), 426–443. doi:10.1080/00207543.2015.1018453

Tseng, M. L., Islam, M. S., Karia, N., Fauzi, F. A., & Afrin, S. (2019). *A literature review on green supply chain management: Trends and future challenges* (pp. 141, 145–162). Resources, Conservations, and Recycling.

Tseng, Y., Yue, W. L., & Taylor, M. A. P. (2005). The role of transportation in logistics chain. *Proceedings of the Eastern Asia Society for Transportation Studies*, *5*, 1657–1672.

Tuck, E. O. (1990). Planing surfaces. In M. A. Golberg (Ed.), *Numerical solution of integral equations* (pp. 363–372). Boston, MA: Springer US; doi:10.1007/978-1-4899-2593-0_7

Tu, H., & Guldmann, J. M. (2001). GIS in Coal Transportation Modeling: Case Study of Ohio, *Geographic*. *Information Sciences*, *7*(1), 24–34.

TÜİK (TC Başbakanlık Türkiye İstatistik Kurumu). (2010). *CPA 2008, Avrupa Ekonomik Topluluğunda Faaliyete Göre Ürünlerin İstatistikî Sınıflandırılması*. Ankara, Turkey: TÜİK Yayını.

Tunalı, H., & Akarçay, N. (2018). Deniz Taşımacılığı ile Sanayi Üretimi İlişkisinin Analizi Türkiye Örneği. *İktisadi, İdari ve Siyasal Araştırmalar Dergisi, 3*(6), 111–122.

Tupper, E. C. (2013a). Ship design. In Introduction to naval architecture (5th Ed., pp. 343–377). Elsevier. doi:10.1016/B978-0-08-098237-3.00014-X

Tupper, E. C. (2013b). Ship types. In Introduction to naval architecture (5th Ed., pp. 379–412). Elsevier. doi:10.1016/B978-0-08-098237-3.00015-1

Turkanović, M., Hölbl, M., Košič, K., Heričko, M., & Kamišalić, A. (2018). EduCTX: A blockchain-based higher education credit platform. *IEEE access: Practical Innovations, Open Solutions*, *6*, 5112–5127. doi:10.1109/ACCESS.2018.2789929

Turkey Science Foundation (TBV). (n.d.). Accenture digitalization index Turkey results. Retrieved from https://www.accenture.com/tr-en/insight-accenture-digitization-index-report-2016

Turkish Commercial Code. (2011). Retrieved from www.mevzuat.gov.tr/MevzuatMetin/1.5.6102.pdf

Turkish Industry & Business Accociation (TUSİAD). (2014). *Focal point of digital market E-commerce,* TÜSİAD-T/2014, 06-553.

Turkish Industry & Business Accociation (TUSIAD). (2017a). *Digital conversion efficiencies of industry in Turkey.* BCG. November 2017. *TÜSİAD-T*, *2017*, 12–589.

Turkish Industry & Business Accociation (TUSİAD). (2017b*). Efficıent power of the economy in the digitalized world: E-trade*, TÜSİAD-T/2017, 04-587.

Türk, Z. (2004). "Stratejik Yönetim Muhasebesi Yaklaşımı: Değer Zinciri Maliyet Analizi", AÜ SBF Dergisi, Cilt 59. *Sayı*, *3*, 2.

Tuzkaya, Ü., & Önüt, Z. (2006). Multiechelon and multitransport mode product distribution network design: an application, *4th International Logistics and Supply Chain Congress*, İzmir, Turkey.

Twede, D., Clarke, R. H., & Tait, J. A. (2000). Packaging postponement: A global packaging strategy. *Packaging Technology & Science*, *13*(3), 105–115. doi:10.1002/1099-1522(200005)13:3<105::AID-PTS503>3.0.CO;2-9

Ubeda, S., Arcelus, F. J., & Faulin, J. (2011). Green logistics at Eroski: A case study. *International Journal of Production Economics*, *131*(1), 44–51. doi:10.1016/j.ijpe.2010.04.041

Ugboma, C., Ugboma, O., & Ogwude, I. C. (2006). An analytic hierarchy process (AHP) approach to port selection decisions – Empirical evidence from Nigerian ports. *Maritime Economics & Logistics*, *8*(3), 251–266. doi:10.1057/palgrave.mel.9100160

Uğur, A., & Kınacı, A. C. (2006). Yapay zeka teknikleri ve yapay sinir ağları kullanılarak web sayfalarının sınıflandırılması. *XI. Türkiye'de İnternet Konferansı Bildirileri*, 362.

Uğurlu, Ö., Erol, S., & Başar, E. (2016). The analysis of life safety and economic loss in marine accidents occurring in the Turkish Straits. *Maritime Policy & Management*, *43*(3), 356–370. doi:10.1080/03088839.2014.1000992

Uğurlu, Ö., Kum, S., & Aydoğdu, Y. V. (2017). Analysis of occupational accidents encountered by deck cadets in maritime transportation. *Maritime Policy & Management*, *44*(3), 304–322. doi:10.1080/03088839.2016.1245449

Uğurlu, Ö., Yildirim, U., & Yuksekyildiz, E. (2013). Marine accident analysis with GIS. *Journal of Shipping and Ocean Engineering*, *3*(1–2), 21.

UK Department of Transport. (2017). *Transport infrastructure for our global future. A study of England's port connectivity.* Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/710030/transport-infrastructure-global-future-a-study-england-port-connectivity.pdf

Ukpandi. (2019, May 25). Liquefied gases. Retrieved from https://www.ukpandi.com/fileadmin/uploads/uk-pi/LP%20Documents/Carefully_to_Carry/C2C_Articles_2018/Liquefied_Gases.pdf

UNCTAD (United Nations Conference on Trade and Development). (2006). Report of the ad hoc expert meeting on logistics services. Intergovernmental Meetings, Geneva, 13 July, 2006. Retrieved from http://www.unctad.org/en/docs/c1ahm1d3_en.pdf

UNCTAD, Review of Maritime Transport, United Nations Publications, 2015, Ref: UNCTAD/RMT/2015 Retrieved from http://unctad.org/en/PublicationsLibrary/rmt2015_en.pdf

UNCTAD. (2017). *UNCTAD Review of maritime transport 2017*. United Nations Publications. Retrieved from http://unctad.org/en/PublicationsLibrary/rmt2017_en.pdf

UNCTAD. (2018). *Review of maritime transport 2018*. Retrieved from https://unctad.org/en/PublicationsLibrary/rmt2018_en.pdf

UNCTAD. (2018). *Review of maritime transport*. doi:10.18356/fd502c06-en

UNCTAD. (2018). *UNCTAD 50 years of review of maritime transport, 1968-2018: Reflecting on the past, exploring the future*. Retrieved from https://unctad.org/en/PublicationsLibrary/dtl2018d1_en.pdf

UNCTAD. (United Nations Conference on Trade and Development). Trade and development aspects of logistics services, Intergovernmental Meetings, Geneva, 7 July, 2006. Retrieved from http://www.unctad.org/en/docs/ c1ahm1d2_en.pdf

UNCTAD. Negotiations on transport and logistics services: Issues to consider, Issue Nr. SDTE/TLB/2005/3, Geneva, 2006. Retrieved from http://www.unctad.org/en/docs/ sdtetlb20053_en.pdf

Underwood, S. (2016). Blockchain beyond Bitcoin. *Communications of the ACM, 59*(11), 15-17. Retrieved from https://cacm.acm.org/magazines/2016/11/209132-blockchain-beyond-bitcoin/abstract Unıted Natıons Conference on Trade and Development (UNCTAD). (2018). *Digitalization and trade: A holistic policy approach is needed, Policy Brief*, April 2018, 64.

UNEP/GRID-Arendal. A history of waste management; UNEP/GRID-Arendal: Arendal, Norway. (2006). Available at http://maps.grida.no.go/graphic/a-history-of-waste-management

United Nations Commission on International Trade Law. (2013). Recognizing and preventing commercial fraud. Retrieved from http://www.uncitral.org/pdf/english/texts/fraud/Recognizing-and-preventing-commercial-fraud-e.pdf

United Nations. (2017). Factsheet: People and oceans. Retrieved from https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact-sheet-package.pdf

Ünver, M. (2016). Ülkelerin Denizyolu Taşımacılığı Bağlantılılık Düzeyinin Gelişmekte Olan Doğu Asya ve Pasifik Ekonomilerine Yapılan İhracata Etkisi. *Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *7*(15), 265–287.

Urošević, S., Pejčić, B., & Đorđević, D. (2012). Contemporary tendencies in waste management in Serbia. *Economics Management Information Technology*, *1*(3), 159–166.

USCG. (1990). *USCG chemical data guide book for bulk carriers*. New York: United States Coast Guard.

Usta, M. A., Akyazi, Ö., & Akpinar, A. S. (2011, June). Aircraft roll control system using LQR and fuzzy logic controller. In *Proceedings 2011 International Symposium on Innovations in Intelligent Systems and Applications* (pp. 223-227). IEEE. 10.1109/INISTA.2011.5946069

Utkulu, U., Aydemir, İ., & Özken, A. ve Yılmaz, M. (2009). Türkiye'de Dış Ticaret İşlemleri ve Uygulaması (2. baskı). Ankara, Turkey: Gazi Kitabevi.

Uzer, B. (2017). *Sanal Para Birimleri,* Central Bank of Turkey Republic General Directorate of Payment Systems, Thesis of Expertise.

UZUNOĞLU Sadi ve diğerleri, Dış Rekabet Baskısındaki Sektörlerde Maliyet Profili, İTO (İstanbul Ticaret Odası) Yayını, Yayın No: 2001-43.

Valle, C. A., Beasley, J. E., & Salles da Cunha, A. (2016). Modelling and solving the joint order batching and picker routing problem in inventories. In *International Symposium on Combinatorial Optimization* (Vol. 9849, pp. 81–97). Salerno, Italy: Springer International Publishing. 10.1007/978-3-319-45587-7_8

Vámos, T. (1992). Judea pearl: Probabilistic reasoning in intelligent systems. *Decision Support Systems*, *8*(1), 73–75. doi:10.1016/0167-9236(92)90038-Q

Vamråk, V., Bua, N. H., Hassani, V., & Auestad, Ø. F. (2016). Robust lateral control of a surface effect ship using H∞ mixed sensitivity synthesis. *IFAC-PapersOnLine*, *49*(23), 540–545. doi:10.1016/j.ifacol.2016.10.491

van Gils, T., Braekers, K., Ramaekers, K., Depaire, B., & Caris, A. (2016). Improving order picking efficiency by analyzing combinations of storage, batching, zoning, and routing policies. In *Proceedings 7th International Conference on Computational Logistics, ICCL 2016*. Hasselt University, Diepenbeek, Belgium: Springer Verlag. 10.1007/978-3-319-44896-1_28

van Gils, T., Ramaekers, K., Braekers, K., Depaire, B., & Caris, A. (2017). Increasing order picking efficiency by integrating storage, batching, zone picking, and routing policy decisions. *International Journal of Production Economics*, *197*(1), 243–261.

Vanem, E., Antão, P., Østvik, I., & Comas, F. (2008). Analysing the risk of LNG carrier operations. *Reliability Engineering & System Safety*, *93*(9), 1328–1344. doi:10.1016/j.ress.2007.07.007

Varbanova, A. (2017). Liner shipping networks and ports connectivity in the Black Sea region. *International Scientific Journal*. *Trans Motauto World*, *2*(5), 192–195.

Varyani, K. S., Gatiganti, R. M., & Gerigk, M. (2000). Motions and slamming impact on catamaran. *Ocean Engineering*, *27*(7), 729–747. doi:10.1016/S0029-8018(99)00011-6

Vasiliauskas, A. V., & Jakubauskas, G. (2007). Principle and benefits of third-party logistics approach when managing logistics supply chain. *Transport*, *22*(2), 68–72. doi:10.3846/16484142.2007.9638101

Vaughan, T. S., & Petersen, C. G. (1999). The effect of warehouse cross aisles on order picking efficiency. *International Journal of Production Research*, *37*(4), 881–897. doi:10.1080/002075499191580

Veldman, S., Garcia-Alonso, L., & Vallejo-Pinto, J. A. (2011). Determinants of container port choice in Spain. *Maritime Policy & Management*, *38*(5), 509–522. doi:10.1080/03088839.2011.597450

Veneti, A., Makrygiorgos, A., Konstantopoulos, C., Pantziou, G., & Vetsikas, I. A. (2017). Minimizing the fuel consumption and the risk in maritime transportation: A bi-objective weather routing approach. *Computers & Operations Research*, *88*, 220–236. doi:10.1016/j.cor.2017.07.010

Verghese, K., Horne, R., Fitzpatrick, L., & Jordan, R. (2006). *PIQET A packaging decision support tool*. Paper presented at the 5th Australian Conference on Life Cycle Assessment, November, Melbourne.

Verghese, K., & Lewis, H. (2007). Environmental innovation in industrial packaging: A supply chain approach. *International Journal of Production Research*, *45*(18–19), 4381–4401. doi:10.1080/00207540701450211

Verhoeven, F., Sinn, F., & Herden, T. T. (2018). Examples from Blockchain implementations in logistics and supply chain management: Exploring the mindful use of a new technology, MDPİ. *Logistics*, *2*(3), 1–19. doi:10.3390/logistics2030020

Vernengo, G., & Brizzolara, S. (2017). Numerical investigation on the hydrodynamic performance of fast SWATHs with optimum canted struts arrangements. *Applied Ocean Research*, *63*, 76–89. doi:10.1016/j.apor.2017.01.009

Vickerman, R. (2018). Can high-speed rail have a transformative effect on the economy? *Transport Policy*, *62*, 31–37. doi:10.1016/j.tranpol.2017.03.008

Vickery, S. K., Jayaramb, J., & Dröge, C. (2003). The effects of an integrative supply chain strategy on customer service and financial performance: An analysis of direct versus indirect relationships. *Journal of Operations Management*, *21*(5), 523–539. doi:10.1016/j.jom.2003.02.002

Vidulich, M. A. (2000). The relationship between mental workload and situation awareness. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *44*(21), 3-460-3–463. 10.1177/154193120004402122

Vina Del Mar MoU. (2017). *Annual report on Port State Control Latin American Agreement 2016*. Retrieved from http://www.equasis.org/Fichiers/Statistique/MOA/PSC Annual Reports Vina Del Mar MoU/PSC_ ANNUAL_REPORT_VDMOU_2016.pdf

Vitasek, K., & CSCMP. (2013). Supply chain management terms and glossary. Retrieved from https://cscmp.org/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx?hkey=60879588-f65f-4ab5-8c4b-6878815ef921

Vlachos, I. P. (2016). Reverse logistics capabilities and firm performance: The mediating role of business strategy. *International Journal of Logistics Research and Applications*, *19*(5), 424–442. doi:10.1080/13675567.2015.1115471

Vms. (2016, Jan. 23). Gas tanker operating manual. Retrieved from http://seaworm.narod.ru/2/v-gom.pdf

Voortman, C. (2004). *Global Logistics Management* (1st ed.). Lansdowne, South, Africa: Juta and Company Limited.

Vos, D., Overweel, L., Raateland, W., Vos, J., Bijman, M., Pigmans, M., & Erkin, Z. (2018). DEFenD: A secure and privacy-preserving decentralized system for freight declaration. arXiv preprint arXiv:1803.09257.

Wagner, S. M. (2008). Innovation management in the German transportation industry. *Journal of Business Logistics*, *29*(2), 215–231. doi:10.1002/j.2158-1592.2008.tb00093.x

Wallin, T. O., Mills, J. C. Jr, & Kidder, A. (1988). Transport barriers to the expansion of United States exports of bulk commodities: A ten-year perspective with focus on coal foreign summaries. *Transport Reviews*, *8*(4), 301–315. doi:10.1080/01441648808716695

Walmart. (2006). *Wal-mart unveils "packaging scorecard" to suppliers*. Retrieved from http://corporate.walmart.com/_news_/news-archive/2006/11/01/wal-mart-unveils-packaging-scorecard-to-suppliers

Wang, C., & Ahmed, P. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews*, *9*(1), 31–51. doi:10.1111/j.1468-2370.2007.00201.x

Wang, H., Liu, J., Liu, K., Zhang, J., & Wang, Z. (2018). Sensitivity analysis of traffic efficiency in restricted channel influenced by the variance of ship speed. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, *232*(2), 212–224. doi:10.1177/1475090217720549

Wang, J., & McOwan, S. (2000). Fast passenger ferries and their future. *Maritime Policy & Management*, *27*(3), 231–251. doi:10.1080/030888300411086

Wang, L., & Yang, Z. (2018). Bayesian network modelling and analysis of accident severity in waterborne transportation: A case study in China. *Reliability Engineering & System Safety*, *180*, 277–289. doi:10.1016/j.ress.2018.07.021

Wang, S., Su, Y., Zhang, X., & Yang, J. (2012). RANSE simulation of high-speed planning craft in regular waves. *Journal of Marine Science and Application*, *11*(4), 447–452. doi:10.100711804-012-1154-x

Wang, S., Wan, J., Zhang, D., Li, D., & Zhang, C. (2016). Towards smart factory for industry 4.0: A self-organized multi-agent system with big data-based feedback and coordination. *Computer Networks*, *101*, 158–168. doi:10.1016/j.comnet.2015.12.017

Wang, W., Peng, Y., Song, X., & Zhou, Y. (2015). Impact of navigational safety level on seaport fairway capacity. *Journal of Navigation*, *68*(06), 1120–1132. doi:10.1017/S0373463315000387

Wang, Y., & Cullinane, K. (2008). Measuring container port accessibility: An application of the principal eigenvector method (PEM). *Maritime Economics & Logistics*, *10*(1-2), 75–89. doi:10.1057/palgrave.mel.9100192

Wang, Y., & Cullinane, K. (2016). Determinants of port centrality in maritime container transportation. *Transportation Research Part E, Logistics and Transportation Review*, *95*, 326–340. doi:10.1016/j.tre.2016.04.002

Wartsilla. (2018, Oct. 13). Wartsilla dual fuelL engines to power four new LNG carriers. Retrieved from https://www.thefotosgratis.eu/w%C3%A4rtsil%C3%A4-dual-fuel-engines-to-power-four-new-lng-carriers.html

Wasesa, M., Stam, A., & van Heck, E. (2017). Investigating agent-based inter-organizational systems and business network performance: Lessons learned from the logistics sector. *Journal of Enterprise Information Management*, *30*(2), 226–243. doi:10.1108/JEIM-07-2015-0069

Waste, Z. (2019) *Zero waste management official.* Available at https://sifiratik.gov.tr

Waters, D. (2003). In D. Waters (Ed.), Logistics, an introduction to supply chain management (p. 23). New York: Palgrave Macmillan.

Waters, Donald, W. (2003). Logistics, an introduction to supply chain management (D. Waters, Ed.). Palgrave Macmillan, New York.

Waters, D. (2007). Global logistics: new direction. In *Supply chain management* (5th ed., p. 18). London, UK: Kogan Page Publishers.

Watkins, K. E. (2018). Using value sensitive design to understand transportation choices and envision a future transportation system. *Ethics and Information Technology*. doi:10.100710676-018-9478-0

Webb, M. (2006). Supply chain and logistics the key to economic growth, Engineering News, February 2006, Volume 26, No.3. Retrieved from http://www.engineeringnews.co.za/article/supply-chain-and-logistics-the-key-to-economic-growth-2006-02-03

Weeks, K., Gao, H. M., Alidaeec, B., & Rana, D. S. (2010). An empirical study of impacts of production mix, product route efficiencies on operations performance and profitability: A reverse logistics approach. *International Journal of Production Research*, *48*(4), 1087–1104. doi:10.1080/00207540802566428

Weernink, M., Engh, W., Francisconi, M., & Thorborg, F. (2017). The blockchain potential for port logistics. Retrieved from http://smart-port.nl/wp-content/uploads/2017 /06/Bijlage-6_White-Paper-Blockchain.pdf

Wei, C., Li, Y., Yu, S., & Yi, H. (2016). Experimental study on the high speed mono-wave-piercing boat. *Journal of Shanghai Jiaotong University (Science)*, *21*(5), 524–529. doi:10.100712204-016-1758-4

Weick, K. E. (1982). Management of organizational change among loosely coupled elements. In P. S. Goodman (Ed.), *Change in organizations* (pp. 375–408). San Francisco, CA: Jossey-Bass.

Weizenbaum, J. (1966). ELIZA---a computer program for the study of natural language communication between man and machine. *Communications of the ACM*, *9*(1), 36–45. doi:10.1145/365153.365168

Wen, J., He, L., & Zhu, F. (2018). Swarm robotics control and communications: Imminent challenges for next generation smart logistics. *IEEE Communications Magazine*, *56*(7), 102–107. doi:10.1109/MCOM.2018.1700544

Wenjuan, Z. (2002). Different Scenarios for Boras as a Regional Logistics Center, Göteborg University School of Economics and Commercial Law, Master Thesis N: 2002.36, ISSN 1403-851X, Goteborg. Retrieved from http://gupea.ub.gu.se/bitstream/ 2077/2364/1/gbs_thesis_2002_36.pdf

Wen, L., & Huang, L. (2019). Analysis of influencing factors of Chinese provincial carbon emissions based on projection pursuit model and Markov transfer matrix. *International Journal of Climate Change Strategies and Management*, *11*(3), 406–423. doi:10.1108/IJCCSM-05-2017-0116

Wen, M., Pacino, D., Kontovas, C. A., & Psaraftis, H. N. (2017). A multiple ship routing and speed optimization problem under time, cost and environmental objectives. *Transportation Research Part D, Transport and Environment*, *52*, 303–321. doi:10.1016/j.trd.2017.03.009

Wen, Y.-H. (2012). Impact of collaborative transport management on logistics capability and competitive advantage for the carrier. *Transportation Journal*, *51*(4), 452–473. doi:10.5325/transportationj.51.4.0452

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171–180. doi:10.1002mj.4250050207

Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*, *69*(6), 709–748. doi:10.1111/j.1468-0084.2007.00477.x

Whittington, H. W., & Bellhouse, G. M. (2000). Coal-fired generation in a privatized electricity supply industry. *International Journal of Electrical Power & Energy Systems*, *22*(3), 205–212. doi:10.1016/S0142-0615(99)00047-2

Whyatt, J. D., & Metcafle, S. E. (2004). Optimising the environmental benefits of emission reductions from UK coal- and oil-fired power stations: A critical loads approach. *Environmental Science & Policy*, *7*(6), 451–463. doi:10.1016/j.envsci.2004.08.001

Wiersum, K. F. (1995). 200 years of sustainability in forestry: Lessons from history. *Environmental Management*, *19*(3), 321–329. doi:10.1007/BF02471975

Wilding, R., & Juriado, R. (2004). Customer perceptions on logistics outsourcing in the European consumer goods industry. *International Journal of Physical Distribution & Logistics Management*, *34*(8), 628–644. doi:10.1108/09600030410557767

Wilmsmeier, G., & Hoffmann, J. (2008). Liner shipping connectivity and port infrastructure as determinants of freight rates in the Caribbean. *Maritime Economics & Logistics*, *10*(1-2), 130–151. doi:10.1057/palgrave.mel.9100195

Wilmsmeier, G., Hoffmann, J., & Sanchez, R. J. (2006). The impact of port characteristics on international maritime transport costs. *Port Economics Research in Transportation Economics*, *16*, 117–140. doi:10.1016/S0739-8859(06)16006-0

Wilmsmeier, G., & Monios, J. (2016). Container ports in Latin America - challenges in a changing global economy. In P. T.-W. Lee, & K. Cullinane (Eds.), *Dynamic shipping and port development in the globalized economy* (pp. 11–52). Basingstoke, UK: Palgrave Macmillan.

Windt, K., Böse, F., & Philipp, T. (2008). Autonomy in production logistics: Identification, characterisation and application. *Robotics and Computer-integrated Manufacturing*, *24*(4), 572–578. doi:10.1016/j.rcim.2007.07.008

Winkelhaus, S., & Grosse, E. H. (2019). Logistics 4.0: A systematic review towards a new logistics system. *International Journal of Production Research*, 1–26. doi:10.1080/00207543.2019.1612964

Winograd, T. (1980). What does it mean to understand language? *Cognitive Science*, *4*(3), 209–241. doi:10.120715516709cog0403_1

Winter, S. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, *24*(10), 991–995. doi:10.1002mj.318

Wisner, J. D., Tan, K., & Leong, G. K. (2012). *Principles of supply chain management*. USA: South-Western.

Witolla, T., Sames, P., & Greig, A. (2016). Vessels for the future. *Transportation Research Procedia*, *14*, 1641–1648. doi:10.1016/j.trpro.2016.05.129

Woodland, N. J., & Bernard, S. (1952). *U.S. Patent No. 2,612,994*. Washington, DC: U.S. Patent and Trademark Office.

Woolcott, T. W. (1987). *LPG tanker practice*. Glasgow, UK: Nautical Publishers.

Wooldridge, J. M. (2002). *Econometric analysis of cross section and panel data*. The MIT press.

World Bank News. (2018). *Strong trade growth in 2018 rests on policy choices.* Retrieved from https://www.wto.org/english/news_e/pres18_e/pr820_e.htm

WORLD BANK. (2010). *Doing business report 2011*. Washington: World Bank Press.

World Bank. (2018). *Connecting to compete 2018: Logistics performance index (LPI).* Retrieved from https://lpi.worldbank.org/

World Bank. (2019). Air transport, passengers carried. Retrieved from https://data.worldbank.org/indicator/IS.AIR.PSGR

World Bank. (2019). CO2 emissions (Metric tons per capita). Retrieved from https://data.worldbank.org/indicator/en.atm.co2e.pc

World Bank. (2019). Energy use (kg of oil equivalent per capita). Retrieved from https://data.worldbank.org/indicator/EG.USE.PCAP.KG.OE

World Bank. (2019). GDP (Current US$). Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

World Commission on Environment and Development-WCED. (1987). *Our common future*. New York, NY: Oxford University Press.

World Economic Forum. (2015). Beyond supply chains: empowering responsible value chains. Cologny/Genève: World Economic Forum.

World Economic Forum. (2016). The new plastics economy: Rethinking the future of plastics. Cologny/Genève: World Economic Forum.

World Shipping Council - Partners in Trade. (n.d.). Retrieved from http://www.worldshipping.org/about-the-industry/how-liner-shipping-works

World Trade Organization – WTO a. (2018). *Annual report 2018.* Retrieved from https://www.wto.org/english/res_e/publications_e/anrep18_e.htm

World Trade Organization – WTO b. (2018). *Strong trade growth in 2018 rests on policy choices.* Retrieved from https://www.wto.org/english/news_e/pres18_e/pr820_e.htm

World Trade Organization (WTO). World Trade Report 2018. (2018). *The future of world trade: How digital technologies are transforming global commerce,* World Trade Organization. Retrieved from https://www.wto.org/english/res_e/publications_e/world_trade_report18_e_under_embargo.pdf

WORLDBANK. (1999). *Entering the 21st century: World Development Report 1999/2000*. New York: Oxford University Press.

Worldbank. (2019a). Databank. Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

Worldbank. (2019b). Databank. Retrieved from https://data.worldbank.org/topic/trade

Wu, S. J., Melnyk, S. A., & Flynn, B. B. (2010). Operational capabilities: The secret ingredient. *Decision Sciences*, *41*(4), 721–754. doi:10.1111/j.1540-5915.2010.00294.x

Xiao, Y., Wei, Z., & Wang, Z. (2008). A limited-memory BFGS-type method for large-scale unconstrained optimization. *Computers & Mathematics with Applications (Oxford, England)*, *56*(4), 1001–1009. doi:10.1016/j.camwa.2008.01.028

Xue, C. (2013). Service capability evaluation of third party logistics enterprise in a cluster environment. *Journal of Applied Sciences (Faisalabad)*, 2625–2631.

Xue, Y., Clelland, D., Lee, B. S., & Han, D. (2011). Automatic simulation of ship navigation. *Ocean Engineering*, *38*(17–18), 2290–2305. doi:10.1016/j.oceaneng.2011.10.011

Xu, G. D., & Meng, Q. (2016). Waves induced by a two-dimensional foil advancing in shallow water. *Engineering Analysis with Boundary Elements*, *64*, 150–157. doi:10.1016/j.enganabound.2015.12.005

Xu, L., Chen, L., Gao, Z., Chang, Y., Iakovou, E., & Shi, W. (2018). Binding the physical and cyber worlds: A blockchain approach for cargo supply chain security enhancement. In *Proceedings 2018 IEEE International Symposium on Technologies for Homeland Security, HST 2018*, 1–5. 10.1109/THS.2018.8574184

Xu, X., & Gursoy, D. (2015). Influence of sustainable hospitality supply chain management on customers' attitudes and behaviors. *International Journal of Hospitality Management*, *49*, 105–116. doi:10.1016/j.ijhm.2015.06.003

Yalçın, Ö., Topcu, N., Arar, Ö. F., Akpınar, S., & Gürbüz, A. (2014, April). Akay02 driverless vehicle architecture for campus environment. In *Proceedings 2014 22nd signal processing and communications applications conference (SIU)* (pp. 2257-2260). IEEE. 10.1109/SIU.2014.6830715

Yang, C. C. (2012). Assessing the moderating effect of innovation capability on the relationship between logistics service capability and firm performance for Ocean freight forwarders. *International Journal of Logistics Research and Applications*, *15*(1), 53–69. doi:10.1080/13675567.2012.669469

Yang, C. C., Marlow, P. B., & Lu, C. S. (2009). Assessing resources, logistics service capabilities, innovation capabilities and the performance of container shipping services in Taiwan. *International Journal of Production Economics*, *122*(1), 4–20. doi:10.1016/j.ijpe.2009.03.016

Yang, Y.-C., & Chen, S.-L. (2016). Determinants of global logistics hub ports: Comparison of the port development policies of Taiwan, Korea, and Japan. *Transport Policy*, *45*, 179–189. doi:10.1016/j.tranpol.2015.10.005

Yang, Z., Bonsall, S., & Wang, J. (2009). Use of hybrid multiple uncertain attribute decision making techniques in safety management. *Expert Systems with Applications: An International Journal*, *36*(2), 1569–1586. doi:10.1016/j.eswa.2007.11.054

Yanjuan, C., & Minghua, D. (2006). Research on the development and strategy of the international logistics of China, International Conference on Management Science and Engineering, 6-7 October 2006, pp. 1084-1088. Retrieved from http://www.seiofbluemountain.com/upload/product/201001/12640404311mlqdr2m.pdf

Yanuar, G., Gunawan, Muhyi, A., & Jamaluddin, A. (2016). Ship resistance of quadramaran with various hull position configurations. *Journal of Marine Science and Application*, *15*(1), 28–32. doi:10.100711804-016-1340-3

Yanuar, W., Waskito, K. T., Pratama, S. Y., Candra, B. D., & Rahmat, B. A. (2018). Comparison of microbubble and air layer injection with porous media for drag reduction on a self-propelled barge ship model. *Journal of Marine Science and Application*, *17*(2), 165–172. doi:10.100711804-018-0028-2

Yapay Zeka. (2012). Retrieved from http://www.turkcebilgi.com/yapay_zeka

Yatsyshina, P. (2016). Factors of distribution network design: Evidence from Russian market. (Master's Thesis), St. Petersburg University, Graduate School of Management.

Yenal, S. (2011). *Dünyada ve Türkiye'de Uluslararası Deniz Yolu Taşımacılığının Gelişiminin Değerlendirilmesi.* Retrieved from http://www.tmo.gov.tr/upload/document/tmodanhaberler/denizyolu.pdf

Yeo, G. T., Thai, V. V., & Roh, S. Y. (2015). An analysis of port service quality and customer satisfaction: The case of Korean container ports. *The Asian Journal of Shipping and Logistics*, *31*(4), 437–447. doi:10.1016/j.ajsl.2016.01.002

Yeo, G.-T., Ng, A. K. Y., Lee, P. T.-W., & Yang, Z. (2013). Modelling port choice in an uncertain environment. *Maritime Policy & Management*, *41*(3), 251–267. doi:10.1080/03088839.2013.839515

Yigit, K., & Acarkan, B. (2018). A new electrical energy management approach for ships using mixed energy sources to ensure sustainable port cities. *Sustainable Cities and Society*, *40*, 126–135. doi:10.1016/j.scs.2018.04.004

Yılmaz, F., & Ece, N. J. (2017). Analysis of the relationship between variables related to Paris Mou - PSC inspections and the results of inspection applied to Turkish flagged ships. *Journal of ETA Maritime Science*, *5*(2), 172–185. doi:10.5505/jems.2017.20592

Yin, Z., & Zhang, J. (2013). Identifying changes in human operator mental workload by locally linear embedding and support vector clustering approaches. *IFAC Proceedings Volumes, 46*(13), 353–358. doi:10.3182/20130708-3-CN-2036.00011

Yöntem ve Türk Telekominikasyon. (2019). *Zero waste project*. Retrieved from http://ww.yöntemizlik.com.

Yoo, B., & Donthu, N. (2001). Developing and validating a multidimensional consumer-based brand equity scale. *Journal of Business Research*, *52*(1), 1–14. doi:10.1016/S0148-2963(99)00098-3

Yoo, B., Donthu, N., & Lee, S. (2000). An examination of selected marketing mix elements and brand equity. *Journal of the Academy of Marketing Science*, *28*(2), 195–211. doi:10.1177/0092070300282002

Yoon, H. K., Nguyen, V. M., & Nguyen, T. T. (2018). Development of solution for safe ship considering seakeeping PERformance. *TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 12*(3), 517–525. doi:10.12716/1001.12.03.10

Yousefi, R., Shafaghat, R., & Shakeri, M. (2013). Hydrodynamic analysis techniques for high-speed planing hulls. *Applied Ocean Research*, *42*, 105–113. doi:10.1016/j.apor.2013.05.004

Yuan, Y., & Wang, F. Y. (2016, November). Towards blockchain-based intelligent transportation systems. In *Proceedings 2016 IEEE 19th International Conference on Intelligent Transportation Systems (ITSC),* (pp. 2663-2668). IEEE. 10.1109/ITSC.2016.7795984

Yu, C. J., Wu, L., Chiao, Y., & Tai, H. (2005). Perceived quality, customer satisfaction, and customer loyalty: The case of Lexus in Taiwan. *Total Quality Management & Business Excellence*, *16*(6), 707–719. doi:10.1080/14783360500077393

Yuen, C.-L., Zhang, A., & Cheung, W. (2012). Port competitiveness from the users' perspective: An analysis of major container ports in China and its neighbouring countries. *Research in Transportation Economics*, *35*(1), 34–40. doi:10.1016/j.retrec.2011.11.005

Yüksel, A. E. B. (2015). Lookıng at electronic money, virtual money, Bitcoin and Linden dollars from a legal perspective, *İstanbul Law Review C. LXXIII*, 2, 173-220.

Yun, L., & Bliault, A. (2012). *High performance marine vessels*. Boston, MA: Springer US; doi:10.1007/978-1-4614-0869-7

Yurtay, Y., Yurtay, N., Akçetin, E., & Kılıç, A. (n.d.). Freight optimization in container loading: Case study. *Yönetim ve Ekonomi Araştırmaları Dergisi, 12*(23), 228-247.

Zaghi, S., Dubbioso, G., Broglia, R., & Muscari, R. (2016). Hydrodynamic characterization of USV vessels with innovative SWATH configuration for coastal monitoring and low environmental impact. *Transportation Research Procedia*, *14*, 1562–1570. doi:10.1016/j.trpro.2016.05.121

Zahra, S., Sapienza, H., & Davidsson, P. (2006). Entrepreneurship and dynamic capabilities: A review, model and research agenda. *Journal of Management Studies*, *43*(4), 917–955. doi:10.1111/j.1467-6486.2006.00616.x

Zaman, A. U., & Lehmann, S. (2011). Urban growth and waste management optimization towards 'zero waste city'. *City, Culture, and Society*, *2*(4), 177–187. doi:10.1016/j.ccs.2011.11.007ACBE. (1998) *Eighth progress report to and response from the deputy prime minister and the secretary of state for trade and ındustry, Advisory Committee for Business and the Environment,* HMSO, London. Retrieved from https://webarchive.nationalarchives.gov.uk/20031221205354/http://www.defra.gov.uk/environment/acbe/

Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of Marketing*, *60*(2), 31–46. doi:10.2307/1251929

Zeynel, D. (2002). *Mikro Ekonomi, 14.b*. Bursa, Turkey: Ekin Kitabevi.

Zhang, A., & Lam, J. S. L. (2014). Impacts of schedule reliability and sailing frequency on the liner shipping and port industry: A study of Daily Maersk. *Transportation Journal*, *53*(2), 235–253. doi:10.5325/transportationj.53.2.0235

Zhang, G., Thai, V. V., Yuen, K. F., Loh, H. S., & Zhou, Q. (2018). Addressing the epistemic uncertainty in maritime accidents modelling using Bayesian network with interval probabilities. *Safety Science*, *102*, 211–225. doi:10.1016/j.ssci.2017.10.016

Zhang, J., Wang, X., Chan, F. T. S., & Ruan, J. (2017). On-line order batching and sequencing problem with multiple pickers: A hybrid rule-based algorithm. *Applied Mathematical Modelling*, *45*(1), 271–284. doi:10.1016/j.apm.2016.12.012

Zhang, R., & Furusho, M. (2016). Constructing a decision-support system for safe ship-navigation using a Bayesian network. In V. G. Duffy (Ed.), Vol. 10917, pp. 616–628. Cham, Switzerland: Springer International; doi:10.1007/978-3-319-40247-5_62

Zhang, S., Villavicencio, R., Zhu, L., & Pedersen, P. T. (2017). Impact mechanics of ship collisions and validations with experimental results. *Marine Structures*, *52*, 69–81. doi:10.1016/j.marstruc.2016.12.003

Zhang, Y., Guo, Z., Lv, J., & Liu, Y. (2018). A framework for smart production-logistics systems based on CPS and industrial IoT. *IEEE Transactions on Industrial Informatics*, *14*(9), 4019–4032. doi:10.1109/TII.2018.2845683

Zhao, G. Z., Wang, F., & Zhang, Z. Y. (2008). The Complexity of Coal Logistics Network Analysis and Optimization Method Research. *Techniques and Approaches*, *27*, 117–119.

Zhao, M., Dröge, C., & Stank, T. (2001). The effects of logistics capabilities on firm performance: Customer-focused versus information-focused capabilities. *Journal of Business Logistics*, *22*(2), 91–107. doi:10.1002/j.2158-1592.2001.tb00005.x

Zhao, S., Shi, X., Shi, Y., & Bian, X. (2003). Simulation study of plane motion of air cushion vehicle. *Journal of Marine Science and Application*, *2*(2), 67–71. doi:10.1007/BF02918666

Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2017). An overview of blockchain technology: Architecture, consensus, and future trends. *Proceedings - 2017 IEEE 6th International Congress on Big Data, BigData Congress 2017*, 557–564. doi:10.1109/BigDataCongress.2017.85

Zheng, Y., Talley, W. K., Jin, D., & Ng, M. (2016). Crew injuries in container vessel accidents. *Maritime Policy & Management*, *43*(5), 541–551. doi:10.1080/03088839.2016.1150610

Zhou, J., Tang, W., & Zhang, S. (2009). Sea keeping analysis of air cushion vehicle with different wave angles under the operation resistance. *Journal of Shanghai Jiaotong University (Science)*, *14*(4), 471–475. doi:10.100712204-009-0471-y

Zhu, Q. H., Geng, Y., & Lai, K. H. (2010). Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications. *Journal of Environmental Management*, *91*(6), 1324–1331. doi:10.1016/j.jenvman.2010.02.013 PMID:20223586

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, *13*(3), 339–351. doi:10.1287/orsc.13.3.339.2780

Zong, Z., Sun, Y., & Jiang, Y. (2018). Experimental study of controlled T-foil for vertical acceleration reduction of a trimaran. *Journal of Marine Science and Technology*. doi:10.100700773-018-0576-9

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