Handbook of Research on

Recent Perspectives on Management, International Trade, and Logistics

Güner Koç Aytekin and Çağlar Doğru

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Handbook of Research on Recent Perspectives on Management, International Trade, and Logistics

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

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Mexico, like other countries, invested in measures to attract foreign direct investment to their territories. It therefore signed USCM in 1994, a treaty that imposed Mexico as the largest direct exporter of the United States, a country that is likely to leave the treaty by renegotiating TMEC (USMC). Therefore, this research is carried out to determine the advantages and disadvantages of renegotiation based on Sinaloa's agricultural exports, with the question of whether it would negatively impact the USMC renegotiation of Sinaloa's agricultural exports, with the hypothesis that renegotiation of USMC has a negative effect on Sinaloa agricultural exports. The purpose of this chapter will be with results in favor of the hypothesis employed.

This chapter is an action research done for one of the largest eCommerce logistics organization (having presence in India) to design a working mathematical model which rates the field operations staff all around the country based on the dynamic targets depending upon different parameters, and then finally ranks the field executives relatively across the country. To ensure that the rating of the field executives is a fair and transparent process and discounts the influence of the nature of shipments provided to them problem, the authors worked with one of the largest global eCommerce delivery firms to design a rating system of the field supervisors using R.

In this chapter, a multi-disciplinary approach for creating sustainable competitive advantage is examined. This is the integration of human resources management and supply chain management. The primary aim is to come up with a solution to the research question of 'how do organizations create sustainable competitive advantage by integrating human resources and supply chain management?' In order to put forth the solutions, the resource-based approach is employed. A detailed literature review is given on the integration of two business functions to create sustainable competitive advantage. This chapter contributes to the literature, first by laying out the importance of resource-based view in both human resources and supply chain management, second by examining how do these two functions unite in order to obtain sustainable competitive advantage, and lastly, by enriching the limited number of studies so far on the integration of human resources and supply chain management with the help of a literature review.

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The majority of the nations around the world have become melting pots of civilization, leading to an increasing interconnectedness of the global food system. However, with the long-winded food supply chains there exists information asymmetry between the consumers and the food they consume, making them more vulnerable to the outbreaks of diseases caused by tainted food. As an assurance that food is acceptable for human and animal consumption, food safety averts any exposure to food frauds and foodborne illness outbreaks therefrom. For this reason, the law endows the food regulators and the food business operators (FBOs) with the "trace, alert, and recall" tools at all levels of a food supply chain to regulate the safety of both the domestic as well as the imported articles of food. As a risk assessment and management tool, traceability furthers the mandate of law enforcement in facilitating and targeting the recall or removal/withdrawal of articles of foods.

The purpose of this study is to evaluate the risks encountered in the international trade process. E7 economies are included in the study. For this purpose, six criteria that should be taken into consideration are determined by considering similar studies in the literature. In the analysis process of the study, AHP method is used to identify which type of risk encountered in the international trade process is more important. In this process, opinions are received from three different experts on the subject. It is concluded that the exchange rate risk is the most important in this process. In addition to this situation, political risk and payment risk are other important factors for this situation. On the other side, it is also determined that documentary risk and carriage risk have lower role in comparison with others. Accordingly, it is essential for companies to take the necessary measures. In this context, it is possible to decrease the exchange rate volatility by using financial derivative products.

The purpose of this study is to determine the main causes behind companies causing carbon emissions. In this way, the main reasons for companies to make carbon emissions have been explored. For this purpose, six different variables that are thought to be effective on this issue were determined. After that, an examination was made with fuzzy DEMATEL method in order to determine which of these factors are more important. The findings indicate that legal deficiency is the main reason for companies to cause carbon emissions. In this situation, it is a must to take necessary measures for the solution of this problem. In order for overcome legal deficiency problem, it is understood that the legal infrastructure

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should be adapted to this process. In order to increase the international trade volume, it is necessary to impose penal sanctions on companies and to regularly inspect these companies. In addition to these, incentives can be given to companies that are in competitive sectors and to create an awareness on this subject, governments can facilitate training programs.

In today's business world, having talented, educated, and qualified employees who can use technological developments has become an important advantage. Maintaining this superiority can be done with employees who are technically business-oriented. Economic uncertainty in the global markets enables countries to attach importance to vocational education, which will make their youth a part of the current economic process. The aim of this study is to reveal the necessity of vocational education in vocational high schools and vocational schools of higher education in our country to sustainably meet the global workforce needs of supply chain management. In this context, South Korea has been selected on global scale, which is thought to play an important role in the vocational education policies implemented in her development, and the general and vocational education system examined has been compared with the situation in Turkey.

Supply chain management is going on changing and developing in line with the needs of the growing global supply chain. Performance of supply chain, considered as a whole so that businesses can accommodate these evolvements and change, needs to be improved in the long run. Actually, businesses work with suppliers complying with their policies from past to present. However, other dimensions of sustainability should be considered, as well as economic criteria when selecting suppliers. With the right supplier selection made in this respect, by contributing to the efficient functioning of the supply chain, it will increase customer satisfaction, and therefore, the enterprises will reach the goals they set. The solution of the multi-objective sustainable supplier selection problem has been realized by using the "satisfied optimal supplier design" algorithm, also called fuzzy goal programming, with de novo-based interval type-2 proposed in this study.

Supply chain management is the managing of all processes of goods, services, and information from suppliers to customers. Transportation network design is an important part of effective supply chain management. This chapter presents the two-stage fixed-charge transportation problem in a supply chain to minimize the total cost containing the opening cost of distribution centers, transportation cost from manufacture

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to distribution centers and from distribution centers to customers, and fixed cost for transportation from distribution centers to customers. There are the capacity constraints on distribution centers in order to consider real life situations in this chapter. A constructive based algorithm and a population-based algorithm are proposed to solve this complex optimization problem. Taguchi experimental design is applied for determining the best combinations of parameters. The experimental studies are conducted to compare the performance of the proposed algorithms according to solution quality.

Considering the globalization and the global economy, companies need to make strategic decisions in the furniture sector, as in many other sectors. In today's competitive conditions, supply chain management plays a major role in the success of firms and ensuring their sustainability in the sector. Therefore, companies need to work with suitable suppliers to be successful in supply chain management. There are many different methods used in the literature for evaluating suppliers. Fuzzy analytic hierarchy process (FAHP) method, which is one of the multi-criteria decision-making (MCDM) methods, is widely used in supplier selection problems. This study aimed to determine the best suppliers of a furniture production company in Turkey using the FAHP. In the study, four suppliers of the company were evaluated according to price, quality, delivery, innovativeness, and reliability criteria. As a result of the application, the ranking of the suppliers was made, and the best supplier selected.

Supply chain management (SCM) systems provide the ability of information sharing and interpretation of contextual information to businesses and help their day-to-day operations. This chapter presents an introduction to radio frequency identification (RFID) technology and its applications in SCM. The chapter also describes the technical basics of RFID systems and examines several industry-specific applications of this technology to SCM to provide crucial implementation reviews. Next, the chapter emphasizes many inherent vulnerabilities of this pervasive computing technology in the context of security and privacy. This chapter presents a classification mechanism for risks that RFID networks come across by describing a categorization of RFID attacks, describing their main characteristics, and discussing possible countermeasures. The chapter aims to classify the existing weakness of RFID communication so that an appropriate understanding of RFID attacks can be realised, and subsequently, more effective procedures can be deployed to combat these attacks.

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Studies show that there are differences among generations in terms of characteristics and work attitudes and values, and these differences in their work values and attitudes as well as their characteristics affect their leadership styles at the workplaces. However, little research has been produced from the perspective of leaders. This research's purpose of the project is to set forth whether the leaders in different generations are adapting different leadership styles according to the generations or not in order to be successful during their leadership. The study was conducted in automotive industry in Turkey. Two mixed focus group discussions were conducted with leaders representing each generational cohort groups. The study's results support that there are more differences than the similarities among the generations, which is in compliance with many studies conducted by the researchers. Also, the leaders tend to adapt different leadership styles according to the generations of their subordinates.

The selection of supplier is a crucial process. The main objective of supplier selection problem is to determine the most suitable suppliers with respect to the company's goals. The selection of supplier is, therefore, an important process for the firm to obtain goals of business. MCDM methods are useful to address this problem as supplier selection problem contains many criteria. An integrated MCDM model comprising BWM and fuzzy CODAS is proposed to address a supplier selection problem for a Turkish furniture workshop in this study. This study aims to fill the research gap in the literature. This research gap is that the number of studies using the BWM and CODAS method together is limited.

In today's conditions, where information plays a leading role in all administrative and operational processes of the business, it is very important to collect, store, and present information to the user for the effectiveness and efficiency of all business processes. One of the tools that is important in information management and frequently preferred by businesses is the enterprise resource planning (ERP) system. This study aimed to identify the problems faced by enterprises and the root causes underlying these problems in the ERP system transition process. The problems experienced in system transition were identified by taking part in the system installation process of a medium-sized enterprise that decided to implement an ERP system, for 18 months. As a result of the study, it was determined that the enterprise had problems mostly in the design and data transfer stages of the system. The main causes of these problems were determined as the difficulties encountered in restructuring the business processes and the resistance of the employees to change.

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Foreword

The Coronavirus outbreak, which began in Wuhan, China in December of 2019, spread around the world rapidly. On March 11, 2020, the World Health Organization declared the outbreak a pandemic and three days later revealed Europe had become the new epicenter. As the virus, officially named Covid-19, spread around the world, the rapid increase in deaths forced countries to take serious measures. With industrialized countries closing their borders, stopping the production of workplaces, and quarantining workers in their homes, the pandemic, a global health problem, became a global economic problem.

Starting from April 2020, production and international trade decreased rapidly in many countries, especially China, the USA, Japan and the industrialized countries of Europe. The world began to experience a global economic recession. The world's supply chain was negatively affected by these developments. In essence, the world supply chain became disrupted and its sustainability called into question.

The pandemic caused the realization of how weak and inadequate the sustainability of the economic organization, production and supply chains that dominate the world are actually. As a result, a search was launched in academic circles and country administrations for a global economic organization and supply chain that is much more effective and resilient to adverse developments.

The book in your hand was prepared for publication at a time when a more effective and sustainable global economic structure and supply chain is being sought. The articles in this book were written by competent academics on many important topics such as entrepreneurship, manufacturing, International Trade and supply chains. Many new approaches and inventions in production, international trade, and supply chains in line with the Industry 4 were examined and suggestions were made. Hence it is a publication that could explain and respond to many problems arising in the global economy and supply chain due to the pandemic. It has qualified as a valuable resource book for researchers who are doing or will do research on the subject.

I congratulate the editors Güner Koç Aytekin and Çağlar Doğru, who prepared this book for publication in such a timely manner, and all the authors who contributed to the parts of the book with their work.

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Preface

In this globalization era, entrepreneurship and its implications on international trade and supply chain management is getting more and more critical. In today's change-oriented and complex business environment, both entrepreneurs and managers have to keep up with the latest developments around them. With the help of globalization, today it is getting more and more attractive for entrepreneurs to generate innovative ideas in order to run business both national and international, even global.

Competitive advantages and the key for sustainable growth for globally founded institutions lie behind effective supply chain management originating from a single idea about establishing a company to the end of reaching consumers process. Throughout this reference book; effective management of the supply chain, including especially the latest trends as, supply chain modeling, e-business solutions, digitalizing the supply chain process, logistics management, international trade applications and management issues are put forth. Moreover there exist the latest data based on research on the issues of management, international trade, supply chain management, supplier evaluation techniques, contemporary management techniques, and international trade in this book.

On the basis of technological advances during the industrial revolution, management concept revolved into the meaning of using members of the organization for achieving organizational goals, understood as 'business management' today. Business management concept has revolved as a separate discipline during and after the industrial revolution. In connection with this development, this discipline has combined so many different theories from different disciplines and approaches from different researchers and applications from different managers and other professionals.

This amazing development of management has reached at its peak in todays' global business environment. Todays' dynamic, chaotic and complex environment makes it a must for managers to adapt contemporary approaches for maximizing both individual and organizational effectiveness. Different contemporary management techniques, approaches and implications have been taken part in todays unstable, dynamic and knowledge intensive environment.

Nowadays, with the help of technological advances in communication, computer programming and software, transportation and other engineering solutions, new management techniques, new organizational structures and contemporary leadership styles have been necessary to survive in such a dynamic and complex environment. Among these are, some theories have emerged for organizations to adapt to their environments. These are mainly classified as, contingency approach, organizational configuration, resource dependence theory, organizational strategy approach, information processing approach, agency theory, transaction cost theory, institutionalization theory and population ecology. Other contemporary concepts and implications are, total quality management, core competence, outsourcing, within the restructuring of organizations; network organizations, cluster organizations, reengineering business pro-

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cesses, and beyond these, empowering employees, downsizing and delayering applications and learning organizations gain importance.

The main objective of this reference book is to provide theoretical infrastructure and furthermore to share the latest empirical research findings within management, logistics and supply chain management. A tremendous contribution is intended to be made to the contemporary research on international trade by collecting the most up to date research findings and combining these with the theoretical framework. The most popular contemporary topics in, international trade, and global supply chain management fields provide valuable insight for understanding today's business organizations operating in a global, dynamic and complex environment. Each separate chapters of the book handle an up-to-date topic on the basis of technological advances.

In this context;

Chapter 1 contributes to the literature by providing a study on service design and enterprise risk management for knowledge-based services. In this chapter a practical approach for auditors and consultants is also presented.

Chapter 2 analyzes freight village as dry port. In this chapter an ongoing Italian case is examined. Chapter 3 clinches renegotiation of TMEC on the agricultural exports of Sinaloa. Chapter 4 investigates the design and deployment of dynamic performance targets for the lastmile field executives in e-Commerce logistics industry.

Chapter 5 integrates the two vital business functions which are human resources management and supply chain management. This is achieved by providing an understanding of sustainable competitive advantage on the basis of resource-based view.

Chapter 6 sets forth the regulation of agri-food safety by regulations and utilization of traceability and recalls in India and United States of America. Chapter 7 presents a comprehensive evaluation of significant risks in international trade of E7 Economies using the AHP Method.

Chapter 8 contributes to literature by presenting the negative role of environmental pollution on international trade. In this chapter there are strategy recommendations for solving that problem.

Chapter 9 provides an examination of vocational schools as sustainable human resources in supply chain management. In this chapter, the cases of Turkey and South Korea are discussed.

Chapter 10 analyzes fuzzy goal programming with interval type-2 for solving multi-objective sustainable supplier selection problems. Chapter 11 exhibits managing transportation in supply chain and presents metaheuristics for solving a capacitated fixed-charge transportation problem.

Chapter 12 manifests the selection of the best supplier in furniture industry by using fuzzy analytic hierarchy process. Chapter 13 reviews the applications of radio frequency identification technology and security issues in supply chain management.

Chapter 14 aims to determine the critical factors for effective backhauling in distribution channels of British supermarkets. Chapter 15 reviews the impact of strategic orientation and reverse logistics capabilities on organizational performance.

Chapter 16 investigates the innovation performance with AHP and TOPSIS integrated approach. In this chapter also an application in hazelnut sector is conducted. Chapter 17 sets forth the differences in leadership styles among generations.

Chapter 18 puts forward the supplier evaluation with BWM and Fuzzy CODAS methods.

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Chapter 19 conducts an action research to identify the problems in the ERP system installation process in small and medium sized enterprises. Chapter 20 reveals the economic opportunities in "one belt one road" project and Turkey's position in this project.

Chapter 21 conducts an analysis of the effects of the exchange rate on the export share of sales in Borsa Istanbul firms in Turkey.

Handbook of Research on Recent Perspectives on Management, International Trade and Logistics is a refereed, scientific, and pivotal reference book that provides vital research on the application of business organizations operating in a global, complex environment. While highlighting topics such as management, international trade, logistics and supply chain management.

This book is ideally designed for logistics and human resources professionals, managers, leaders, executives, CEOs, specialists, consultants, researchers, students, and professors seeking current research on international trade, logistics, human resources management and management information systems.

Consequently, we wish everyone would benefit from this peer-reviewed scientific book.

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Chapter 1
Service Design and Enterprise Risk Management for Knowledge-Based Services:
A Practical Approach for Auditors and Consultants

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ABSTRACT

Services make most of the value in developed economies. In knowledge-based (credence) services, during each transaction, clients look for transmission of value through advice, information, knowledge, or counselling. Providers and clients interact during the service profusion; the human nature of these transactions makes errors inevitable. This chapter intends to guide managers step-by-step in providing better services and managing risks effectively. Each phase includes the presentation of a hands-on managerial tool. To design or improve a service, blueprint can help to visualize and fine-tuning its value chain. Riskoprint allows capturing the complexity of service risks, their sources, and severity. Finally, feed-forward controls contribute to preventing and recovering from service failures.

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INTRODUCTION

This chapter builds on the authors' research and experience in services and risk management. We show both theory and practice elements to successfully manage services and, more specifically, knowledge-based (credence or professional) services. The chapter consists of four main parts: Next to the current introduction (section one), section two elaborates on the nature of service provision. Section three provides guidelines for effective service design. Then, the concept of risk management for services is explained in section four. In section five, we show an approach to handle (knowledge-based) service risks. Finally, takeaways, directions for future research, conclusions, references, and recommended readings complete the current reasoning in sections six to ten. #servicesandriskmanagement

Understanding the Particular Nature of Services

Banking, insurances, private and governmental agencies, education, transportation, and other industries generate economic value without producing physical output. After each purchase, a service client is left with an experience. Purchasing these intangible goods (services) makes most of the spending today. Surprisingly, although modern economies rely heavily on the production and consumption of services, several providers do not master their specificities. This lack of knowledge and expertise makes it challenging for firms to deliver high-quality services and handle their risks – this is even more striking in industries where competition is fierce. For instance, although the demand has been ever increasing in aviation[1], making flyers happy was a goal far from being attained. The University of Michigan's American Customer Service Index has ranked airlines "in the bottom 20% of U.S. companies" according to their customers' satisfaction. Airlines have not changed their position significantly in this ranking since 1994 (Reed, 2018). Extensive literature points out four fundamental differences between products and services: Services are intangible, instantaneous, heterogeneous, and perishable goods[2]. Manufacturers' output is instead tangible, with different production and consumption places, standardized and non-perishable. Next to intangibility, we already suggested, a service experience's heterogeneity lies in the variable interaction between a provider and client. Instantaneity stands for the impossibility of producing and consuming services at two different points in time. A consumer's experience, i.e., consumption, is live, as it coincides with its production. Perishability represents the impossibility of inventory a service - an empty hotel room is lost production capacity, which cannot be employed ever again.

Besides this set of specific features, the nature of services spans from a decreasing degree of tangibility to an increasing abstraction (Shostack, 1977). In this chapter, we focus more closely on knowledge-based or credence services. These services stand on the highest degree of intangibility, where the physical dimension is somehow negligible. Debély, Dubosson, and Fragnière (2008) call knowledge-based "services provided face-to-face, i.e., 'brick and mortar' [...] based on knowledge". These authors define "knowledge-based services as services that are delivered by highly educated and informed employees, responding to specific diagnosed customer demands by offering and delivering customized value-added solutions and relations" (p. 167). These are pervasive and ever-growing in our economies. Clients look for transmission of value through advice, information, knowledge, or counseling; the production process relies heavily on individuals. With these services, humans only can make a difference throughout the production process. Automation can hardly replace the human touch to come up with perfect execution. Humans can merge expertise that required ages to build and specialized knowledge. How does a physician,

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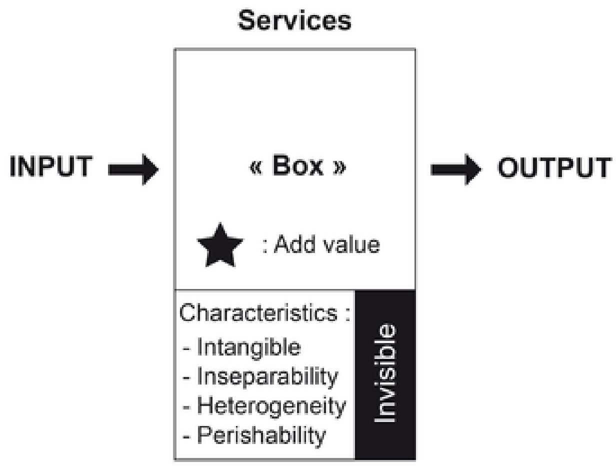
Figure 1. Contextual scheme of a service



an I.T. expert, an artisan, a plumber, a lawyer, or a musician, provide the value? Knowledge-based services deal with transferring intangible – we like calling it "invisible" value (Catenazzo and Fragnière, 2011).

Knowledge-based service experience is individual and unique, mostly based on the interaction between the contractor and customer. Given the high degree of abstraction, each provision of a knowledge-based service must be brand new and freshly crafted at all times. A client must perceive all details of a service experience positively. Yet meeting this goal is even more critical within tight time constraints imposed by productivity standards. Squeezing production processes hits the quality of service outputs. Providers should ensure and monitor client satisfaction at all times to ensure successful execution. Like musicians who spend countless hours rehearsing on a few music sheets, service providers must go through this learning process too. This mindset is somehow confusing. In an editorial of – at the time newly born – *Service Science* (Fragnière, 2009), the author posited that the industrial production system, which is enforced seemingly to all productions, unlikely apply to services. The quantity of output, the number of defects, the degree of conformance to product specifications and checklists work excellently on the factory floor, but not enough for services. Industrialization made consumers used to standardized products with excellent value for money. On the other hand, cheap standardized services do not bring substantial value to customers. Renauld (2020) reports that artisans and artists criticized heavily standardized production and product quality at the beginning of the Industrial Revolution. We believe that these claims against industrial production make all their sense in the production of services: Only bespoke knowledge-based services crafted live by experienced professionals can go the extra mile.

Debély, Dubosson, and Fragnière (2008) suggest a production framework for these specific services. They argue that the production of knowledge-based services should include the following ingredients:

1. "A clear understanding of customer needs and expectations;
2. Elaboration of a diagnosis (Karmarkar and Pitbladdo, 1995);
3. Translation into services alternatives and proposals (offer), each with a specific price;
4. Design of the delivered products and efficient use of delivery processes (incl. using existing pre-packaged products or assembling of modules of products);

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5. Delivery of high quality tailored solutions, and so of added value, hopefully, perceived by the customer;
6. After-sale management and customer relationship (using this information in a learning process to become more knowledgeable for the next transaction)" (p. 170).

We already mentioned the pivotal role of details in service production. Because it is almost impossible to standardize such services, it is critical to notice important details. "For example, consider whether a pizzeria's customer, seated alone at a table, appears harried and exhausted after a long working day. He may be more irritable if the waiter does not come immediately to take his order. If someone accompanies the same customer, who appears to be in a more leisurely mood, he might be more attentive to his companion and less likely to be irritated with the waiters" (Catenazzo and Fragnière, 2011, p. II). Unfortunately, there is no magic formula to ensure success. Nor a checklist to follow and track. There is no objective comparison standpoint to justify performance or compliance to specifications: Everything lies in the clients' minds. The customers' (idiosyncratic) perceptions are the king. The risk of dissatisfaction is, therefore, incredibly high. Delivering low-quality services is an omnipresent risk but not an acceptable option: a disappointing experience can permanently tarnish an establishment or service provider's reputation.

A great way to excel with services is to assess the customer immediately and anticipate her / his needs. This approach is nevertheless easy to conceptualize but challenging to operationalize; how to identify the necessities "and expectations of the many strangers they will encounter each day?" (Catenazzo and Fragnière, 2011, p. II) Service providers must create and deliver value to each client on the spot. "Unforeseen problems in providing an outstanding service experience may occur at any time" (Catenazzo and Fragnière, 2011, p. II) and severely hamper a business. Betting on exceptional service recovery may not be a good tactic either: The debate among researcher for or against the existence of a service recovery effect or paradox (e.g., Boshoff, 1997; Ok, Back, and Shanklin, 2007; Priluck and Lala, 2009) is far from being over. Conversely, there is no doubt that clients can influence each other quickly, both on the positive and, more frequently, on the shortcomings of their purchases. Do you check peer-users rating platforms before making a purchase? Do you trust them? A study on 1,000 shoppers in the United States displays that, in October 2018, almost one-fifth (19%) always trust online reviews as much as personal recommendations, whereas only 6% do not at all (Statista, 2019). This challenging setting pushes us to comprehend better the challenges of producing services and, more importantly, managing its risks. #servicerisks

DELIVERING GREAT SERVICES: A FEW TIPS

Blending expertise, technical knowledge, and a high dose of hospitality can help you turn into a great knowledge-based services provider. Continuous rehearsal and fine-tuning will make you fly high. However, designing and strenuously improvements should follow a plan. How to make a service experience invaluable in the eyes of the clients? We can break down a service delivery process into three levels:

1. Designing the service
2. Performing the service
3. The aftermath of the service

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Designing a Service

Despite their invisible nature, thoughtfully creating services is still paramount. We speak about designing a service. Like an artisan spending an enormous amount of time fine-tuning every detail of a piece, a service creation stands for crafting "invisible value." For the highest-quality execution, providers must conceive how to deliver a service, and then plan it out. Design and planning are also fundamental to identifying potential risks correctly. When the service production starts, the provider and the client typically meet (physically or remotely) to map expectations. Clients become active in the creation (or experience) of the service, acting almost as co-providers. Listen to your clients, and ask them to play the game! Involvement helps to create long-lasting ties; several clients value this unique connection. Within a client-provider relationship, service providers should continuously use their experience to detect the level of client satisfaction. "Ultimately, they can adjust their performance along the way and offer efficient solutions to any unexpected problems. This concept implies taking the temperature of a client and is a long-time hallmark of businesses such as gourmet cuisine. The chef who walks around between tables, asking customers whether everything is satisfactory, is a perfect example. The chef's expertise permits her/him to diagnose in real-time any slippage in quality and to make adjustments constantly. Moreover, in this context, this precise enhances the perception of the service experience overall, because customers tend to be flattered that they can interact so closely with the mastermind" (Catenazzo and Fragnière, 2011, p. IV).

We believe that mapping a transaction, i.e., a service experience, using blueprint is worth its effort. Drawing the service production plan is useful to visualize ideas too often blurry or difficult to communicate. A blueprint is indeed a schematic representation (real or desired) about the functioning of a concept, business, service, or even a detailed service provision. The improvement or update of specific processes can also benefit from the use of this visual tool. In the case of services, and more specifically for knowledge-based services, a blueprint can provide a simplified and readable way, the stages of a process. Also, it gives a picture of its intervening actors. This technical drawing allows for visualizing information flows. As we will show later in this chapter, the blueprint is also useful to handle risks. We mostly use a traditional diagram over two axes (Figure 2): The horizontal includes the various stages of the service's storyline, while the actors involved are on the vertical axis. The horizontal axis consists of three parts: 1) the pre-transaction, i.e., the phase that precedes the contact with the customer. Next, 2) the transaction corresponding to the core and the additional service, and finally, 3) the post-transaction, i.e., the customer service phase. In the vertical axis, you will find 1) the customer, and 2) the front office directly in contact with the final customer. The service provider of the service makes the front office team. 3) The back office, i.e., staff working behind the scenes, interacts with both the front office and the other actors.

Additionally, it is advisable to add a visibility line, a rift between what the customer perceives from a service and what remains hidden during its production. Arrows, connectors eventually link various geometric shapes, or both can occupy the axes' space. Altogether, these depict a thread with a (logical) sequence of actions, conditions, or events making up the service provision. A blueprint (see an example in Figure 2) may include several routes, yet there is always a starting point and an end. The reader or user's attention should span in the space between the two axes, from the left towards the right hand-sides. #serviceblueprint

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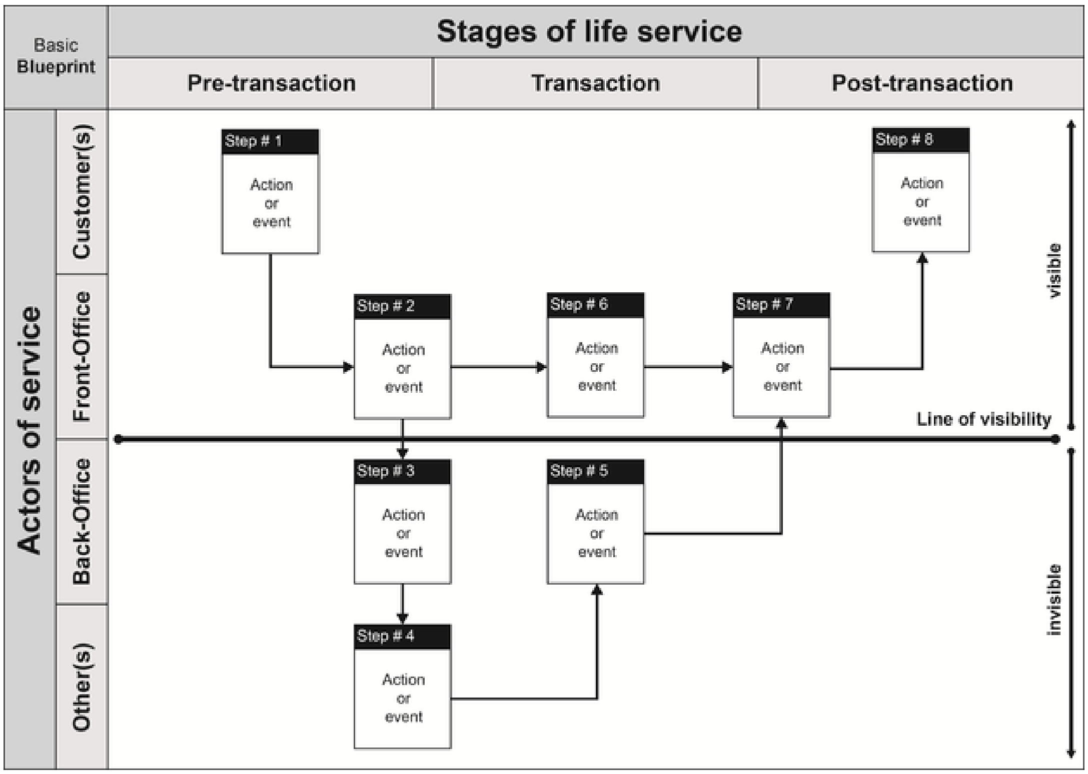
Figure 2. A simplified example of a blueprint (Barbieri, Fragnière, and Moreira, 2017, p. 99), inspired by the examples provided by Lovelock, Wirtz, Lapert, and Munos (2008)



Performing the Service

Companies are increasingly focusing on profits and dehumanizing services, particularly at the operational level. Like manufactured products, both staff members and clients frequently go through a conveyor belt during service production. Financial constraints and strains on the short-run profitability hamper to quality output. This trend is observable in knowledge-based services increasingly going towards mass-production; think about the emergency room at the hospital or overcrowded rooms in schools. Happily, this is not the case everywhere. Again, the industrial model looks attractive to businesses. Despite being extremely beneficial to manufacturing products, it is inadequate for services. Exerting intense pressure on frontline staff does not lead to high-quality service; see, for example, staff members' role in the service profit chain (Heskett *et al.,* 1994). Chatbot and other automatic customer relationship systems do reduce operational costs. However, what about making each customer feel s/he is essential for service providers, not just another lemon to squeeze?

Providing high-end services imply being proficient at "reading between the lines" to anticipate how best to fulfill the client's wishes. The production phase is the most delicate to manage, and again, its outcome is often unpredictable. In many cases, there are failures. A successful execution needs time and training. Beware! An ignored detail might jeopardize the entire experience. There is no formal training to follow nor a degree to obtain to attain this goal: experience in dealing with clients is the key. Observing

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the client, decoding her / his language, and capturing the underlying meaning of her / his requests are skills that need time. In the long run, treating clients like masses to model, segment, and measure them does not create a genuine connection between the service provider and each client. Spending time with clients to learn about them individually when producing a high-end service is pivotal. Focusing on every single client contributes to creating the best connection. #eachclientisimportant

The Aftermath of the Service

The final step in the service experience is an enormous opportunity to gain information. As usual, it is necessary to plan the final stage of the process carefully. The client must feel just as important as at the beginning of the service. It is critical to continue to maintain a healthy client-provider relationship throughout the final phase of the service. A failure occurring at the end would be even worse than at the beginning. The aftermath of service can provide information for designing future services. We can also use this time to cement further the ties between the client and the provider. Just like an artisan, service delivery uses knowledge and experience to attain perfect real-time execution. Knowledge acquired over time provides value in the eyes of the clients. It also reduces the inherent risks of dissatisfaction and a bad reputation following the delivery of an "invisible" good. Failures may still arise at this stage! Providers must keep an eye on the ball, namely the conception, production, and conclusion of the service experience.

Several businesses, such as hotels and banks, ask their clients regularly to fill out satisfaction surveys. A questionnaire is an excellent tool to measure customers' perceptions. However, the results from a poll alone cannot solve everything. These tools are too standardized and hardly capture the heterogeneity of the service experience. Furthermore, the average return rate is low; only a tiny share of clients participates in opinion polls. Next, it is well-known that most dissatisfied customers neither complain nor share their disappointment with the service providers (Hart, Heskett, and Earl Sasser, 1990); they add up to the "silent mass" (Voorhees, Brady, and Horowitz, 2006) of defective and dissatisfied clients. Even worse, they more frequently spread the negative voice, e.g., a negative review on online platforms. When the snowball of negative word of mouth kicks off, it is uncontrollable. No company is too big to fail. Once again, direct personal genuine exchange with clients provides valuable thick data (as called in Madsbjerg, 2017) for their businesses. For large organizations, these informal insights should add up to the increasing mass data collection and analytics. #getfeedback

ENTERPRISE RISK MANAGEMENT FOR PROVIDERS OF KNOWLEDGE-BASED SERVICES

Risk management methodologies aim to identify, analyze, and control an organization (e.g., COSO ERM, ISO 31000). These techniques enable managers to ascertain the principal risks preventing organizations from reaching their goals – yet they cannot apprehend in full human nature in services, a fundamental source of operational risks. In knowledge-based services, risks are pervasive and originate mostly by their human-based nature. These professionals must strive to follow the company processes and to be creative to shape the service specifically to every single client. Challenging. Providers should also realize the importance of interacting positively with clients to reduce the risk of dissatisfaction. This threat is, in our opinion, the greatest during service production. Negative word-of-mouth can be more devastating

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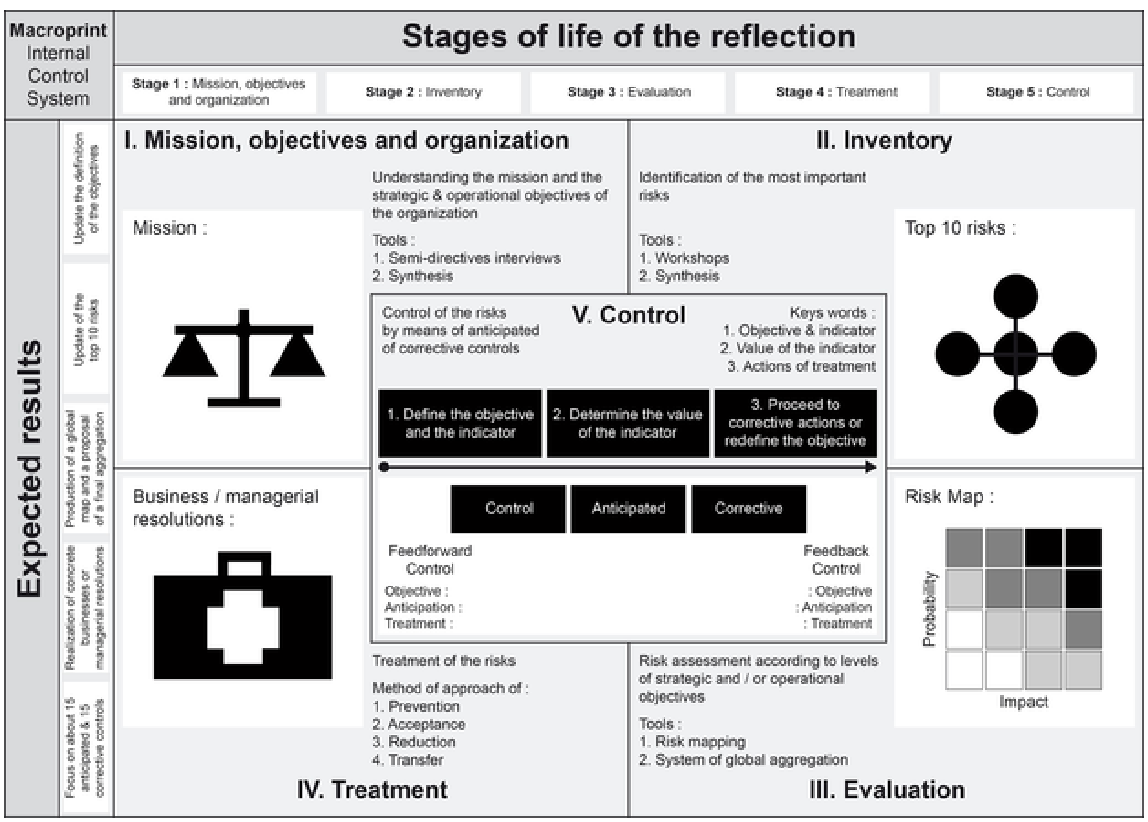
for services than for physical products. In the social media era, the risk of a short video getting viral is just around the corner. A bad reputation can devastate a knowledge-based service provider even more severely than fire.

Enterprise risk management is an iterative process that requires extensive efforts and time before providing real benefits for a service company. To illustrate it, we suggest using a tool called "macroprint" (see Figure 3). This process is valid for ERM standards, such as the COSO II or ISO 31000. The following explanations and tools target large organizations that can afford a team of experts looking after risks neatly and systematically, as well as the smallest individually owned and managed businesses. Two major risk categories typically apply in the provision of a service: 1) the risks related to the physical aspects of the service, and 2) the risks associated with the actual production of the service.

Regarding the first category, i.e., the physical aspects of the service, we believe that regulations are sufficient to ensure public places' safety and efficiently manage several risks, such as fires, building collapses, short-circuits, and more. Insurances also represent a relief against economic losses. Beware: insurances can never cover missed opportunities and, more importantly, faded or lost relationships! In restaurants and hotels, cleanliness, sanitation, and hygiene are also critical. These service producers need to be incredibly rigorous about enforcing the existing guidelines. Ideally, they may want to go further and obtain the appropriate certifications to guarantee the quality of all aspects of their services. #macroprint

Figure 3. The Macroprint



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Mission, Objectives, and Organization

This first step is essential to recognize and define each risk to the respective business objective. Without setting up this initial phase properly, it will not make sense to deploy a risk management strategy. Identifying risks carefully also applies to knowledge-based services, where the supply chain is often intangible and spreads everywhere, thanks to information technologies. This initial stage entails defining the mission, business objectives, operational and strategic goals, and understanding the organization in general. With this respect, we encourage risk managers to spend some time experiencing all company departments and running semi-directed interviews with the staff to get a global picture of the organization through its members' eyes. Do not underestimate the time needed to achieve this phase in full! – Similarly, the temptation to jump to the next step of the methodology should not influence the process. #riskidentification

Risk Inventory

Once the business objectives and the respective risks are defined precisely, a list can be set up. This list of risks is more formally called "risk inventory." The risk inventory is a vital brick to develop a coherent risk management strategy afterward. We employ semi-directed interviews again and couple them with focus groups gathering several staff members to establish risk inventory. All levels of the organization chart, from top management to unskilled staff, should join these sessions. All points of view are worth; for knowledge-based services, team-members' directly in contact with the final clients are extremely valuable - even more than decision-makers behind the scenes. #riskinventory

Risk Assessment

After the inventory, follows the risk assessment. Risk management should assess all risks according to two criteria: the likelihood and potential damage. Then, do not forget to map all risks. A risk map or matrix is a visual tool for the criticality of one or more risks, with a color code. Traditionally, green is for non-critical, yellow, or orange for moderate, and red is for the most severe risks. The horizontal axis relates to the impact of an outbreaking risk, from the least to the most damaging. The vertical axis stands for the probability of a risk, from the least to the most likely. Thanks to such a simple and intuitive tool, (risk-) managers can make decisions on how to prioritize their efforts against risks. They will work in priority on the most critical risks, and then the others. #riskmap

The fourth step consists of designing risk treatments, also called risk strategies. Treatments can target the reduction, avoidance, and the transfer of risks. Both managers and risk team members should devise how to reduce the likelihood, the magnitude of the damage, deploy monitoring tools, or eliminate each risk. In simple words, this step consists of knowing the risks and implementing the necessary means to prevent them from happening, materializing, or handling when they break out in a company. Some risks are inevitable and impossible to eliminate. In this case, managers can still decide or estimate the residual risks to accept. The threats (risks) must have been identified and assessed in the risk management plan. During the risk treatment phase, you must devise the weapons to deploy against risks. #risktreatment

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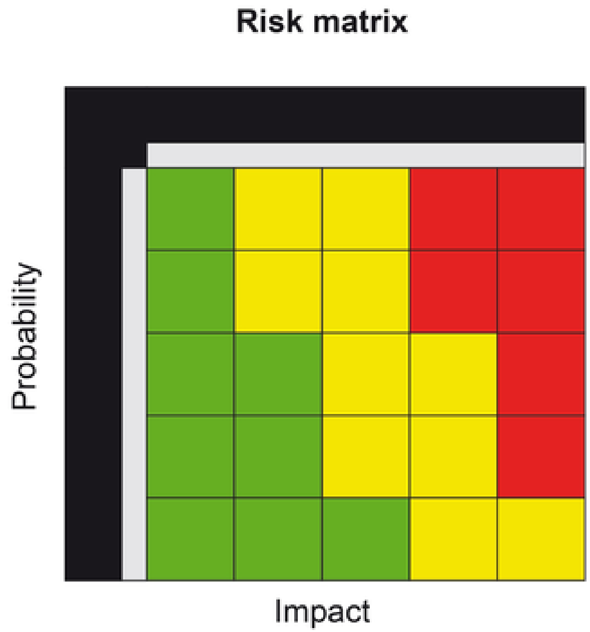
Figure 4. Risk map



- **Avoidance:** there is no way to decrease either the likelihood or the impact of a risk. In this case, it might be More feasible to give up taking a risk. In other words, decision-makers should consider eradicating the source (activity) of the risk.
- **Risk reduction** consists of implementing measures to reduce the likelihood of a risk outbreak, its potential damage, or both.
- **Transfer risk** to a third party, for example, through insurance, a deposit, or other financial tools.
- **Accepting a risk** occurs mostly when the risk is considered not critical enough to justify efforts against it.

Risk Control

Risk control, which coordinates the first four stages, represents the last step in a well-planned and devised enterprise risk management. This phase entails the development and tracking of risk management measures. Risk control includes the following:

1. The definition of the business objectives ;
2. The measurement of business objective achievements ;
3. The correction phase, namely doing nothing, reconsidering the business objective, executing risk mitigation strategies.

The Institute of Internal Auditors' (IIA) guidelines and other bodies suggest two categories of controls: Feedback and feed-forward control. Feedback controls consider risk indicators and their levels over time. Most companies run their risk management in this way. However, in knowledge-based services,

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the efficacy of this type of control is questionable. When an alert arises, it is, in general, too late to launch the correction. The service experience is already over, and the failure has already happened and probably experienced by the client.

Conversely, feed-forward controls are more suitable to deal with the intangible nature of services. A forecast regarding the achievement of a business objective replaces risk inventory. Feed-forward controls are more elaborated and need better-synchronized and organized devices. To accurately predict or anticipate the completion of business objectives, we rely on red flags: Weak signals indicating that the situation regarding risk is deteriorating and gradually reducing the probability of reaching the expected goal. When the level of a risk deteriorates too much, an alert will arise. Based on this alert, the risk manager should appraise the situation and implement preventive mitigation strategies – called reduction strategies in COSO, according to its criticality. If this system looks intuitive, it may be hard to enforce within knowledge-value service organizations. The qualitative and human nature of the services businesses hampers the use of traditional dashboards. Alternative approaches must then be found and implemented within service organizations. #riskcontrol

A METHODOLOGY FOR EFFECTIVE RISK MANAGEMENT IN KNOWLEDGE-BASED SERVICES

Internal Control System (ICS) gathers critical controls to pilot a business through the risk management team. Well-known risk modeling and analysis tools still do not integrate the human factor enough, yet vital for knowledge-based services. As already mentioned, feed-forward controls are more suitable to deal with the intangible nature of services. Feed-forward control is activated when the anticipatory indicator is in the trigger zone. A (risk) manager must decide then to implement or not the related mitigation strategies. The creation of a guide for each control can help to interpret alerts correctly. A dashboard must be set-up to enable coherent and coordinated monitoring. The control panel should provide all the information related to the follow-up. To make the current approach more practical, we recommend that the risk manager ask the following questions to assess each of the controls in place:

- How is the service provisioned?
- How is the service priced?
- How is the service protected?

As soon as you have answered precisely to the above questions, you can dig more in-depth with the following:

- What is the perceived value attribute of the service that needs to be protected?
- What are the objective, anticipative indicators, and preventive actions offered by the proposed control?
- Is the proposed control reliable, relevant, and realistic?
- Does the proposed control provide a suitable cost/benefit ratio?

Practically, our feed-forward control approach based on a blueprinting and theatre reenactment goes through four steps:

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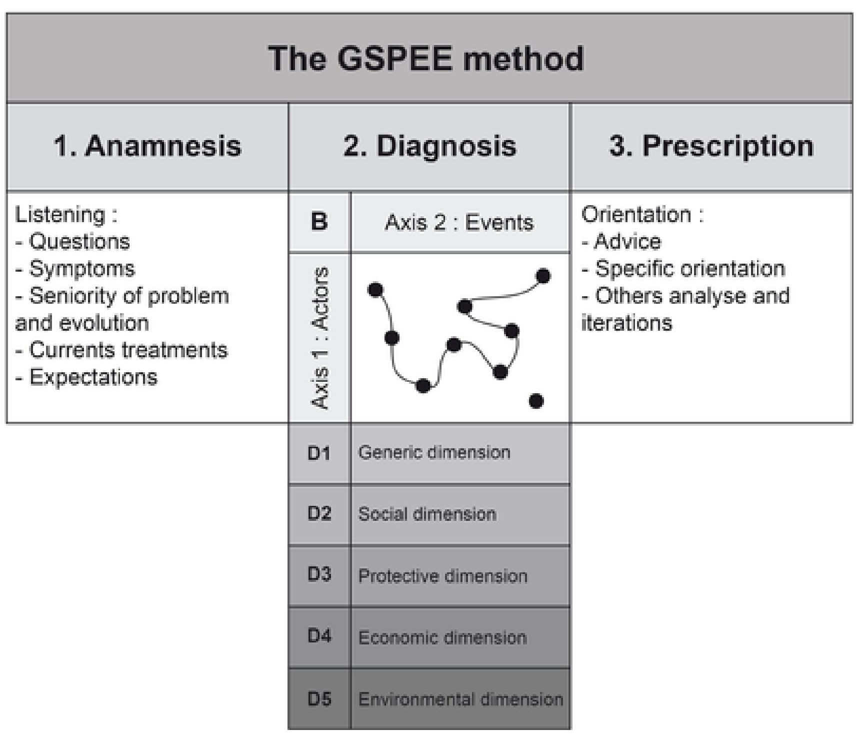
- Ethnomethodology through site visits, immersion work, and semi-directed interviews with service providers and clients to identify the main attributes of service experience ;
- Development of a service blueprint to visualize the elements of the service interaction ;
- Rehearsal of the script to maximize authenticity, imagine the service and work through the design process iteratively ;
- Development and delivery of effective feed-forward control to improve the quality and performance of service experiences.

We strongly encourage organizations to develop visual tools where the management can get the full picture of the process of value creation. We suggest a concrete solution of service risk management using a framework embedding the Generic, Social, Protective, Economic, and Environmental (GSPEE) dimensions. GSPEE allows monitoring the health status of different actors, the service itself, and the business simultaneously (Figure 5). To illustrate our approach, we make an analogy with the medical examination, which is indeed a typical example of a knowledge-based service. There should be a 1) anamnesis phase in the management of service risks, during which the doctor receives the patient's medical history and current symptoms through a careful interview process. Risk managers should proceed accordingly with business objectives, risk identification, risk logs, and other internal records. 2) Diagnosis, in which the physician uses evidence to identify a disease or condition. In our case, this phase stands for getting a picture of the total risk measurement system. The following step is 3) prescription by which the doctor guides the patient into treatment. Accordingly, risk management should deploy suitable tools to fight against the risks.

Figure 5. GSPEE method (Barbieri, Fragnière, Sitten, and Zambrano, 2013, p. 210)



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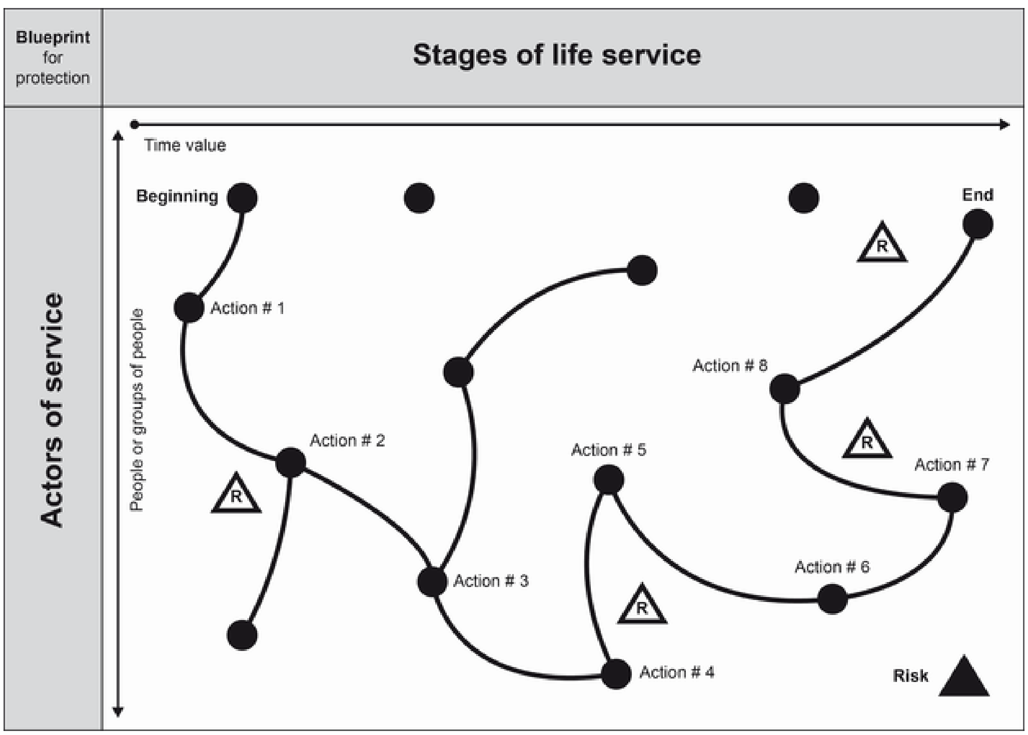
Concerning the second phase, the blueprint reported in Figure 2 for service design needs enhancements to embed the risk dimension. Within this more elaborated framework, a blueprint will serve as a diagnostic tool. Our experience shows that using a visual tool like the blueprint combined with this threefold GSPEE increases the likelihood of success. A service blueprint helps to diagnose problems within service production and suggesting improvements. It is also helpful as a risk anticipation tool to protect a service or support service innovation (Figure 6). As already mentioned, to manage risks, managers should get a picture of the entire organization and its informational and procedural flows. In addition to streamlining the design of a service, the use of blueprints can be of help in managing service risks. To create or model a blueprint, you should first establish a list of all the service production stages and the respective actors involved in the process. The blueprint consists of two perpendicular axes (x-horizontally and y-vertically). Then, in the quadrant between the axes, it is possible to put (draw) actions, conditions, or events keeping the chronological order (horizontally). The respective provider (individual or group) will appear in vertical.

Figure 6. The service risk blueprint



We provide the example of using the service blueprint GSPEE methods in the provision of hospitality services. To make this service experience visible, we modeled an existing workflow, and we have transcribed on a first blueprint (see Figure 7). This first visualization presents the essential service experience with the key attributes and the potential identified issues. This design process allows tracking the service's critical features, which define the notion of value in a client's eyes. It also helps to undertake social, protective, economic, and environmental analyses. A next step entails running a risk analysis with warnings.

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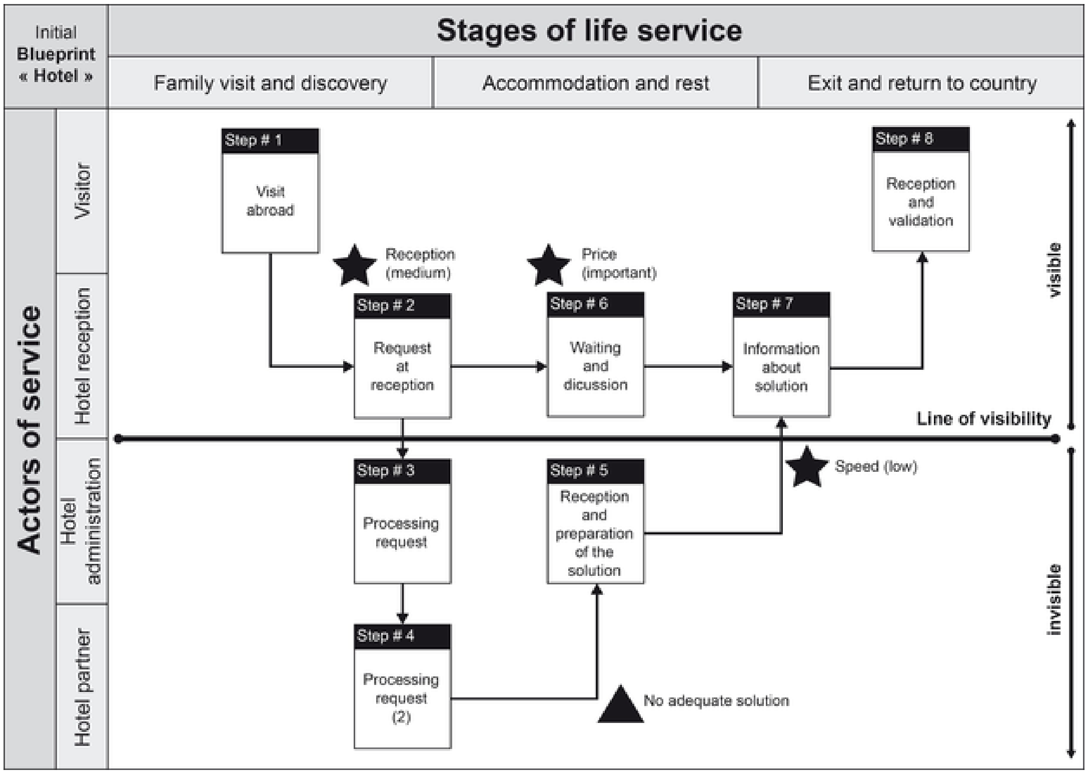
Figure 7. The initial service risk blueprint (adapted from Barbieri et al. 2017)



Next, we recommend developing a new optimized blueprint. This second blueprint (Figure 8) shows the way to anticipate these potential risks. Thanks to this updated blueprint, it will be possible to devise an action plan for the proposed solutions and, if required, prepare a final report.

Running all the above analyses may be demanding and time-consuming, especially for the smallest organizations. To sum up, we conceptualize a tool called "Riskoprint" (Figure 10). This tool merges the blueprint with the risk map.

The Riskoprint consists of three axes. Horizontally, the sequential stages of service production, from its beginning towards its end. The pre-transaction (A) defines what happens before the service, while the post-transaction (C) after the service. In between lies the transaction (B), i.e., the core service production. The service actors' vertical dimension shows the type of individuals or groups involved in the service experience. The customer is the first (1) player acting with Front Office (2) in the interaction space of the service production. In the invisible side of service production, (3) the BackOffice of the service. Other stakeholders in the service production and consumption, such as partners, competitors, support, and more, make up the miscellaneous addition player (4). The third dimension, not visible in a bidimensional chart like in Figure 10, embeds the potential damage of the identified risks on the overall experience. Do not forget to assess each risk through the customers' perspective, not yours or the service providers. In the chart below, three colors allow distinguishing this third dimension. The implied actors' service risks are intensely in red, zones A1, B1, B2, and C1. The yellow zones (A2, B3, C2) mean that the clients perceive these risks with an intermediate severity, and the green (A3, A4, B4, C3, and C4) where the risk exert no significant influence on the client. #riskoprint

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Figure 8. The enhanced service risk blueprint (adapted from Barbieri et al. 2017)

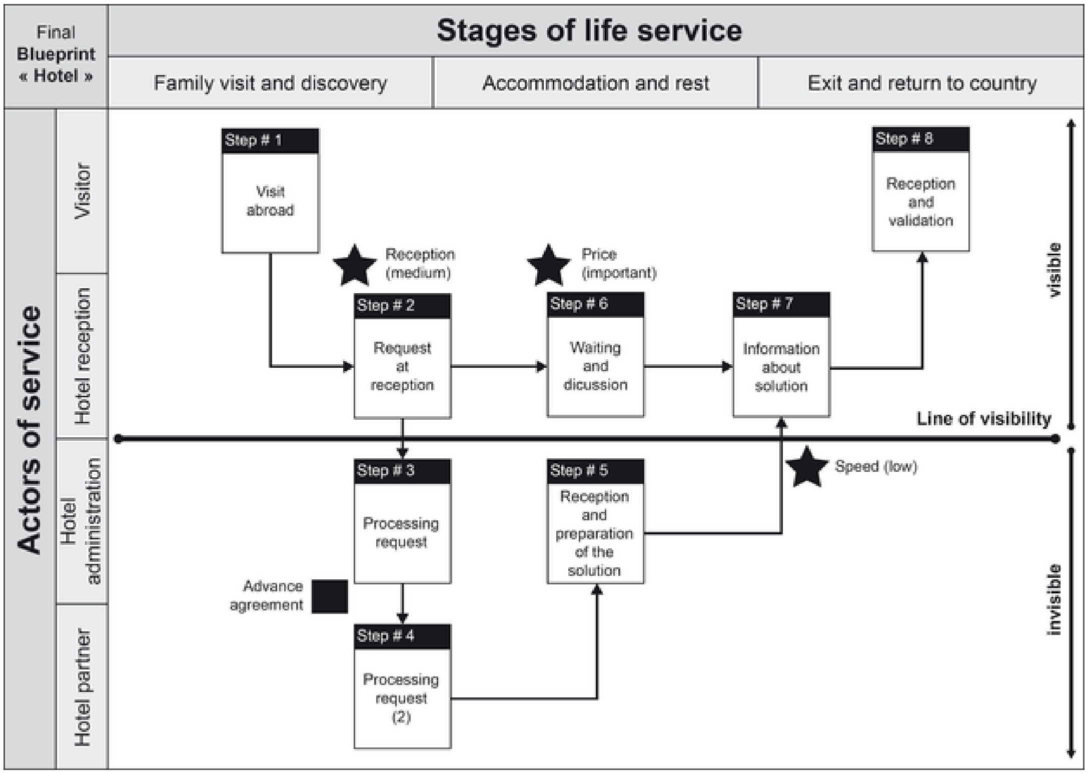

Figure 9. Building a Riskoprint (adapted from Barbieri et al. 2017, p. 533)

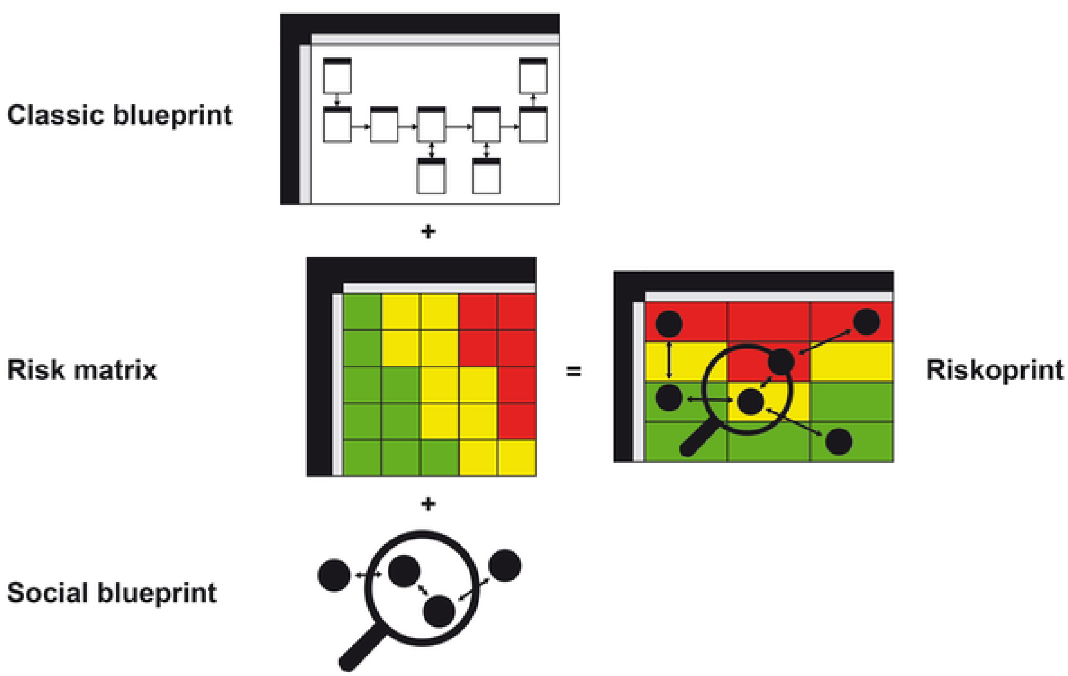

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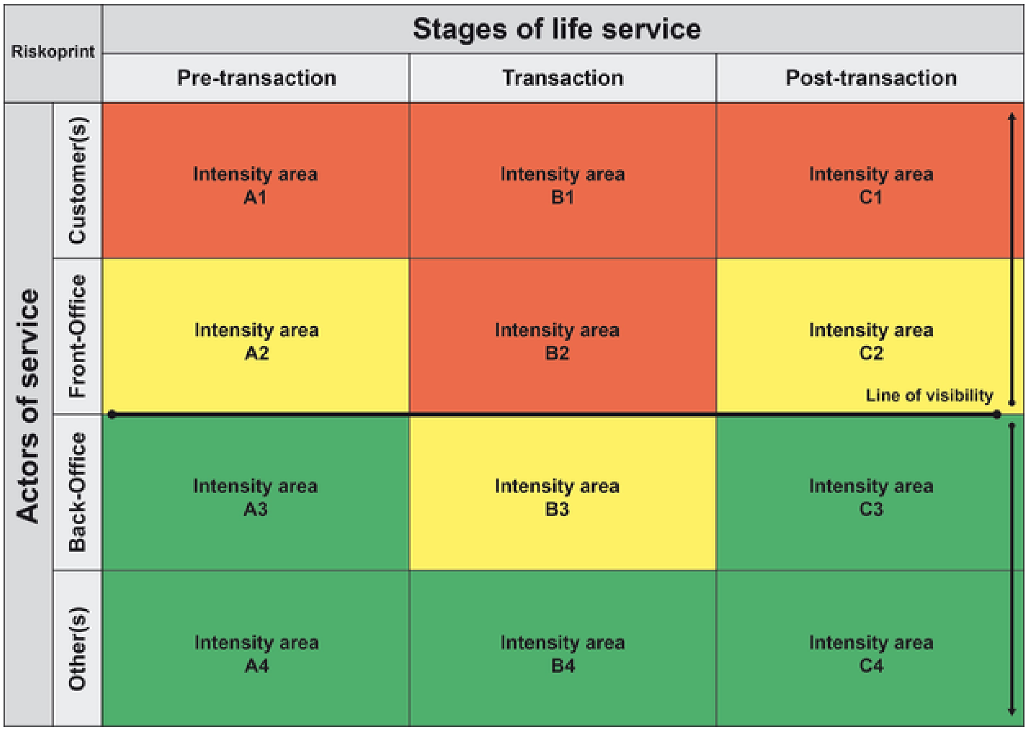
Figure 10. The Riskoprint



FUTURE RESEARCH DIRECTIONS

Knowledge-based services are increasingly important not only in western countries. Developing countries, from Latin America to South-Eastern Asia, are turning to services economies rapidly. Businesses based in these countries should apply theories and tools presented in this chapter to assess their efficacy. The authors' knowledge originates mostly from studies developed by service management scholars working primarily in western countries. We believe that some adjustments may be needed to deal effectively with cultural and organizational specificities. Likewise, this chapter authors' have experienced from the inside businesses and public administrations based mostly in Switzerland.

Furthermore, this chapter focuses on knowledge-based services provided by individuals and profit-oriented organizations. Non-profit organizations of all sizes and goals as well as public administrations will undoubtedly benefit from reviewing their activities under the theoretical and applied lenses presented in this chapter. Recent informal discussions with the head of a department in a public administration have highlighted the need and potential of devising finely tuned risk management tools adapted clearly to governmental or other public administrations. We believe these are promising areas to improve knowledge-based services further and effectively manage their related risks.

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CONCLUSION

A service acquires value once the client perceives its benefits. For knowledge-based services, a service worth lies in transmitting value through advice, information, knowledge, or counseling. Emphasizing the importance of the exchange between the provider and the client is fundamental. Similarly, risk management practices should embed the high load of human interaction in providing these services. We hope that the explanations and tools presented in this chapter will help service managers to improve the design of their services. We hope that these recommendations will also help managers deploy well-designed risk handling practices specially adapted to deal with the unique nature of services.

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ENDNOTES

[1] At least at the time of writing this chapter, whose first draft was completed in the first quarter of 2020.

[2] For recapitulation tables about the early studies, see Zeithaml, Parasuraman, and Berry, 1985, p. 34-35.

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Chapter 2
Freight Village as Dry Port: An Ongoing Italian Case Study

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ABSTRACT

The authors intend to suggest an interpretation of dry ports as functional organs of a larger facility, known in Italy as "interporto," with reference to an Italian reality. This research fills a gap in literature as to the authors' knowledge. There is lack of research on the dry port concept, and this is the first chapter presenting this concept in an interpretation "functional" to the co-modality model of an "interporto." The chapter firstly aims at contributing to finding possible contact points between what has up to now been defined as "dry port" and the concept of "co-modality." The following section briefly defines the characteristics of a facility such as "interporto." Then the connections between recent developments in shipping and in terminal business and the increased role of dry ports in the value chain are explored. Finally, the authors suggest challenges and opportunities for further study and draw their conclusions.

INTRODUCTION

The considerable growth of maritime container trade in the last twenty years has given shipping companies a great impulse to increase their hold cargo capacity, by the use of larger ships (mega-ships), which on the one side provide economies of scale and on the other enable to keep competitive fees.

Such evolution had to be accompanied by a greater throughput capacity of the port gateway, with a propensity of the latter to develop more adequate and specialized equipment, plants, technologies and an "Information & Communication System".

Because of such accelerated evolution coming from outside, ports faced radical changes, not only in dimensions but also operatively. The pressure for fast and efficient handling and, most of all, the reduc-

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tion of turnaround time in ports led to a revision of logic connections with the hinterland, by the Port Authorities' governance as well as by the numerous other actors at play.

These transformations contributed to the development of facilities known as "inland terminals", which enable to increase the quays' capacity, and at the same time to having a better connection to the hinterland, thus becoming a competitive market lever for distribution and a storage point for freight to be exported.

So, the "inland terminal", as in the double star theory **(1)**, is, with the port, an essential part of a dyad, further link to a complex transport chain, where the use of intermodality, surpassing simple positioning of maritime containers, finds full implementation in many modal exchanges, useful to connect origin and destination points which are frequently rather far apart.

The expression "inland terminal" is mostly used in a geographical approach rather than in a transport-oriented one, the reason being that it is consistent with different spatial and infrastructural contexts, specific to the different economic aims it is involved in.

The main objective of this chapter may be summarized as follows: by analyzing the literature in the aforementioned areas it intends to suggest, because of the obvious contact points with the intermodal - or in other words "co-modal" - topic, an interpretation of dry ports as functional organs of a larger facility, known in Italy as "*interporto*".

This research fills a gap in literature: to the Authors' knowledge, there is lack of research on the dry port concept and this is the first chapter presenting the concept of dry port in an interpretation "functional" to the co-modality model of an "*interporto*".

Finally, the Authors of this chapter deliberately chose to refrain from adopting and presenting any mathematical or economic model; instead, they build on direct field experience and they have in mind to analyse an Italian study case as their next step.

The sequel of this chapter is organized as follows. Section "Backgrounds" aims at contributing to finding possible contact points between what has up to now been defined as "dry port" and the concept of "co-modality", as expressed by the EU Commission. The intention is furthermore to deepen the literature debate on the role a "dry port" can play within a transport chain (port-to-door, port-to-market), coming back to what makes the distinction: greater or smaller closeness to the port. Section "Main focus of the chapter" briefly defines the characteristics of a facility such as "*interporto*", then attempts to closely verify its propensity, mainly in the Italian case, to carry out the functions, typical for a dry port, which the examined literature generically allocates to an inland terminal, thus bringing it into the context of a logistic-transport system of a maritime kind. It also pursues the objective of marking a difference, of functional and substantial nature rather than semantic nature, between the concept of inland terminal and the concept of "*interporto*". In Section "Solutions and Recommendations", this chapter aims at exploring connections between recent developments in shipping and in terminal business, with the increased role of dry ports in the value chain. Section "Future research direction" suggests opportunities for further study, while conclusions are drawn in the last Section.

BACKGROUND: "CO-MODALITY" AND DRY PORTS

The Concept of "Co-Modality"

The United Nation Economic Commission for Europe (2001) has certainly offered an important contribution to the definition of the expression "co-modality": «*A number of major facility projects will help to*

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alleviate environmental pressure on specific corridors. Shifts to more environmentally friendly modes must be achieved where appropriate, especially on long distance, in urban areas and on congested corridors. At the same time each transport mode must be optimized. All modes must become more environmentally friendly, safe and energy efficient. Finally, co-modality, i.e. the efficient use of different modes on their own and in combination, will result in an optimal and sustainable utilization of resources».

It seems useful to observe that this definition inaugurated a new course in European transport policy: it is not any more directed, as stated by the 2001 "White Book", at juxtaposing the various transport modes; rather, it aims at their optimal exploitation within the specific characteristics of each one and their combinations. As a logical consequence of the above-mentioned new course, a reduction of economic and environmental costs is thus obtained by using the mode most suitable for the route to be followed.

Distance of Dry Ports from the Market

In consideration of the above, it seems evident that the role of dry ports, on top of decongesting quays and areas immediately close to the port, is also that of further routing goods arriving from the port to its gravitational area, "port-to-door", and that of routing cargos, after maybe handling them, to farther destination markets, "port-to-market".

These are exactly the reasons why the authors feel that in this point the synthesis, better described by the expression "co-modality", among the various kinds of transport (rail, road, river) is achieved or can be achieved.

The fundamental elements which qualify dry ports as ideal node for transport networks are not only of a geographical nature, and even less of an infrastructural nature; they rather consist in a wide spectrum of services, as argued above.

Dry Ports and the Network

Even if the concept of dry ports has evolved in the past decade (Roso et al. 2019), the authors wish to point out, in particular, the definition given by Roso (2009), which clearly brings into evidence the fact that a dry port completely substitutes the port, and that the services rendered for cargo units or products are very similar in customers' perspective, starting, of course, from the important customs services: «*an inland intermodal terminal directly connected to seaport(s) with high capacity transport mean(s), where customers can leave/pick up their standardized units as if directly to a seaport*».

As to the role of a dry port as connector to its hinterland, with the consequent local and/or regional distribution functions, it seems to be just as relevant as the one between dry port and quay. If the latter relationship needs to rely on efficient railway facilities and reliable services, such as to satisfy a general principle of co-modality, the same can be argued for the above mentioned re-distributive functions, mainly centred on railway services following a model of terrestrial intermodality.

Distance Criteria

According to Roso et al. (2009), when a dry port is a platform for transhipment operations and for routing cargo units towards markets outside of its hinterland (port-to-market), it contributes to improving access from the port not only to its hinterland, but also to a broader area.

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In the view of these scholars, in such cases the use of the railway mode is plausible, with interchange to lorry only at destination.

It should be added that in such cases the logic of a simple “stop” of the charge unit is overcome, even in the case of a “closer” or “midrange” dry port (Nguyen and Notteboom, 2019), because it is frequently joined to some manufacturing of the goods, net of temporary warehousing services, only temporarily interrupting the co-modal chain.

A clear and important contribution towards a functional distinction between inland terminal and dry port is offered by Van Klink (1998). According to him, the dry port concept goes beyond a simple use of modes alternative to the road, such as railway or river, and this with the guarantee of large quantities of goods.

Main Functions of a Gateway

A dry port is the ideal interface for shippers and carriers towards the port and shipping companies. As Notteboom and Rodrigue (2012a) show very well in one of their studies, these functions can be separated and draw a hierarchy on the scale of value added to goods in transit.

According to these two scholars, inland terminals belonging to the “rail terminal” category are part of a hierarchic logic of a gateways and corridors system, where they can carry out three main functions: “Satellite terminals”; “Freight distribution clusters (load centres)”; “Transhipment facilities”.

“Satellite terminals” (Muravev et al. 2019) are close to the port facility, near its metropolitan area (the distance is frequently below 100 km), because they carry out typical port functions. They make spaces available for traffic concerning the maritime zone, and they offer services which would be more expensive at the port, such as warehousing or deposit for empty containers. The majority of them has a function of mere transhipment of goods from train/barge to lorry and vice versa, as the scholars mention in the cases of “Container Transferium” at the port of Rotterdam or of “Gateway Access Point” in Belgium.

“Load centres”, on the other hand, are larger intermodal facilities, ensuring access to well defined regional markets, which include production and consumption functions. They are normally located close to logistics parks and free trade zones (or foreign trade zones).

In case this last structure was located along an important railway corridor, with distribution activities it might also enable to reach wider and farther markets.

“Transhipment facilities” connect vast goods circulation systems, by the same mode (rail - rail) as well as by intermodality (rail - lorry or even rail - barge). The origin or destination of goods is external to the terminal’s market area: it is a function which resembles those of transhipment hubs in the maritime transport network.

Main Differences Between “Retroporto” and Inland Terminal

While arguing the above, Notteboom and Rodrigue (2012a) admit that the various detected functions should not in any way be intended as “exclusive”, and that therefore inland terminals may carry out even more than one of them. Consequently, notwithstanding the fact that this facility is undoubtedly the first level of a functional hierarchy, suitable to narrowly define the port’s hinterland, the existence of a single universal model of listing cannot at all be certified.

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Bologna (2010) supplies an important contribution to this issue, clarifying the difference in meaning of expressions such as "*retroporto*" and "inland terminal", which sometimes, in his view, are used indiscriminately.

By "*retroporto*" he means a facility of territorial continuity. In this case, customs offices, health offices, operators, organisms and regulation Authorities configure some kind of "prolongation of the port", with functions auxiliary to the ones typical for a port. Here it is possible to carry out operations making operability in the port area more fluid and efficient. It is thus a facility located close to the port, at a distance which does not impact on transfer costs, and maybe enjoying particular benefits.

By "inland terminal" he means a facility located close to the destination market, which is at the same time intermodal railway terminal and logistics platform. In brief, the thesis brought forward by Bologna (2010) is that a "*retroporto*" serves the port, while an inland terminal serves customers: *«a "*retroporto*" is aimed at alleviating congestion in port areas and in the access roads to a port; its function is to regulate flows and to distribute traffic loads across the entire day, so as to avoid paralysing peaks. An inland terminal is a node of the supply chain».*

The scholar argues that a "*retroporto*" does not refer to the final customer, since it is an auxiliary facility to the port's operational cycle, as opposed to an inland terminal, which can carry out the functions of an intermodal gate and a logistics centre for cargo distribution and consolidation. In both cases, however, intermodality is considered an irreplaceable resource, and the economic sustainability of the organisation depends on it.

Some Examples

Roso et al. (2009) seem to suggest, as already mentioned, a "finer" distinction. Just as the one by Notteboom and Rodrigue (2012a), it also correlates particular service characteristics to the distance between a dry port and a port. A "close dry port", in the immediate vicinity of the port's hinterland, significantly contributes to increasing the port's terminal capacity, with possible positive repercussions on productivity improvement, because it becomes attractive to the "touch" of new generation container ships. This kind of facility is an ideal location for depositing empty containers, which are ready to enter circulation again, just at the moment they are requested.

In order to clarify the "close dry port" model, the authors mention the example of "MIST [*MacArthur Intermodal Shipping Terminal*] terminal of Minto", 45 km from the port of Botany (Sydney – Australia). As examples of "midrange dry port" and "distant dry port" they mention Falköping (Sweden) dry port and Virginia Inland Port (VIP – Norfolk, State of Virginia, USA). The former is at about 130 km from Göteborg port, the latter at about 330 km from the port of Virginia.

Virginia Inland Port is for shippers a land interface to port and shipping lines. In other words, it strengthens access to commercial and industrial areas, as well as to the traditional hinterland area of the port, which is located at Norfolk (East Coast). It is a brilliant example of integration, facilitated also by the fact of having been devised by Port Authorities and officially recognized by U.S.A. Customs as port of access for imports.

Bentaleb et al. (2016) examine the various life phases of a dry port system; in conclusion they supply a table bringing into evidence a categorisation of some dry ports, coherent with the product life cycle theory and in terms of distance.

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Based on the different viewpoints and nuances of literature examined up to now, one can certainly affirm that the concept of "co-modality" is pervasive in any kind of factual situation considered, of course with the limits of extensibility and universality recognized to any categorisation of an object.

As to functional differentiation, notwithstanding conceptual efforts and meticulous etymological research, in every theoretical contribution approached one can indeed observe a structural overlap which leads to focus on the specificity of every case or anyhow to hypothesise that the examined sample should still be considered too small or premature for a satisfactory classification.

Table 1 presents the titles of the above subsections and the related analysed concepts, in order to recap the main takeaways.

Table 1. Titles of the subsections and subsequent concepts

Title of the subsection	Concept
The concept of "co-modality".	Co-modality.
Distance of dry ports from the market.	• "Port-to-door". • "Port-to-market".
Dry port and the network.	• Port. • Dry port. • Hinterland.
Distance criteria.	• Closer dry port. • Midrange dry port.
Main functions of a gateway.	• Satellite terminals. • Freight distribution clusters (load centres). • Transhipment facilities.
Main differences between "retroporto" and inland terminal.	• "Retroporto". • Inland terminal.
Some examples.	• MIST [MacArthur Intermodal Shipping Terminal] terminal of Minto (Sydney - Australia). • Falköping dry port (Sweden). • Virginia Inland Port (VIP - Norfolk, State of Virginia, USA).

Source: Authors' elaboration.

MAIN FOCUS: DRY PORTS AS FUNCTIONAL ORGANS OF FREIGHT VILLAGES ("INTERPORTI")

The Definition of "Interporto"

The definitions "terminal", "dry port", "inland terminal" and "*interporto*" appear in a text of the year 2001 by the Economic Commission for Europe (UN/ECE), in agreement with the European Conference of Ministers of Transport (ECMT) and the European Commission (EC).

In the same order, here is the original definition of each one of these facilities: «*"Terminal": a place equipped for the transhipment and storage of Intermodal Transport Units (ITUs); "Dry port",* "Avamporto*"* [outside port], *"Inland terminal": a land terminal directly connected to a maritime port;* "Interporto*": territorial concentration of independent organisms and enterprises dealing with trans-*

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port of goods (for example couriers, shippers, transport operators, customs) and auxiliary services (for example deposit, maintenance and repair) including at least one terminal».

According to the definition by article 1 of the Italian Act n. 240 of 4th August 1990, "*interporto*" is an *«organic complex of integrated structures and services dedicated to the exchange of goods among the various transport modes, in any case comprising a railway terminal suitable for forming or receiving entire trains and connected with ports, airports and large communication roads»*.

This definition offers further details on the profile of an "*interporto*", listing its main requirements, lacking which the facility cannot be considered an "*interporto*".

From the above one can notice, at first, that the concept of "*interporto*" refers, at least in its initial phase, to a re-organization of railway transport on land, and is thus inevitably closer and more functional to the development of combined land transport than to intermodal transport of maritime nature, where the positioning of maritime containers may not be part of its activities.

On the other hand, in Italy, according to the recent legislative novelties on Port Authorities, brought about by Legislative Decree n. 169 of 2016, "*interporto*" seem to play a new important role exactly within the issue of maritime intermodality. Indeed, art. 7, par. 4 states: *«Pursuing the objectives and aims set by article 1, the Port System Authority (*Autorità di Sistema Portuale - AdSP*) carries out following roles: (…) f) Promotes forms of connection with behind-port and interport logistic systems».*

"Interporto" or Freight Village as Dry Port

It therefore seems plausible, at least since when the above decree came into force, to include among the characteristic functions of an "*interporto*" also those pertaining to a dry port.

The wide variety of services taken into consideration by the legislator in this original definition, which is in some ways generic, makes it one of the potential reference nodes for a new concept of port, coming from a broader strategic-organizational transformation.

The above mentioned case refers to an Italian reality that is gradually taking shape within a network. It includes, on the one hand, the Ligurian inland port network and the new terminal infrastructure by the Savona-Vado port (MAERSK Platform), and, on the other hand, the network of intermodal platforms of the Po plain and the north-western area of Piedmont. In particular, the authors refer to the specific case of the "*interporto*" of Torino-Orbassano, on the Mediterranean Corridor. This hub is located at an adequate distance (mid-range) to act as dry port for the above-mentioned new reality. It also performs the characteristic functions of an intermodal platform for combined inland transport.

Rodrigue and Notteboom (2012) derive the process they call "port regionalization" from combining dry port and logistic corridors. They consider five main criteria decisive in order to be able to classify a facility as a dry port. The first is good accessibility (site and situation), together with a location allowing for a significant import and export activity. They argue that several inland terminals also have an airport in their vicinity. Another essential character is the capability by an inland terminal to ensure efficient repositioning and dynamic cargo rotation of empty containers, sometimes even in markets not close to its location, thus offering shippers good chances for business and asset optimisation. A fourth criterion (trade facilitation) entrusts inland terminals with a fundamental role in promoting the import and export sectors in an entire region, enabling even smaller operators to reach scale economies.

In this chapter, the four criteria mentioned above appear to be perfectly matching with the assumptions for an "*interporto*" facility; however, in support of the suggested thesis, it seems useful to concentrate on the fifth criterion. It looks at the shareholding model, and as a consequence at the management model,

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arguing that governance may indifferently be of public or private nature, or a mix of both. The two scholars affirm that very often dry ports are long term projects, characterized by limited profitability in their initial life phase, as well as by very high risk for private investors and by the fact that the main benefits, even in the starting phase – such as creation of new jobs and more rational use of the territory – are of a socio-economic and urbanistic kind. It therefore seems plausible to them that they are perceived, as indeed they are, as projects of public interest.

The mentioned objectives are undoubtedly the reasons why the Italian network of "*interporti*" was created.

Not by chance, the majority of nodes in this network is owned by mixed public-private shareholding, the public part strongly prevailing.

In general terms, the pattern is that within these areas dedicated to logistics a very varied series of independent logistics suppliers settle down, with evident scale and scope economies.

They can be couriers, customs operators, forwarders, transporters, terminal operators etc., specialized in the various transport modes and in the context of wider and more complex national or global networks.

The "*interporto*" company, on top of functions of property management for the entire compound, is often entrusted with the relevant role of managing some of the property for logistics it owns (warehouses, lots, offices etc.), as well as part of the railway terminal complex (of which it holds the connection contract) joining the "*interporto*" area to the national railway network by a railway station or yard.

On the one hand, it is easy to imagine that this kind of governance enables to pursue objectives of general transport strategy and of institutional connection with other public bodies such as, for example, the Manager of national railway infrastructure, or the Port Authorities, nowadays called Authority of the Port System.

On the other hand, in order to attain commercial objectives with private transport and logistics players, there are two alternative options: 1) to create a "service" company with participation of companies specialized in intermodal transport (combined land transport and intermodal maritime transport), which will care for the development of relationships and of land and sea trade; 2) internally transform the management company itself, so that starting from a simple real estate company it turns into a full logistics operator, by acquiring a different composition of public / private capital, as well as the necessary know-how.

It seems reasonable to argue that, with the briefly mentioned necessary adjustments, "*interporti*", in this way understood, have all the needed requisites in order to carry out the functions of a dry port, in case privileged relationships with the gateway port are activated and an area coherent with the dimension of flows coming from port areas is made available.

This area should be supplied with dedicated regular railway services, up to forms of controlled customs corridor, which turn it into a full customs presidium, without interruption from the quay. Exactly because of the multi-functionality which has always characterized their nature, the offer of "*interporti*" will however not be limited to solving "simple" management problems of space on quays. On the contrary, it will include customs services, administrative, insurance and handling services, which will be more or less consistent, more or less important for shipping lines, freight forwarders and shippers. This will lead to synergies with logistics elements "different" from actual maritime container repositioning, shifting onto combined land transport flows, even if with urban distribution, fully achieving what has been defined both as "port-to-market" and "port-to-door".

All this will of course depend on the one hand on the mix and degree of interaction these components will reach in the logistics compound, as well as on the level of connection the "*interporto*" will be able

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to offer at urban, regional, national and continental level. On the other hand, it will depend on the degree of coordination with sea-borne transport.

Evaluation of possible locations for dry ports has been, as mentioned, the object of studies by scientific literature and of several interesting modellings. One of them, by Ambrosino and Sciomachen (2013), refers to a specific case, concerning the logistic network of North-Western Italian regions. It aims at evaluating possible locations for container flows from the various maritime terminals of the port of Genoa, which head for the hinterland by road and railway. As the scholars highlight, the innovative aspect of this model resides in the fact that a containerized flow, originating from a point of origin and directed to a destination, can be divided along its journey, precisely at a dry port, also according to types of transport modes.

This study brings into evidence some logistics platforms, located just past the Apennines (at about 100 km from the maritime terminals). They are close to the coast and pivotal between port and hinterland. However, in the scholars' perspective, an element of geographic rather than economic convenience prevails.

A distinction of dry ports into categories based on distance seems to make space, at least in this specific case, for allocative considerations which, independently from orography, better define the conditions of the previous transport configuration in the studied country. The mentioned research seems to be aware of this in its conclusions, where it sets the accent on accessibility characteristics rather than on distance.

Still on the mentioned case, even the role of re-sending flows of goods towards "port to market" areas of destination can be seen as a prevailing distinction as opposed to "geographic distance" or "kilometric distance" from port to node, surpassing any "pivotal" optimisation.

In this specific case, at less than twice the distance from the mentioned barycentre (about 150 kilometres), there is a European communication axe of the "core" type, and on it there is a corollary of the most relevant "*interporti*" of the Italian network, in one of the consumption and transformation markets most relevant in Europe in terms of GDP.

Small distances from port terminals are not an isolated case in the Italian landscape, and what was said on the above case may apply to "*interporti*" of Eastern and central areas of the Peninsula. This difference in kilometres seems even more irrelevant when evaluated from the point of view of tariffs and of railway efficiency. As is well known, shuttles originating from ports are not subject to rigid trade-off logics (tonnage, length of the route). They are rather based on frequency, reliability and balance.

Flows generating from the port can converge there, whether they then need to carry on swiftly, by the same mode or by a different one, or whether they need to undergo any handling and transformation and then be forwarded to distribution in the area or in farther away markets.

Convergence with intermodal land flows on land axes/corridors opens an interesting area of study, maybe not yet thoroughly explored, on possible synergies deriving from them for some operational and managerial aspects.

Notteboom and Rodrigue (2009a) seem to agree on the fact that in any case within the scientific community there is insufficient consent on official cataloguing. They argue that in practice such nodes take up different shapes, functions and roles within their network, and are thus not easy to codify. Therefore, they decided to single out and describe three macro-categories: "port terminals", "rail terminals" and "distribution centres". In the "rail terminals" category they seem to identify a "freight distribution cluster", as a complex system, resulting from the combination of a "load centre" with a rail terminal with a "freight distribution centre" and the range of logistics functions typical for it.

In our view also the functions described in the third category, the ones of "distribution centres", seem to be among the typical ones for an "*interporto*".

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Indeed, the transfer service of goods contained in maritime containers, land containers, truckloads, or their different regimentation into "transport sub-units" (pallets), as well as "cross-docking" activities and warehousing activities, are absolutely among the standard functions every medium-large "*interporto*" already carries out usually.

In an ideal interpretation of Legislative Decree n. 169 there should not be any kind of competition between port and "*interporto*", since their market areas are still rather separate, even though, as we shall see in the next paragraph, they are more and more the core of integration strategies and policies. A port should in fact strongly rely on the "*interporto*" in order to maintain its degree of attractiveness and to carry out in an optimal way not only the operations of goods unloading and loading, but also those of penetrating its hinterland, rapidly reaching markets. This is even more true if we think of the marginality conditions of Italian ports in this specific sphere. Competition among "*interporti*" themselves is more easily conceivable, not so much as final destination hubs of the reference market, but mainly as to typical functions of orientation to continental markets. Some service elements are more profitable for a land platform and less for a port, where, on the contrary, they are an impediment and an obstacle for rendering high added value services in the best of ways. Possible future alliances need to be designed on this.

The Relationship Between a Port and an "Interporto"

The relationship between a port and an "*interporto*" may be conditioned, in one country more than in others, by instruments of legal nature, more or less accentuated, more or less consistent, as was the intention of the Act for reforming Port Authorities in Italy. There is a precedent to this regard, concerning the evolution of the railway network in this country (in the past made up of many small stations and of a railway traffic oriented at diffuse traffic, up to single wagon). This evolution was pushed forward in the early nineties of last century, as well as by the free market, also by Act 240/90: they directed it towards a model of large mesh network, the reference stations of which should have been precisely the "*interporti*", as in fact it is nowadays.

With the recent establishment of Port System Authorities (AdSP), and thus with the creation of complex port systems including ports and port terminals differing among themselves as to technical characteristics, functionality and kinds of products, it seems realistic to presume that the maritime and the terrestrial part will further evolve, at a level of complex clusters (Figure 1). Port system performances will more and more depend on associated inland networks, and vice versa (Jeevan et al., 2019). At the same time, the different size scale and offer of services will more and more signal the adequacy of land clusters to support port activities and to release them from local ties which in several ways hinder their growth and efficiency. As Notteboom and Rodrigue (2005) affirm, talking of "port regionalization": «*No single locality can service efficiently the distribution requirements of such a complex web of activities. (…). Port regionalization thus permits the development of a distribution network that corresponds more closely to fragmented production and consumption systems*».

The bodies governing "*interporti*" as well as those administering ports are, as mentioned, of a public nature and governed by public law; by mandate, they can and should play a preeminent role in establishing a layout of reciprocal interdependence from the point of view of connections, service continuity and feasibility, and easy physical and IT access to structures. As to modalities of flow movement and commercial aggregation, it is easy to foresee that their role, also in view of competition rules, can only be that of mere facilitators.

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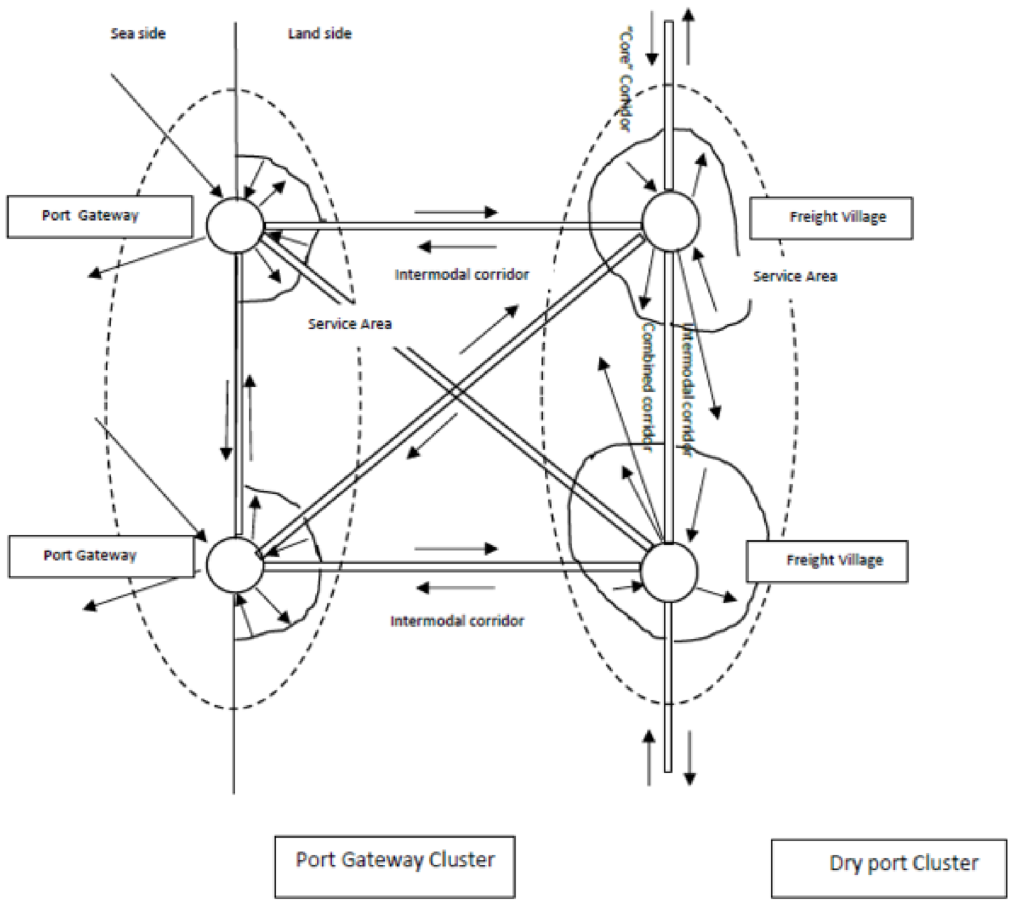
Figure 1. Relationship between maritime and terrestrial complex systems: Port Gateway Cluster and Dry Port Cluster
Source: Authors' elaboration.



Other important stakeholders for the development of more and more agile and performing relationships between port areas and external spaces are the Customs and Monopolies Agencies. The Trans European Network Transport - TEN-T programme foresees, at Union level, many European projects aimed at finding out innovative solutions for the supply chain, involving Customs Authorities. These Agencies have activated innovative and significant tools in order to enhance fluidity of maritime trade, new procedures hastening up container movement between port areas and warehouses for temporary custody, among which road and rail "Fast Corridors" **(2)**, customs clearing on sea (Pre-clearing) **(3)** and the "Solas Branch" (Safety of life at sea) **(4)**.

Not to forget, in this sphere, the entry into force of the new Union Customs Code - UCC (Regulation (EU) n. 952/2013 of 9th October 2013 – Basis Regulation), which foresees remarkable bureaucratic simplifications. The introduction of such innovative practices, combined with the legal rules and the transformation of the shipping market, will lead to important new layouts in logistics clusters. It is not by chance that the first experiments nowadays carried out in Italy in terms of "Fast Corridor" mainly concern "*interporti*". The first Fast Corridor "Tiger Project" successfully experimented in Italy involved the port of Genoa and the "*interporto*" of Rivalta Scrivia.

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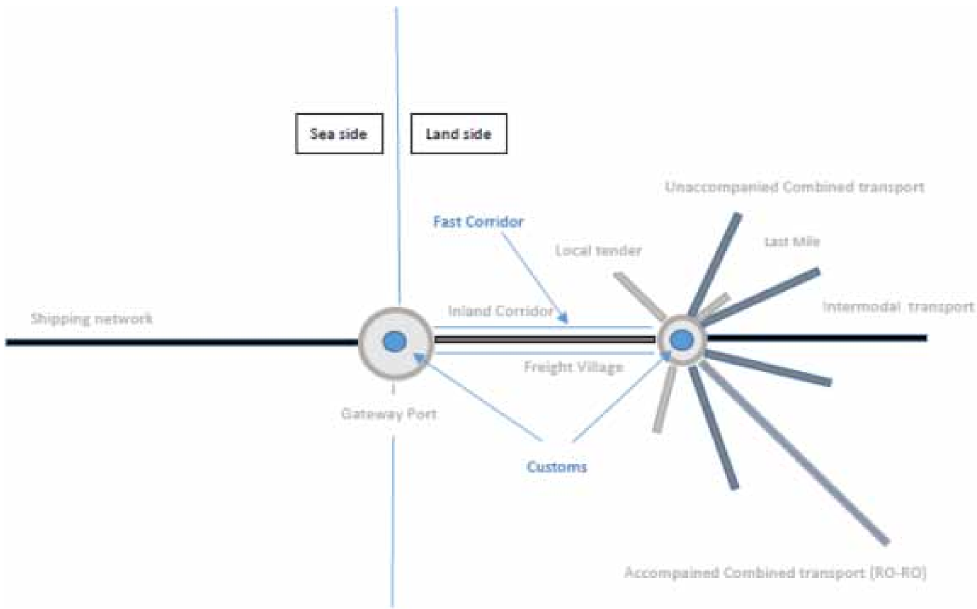
Port flows are often very different from one another. Deep-sea trade might prevail on trade generated by short sea shipping and vice versa, or there can be more or less balanced combinations of the two. For the former, at an "*interporto*" facility not only a change of mode can be enacted: within it, through indirect transhipment, one can move from maritime intermodality to combined land mode. Similarly, for Ro-Ro trade one can move from maritime mode to combined accompanied mode (rolling motorways), frequently appearing in the offer of many "*interporti*" in the North of the Italian peninsula for crossing the Alpine barrier. Figure 2.

Figure 2. Freight Village as co-modal dry port
Source: Authors' elaboration.



STRATEGIC ISSUES: SOLUTIONS AND RECOMMENDATIONS

See Side Activities

In studies on the internationalisation of companies operating in terminal business, aimed at appreciating and examining the role played by the various elements influencing their decisions, one can find useful and interesting research material. It needs to be stated in advance that by its own nature the mentioned sector already has in itself an intrinsic vocation to international expansion and that, having coordinated the "sea side" activities, i.e. shipping and port operations, transport towards the hinterland becomes the central, primary element for completing any initial strategy aimed at entering new markets.

As from the early nineties of last century, there has been a progressive, serious restructuring process of the port and terminal industry. Similarly, to many other industries, also the so-called container port industry was confronted with the challenges deriving from liberalization, privatization and globalization (Dombois and Heseler, 2000). At the same time, transnational terminal companies emerged, able to manage a portfolio of terminals located in different geographical areas and countries (Olivier, 2005).

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In this context Yip (2003) prepares an own model, applicable to the container port industry, which recognizes four different drivers: (1) government drivers; (2) competitive drivers; (3) market drivers and (4) cost drivers. Specifically, they are determinant factors in connoting the internationalisation phenomenon itself. In particular, as far as government drivers are concerned, Haarmayer and Yorke (1993), Grosdidier De Matons (1995), Okuda (2002), Midoro and Parola (2011), Demirel et al. (2012) argue that, while the expression "port reform" is normally used for an articulate modification of the institutional and governance setup of ports, as well as for the involvement of the private sector in financing and managing terminal facilities, the term "privatization" hints at a reorganization aspect consisting in the fact that a private subject takes up fields of competence and functions formerly overseen and carried out by public bodies.

At this point, it seems opportune to remind that the Italian Legislative Decree n. 169/2016 belongs to the family of "port reforms" and that the same was adopted only in 2016, over thirty years from the previous Act reorganizing the sector, dating back to 1984.

This provision certifies, at least at planning level, that an element such as an "*interporto*" is essential for the creation of an effective behind-port network, and qualifies the "*interporto*" as the logistic facility suitable to support sea-borne flows.

It is thus plausible that container industry transformations, even if following a mainstream for many aspects dictated by the market, and in any case influenced by more specifically economic-financial aspects, are combined in Italy, as in the various national – and sometimes even regional and local - environments, with typically local legal elements.

Sea Side Integration

Discussing market drivers, also Satta and Parola (2012) highlight how the presence of common needs in a specific community of customers plays a "contrasting" role as to the logics dominating the processes of the container port industry. On the one hand, indeed, handling services, thanks to the specificities of cargo units, can reach a high level of service standardization, coherent with a global approach; but on the other hand, elements of the service or of the supply chain escape from standardization logics (performance, service yield and availability, kind of pre-existing land connections, networks and facility chains etc.), and in any case need important local adjustments, based on national legislation or answering socio-cultural requirements of a given market.

Studies on the internationalisation of companies operating in the terminal business have classified the various operators, so as to better appreciate the different elements influencing their decisions. Parola and Musso (2007), Soppé et al. (2009), Notteboom and Rodrigue (2012b), Midoro and Parola (2011) have thus singled out four main categories of Intermodal Terminal Operators (ITOs): sheer terminal operators (stevedores); shipping companies (carriers); hybrid operators (hybrids) and financial operators. Among them, it is for the category of carriers that internationalisation strategies are essentially strategies of vertical integration; following them, they get over the difficulty of operating in a market context not corresponding with their core business, acquiring local terminal players. They do this in order to put a coherent terminal network at the disposal of their maritime transport activity, and they manage individual facilities as cost centres (Satta and Parola, 2012).

In pursuing these strategies, carriers tend to use facilities already available outside and communication channels they have activated earlier, in connection with their maritime activities (Peters, 2001).

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The combination of what affirmed above seems to further support the thesis by which at present and in the near future, in an environment of already set up networks, the phenomenon of sea side integration, brought forth by some of the above categories, might end up with crossing, and somehow interfering with, the mentioned company transformations still on at "*interporti*", deeply transforming their nature and business.

OPEN RESEARCH QUESTIONS

The authors propose to focalise a study case pertaining to the mentioned geographic context in a future contribution.

This is because the phenomenon nowadays allocating to "*interporti*" a function similar to the one of dry-ports is still in gestation, at least as far as Italy is concerned.

However, the authors do not rule out the possibility that a radical transformation of the logistics chain beyond ports may be capable, even on a broader geographic scale, of redefining the roles of terrestrial hubs which will come to belong to it.

"*Interporti*", or at least some of them, might thus turn into areas even more specialized and aimed at maritime traffic rather than at terrestrial combined services, which frequently do not cover all characteristic services previously mentioned by the authors when talking about dry ports.

Moreover, the dimensions of maritime transport will bring in important managerial changes, so that operability, information systems, and even governance itself might in the end be unified for ports and "*interporti*".

Another relevant issue which will require monitoring is the one of verifying how, in a market open to free competition, other initiatives with mainly private character might overlap with the "*interporti*" network, attempting to become part of this chain and compete by providing appositely designed infrastructure with even more specialized service packages, or by creating actually dedicated clusters.

By analogy with maritime transport, if, in order to accept mega 22,000 TEU container ships, ports will need to have suitable sea beds and cranes with an outreach to sea of more than 50 metres, inland terminals as well, on their side, will need extremely long and especially wide quays, so as to receive the container peaks these mega ships will pour out at every arrival.

CONCLUSION

In Italy, as well as presumably in other countries, the issue has its own character.

This is due on the one hand to geographic conditions, to past economic aspects and above all to the presence of a solid previous network of "*interporti*", derived from farsighted national planning and programming; and on the other hand to the latest port reform introduced by Legislative Decree n.169 of 2016, repeatedly mentioned above.

According to the latter, the "*interporto*" facility, which, as demonstrated, seems to fit in with the dry port criteria, is recognized as interface of a new, complex port organization system and called to support its intermodal or co-modal development.

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Some of the most important Italian "*interporti*" have indeed for some time been including into their activities a relevant quota of intermodal maritime trade, in practice carrying out functions proper to dry ports, and always coherently with the original logic of progressive modal re-balancing, in favour of co-modality.

In the light of the recent legislation and of the innovations in terms of simplified customs procedures, interesting new experiences unfold themselves, above all concerning ports in Liguria and the "*interporti*" system behind them, located on a couple of the most important TEN-T corridors of "core" relevance.

From this viewpoint it seems useful to closely observe their next developments, with particular attention to integration policies activated by Intermodal Terminal Operators or by shipping lines and to interaction between combined terrestrial industry and intermodal maritime industry.

A further forward-looking point which, by choice and because of the research field, was not discussed in this chapter seems to be the one concerning the functional sphere of "Special Economic Zones" (*Zone Economiche Speciali – ZES)* (Italian Law Decree of 20th June 2017, n. 91, converted with amendments by Act 3rd August 2017, n. 123); and, at Italian level, of those defined by a recent legal provision as "Simplified Logistics Zones" (*Zone Logistiche Semplificate" - ZLS*). The amendment to the 2018 Budget Law, published in the Italian Official Journal n. 302 of 29th December 2017, foresees the establishment of port areas where companies will benefit from some simplified procedures already granted to the "Special Economic Zones".

The above areas, within a particular circumstantial convergence as hinted, may turn out to be useful tools not only for international trade development, but also in support of strategies for rationalising and optimising relationships between terrestrial and maritime sector, thus creating, as argued in the study by Rodrigue and Notteboom (2009), a new generation port regionalization, or better an enlarged dry port cluster.

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KEY TERMS AND DEFINITIONS

Co-Modality: In brief, it is a notion seeking to achieve an optimum in the transport system thanks to an efficient use of different transport modes in combination and on their own.

Combined Transport: Typology of intermodal transport which "combines" at least two modalities of transport.

Dry Port: The expression "dry port" was at first used in order to describe a facility primarily directed at re-distributing flows of goods arriving by sea. Nowadays there is no unanimous consensus concerning cataloguing it. The main reason for the terminological differences is the way the facilities look in different geographic areas.

Intermodal Maritime Industry: The business sector of shipping lines, carriers, Global Terminal Operators (GTO), port operators, stevedores.

Interporto (Freight Village): Logistics and intermodal platform connected with the world's top hubs.

Maritime Container: Known as "ISO container" or "ISO box," it's a standardized Intermodal Transport Unit.

Transport Network: A set of routes linking locations. The framework of each region represents a complex system of all its economic and social relations.

Transport Policy: A policy which decides the distribution of transport resources and plans their implementation.

ENDNOTES

1 These stars revolve around a common point, which is the centre of gravity of the system, each making an elliptical orbit the barycentre of which is one of the two focuses. Almost all history of astronomy texts ascribe the discovery of double stars to Giovanni Riccioli (1598-1671), an Italian Jesuit and astronomer.

2 They are road or rail corridors for container movement, constantly traced and monitored, between port areas and spaces outside ports (without additional formalities), functional to goods warehousing and customs handling at the place of destination.

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3 A procedure by which batches are "declarable" before being unloaded from the ship. Even before the ship arrives and docks at berth, "Customs clearing on sea" enables to carry out not only all Safety & Security controls on the load, but also to anticipate the complex administrative procedure of clearing goods and paying customs duties.

All this happens through online dialogue, on basis of precise IT controls, between Customs Authorities, Maritime Authorities, shipping companies, managers of container terminals and operators, i.e. importers, forwarding agents and customs agents.

Thanks to this procedure, container stopping time at ports will be significantly reduced, all unloading operations will be optimised, and above all, all containers already cleared and released will be directed straight to the exit from the port; while batches to be controlled will be directed to verification areas.

4 After a long and complex bureaucratic/administrative path started in 2003, the "Solas customs branch" was activated in Italy in July 2011, in a temporary setup while waiting for the "online dialogue" among all administrations involved in the clearing procedure to be definitively completed.

The Customs Agency is the coordination office among the various Administrations involved in the clearing procedure: 18 bodies for a total number of 68 applications for certificates, authorisations, licences etc.

This process of interoperability will be advantageous in terms of speed in goods release and of lower costs for operators.

The complete enactment of the "Sole customs branch" is fundamental in the pre-clearing procedure, in order to achieve all advantages in terms of control effectiveness, fast release of goods and consequent efficiency.

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Chapter 3
Renegotiation of TMEC (USMC) on the Agricultural Exports of Sinaloa

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ABSTRACT

Mexico, like other countries, invested in measures to attract foreign direct investment to their territories. It therefore signed USCM in 1994, a treaty that imposed Mexico as the largest direct exporter of the United States, a country that is likely to leave the treaty by renegotiating TMEC (USMC). Therefore, this research is carried out to determine the advantages and disadvantages of renegotiation based on Sinaloa's agricultural exports, with the question of whether it would negatively impact the USMC renegotiation of Sinaloa's agricultural exports, with the hypothesis that renegotiation of USMC has a negative effect on Sinaloa agricultural exports. The purpose of this chapter will be with results in favor of the hypothesis employed.

INTRODUCTION

In Eduardo Galeano's book "The Open Veins of Latin America" he stipulates the phrase: The people who buy rule, the people who sell served; trade must be balanced to ensure freedom; the people who want to die sell to only one people, and the people who want to save sell to more than one (Galeano, 1970).

The regional agreement called the Mexico, North American Free Trade Agreements (NAFTA) signed between the governments of Mexico, Canada and the United States in 1992 that entered into force in 1994, to create a free trade area, at a reduced cost for the exchange of goods between the three countries. In 1994 the North American Free Trade Agreement (NAFTA, now TMEC) entered into force. Since

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1994 when the North American Free Trade Agreement (NAFTA) entered into force, creating one of the largest free trade zones in the world and establishing the basis for strong economic growth and greater prosperity for Canada, the United States and Mexico.

For 15 years, the NAFTA has demonstrated how free trade contributes to increased wealth and competitiveness by providing true benefits to families, farmers, workers, manufacturers and consumers (NAFTA de hoy, 2017). The North American Free Trade Agreement (NAFTA) is a regional agreement between the Government of Canada, the Government of the United Mexican States and the Government of the United States of America to create a free trade zone (Secretariado del TLCAN, 2014).

The North American Free Trade Agreement (NAFTA) or United States, Canada and Mexico Agreement (TMEC) is the set of rules that Mexico, the United States and Canada agree to sell and buy products and services (Castro, 2008). It was an innovative treaty aimed at opening and expanding the North American market. Since then, the NAFTA has systematically removed most of the tariff and non-tariff barriers to trade and investment between Canada, the United States and Mexico, leading to the establishment of a stability and confidence framework for long-term investments.

It has been recently renegotiated as México, United States and Canada Treaty (TMEC). The TMEC was preceded by the Canada-United States Free Trade Agreement (EXPANSION, 2017, p. S.p). President Donald Trump was in a renegotiation crisis due to the entry into power of the government of the United States, who proposed to rearrange the rules established in the treaty with faithful benefits in his favor and if not, he announced the departure of his country from the agreement. The renegotiation has already been finalized, but there is in Mexico a wave of uncertainty about what would happen to its exports, since it is the main supplier of raw materials and a variety of merchandise to the United States.

Currently, a series of changes have emerged in the decisions of the governments involved in the TMEC, mainly the United States. Therefore, it is of utmost importance to research a viable investigation about the impact of the renegotiation on Sinaloa exports, since the state Sinaloa has earned the nickname of being the breadbasket of Mexico for the large amount of raw materials that the state produces. It is the number one state in supplying its agricultural products to the neighboring country (United States). That is why the present project is delimited in a spatial way to firmly base ourselves on determining the advantages and disadvantages that by the renegotiation of the TMEC were implemented in agricultural exports Sinaloans.

Therefore, it is of utmost importance to investigate and determine the impact of the renegotiation of the TMEC on Sinaloan agricultural exports, a state called “the granary of Mexico” for its wealth in agricultural crops and which has earned the first place of exploitation of these raw materials to be exported to the neighboring country, the United States.

That is why this research work is aimed at determining the advantages and disadvantages in production, trade and distribution network that will prevail after the renegotiation. Taking as indicators, Mexico’s exports and trade, the gross domestic product (GDP), GDP per capita, and transportation logistics for export shipments, this chapter intend to

1. Analyze the renegotiation of the TMEC
2. Determine the advantages of Sinaloan exports
3. Determine the disadvantages of Sinaloan exports
4. Analyze the productions of agriculture in Sinaloa
5. Analyze Sinaloa’s trade in relation to the USA

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Some of the questions that this study tries to answer are: Will the renegotiation of the TMEC negatively impact Sinaloa agricultural exports? What would be the production in Sinaloa's agricultural exports based on the renegotiation of the TMEC? How would trade in agricultural exports in Sinaloa be based on the renegotiation advantages of the TMEC? and what would the distribution network in Sinaloa's agricultural exports look like depending on the disadvantages of renegotiating the TMEC?

Mexico, like other countries, invested in measures to attract foreign direct investment to its territories. Consequently, in 1994 it signed the NAFTA (North American Free Trade Agreement), with the United States of America and Canada, a treaty that imposed Mexico as the largest direct exporter to the United States, a country that will possibly exit the treaty by renegotiating the TMEC. Therefore, it is important to carry out this research to determine the advantages and disadvantages that for the above mentioned were implemented in Sinaloenses agricultural exports, which is one of the main export productions and source of employment for many Sinaloenses, it is expected that, if the renegotiation was not feasible for our country Mexico, it would have to abandon said treaty.

The main objective of the study is to determine the advantages and disadvantages of renegotiating the TMEC based on Sinaloa's agricultural exports. The specific objectives are to determine production in Sinaloa's agricultural exports based on the renegotiation of the TMEC, determine trade in agricultural exports from Sinaloa based on the renegotiation advantages of the TMEC and to determine the distribution network in Sinaloa's agricultural exports based on the disadvantages of renegotiation of the TMEC.

THEORETICAL-EMPIRICAL REVIEW OF THE LITERATURE

According to the classic free trade theory developed by David Ricardo, all countries win when they participate in a free trade zone. Theoretically, the idea that each country should specialize according to its comparative advantages has some logic (Dillon, 1991). The TMEC drives economic growth and dynamic trade, stimulates investment and at the same time creates productive alliances, adapts to small and medium-sized companies in a framework of fairness and certainty. TMEC partners promote environmental protection and offer greater job opportunities in North America (Audley, Demetrios, Papademetriou, Polaski, and Vaughan, 2003).

After the declarations of Wilbur Ross, Secretary of Commerce of the United States, on "a sensible negotiation" of the North American Free Trade Agreement, experts see measure in the position of that country. The Secretary of Commerce of the United States, Wilbur Ross, seems to have given the TMEC a breather, after having said in an interview with the NBC network that a "sensible" renegotiation of the treaty would strengthen the weight, experts agreed (El Financiero, 2017). "(This statement) indicates that not only (Trump) is taking a negotiating stance, it indicates that this stance, this softness, reflects the broad consensus that exists in the US, at least among companies, that there are great benefits for both countries (with the TMEC)," said David Shirk of the University of San Diego. On this side of the border, the analysis is similar; For Jessica de Alba, a researcher at the Anahuac University, this first warning from Ross is positive. It is a positive and encouraging reaction in terms of investments and free trade in North America (El Financiero, 2017).

For Ernesto O 'Farrill, president of Bursamétrica, Ross's comments indicate that in the US they are willing to modernize the trade agreement and not abandon it. "The statements are far from the initial position that Mexico was going to bend in the TMEC negotiation, and threatened to leave unilaterally. The statements are showing that the TMEC is alive and can undergo a modernization process, "he as-

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sured. The decision to strengthen the Mexican peso may have the objective of preventing Mexico from having an unfair advantage, in order to reduce its currency appreciation. Which, in turn, means that the United States wants to continue trading with the country, added O'Farril. He explained that the third line of actions focuses on discovering ways to raise wages and improve the living conditions of Mexican workers (El Financiero, 2017).

With this it is understood that it can be a measure to discourage migration to the northern country. For ranchers, the situation shows an opening gesture. "(Washington) has made it clear that they are clear today of negotiating the treaty and that this is convenient for us. In this situation that we have a sensible dialogue on foreign trade, we applaud and congratulate it because it is what our countries require", said Rogelio Pérez, director of Mexican Beef, the exporting branch of the Mexican Association of Livestock Fattening (AMEG) (El Financiero, 2017).

However, Shrik warned that while it may be perceived that the balance is now tilting more on the side that the TMEC will be maintained, it should not be thought that what a cabinet member says is precisely the same as Trump thinks, because a constant in the little more than 40 days that Trump had been in office is the uncertainty in his relationship with Mexico. "We don't know who we're going to wake up with tomorrow," Shrik said, referring to Trump's fickleness. In contrast, Arturo Pérez Behr, president of the National Association of Importers and Exporters of the Mexican Republic, expressed caution before Trump's comments (El Financiero, 2017).

"The fact that there is talk of renegotiation, and no longer a cancellation of the TMEC, is a positive issue, the threat issues are decreasing, it is a good way, but that does not mean that we no longer have to be on the lookout for statements that President Donald Trump makes, hopefully that is already the speech of the government in general, "he said. He explained that Asian countries such as China have taken advantage of what the TMEC establishes legally, so it cannot be considered as abuse. "We have to advocate for our country, whatever suits Mexicans," he added. (El Financiero, 2017)

In a bilateral FTA it is not feasible to negotiate internal aid because it is impossible in practice to identify which products enter a country with aid and which do not. Therefore, domestic aid has not been negotiated in this treaty with the United States (Mypimes, 2017). Today there is a general consensus regarding the benefits of the economic integration of nations. Free trade is good because it allows access to a greater number of goods and at lower prices, which should increase social welfare. It allows access to cheaper inputs and capital goods, which should increase the competitiveness of the productive sectors that add value.

Free trade promotes the efficient allocation of resources because price signals are not distorted: when there is a shortage of a good, its price rises and producers receive the signal to increase supply (and consumers to reduce demand); when there is abundance of a good, its price falls and producers receive the signal to reduce supply (and consumers to increase demand) (Mypimes, 2017).

AGRICULTURAL FREE TRADE: THEORY AND REALITY

From a macroeconomic point of view, opening the current account of the economy is equivalent to opening the economy to the savings of the rest of the world. However, the reality of international trade, in the specific case of the agricultural sector, is far from that first best theoretician called free trade. Why? To resolve this question, it is necessary to understand that the agricultural sector is special and different from the other sectors of the economy and that the conservation of agricultural activities translates into

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a benefit for all of society. When a product is purchased from a peasant, not only the product itself is received, but also the lawful and peaceful occupation of the national rural territory (Mypimes, 2017).

In other words, in addition to a product, peace and tranquility is also received from the peasant in the countryside and, therefore, peace and tranquility in the cities. Of course, this positive externality for society would never be reflected in the free market price of agricultural products. But since societies value this positive externality, we then accept distortions in the price of some products in the agricultural sector in order to make them economically viable and profitable for farmers (Mypimes, 2017).

In practice, international trade in the agricultural sector suffers from three types of distortions or barriers.

First, there are the tariff barriers. These include ad-valorem tariffs (percentage of the price of the good), specific tariffs (a certain value on the price of the good), quotas (import quotas). Second, there are the non-tariff barriers, whose restrictive effects on trade are in many cases greater than the tariff barriers. Among these types of distortions, the sanitary technical and phyto / zoo standards that are imposed for the importation of products stand out. Third, we have export subsidies. Given their fiscal capacity, developed countries prefer to protect the rural sector with domestic aid and export subsidies.

An export is to send national or nationalized goods for use or consumption abroad" (Minister of Foreign Affairs and Cooperation, 2017). Exports are sent abroad to obtain plant products through knowledge developed by man, destined to cultivate the land. Production sent abroad from the primary sector that uses cultivation as its main activity obtains raw materials. Developing countries have to resort to tariff barriers to protect our rural producers. It is very important to keep in mind that what is negotiated in an FTA is border support (tariffs). The reason is simple. In a bilateral FTA it is not feasible to negotiate internal aid because it is impossible in practice to identify which products enter a country with aid and which do not. Therefore, domestic aid will not be negotiated in this treaty with the United States (Mypimes, 2017).

First, because, just as the United States cannot negotiate in this treaty the internal aid that its producers receive. Second, because as the Democratic Security policy progresses successfully and the defeat of the narco-terrorist threat becomes more evident, there will be considerable and increasing increases in employment and in national agricultural production. Third, because E.U., it is the main commercial partner of Colombia. In effect, it receives 40 percent of our agricultural exports and our trade balance with said country has a surplus of 500 million dollars (approximately 1,100 million dollars of exports against 600 million dollars of imports). Fourth, because the United States is the richest market in the world. It is made up of 300 million consumers with an average annual income of $ 30,000 per person.

Fifth, because the United States is a protected market, and therefore a high-price market for many agricultural products. Sixth, because if we do not negotiate and sign the FTA, we lose preferential access to the United States market at the hands of our competitors who have already signed an FTA with that country (Central America, Chile, Australia, etc.). Seventh, because the signing of the treaty is the way to perpetuate beyond 2006 the benefits and job creation attributable to the preferences that the United States grants us with the Atpdea, and eighth: because as security, technological development and advances in infrastructure (irrigation and roads) generate increases in the productivity of the agricultural sector, the profitability of agricultural activities will increase (Mypimes, 2017).

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CONTEXTUAL FRAMEWORK OF EXPORTS IN SINALOA

According to data from the SEDECO COFOCE information system, in Sinaloa at the end of 2015, the agro-food and agriculture sectors contributed 62 percent of total exports in the State. According to this source, the main exporting company in Sinaloa is Sukarne SA de CV Grupo VIZ, with a participation of almost 28 percent of total exports. Followed by the auto parts company located in the city of Los Mochis, Deplhi de México SA de CV, and Envases Universales de México which is in Mazatlán and the agro-industrial sector Citrofrut and Conservas La Costeña, with operations in Rosario and Guasave. The existing companies at the end of 2015 registered in this system was 607 exporting companies (CODESIN, 2017). See table 1 below.

Table 1.

NUM	COMPANY NAME	EXP ENE - NOV 2015 (USD)	SHARE
1	SU KARNE SA DE CV GRUPO VIZ	$ 706,613,325.39	27.64
2	DELPHI DE MEXICO SA DE CV	$ 190,609,983.35	7.46
3	ENVASES UNIVERSALES DE MEXICO SA DE CV	$ 121,929,090.41	4.77
4	CITROFRUT	$ 91,670,524.68	3.59
5	CONSERVAS LA COSTEÑA	$ 90,508,024.29	3.54
6	TERRA WEALTH TRADER SA DE CV	$ 81,213,869.37	3.18
7	COMPAÑIA MINERA PANGEA SA DE CV	$ 69,077,770.88	2.70
8	BIOPARQUES DE OCCIDENTE	$ 54,389,001.85	2.13
9	CEUTA PRODUCE SA DE CV	$ 46,667,563.19	1.83
10	GRANOS LA MACARENA	$ 43,010,555.81	1.68
11	GENERAL BRANDS MANUFACTURAS DE MEXICO, S.	$ 36,893,112.75	1.44
12	GRANEROS UNIDOS	$ 34,534,093.89	1.35
13	PRODUCTORES DEL MAR DE MEXICO	$ 32,790,797.17	1.28
14	AGROIDNUSTRIAS DEANDAR DE DELICIAS SA DE CV	$ 28,883,344.55	1.13
15	EXPORTALIZAS MEXICANAS SA DE CV / RENE PRODUCE	$ 25,718,963.07	1.01
16	AGROEXPORTADORA DEL NOROESTE SA DE CV	$ 24,127,318.57	0.94
17	VALORES HORTICOLAS DEL PACIFICO SA DE CV	$ 22,847,270.70	0.89
18	CONDUCTORES TECNOLOGICOS DE JUAREZSA DE CV	$ 22,696,553.50	0.89
19	INDUSTRIAS MARINO SA DE CV	$ 21,622,249.26	0.85
20	EXPORTADORA AGRICOLA SACRAMENTO SA DE CV	$ 21,562,663.95	0.84

Source: CODESIN Sinaloa Council for Economic Development (2015).

In 2016, 14 countries opened their markets to receive, some for the first time, others after certain limitations, animal products from Mexico. As a result of the negotiations of sanitary protocols carried out by SAGARPA with the authorities of 14 countries and the European Union, the opening of markets was achieved in 2016 for 18 Mexican products, nine of animal origin and nine vegetables, explained the federal agency. Due to the negotiations that were carried out through the National Service of Health, Safety and Agro-Food Quality (Senasica) with various nationals, the prohibition to export pathogen-free eggs and egg products to the European Union was lifted and the market for Mexican honey reopened in Saudi Arabia (Torres, 2017).

Agro will have a privileged place in any negotiation: SAGARPA Regarding products of plant origin, since last year, Mexico has exported blueberry to China; table grape from Sonora to Australia; tomato seedlings to the United States and sugar cane (in vitro or hardened) to Peru. In addition to sorghum brushes to Chile; stevia plants to Guatemala; corn seed to Ecuador; Chili seed to Portugal and amaranth grain for consumption in the neighboring northern country, Turkey and the European Union (Torres,

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2017). According to information from SAGARPA, this year it is expected to expand the offer of Mexican products abroad, for which talks have already started with health services from more than 15 nations. About 13 Mexican products of Mexican origin are expected to "step on" the land of countries such as Russia, China, Indonesia, Iran, Singapore, Vietnam, Taiwan and Japan for the first time (Torres, 2017).

MATERIALS AND METHODS

Type of Research

It is an exploratory investigation, it has the primary objective is to facilitate a greater penetration and understanding of the problem that is faced. It is analytical because it is descriptive and is more linked to statistical and control data, in order to generate a hypothesis about what happened, or to occur, predict failures or events. And of an empirical type since it is based on experimentation or observation (evidence).

Research Design (Table 2)

Table 2.

Variable	Description	Dimensions	Indicators	Research instruments	Operacionalization of variables	Statistical analysis
X0 TMEC	"The North American Free Trade Agreement or NAFTA is a trade agreement between the three countries in North America: Canada, the United States of America and Mexico." (TMEC, 2016: s.p.). (NAFTA, 2016: s.p.).	Renegotiation Advantage Disadvantages	US exit from the treaty. Exports Commerce	Bibliographic analysis Hemerographic Analysis	Review of practical case Bibliographic analysis	Analytical Study Exploratory study Empirical study
Y0 Agricultural Exports	Product of the primary sector that you dare from cultivation as a production activity obtains raw materials	Production Commerce Red de distribution	GDP distribution network GDP per capita in Sinaloa Opening to new markets Logistics	Bibliographic analysis Hemerographic analysis	Review of practical case Hemerographic Analysis	Analytical Study Exploratory study Empirical study

Source: self-made

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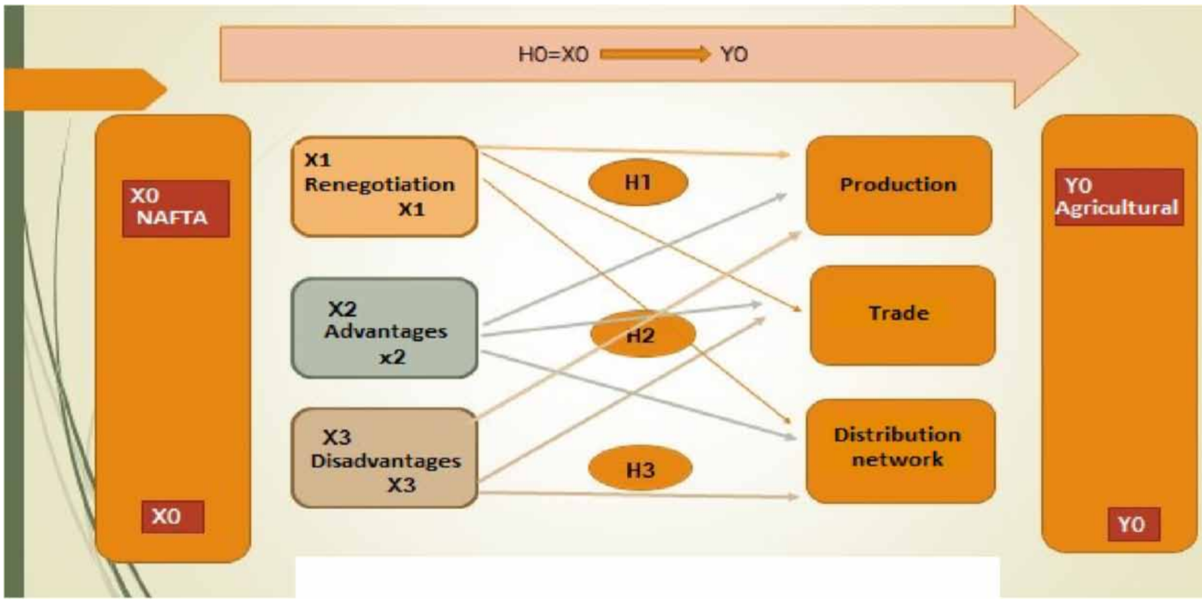
Research Construct (Figure 1)

Figure 1.



Research Instrument

The instrument used in this research project is bibliographic analysis and hemerographic analysis because it focuses on the renegotiation of the NAFTA (North American Free Trade Agreement) for which this research is based mainly on agricultural exports of the state of Sinaloa was proposed with indicators such as the US exit from the TMEC, Exports-Trade, GDP and GDP Per capita of Mexico, opening to new markets, logistics. Materials and methods should be described in sufficient detail to allow others to replicate and build on published results.

DATA ANALYSIS

Quarterly GDP Growth Annual Rate

The Mexican economy grew 2.9 percent at an annual rate in the first quarter of 2016, according to preliminary figures from the National Institute of Statistics and Geography (INEGI).

This advance represents the best first quarter for Mexico since 2013, and the highest quarterly growth since the second quarter of 2014.

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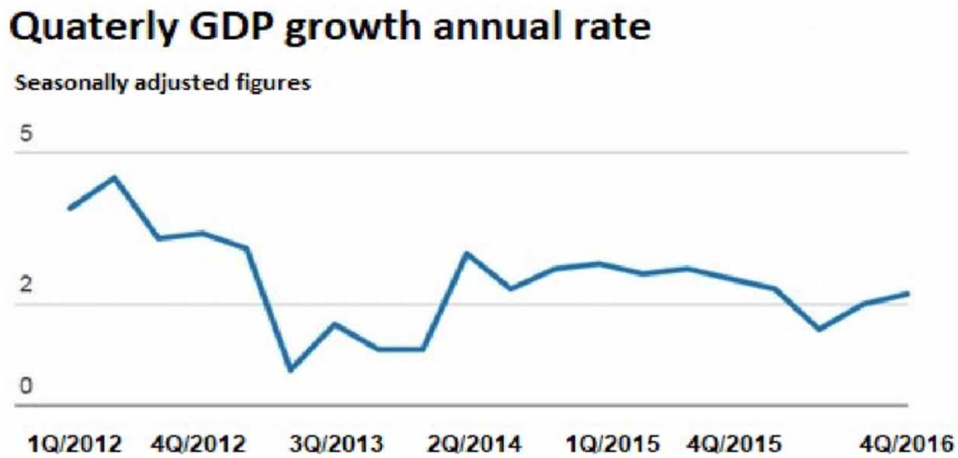
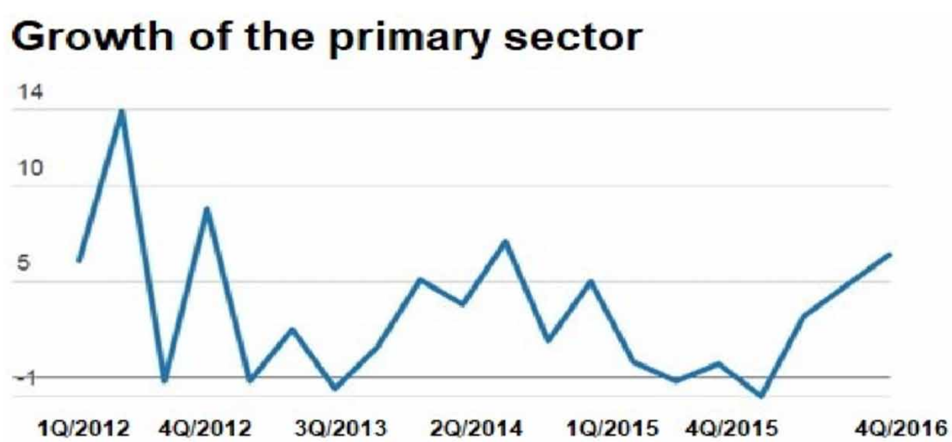
Figure 2.



Growth of the Primary Sector

While the primary activities, that is, those related to agriculture, advanced 3 percent at the annual rate, surpassing the 2.9 percent advance that occurred last year.

Figure 3.



Depreciation Impact on Wealth of Mexicans

GDP per inhabitant represents the economic value of the goods and services generated by a nation that would correspond to each inhabitant if wealth were distributed equitably (BANXICO, 2017) (CONAPO, 2017). The Gross Domestic Product (GDP) is the value of the final goods and services produced by a country during an established period. GDP per capita or per capita is this same measure, but divided by

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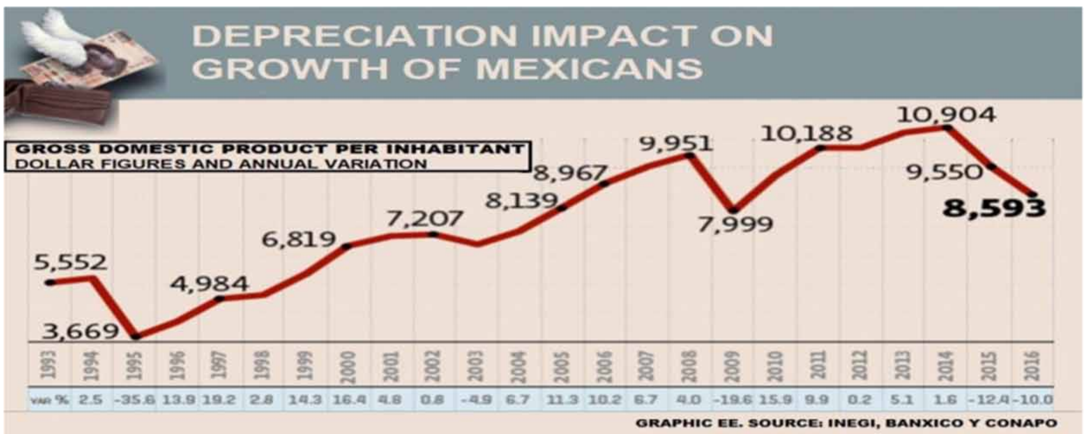
the population of a country. In 2014, the GDP per capita for Mexico reached its highest level in history, but only two years later, this measure registered a drop of more than 20 percent.

The GDP per capita represents the economic value of the goods and services generated by a nation that would correspond to each inhabitant if wealth were distributed equitably. This implies that, if a country's Gross Domestic Product increases while its population remains stable, then the GDP per capita increases; but if the population increases while the GDP remains constant or decreases, then the GDP per capita will also decrease.

Figure 4.



Export Logistics

The success of international trade in any country or region is essential without an access door that allows the proper transit of goods and services. In Mexico, the port of Veracruz is an example of the country's commercial and industrial development since the 16th century. Today, its importance is indisputable and its challenges are increasingly complex, as the evolution of industrial processes and the type of goods test any logistics system. The logistics chain begins with the production of the raw material and ends at consumption centers. In this sense, seaports are nodes in the physical network of maritime transport; and their competitiveness depends on the fact that those they offer are fast, flexible and safe for international trade and shipping lines.

According to a study by the Inter-American Development Bank (IDB, 2017) (IDB) on cargo logistics in Latin America and the Caribbean, there are at least three perspectives to consider to understand the importance of the logistics process in an economy: the generator cargo (industry), cargo operator (services) and the public policy environment. It is the orderly interaction of these three elements that allows logistics operation costs to be consistently reduced over time.

In the first stage of the expansion, 16,000 million pesos will be invested by the Federal Government and by the end of the project in 2030, they will have invested 70,000 million pesos, of which 42,000 would be private and 28,000 publics. The World Bank (Banco Mundial, 2010) (WB) ranked Mexico, in 2010, in 50th place out of 155 countries with a performance of 3,051. Some consultancies have estimated that logistics costs in Mexico represent 15.3% of the Gross Domestic Product (GDP). The logistics costs

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of Mexican companies are 10.3% of sales, of which 40% correspond to transportation costs and 60% to inventories, order processing, storage and planning of transportation operations management (Market, Real Estate, 2017).

Recently, the federal government and the IDB carried out a study on the National System of Logistics Platforms (SNPL) (National System of Logistics Platforms, 2017), which defined that the system would be made up of 85 logistics platforms, highlighting the investment of infrastructure and services, to increase the efficiency of supply chains. In this context, it can be observed the performance of Mexican ports in recent years. For example, in 2010, commercial imports by sea were 75.2 million tons and 122.2 million tons were exported to all regions of the world. In 2013, 81.1 million tons were imported and 129.1 million were exported (Market, Real Estate, 2017). This increase was possible because Mexico traded this way, both on the Gulf and Caribbean coast (15 ports) and in the Pacific Ocean (20 ports), the port of Veracruz being the most representative for the manufacturing industry.

According to the Economic Commission for Latin America and the Caribbean (ECLAC, 20) (CEPAL, 2014), in the ranking of containerized port movements in the 2010 region, the port of Veracruz ranked 18th; and for the first semester of 2013 it was ranked 16. On the other hand, in 2014, according to the study of port technical efficiency, prepared by the IDB, the port of Veracruz occupies the 22nd efficiency site of a total of 63 ports in Latin America and the Caribbean (Market, Real Estate, 2017). The port of Veracruz is the most important commercial port in the country. Through it, 100% of purely commercial cargo transits and the only one that significantly operates the six most important cargo segments nationwide:

Exports registered a decrease of 10.7% when moving 4,730, 856 tons. Trade has as a priority to carry out the expansion of the port because this will promote employment and will boost the economy of the region and the state. The entities where most of these vehicles come from are: Puebla, Estado de México, Aguascalientes, Coahuila, Tamaulipas, Nuevo León and Veracruz. This port is the most representative for the export and import of motor vehicles. According to the following table, the port of Veracruz moves 66% of total vehicle exports by sea (Market, Real Estate, 2017).

In addition, the port of Veracruz, with respect to the movement of vehicles in roll on / roll-off, has a performance of 128.8 UHBO (unit of hour ship in operation). Currently, the port of Veracruz has 48 companies that offer related services in terms of: For the Mexican State, the development of the maritime-port subsector is key to the economic growth of the country; therefore, the interaction of the private sector and the government is important, and the latter has the task of carrying out public policies in order to strengthen and make it more efficient as well as modernizing it.

In the coming decades, the port of Veracruz will be one of the most important logistical-maritime enclaves in the country and on the Atlantic coast to communicate the central region of Mexico with the markets of the United States and Europe. Likewise, it will connect the national industry with global supply chains, which will allow it to be more competitive and face the challenges of global trade and manufacturing (Market, Real Estate, 2017).

Export Movements by System, Mexico 2013

In this pie chart it is made clear that the most used transportation in Mexico for 2013 is by land, followed by sea.

The three products with the highest export of Sinaloa are Tomato, Corn and wheat.

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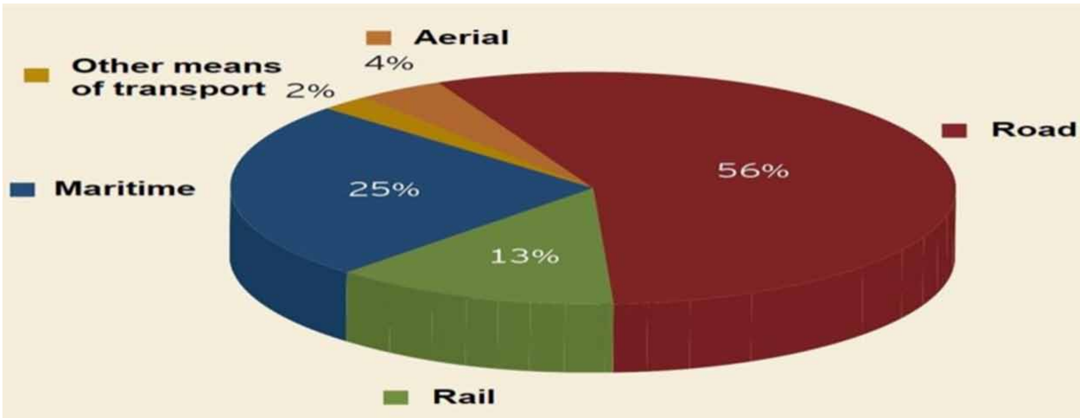
Figure 5.



Sinaloan Exports Of the total Sinaloan exports to other countries, 82.5 percent corresponds to sales to the United States market. In income, this represents 8.9 percent of the State Gross Domestic Product. During 2014, Sinaloa exported products for about 770 million dollars, which represented 0.2 percent nationally. The main shipments were tomato, chickpea, beef, fish oil and flour, shrimp, squid and tuna. The North American Free Trade Agreement (TMEC), which the United States intends to renegotiate, has represented a 339 percent growth in the value of Mexican exports to the United States since its implementation.

Nationally, more than 80 percent of exports go to the United States. This represents a high dependency of the country's productive sectors with the neighbor to the north. And the larger a state's trade with the United States, the greater its vulnerability. Vegetables were the main product in the period from January to June 2010. In the same period, the 10 main imports from the North American market to our country were corn, soy, soy residues, wheat, pork ham, other foods, boneless meat, powdered milk and cream, fructose and starch waste.

Twenty-two states in Mexico export vegetables to the United States. These exports represented about 583 thousand 795 million dollars, Guanajuato being the leading state. 21 other states imported vegetables from the United States for 23 million 139 thousand dollars. That 2014, Sinaloa exported vegetables to the northern neighbor for a value of 12 million 139 thousand 433 dollars. In turn, it imported American vegetables for $ 84,628. Thus, the value of the exports of vegetables from 22 states to the United States exceeds their imports.

The bilateral relationship is key If the United States market is important to Mexico, the same thing happens in reverse. According to the United States Department of Commerce, Mexico is the second destination for exports from that country with 15.7 percent of the total, preceded by Canada with 18.6 percent and is the third largest provider, with 13.1 percent of imports, after China, which accounts for 21.5 percent, and Canada, which accounts for 13.2 percent. For example, Mexico is the second commercial partner of the state of Michigan (our country receives 31.03 percent of the total exports of that North American entity). In the case of California, the Mexican market imports 12.53 of the products that that entity sends abroad. For Nebraska this is 14.53 percent.

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Vegetable Exports and Imports, Mexico-EU

It is noteworthy that the US content of Mexican exports to the American market is almost 40 percent of the components of these products, according to the National Bureau of Economic Research. Renegotiation, under the magnifying glass The announced revision of the Free Trade Agreement draws the attention of the economic sectors of our country. Achieving maintenance and expansion of the agreements is an urgent need for many states highly dependent on the United States market for their exports.

In the case of Sinaloa, this commercial relationship represents 8.9 percent of the state GDP and this is mainly for food. There are other more vulnerable entities. Examples of this are Chihuahua, Baja California, Coahuila and Tamaulipas. For all these states, exports to the United States represent more than 50 percent of its Gross Domestic Product and, for the most part, are from the manufacturing sector (El debate, 2017).

Research Limitations

During the preparation of this research, there were time limitations since it was carried out during a seven-week stay, and the research period could not be exceeded, the money limitation was found since the necessary financial resources were not available to carry out a field research, data collection since the variable “Y” which is agricultural exports made it difficult to extract information, and reliability due to the information collected.

RESULTS

As an analysis of the results of this research, Mexico has quarterly GDP growth at an annual rate in the last three years with a constant 2%, GDP per capita has been increasing until 2014, where from that year it has been decreasing, it has a behavior of the primary sector that has been in constant change for 2015, down to minus 1 but for 2016 it has increased up to 6% according to the financier, Mexico’s exports to the US have grown by 339% in terms real since the implementation of the NAFTA with less quantity are imports by Mexico from the US with 151%.

Mexico-US trade has been in constant change, it is currently at 81%, in 2014 the Mexican states exported to the United States for a total value of 583 million 794 thousand 468 dollars, Sinaloa with the amount of 12, 139, 4443 dollars of which the three exported vegetables are tomato, corn and wheat, Mexico imported a smaller quantity of US vegetables for a total value of 23 million 139 thousand 098 dollars, Sinaloa exports to the US 82.5%.

Of the Sinaloan exporting companies in first place is Graneros United with 34, 893, 112.75 (USD) with participation of 1.35 and in the general ranking of exporting companies is in 12th place. In second place, Agroindustrias de Andar de Delicias SA de CV with 28, 883, 344.53 with participation of 1.13 in the general position 14, and in third place Agroexportadora del Noroeste SA de CV with 24, 127, 318.57 participation 0.94 according to CODESIN.

In 2010, the World Bank places Mexico in 55th place out of 155 countries with transportation performance 15th in port technical efficiency according to the economic commission for Latin America. According to Yuridia Torres, the financier Mexico can expand and open its market to new countries such as China, Australia, Peru, Chile, Guatemala, Portugal, Turkey, Russia, Indonesia, Iran, Singapore,

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Vietnam, Taiwan, Japan, and the European Union. It would be a greater advantage if the renegotiation of the TMEC were not to be satisfactory for Mexico.

It was questioned in this study that the renegotiation of the TMEC has a negative effect on Sinaloan agricultural exports, with the in-depth investigation that was carried out, it is concluded that possibly if the United States decides to exit the treaty, it would greatly affect Sinaloa. As the main export destination to that country with 82.5 percent sales to its market, but this is no longer a fact with greater probability since President Donald Trump is considering renegotiation after the new elections in Mexico in 2018 to further facilitate the procedures that they are necessary and not the final solution, which leads us to conclude that the hypothesis is negative.

Renegotiation together with the advantages and disadvantages has a direct relationship with agricultural production in Sinaloa, with a serious negative effect, since overproduction would be created if the new destination for exporting from Sinaloa was not quickly available. Renegotiating together with the advantages and disadvantages has a direct relationship with agricultural trade in Sinaloa, it would negatively affect since Sinaloa would be left without its main export destination, but it would have the alternative of opening up to send its products to new countries like China, Peru, Chile, Guatemala, Portugal, Turkey, Russia, Indonesia, Iran, Singapore, Vietnam, Taiwan, Japan and the European Union, which are countries that in 2016 opened their market to Mexico.

The renegotiation together with the advantages and disadvantages has a direct relationship with the agricultural distribution network in Sinaloa, it would greatly affect the sea and land ports since they are the most popular transportation routes in Mexico, being used more frequently auto transport and later the seaports, the most used being the one in Veracruz.

DISCUSSION

Mexico is a very capable country, with sufficient resources to stand out before other countries in Latin America and the world, it is only a matter of having an efficient president who knows how to take advantage of and exploit the riches of this country, who focuses on being persevering and growing every day more to become a developed country, increasing the quality of life of its inhabitants. Mexico should not be so dependent on the United States since it can maintain its economy even without its support. It must eliminate prejudices and uncertainties and export its productions to new markets, risking out of their comfort zone to obtain even more favorable results for the Mexican economy.

This research can be of great help to the main agricultural exporting companies in Sinaloa, to different secretaries such as, secretary of economy, SAGARPA, SEDECO, SENASICA, PROMEXICO, Chambers of Commerce, students of the Autonomous University of Sinaloa (UAS) to the degrees of Economy and International Commerce.

In this context, the expansion of the Veracruz port complex, which is expected to be completed in 2025, is an indicator of public policy aimed at strengthening the port network. With a total investment of 60,000 million pesos, and 23,933 million pesos between 2013 and 2018, the port will achieve the highest number of maritime entries and freight mobility in accordance with the National Infrastructure Program 2014-2018. With this, an expansion of the port in the north is expected in: breakwater, navigation channel, piers and specialized terminals, specialized equipment, new yards and storage area.

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In this research, there were different limitations due to the difficulty of obtaining specific information when compiling the concepts that defined the variable "Y", which is called agricultural exports, and the reduced amount of time that it had to carry out the research project.

CONCLUSION

As a general conclusion of this research project, it is contended that the renegotiation of the TMEC does not have to put the agricultural commodities and products from the State of Sinaloa in a wave of uncertainty regarding its exports, since it was accepted the renegotiation and a fair agreement was reached for the three countries. Included in this agreement, there are different clauses that protect agricultural exports from any unfair act that is intended to be done. Besides, this made us investigate new possibilities for agricultural export growth for Mexico since Countries like China, Australia, Singapore and others have opened their markets to receive imports of agricultural goods from México. Finally, the results are satisfactory for the continuing growth of agricultural products from Sinaloa to Canada and United States, the TMEC partners

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KEY TERMS AND DEFINITIONS

Agricultural: Belong or relating to agriculture or farmer.
Exports: To send goods to another country for sale.
NAFTA: North America Free Trade Agreement.
Renegotiation: Negotiation whose purpose is to introduce modifications to something already agreed.
Sinaloa: One of the 32 federal states of Mexico, located in the Northwest.
TMEC: México, United States, and Canada treaty.
USCM: United States, Canada, and Mexico.

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Chapter 4

Design and Deployment of Dynamic Performance Targets for the Lastmile Field Executives in eCommerce Logistics Industry

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ABSTRACT

This chapter is an action research done for one of the largest eCommerce logistics organization (having presence in India) to design a working mathematical model which rates the field operations staff all around the country based on the dynamic targets depending upon different parameters, and then finally ranks the field executives relatively across the country. To ensure that the rating of the field executives is a fair and transparent process and discounts the influence of the nature of shipments provided to them problem, the authors worked with one of the largest global eCommerce delivery firms to design a rating system of the field supervisors using R.

INTRODUCTION

In today's World of enhanced competition, the selling price of the products are governed by the market forces of demand and supply, and the firms enjoy a very little influence over the same. So, they have no option available than to resort to operational excellence for lean processes and reduced waste. They need to attack the problems as soon as they rise, in a smart manner. The ever-increasing competition and

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ever-decreasing profit margins have made it all the more essential to survive using operational excellence as the savior. The field executives are the key pillars for achieving operational excellence. The last leg of delivery is handled by the delivery staff or field executives (FEs) and thus their performance directly impacts the company overall performance as a logistic service provider. Hence, there is a need to design a monitoring system on the FEs which showcase their performance on day to day basis and at the same time over a period of time relative to other FEs in the same DC (Distribution Center) and also across the country. This not only helps the higher authority to keep an eye on FEs performance but also helps FEs to improve their performance as they get real time analysis on their performance respect to other FEs in the company. This, in turn, creates a sense of competition among the FEs which is beneficial for the company. There is need for a transparent system which would judge people solely on their performance and eliminate the middlemen intervention in the hiring or incentive process.

Since the eCommerce transactions happen in a humongous quantity, they generate a lot of data related to the influence of the shipment specific factors on the delivery performance which can be used the eCommerce delivery service providers to come up with a dynamic rating system for the FEs.

Since the lastmile logistics industry is being run by the field executives, it becomes essential to manage and monitor the performance of the field executives. Verill (2016) said that only what is measured can get improved, and emphasized on rewarding the aspects like attendance and regularity, and on quantifying the wow moments. The performance management consists of a set of activities starting with the setting of the targets. Therefore, this paper attempts to create a target setting framework for the field executives of the lastmile logistics industry.

Supply chains can perform well only if the human resources operating the same are well motivated and rewarded for the performance, while being penalized for the under-performance. This requires a fair, transparent and scientific method of appraisal which considers the shipment-related factors impacting their performance. Supply chains are more likely to be successful when the human resource factors create a competitive advantage (Gowen and Tallon, 2003 and Huo et al, 2015).

There has been a surge in eCommerce transactions in India and globally. This has led to creation of lot of employment opportunities in the eCommerce Sector. With the new employee acquisition, there comes a more important responsibility to retain the talent. An important pre-requisite to retain the talent is to ensure rewards to the performing talent in a fair and transparent manner. However, by virtue of its nature, the logistics sector in India has been an unorganized one. The delivery boys are generally outsourced to an outside organization. Also, since the job profile is more transactional and less cognitive in nature, the workforce in the doorstep delivery is at the lower end of intellectual spectrum of workforce. There is a prevalent practice of favoritism being displayed by the supervisors in hiring as well as the career progression of the field staff.

Also, the currently used evaluation models in this industry have not incorporated the impact of variability in location, payment mode and shipper type on a FE's performance to convert a shipment. For instance, the chances to convert a prepaid Flipkart shipment vs chances to deliver a cash on delivery (cod) HomeShop18 shipment differ drastically. Similarly, the field executives serving higher order density localities will tend to appear more productive than the ones serving the low order density localities. Also, these evaluation models have the dependency on the delivery center heads for field executive's ratings, thereby bringing in the respective heads and supervisor's bias against a particular FE.

This research work describes the setting of smart and dynamic productivity targets for the field executives (which are function of delivery location, number of shipments, nature of shipments, etc.) given

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that each delivery location, and each shipment type has its unique characteristics which are beyond the control of the field executive.

This paper is structured in the following manner. The Section 1 (i.e. the current section) explains the background and the motivation behind this research. The Section 2 does a review of the existing literature on performance management frameworks and goal setting. The Section 3 explains the basic working of the lastmile logistics in the eCommerce industry. The Section 4 lists down the key concerns of the logistics sector that are not addressed by the existing frameworks on performance management. The Section 5 discusses the parameters, and the scope of the framework. The Section 6 explains the rationale for the different criteria and the rating process for each of them. The Section 7 covers the consolidation of the final score, followed by the section 8 in which the caveats for using the proposed model have been mentioned. Finally, the paper concludes with Section 9.

LITERATURE REVIEW

The importance of goal setting for the employees cannot be undermined. As early as in nineteenth century, Bryan and Hartner (1897) discovered the improvement in the performance of the telegraph operators when the goals were defined and clearly known to them. Taylor (1911) also emphasized that each worker should have a specified task to perform with a specific amount of work to be done in a specific time. Wyatt, Frost and Stock (1934) found that the monotony or boredom at work was reduced by giving specific goals to the factory workers. Locke (1960) while proposing the Goal Setting Theory of Motivation suggested that goal setting is essentially linked to task performance. Meyer, Kay and French (1965) advocated the significance of goal setting in performance appraisals. Longnecker (1999) advocated that performance management systems are required to justify a wide range of human resource decisions such as salary increments, promotions, retrenchment, validation of selection criterion, etc. He also said that effective performance appraisals are required to maintain a competitive edge. Roberts (1992) emphasized that the acceptance to the appraisal system by the rater as well as the ratee is very important for its effectiveness.

There have been several works on performance management framework. A few of the pioneering works on development of performance management frameworks are by Ross (1984), Globerson (1985) and Colney (1986). Ambrose and Alder (2000) did the study on designing, implementing computerized performance monitoring to enhance organizational justice. Ribitzky (2007) claimed that the active monitoring of the employees is on the rise. Zetlin (2010) said that the mobile technologies such as Xora can be used to track the workers and bring in efficiencies in the performance of the mobile workers. He said that the use of such technologies may create a concern of privacy intrusion in the initial period, but over a period of time, the employees tend to realize its benefits.

Bhave (2014) discussed that use of electronic performance monitoring improves the performance of the employees. Masood et al. (2016) integrated several ontologies to monitor the performance of service oriented systems, and carried out the performance evaluation and made the use of real web service to measure the response time, delay, etc. Tomczak and Lanzo (2017) emphasized that the electronic performance management systems need to be designed while keeping the employee attitudes and perceptions in mind, in order to get the most out of them. He also advocated that real-time tracking through electronic performance monitoring should be a tool for learning and development rather than deterrence, and that

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it should be related to work related behaviors only. Also, he stressed on the need for the transparency to be displayed by the organizations on the use of EPM.

A BRIEF INTRODUCTION TO THE LASTMILE DELIVERY PROCESS IN ECOMMERCE INDUSTRY

There are 3 stages in delivery in logistics industry- first mile, mid mile and last mile. As soon as the soft data of the shipments is received by the logistics firms, the system gets to know about the incoming shipments details like the pickup place, shipper name, destination of the shipment and other important details. Hence the planning is done to pick up the shipments from the various pickup centres setup all across the geographies. Once a shipment is picked up, it is sent to the Pre- Processing Centres (PPCs) for sorting and bagging. The process mentioned above falls in the first mile category

The mid- mile process starts when the PPCs sends the bags to the Hubs, which act as an intermediary between the PPCs and Delivery Centers. In the Hubs, the bags are sorted and then sent to their respective delivery centers or Hubs using the respective milk runs

Once the delivery centers receive the shipments it is then timed accordingly for the delivery to the consignee. This is the last mile process, on receiving the shipment by the consignee the process gets completed. The delivery is attempted for many times and if it's not delivered after the nth attempt, the shipment is sent back to the shipper. This is known as reverse logistics. Reverse logistics also occur in the case when the customer finds the product damage or faulty and ask for the shipper for the replacement or refund.

The Figure 1 states the different steps that a shipment has to go through from the pickup stage to the delivery at customer's doorstep.

Figure 1. Journey of a shipment from consignor till customer

THE KEY CONCERNS OF THE ECOMMERCE INDUSTRY THAT COULD NOT BE EXPLAINED BY THE EXISTING PERFORMANCE RATING FRAMEWORKS

There are several gaps in the existing literature on performance rating systems that make them less useful for the lastmile industry.

First, the traditional employee rating frameworks have been based upon the end-of-the-year appraisal. The targets are set at the beginning of the year and the employees' performance is evaluated after the end of the year. Now, it is being increasingly realized that the performance evaluation has to be an ongoing activity in the context of changing times that require the organizations to be more dynamic. Today's

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organizations are working in a VUCA world that is volatile, uncertain, chaotic and ambiguous. A few of the obvious reasons for this can be cited as the ever-changing moves by the competing players, by the regulators, the changing consumer preferences, the ever-evolving business models, the increasing automation of business processes, etc. In such a situation, the targets also need to be constantly changing throughout the year. This can be done when the targets keep evolving on real-time basis and are linked to the current values of internal and external variables.

Second, in traditional framework, there is a lack of emphasis on creation of fair targets for the employees. The targets of each of the employees performing the same job may be different depending upon the job conditions which are offered to them. For example, a sales person selling a premium product in a posh geography has a higher chance of converting the sales leads as compared to another sales person selling that product in a downtown locality even if both of them may be equally good at selling. Thus, the existing studies have not considered how to even out the assignment asymmetry while setting the targets for the executives. Unless this assignment asymmetry is evened out, there cannot be a fair comparison between the performance of the multiple field executives.

Third, since each job is different from every other in terms of the nature of skill set and competencies required, and in terms of market dynamics, there is a need to have a more specific framework considering the ground realities of that industry. This need was considered by many researchers earlier also, responding to which, Conley (1986) had designed a performance management framework that was customized to be specifically applied to teachers. Locke (1991) came out with the model that can address the goal setting needs of the sports industry. Roberts (1994) developed such a framework for municipal corporations' personnel administrators. Gamini & Sivalogathasan (2010) developed it for banking sector. However, there is no such work for the lastmile logistics sector which has recently evolved in past five years with the growth in the volumes of eCommerce transactions.

Fourth, the existing frameworks are silent on the use of data analytics for making the structured decisions on employee incentives and retrenchment processes in the presence of large data sets, as in the case of the eCommerce industry.

METHODOLOGY

The Model Proposed for Target Setting of Field Executives

The following steps have been carried out in this action research:

Selection of Evaluation Criteria for the Performance of Field Executive

The evaluation parameters were selected in accordance with the suggestions from all the relevant stakeholders: the operational staff and the managers. Seven parameters were presented to the stakeholders, followed by the structured application of Analytic Hierarchy Process through which the four factors were finalised, along with their weightages.

The performance of FE's needs to be calculated based on the following parameters:

- Conversion%
- Attendance

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- Same Day attempt %, and
- Compliance issues (Genuine fuel bill claims, Genuine delivery attempts)

Let us now discuss these parameters one by one in Section 6.

Table 1. Sum of weighted ratings obtained for the different prospective criteria in AHP exercise

Parameter	Sum of weighted ratings (on a scale of 0 to 1 per pairwise comparison) obtained
Conversion %	11.23
Attendance	5.05
Daily Status Update	3.11
Compliance	0.99
Weight of shipment	0.25
Dimensions of shipment	0.19
Mode used for delivery	0.18

Table 2. Calculation of weightages for the criteria on the basis of ratings

Parameter	Sum of ratings obtained	Weightage as per the ratings	Rounded-off Weightage
Conversion %	11.23	53.47%	55%
Attendance	5.05	24.04%	25%
Daily Status Update	3.11	14.80%	15%
Compliance	.99	4.71%	5%

DESIGN OF THE RATING SCALE FOR EACH CRITERION

Factors Affecting the Conversion

On visiting a few delivery centers of the company and having a discussion with the DC Heads and Supervisors, the following parameters were decided on which the conversion targets shall be based: Locality, Shipper type, Attempt count, Product type and Payment mode. The two-way ANOVA tests were conducted to check the factors that have a significant influence on the conversion rate. The Table below shows the two-way ANOVA conducted on the Pin Code and the Product Type. The Pin Codes A,B, C and D were selected in the decreasing order of the order density, with Pin Code A having the highest order density.

Thus, Two-way ANOVA tests were deployed to check the influence of all the five variables on the conversion rate, taking two of these variables each time; and it was discovered that there is a significant association of each of these categorical variables with the conversion rates. We got the F-values to be greater than the critical F values in all the ANOVA tests.

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Table 3. Results of two-way ANOVA for the influence of product type and PIN Code on conversion rate

Anova: Two-Factor Without Replication

SUMMARY	Count	Sum	Average	Variance
PPS	4	3.41	0.85	0.01
COD	4	3.07	0.77	0.01
RS	4	2.52	0.63	0.00
PIN A	3	2.50	0.83	0.02
PIN B	3	2.35	0.78	0.01
PIN C	3	2.21	0.74	0.01
PIN D	3	1.95	0.65	0.01

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Product Type	0.099	2	0.05	208.07	0.00	5.14
PIN Code	0.055	3	0.02	77.07	0.00	4.76
Error	0.001	6	0.00			
Total	0.156	11				

We also confirmed the above on the basis of prevailing theoretical constructs. The rationale for these 5 factors is explained below:

Pincode: the chances to deliver a shipment vary with geographical variations. Also, making a successful delivery in a residential society is in sheer contrast to that in tech parks.

Shipper Type: The chances for a successful delivery also heavily rely on the shipper whose shipment the FE is taking out for delivery.

Product Type: it is classified into 3 categories – Cash on delivery (COD), Prepaid (PPD) and Reverse Shipment (Rev). The chances for a successful delivery relied heavily on the product type.

Attempt Count: The chances of a successful delivery decreased with the increase in the attempt count.

Rating Targets and Scores for Conversions

Once we had found the factors influencing the conversion rate, the levels for each factor were decided, and the shipment types were determined with each possible combination of factor levels. The Table 4 shows the levels corresponding to each of the factors.

Since there are four factors affecting conversion, at 3, 3, 4 and 3 levels, we have 3*3*3*4 = 108 shipment types. After determining the 108 shipment types as explained above, the conversion targets were calculated for each shipment based on the past aggregate average for the past one year. The Table 5 shows the expected conversion for each shipment type.

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Table 4. The levels corresponding to the factors affecting conversion rates

Factor	Number of Levels	Levels
PIN Code Class on basis of order density	3	High, Medium, Low
Product Type	3	Prepaid, Cash on delivery, Reverse pickup
Attempt Count	4	1, 2, 3 and 4
Shipper Category on basis of product quality and brand perception	4	High, Medium, Low

Table 5. Expected conversion for each combination on an aggregate level

Pincode	City	Shipper_code	Attempt_Count	Product_type	Fwd_Vol	Deliverd_Vol	aggregated_conv
110001	DELHI	241069	1	cod	44	26	0.590909091
110001	DELHI	28446	1	cod	1342	860	0.640834575
110001	DELHI	28992	1	cod	18	15	0.833333333
110001	DELHI	30893	1	cod	103	68	0.660194175
110001	DELHI	321931	1	cod	1707	1117	0.654364382
110001	DELHI	34004	1	cod	13	10	0.769230769
110001	DELHI	35375	1	cod	115	84	0.730434783
110001	DELHI	501415	1	cod	154	94	0.61038961
110001	DELHI	661365	1	cod	17	12	0.705882353

Legends: Fwd_Vol is the volume of shipments handed over to a field executive, while Delivered_Vol is the volume delivered by him.

Each shipment instance (converted or non-converted) of FE is mapped against the Expected conversion (Target conversion) and a delta conversion is calculated as follows:

Δ conversion = Actual conversion - Expected conversion

- Post this, the Δ (conversion) of each FE is aggregated for an entire year, and a net overall conversion score is reached.

The table 6 is a hypothetical sample of how the deviation of the observed conversion was computed from the expected conversion.

After the computation of delta conversion, the percentile rank of FEs was calculated. Post the computation of the percentiles, the FEs were assigned the ratings based on the frequency distribution shown in Table 7 with 5% of FEs getting 1 and 5 Ratings each, 10% of FEs getting 2 and 4 Ratings each and 70% of FEs getting 3 Rating. This was done as per the requirement of the human resource function.

Rating Rationale for Attendance (Attendance Score)

The following are the steps followed in rating the delivery executives for attendance:

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Table 6. Computation of delta between observed and expected conversion

Emp_code	Employee name	Total Vol	Total Delivered	Expected Conversion	Delta %
101	A	7,304	4,720	5,131	-6%
102	B	4,642	3,680	3,753	-2%
103	C	320	202	227	-8%
104	D	9,146	6,191	6,343	-2%
105	E	3,951	2,113	2,647	-14%
106	F	8,741	6,121	6,195	-1%
107	G	9,108	5,093	5,552	-5%
108	H	1,432	939	1,025	-6%
109	I	8,021	5,145	5,461	-4%

Table 7. Frequency distribution used for conversion rating

FE Distritution

Rating	Employee%
1	5%
2	10%
3	70%
4	10%
5	5%

1. Receive the attendance of the FEs from the HR department. Compile the attendance of both on roll and off roll employees.
2. Fetch the holiday's data of each state for the period you are considering the ranking for.
3. Generate the attendance points based on the raw attendance and give extra points for people who came on holidays.
4. Fetch the tenure data and based on it give extra weightage as explained in the above example.
5. Finally, sum the total attendance of each FE and divide it by the maximum total attendance possible.
6. Finally set percentiles and calculate their grades, with the same distribution as in the case of conversion.

The Table 8 shows how the attendance is converted into a rating using the frequency distribution mentioned in Table 7, after computing the percentiles on the basis of attendance

Rating Rationale for Same Day Status Update (Productivity Score)

This parameter decides whether a FE is updating the status of a product being delivered or not from the same day of delivery. This is supposed to be the most basic duty of a Field executive and a FE is expected to deliver 100% on that.

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Table 8. Attendance rating score of the FEs

Emp_code	Employee name	Expected_days	Tot_Att	Attendance %	Attendance grade
101	A	304	305	100%	5
102	B	304	275	90%	3
103	C	304	288	95%	3
104	D	304	302	99%	4
105	E	304	283	93%	3
106	F	304	286	94%	3
107	G	304	294	97%	4
108	H	304	304	100%	5
109	I	304	283	93%	3

- Data for same day update can be fetched simultaneously while fetching the data from SQL query for calculating conversion
- The total same day update of a FE are aggregated for an entire year.
- Same day update% is calculated by dividing total same day update count by Total volume.

RATING RATIONALE FOR COMPLIANCE (COMPLIANCE SCORE)

Fake Attempt

An attempt is said to be fake if the FE sitting at delivery center only updates on the system saying that he attempted to deliver the shipment but the consignee didn't pick the call or was not present at the place of delivery, where the actual case is they never visited the delivery location. It is important to find out whether the person is doing fake attempts or not. Many a times, the field executives may show a delivery attempt while actually they have not done it. The rules can be applied on the data to identify whether a delivery attempt is a fake or genuine. Such rules are applied on data related to call bridge of the field executive with the consignee (the number of calls made, call talk time and call ringing time), the latitude and longitude details of the distribution center and the field executives at the time of delivery attempt, etc.

A few indicators related to the call bridge and the latitude longitude coordinates can signal the fake delivery attempts using the machine learning rules. For example: Each DC latitude and longitude can be obtained from google. Then for each update on the system by FE, its latitude and longitude can be obtained. And if it is found that the distance between the update and the DC is less than 50 metres, it can be considered as a fake attempt. Also if the update regarding multiple shipments is made on the system in less than one minute even though the distance is more than 50 metres, it is still considered under fake attempt.

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Non-Genuine Fuel Claims by the Delivery Executives

Regression models can be built, which come up with the fuel consumption for a route as a function of distance travelled, the order density, and the customer demographics of that locality. The fuel bills that are significantly beyond the amount predicted by such regression models can be tested for the authenticity. This can go a long way in ensuring that the dwindling margins do not get sidelined with the unethical practice of excessive fuel bills claims resorted to by a small percentage of the field executives.

Process used for Assigning the Compliance Score

1. Data is collected from the HR department regarding all misconducts of FE
2. The factors considered for are: Advisory, Absconding, termination, warning letter and show cause suspension.
3. Total misconducts are counted and aggregated for an entire year.
4. Finally, percentiles are set and Ratings are given accordingly.

Consolidated Rating

As explained in Section 6, we can get conversion score, attendance score, productivity score, and compliance score for each FE.

A cumulative score is developed from it giving weightage equal to 55%, 25%, 15% and 5% (as shown earlier in Table 1) respectively to finally arrive at overall grade, as shown in Table 9.

Table 9. Representation of the Overall Score computation

Weightage	55%	25%	15%	5%	100%
FE name	Conv. Grade	Att. Grade	Same day status Grade	Compliance Grade	Overall Grade
A	2	4	4	3	2.85
B	3	3	2	3	2.85
C	2	5	3	3	2.95
D	4	2	3	2	3.25
E	5	1	4	3	3.75
F	1	3	3	4	1.95

After assigning the overall score to each FE, the overall grades were assigned using the distribution shown in the Table 7. The Table 10 shows that on the basis of FE ratings, the FEs were classified into five categories as devised by the HR in accordance with the company's employee appraisal policy.

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Table 10. Grade ranges of the final appraisal

Performance Category	% of FEs	Grade Range
Outstanding	5%	>3.85
Very good	20%	3.4 to 3.85
Good	60%	2.7 to 3.4
Fair	10%	2.2 to 2.7
Poor	5%	<2.2

Results of the Action Research Study

This study found that the four factors are a key determinant of an FE's performance- conversion rate, regularity, same day status updation and compliance. The study also discovered that the conversion rate of the shipments is dependent upon the locality of order, the product type, the shipper and the attempt count. Not only this, the rating and ranking model proposed in this study for the field executives offers many advantages for the ecommerce delivery firms. First, this model brought it a standardized system of employee rating and ranking, maintaining a record of employee performance and basis for human resource decisions related to promotions, rewards, incentives distribution, retrenchment, etc. Second, with the deployment of this model, the control of the field executives passed from the distribution centers to the back office, which makes it more robust and free from bias. Now, the influence of favourable distribution of shipments to a few preferred field executives by the distribution center can be discounted to bring all the evaluation of all the executives at the same level. Fourth, the unethical activities of fake attempts and wrong fuel bill claims can be kept under check.

Caveats in Using the Dynamic Performance Rating Models

There are some cautions to be exercised for the use of dynamic performance rating model as shown above. First, as we have seen above, the dynamic realtime performance rating of the executives is based on tremendous amount of data for millions of shipments, and therefore, requires the use of data analytics tool, which comes at a cost. This cost of using data analytics (hiring data scientists and infrastructure) needs to be significantly lower than the expected benefits to be reaped through this exercise. Second, since these models also require to track the activities of field executives more closely, that results in a very grey line between the employee privacy and employee management (Zweig and Webster, 2002, McNall and Stanton, 2011). In other words, while the firms track the realtime activities of the field executives using technology, they should not intrude beyond a point in the lives of the employees. Thirdly, the tracking system has a degrading effect on the workforce (Zetlin, 2009). So, the realtime tracking system needs to be seen by the employees as a big help rather than as a big brother. The third caution is that these models being little more sophisticated in computation, need to be explained well to the employees so that they are able to comprehend the same well. Fourth, the firms need to invest in the infrastructure and data scientists to capture the real time data and leverage it for dynamically changing targets. Fifth, the performance appraisals, at times, impact the creativity of the executives (Barkus, 2015). This performance monitoring framework, like any other one, should be applied in a way that it does not hamper the creativity of the workforce.

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CONCLUSION

With the ever increasing competition and the resulting price wars, the selling price of the product is driven by the market forces and the consumer has been increasingly becoming a price setter rather than a price taker. Therefore, the manufacturers and supply chain networks need to work upon the operational efficiencies to make a decent profit margin. This in turn requires the logistics of the foods to be agile, lean while not compromising on customer responsiveness. This study lays a foundation for bringing in more efficiencies in the eCommerce logistics, which shall in turn, enhance customer satisfaction, increase the morale of the delivery boys and further expedite the digitalization of transactions in India and the World.

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Chapter 5

An Integration of Human Resources and Supply Chain Management for a Sustainable Competitive Advantage: A Resource-Based View

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ABSTRACT

In this chapter, a multi-disciplinary approach for creating sustainable competitive advantage is examined. This is the integration of human resources management and supply chain management. The primary aim is to come up with a solution to the research question of 'how do organizations create sustainable competitive advantage by integrating human resources and supply chain management?' In order to put forth the solutions, the resource-based approach is employed. A detailed literature review is given on the integration of two business functions to create sustainable competitive advantage. This chapter contributes to the literature, first by laying out the importance of resource-based view in both human resources and supply chain management, second by examining how do these two functions unite in order to obtain sustainable competitive advantage, and lastly, by enriching the limited number of studies so far on the integration of human resources and supply chain management with the help of a literature review.

INTRODUCTION

One of the eye-catching topics in strategic management which is the resource-based view has roots in the early study of Penrose (1959) named as *The Theory of the Growth of the Firm*. On the contrary to Rugman and Verbeke (2002), Penrose added much to the strategic management literature by fostering the concept of competitive advantage and the circumstances for sustaining this advantage by interacting

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with economic parties (Kor and Mahoney, 2003). And even after Wernerfelt (1984) generated the basis of modern resource-based view, the concept could not attract enough attention until 90s. But since 90s, there is a huge interest in resource-based approach. Along with this approach in strategic management another concept that is competitive advantage has been at the heart of business management. Early works of Ansoff (1965) and Porter (1980), concentrated on the internal strengths and weaknesses as well as opportunities and threats in the environment. These internal strengths and weaknesses have been built upon the resource-based view in strategic management.

Human resources management is unquestionably a factor that enhances both internal strength and competitive advantage for organizations. So far many researchers have underlined that effective human resources practices lead an organization to attain its goals and to have advantages over other organizations (i.e. Amarakoon et al., 2018; Chadwick and Dabu, 2009; Mayfield et al., 2016; Wright et al., 1994). Naturally, it is because of the importance of human resources as a valuable and unique asset for an organization since human resources are widely accepted as crucial sources by resource-based approach (Omondi-Ochieng, 2019; Wright et al, 2001).

Like human resources management, supply chain management is a vital function of a business since it includes management of raw materials, transportation, manufacturing, distribution and retailing activities (Hugos, 2018). With the help of globalization and improvements in information technologies, today supply chain management requires bringing separate organizations together which are responsible for every single chains of supply. This enables organizations to operate effectively and to interact with other organizations in their supply chains. To be successful in these operations, organizations need to develop capabilities for supply chain management so as to gain competitive advantage. This will also enhance them to possess unique resources from the perspective of resource-based approach.

In this chapter, it is aimed to integrate two vital functions of business management which are human resources management and supply chain management within the perspective of resource-based approach so as to gain sustainable competitive advantage. This will be achieved by carefully providing a literature review, and taking the supply chain management capabilities of human resources as a valuable resource for organizations. In previous research it was noted that human resources management played a key-role for supply chain management (e.g. Bendoly, 2006; Santos, 2000). Up to now, only limited studies have attempted to integrate these two main functions and they concentrate mostly on sustainability (e.g. Gowen and Tallon, 2003; Jabbour and de Sousa Jabbour, 2016). Nowadays, the whole world is facing a pandemic and it reshapes the whole manufacturing, distributing and retailing activities around the globe. This underlines the importance of supply chain management. It is obvious that only the organizations investing on effective supply chain management will survive. This can be attained by the organizational resources and one of the crucial factor is human resources. In this respect, after giving a brief background that provides definitions of sustainable competitive advantage and resource-based view, firstly human resources management for sustainable competitive advantage will be given. Following this section, human resources management will be taken from the perspective of resource-based view. In addition to this, supply chain management activities will be examined from the same perspectives. After discussing these concepts in two main sections, an effective integration of them will be provided. At last; contributions to the theory, future research directions, and conclusion sections will be given.

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BACKGROUND

Sustainable Competitive Advantage

In the strategic management literature the concept of competitive advantage has attracted attention from many scholars (e.g. Albrecht et al., 2015; Powell, 2001; Tallman et al., 2004). In addition to this, a further improvement has been achieved by defining the circumstances for sustaining the competitive advantage of firms in a long range of time. With the help of this attempt, the concept of sustainable competitive advantage has gained more importance lately. This is achieved based on the early contributions of Porter (1985) and Barney (1991). According to Barney (1995), an organization is supposed to have sustainable competitive advantage only when it has rare and valuable capabilities, skills and assets.

Organizations with sustainable competitive advantages seem to possess rare and inimitable capacities, capabilities, assets or wealth which make rival organizations unable to use same resources. Organizations generally try to get sustainable competitive advantages by generating knowledge (Mahdi et al., 2019), making innovations (Chatzoglou and Chatzoudes, 2018), hiring and motivating high-skilled employees (Barney and Wright, 1998), generating or using latest technologies, machines and equipment (Powell and Dent-Micallef, 1997) and having effective production, marketing or management capabilities (Aaker, 1989). From this point of view sustainable competitive advantage is widely used in resource-based view.

Resource-Based View

Built upon the competitive advantage literature, resource-based view is an approach that defines and examines the factors which enhance sustainable competitive advantages (Peteraf, 1993). Up to now, numerous researchers have contributed to the resource-based view to gain importance in strategic management literature (e.g. Alexy et al., 2018; Conner, 1991; Mahoney 2001). According to Barney (1991), the core proposition of resource-based view is an organization's need for acquiring and using rare, valuable, inimitable and non-substitutable resources, capabilities, assets and capital so as to possess sustainable competitive advantage. Serving for the proposition of resource-based view, some previous researches were also assessed the approaches: distinctive competences (Bryson et al., 2007; Coates and Mcdermott, 2002), dynamic capabilities (Eisenhardt, and Martin, 2000; Kim et al., 2015), knowledge-based approach (Cabrera-Suárez et al., 2001).

With the contributions of resource-based view to strategic management literature, organizations generate strategies to acquire and hold valuable and inimitable resources. In the literature, some factors were found to be related to resource-based view in order to get sustainable competitive advantage. Among them there exist; corporate environmental strategy (Aragón-Correa and Sharma, 2003), technology (Dubey et al., 2019), human resources management (Colbert, 2004), social responsibility (Sodhi, 2015), operations management (Bromiley and Rau, 2016), supply chain management (Shibin et al., 2020).Since the aim of this chapter is to examine the human resources and supply chain management to have sustainable competitive advantage, in the following section these two functions are analyzed.

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MAIN FOCUS OF THE CHAPTER

Human Resources Management from the perspective of Resource-Based View

Human resources management consists of activities related to the members or employees of an organization. It concentrates on the human side of organizations which is a vital factor for reaching organizational goals and objectives. Among the basic human resources management practices there exist; analyzing and designing jobs, human resources planning, recruiting, selecting, placing, and orienting employees, conducting training and development programs, managing compensation, motivating human resources, evaluating performance and managing talents and careers (Armstrong and Taylor, 2020; DeCenzo et al., 2016; Noe et al., 2018). Besides the basic practices, human resources management includes leadership and organizational behavior. Moreover, with the latest development in digitalization era, human resources management has built close relationships with knowledge management and artificial intelligence applications.

In the resource-based view literature, in order to provide sustainable competitive advantage, organizational resources, assets or capabilities must be valuable, rare, non-substitutable and inimitable (Barney, 1991). Moreover according to the resource-based view, an organization uses human resources management to generate competencies, which are specific to the organization. These competencies and capabilities are tangible or intangible specific approaches based on knowledge generated within and organization (Amit and Belcourt, 1999). It also gains the capability of generating tacit knowledge (Aït Razouk et al., 2009) and building social and organizational networks among members (Collins and Clark, 2003). In this respect, human resources management plays an active role in creating and using new knowledge as a way of gaining power for adaptation to the environment. This process is called as organizational learning (Snell et al., 1996). Furthermore, human resources management helps the organization build a shared climate for organizational success, and provide effective leadership for employees. Also gaining these types of capabilities, innovation and creative work behavior will be enhanced. And with the help of these capabilities, organizations will generate specific and valuable resources.

Human Resources as a Sustainable Competitive Advantage

The organization-specific, tangible and intangible resources, capabilities and competencies that ease an organization to have competitive advantage are called as ‘strategic assets’ (Amit and Shoemaker, 1993). In this respect lately in the literature, strategy and human resources management are combined as strategic human resources management. At this point, human resources are absolutely the most strategic and valuable assets of an organization to achieve sustainable competitive advantage. This is because, an organization can hire high-skilled employees, create knowledge, manage talent, build social relationships, demonstrate effective leadership, increase individual and group performance, enhance organizational commitment, organizational citizenship behavior and job satisfaction of employees by the help of human resources. These resources are inimitable, valuable and incompatible for an organization which in turn provide competitive advantage. Other organizations may easily imitate strategies but they won’t probably hire the same high-skilled and motivated employees.

As also previously discussed by Dunford et al. (2001), there is a debate on whether human resources itself or human resources management practices provide basis for sustainable competitive advantage. According to Lado and Wilson (1994), it was the human resources practices that enhance organizations

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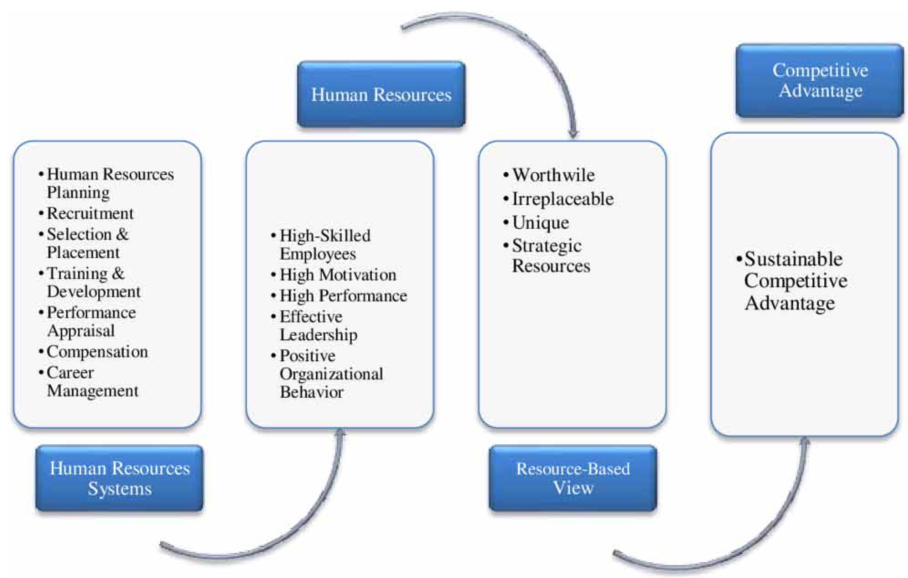
to have sustainable competitive advantages. They have proposed that, unless there are effective human resources systems applied for recruitment, selection, training development, performance appraisal, pay and promotion; members or employees of the organizations can't be taken as a primary source of competitive advantage on their own. Because they claim that, unless there are effective human resources systems, the human capital is not capable of a sustainable competitive advantage for an organization. And these human resources systems should utilize managerial and transformational competencies and should also enhance the development of human capital in an organization (Lado and Wilson, 1994). On the contrary Wright et al. (1994), claimed that human resources could be imitated by other organizations, so competitive advantage was held if only human resources are high skilled and highly motivated. This understanding underlines the importance of human capital instead of human resources practices and systems. So which party is right? Obviously in today's unstable and uncertain business environment, organizations should both set effective human resources systems and should attract high skilled and highly motivated members so as to have sustainable competitive advantage. This approach is demonstrated on Figure 1.

Figure 1. Human resources as a sustainable competitive advantage



Supply Chain Management and Resource-Based View

Based on the needs of complex and uncertain business environment, supply chain management concept has gained importance since 1990s. Among the principal reasons of gaining more and more importance, there exist, (1) the rise of globalization (Koberg and Longoni, 2019) and its forcing managers to rethink the effectiveness of flow of materials in and out of their firm (Mentzer et al., 2001), (2) tendency of building close relationship with suppliers (Wu and Choi, 2005), (3) the need for meeting quality standards of goods and services (Flynn and Flynn, 2005), (4) customer expectances of timely and accurate deliveries (Garg et al., 2006) (5) companies' need of generating competitive advantage by effective supply chain management (Barney, 2012; Markley and Davis, 2007).

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In general, supply chain management is built upon logistics which is a one-time plan for achieving the flow of materials or goods and services. Supply chain management is a broad concept which focuses on the link, cooperation and coordination among the members of the chain (e.g. suppliers, distributors, customers) and also processes (Christopher, 2016). Among the main functions in supply chain management, there exist; supplying raw materials or other inputs, procurement activities, operations management, distributing products and reaching out to customers by achieving supply base management, strategic orientation, cross-functional groups and process driven approach (Monczka et al., 2015).

Establishing supply network and building mutually beneficial relationships with supply chain members enable organizations to have vital resources. These resources can also be accepted as valuable, unique and inimitable assets from the perspective of resource-based view. This is because members of a supply chain integrate information systems and share knowledge or create new knowledge. Moreover, they exert cooperative efforts in a wide variety of activities including i.e. product development, product design, marketing research, pricing, placing and promotion (Cooper et al.1997). The cooperation, coordination and value sharing capabilities are valuable resources for organizations which will lead them achieve effective supply chain management.

Supply Chain Management for Sustainable Competitive Advantage

Since the supply chain management capabilities serve as valuable and specific resources of organizations, they are also accepted as the assets for sustainable competitive advantage over competitor firms. The reason is that, in the supply chains, companies are fully cooperative and they share knowledge with each other as evident in the literature (e.g. Marra et al., 2012; Shih et al., 2012). These close relationships foster innovation and new knowledge generation that enhance cost reductions and quality improvements in products. Moreover, supply chains provides more productivity and effectiveness in every step of value creating. All of these results provide sustainable competitive advantage for the firms in the supply chain over their rival firms in the market.

Every effort for increasing the quality of supply chain network and strengthening the relationships between member organizations in the network is beneficial for the sustainable competitive advantage. These efforts are likely to be generating open communication channels, knowledge sharing, supporting suppliers contributions for improving quality, cost and performance, developing management and technical capabilities (Lawson et al., 2015; Monczka et al., 2015; Prajogo et al., 2012). A typical supply chain for generating sustainable competitive advantage is shown on Figure 2.

Integration of Human Resources Management and Supply Chain Management

Latest developments in supply chain management necessitate a more holistic and multidisciplinary approach so as to sustain advantages obtained in the supply chain network. There are studies in the literature proposing more multidisciplinary perspectives for supply chain management (e.g. Hirsch-Hadorn et al., 2006; Pagell and Shevchenko, 2014). Hence, one of the most important perspectives for enriching the supply chain management is absolutely the human resources. This is because human resources are vital for customer and supplier partnerships (Jick, 1990), operations management (Boudreau, et al., 2003; Palšaitis et al., 2017), retailing (Rosenthal et al., 1997), storage and distribution (Kasonde and Steele, 2017), knowledge generation and sharing (Cabrera and Cabrera, 2005), leadership and innovation (Chen and Huang, 2009).

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Figure 2. Supply chain as a sustainable competitive advantage

Although human resources management and supply chain management were treated as unrelated structures in the past, now there are enough evidences that their union is beneficial for organizations (e.g. Lengnick-Hall et al., 2013; Scarbrough, 2000). Specifically, in the literature there are studies revealing the causal relationship between human resources and supply chain management both in causal (e.g. Vanichchinchai and Igel, 2011) and empirical research (e.g. Gómez-Cedeño et al., 2015).

Human resources strengthen the capacity of supply chain management and for this reason the integration of them provides effectiveness and efficiency in organizations and ease them to have competitive advantage in the market. This is due to several reasons:

1. Human resources practices and systems reinforce the effectiveness of supply chain practices and help supply chain employees develop new skills and competencies (Ellinger and Ellinger, 2014),
2. Human resources management increases the likelihood of supply chain management success, since it develops training and development programs for supply chain employees, evaluates their performance and gives feedback to them and also rewards and motivates them for high performance (Gowen and Tallon, 2003),
3. Recruiting and selecting high-skilled and highly motivated employees helps improve supply chain management performance,
4. A multi-functional approach to supply chain management reinforces the competitiveness of supply chains since they are already compromised of several business functions like, human resources management, financial management, marketing management, operations management, etc.
5. Human resources management provides basis for positive attributions towards the supply chain by creating a suitable climate which in turn enhances employees to demonstrate favorable behaviors,
6. Human resources management helps employees build effective communication channels not only in their own organizations but also in the supply chain. This process fosters knowledge sharing and improves creativity in the supply chain.

The integration of human resources management and supply chain management for sustainable competitive advantage is reinforced by some additional factors which are illustrated on Figure 3.

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Figure 3. The integration of human resources management and supply chain management

FUTURE RESEARCH DIRECTIONS

As noted in this chapter that there are limited studies revealing the advantage of the integration of human resources management and supply chain management. So, it is obvious that there is a strong need for future research. Future research should examine the role of each human resource practices on reinforcing the supply chain management. Moreover, examining which activities should be conducted by human resources managers to provide supportive and creative climate for supply chain practices would be beneficial for the literature. Also, empowering employees should be investigated so as to reveal its advantages on supply chain management.

Another underemphasized point in the literature is leadership. The subject of which types of leadership foster the linkage between human resources management and supply chain management would be expected to be beneficial. Although there are more studies concentrated on the link between green human resources and green supply chain management, there is still need for more research on these topics. Specifically the effects of talent management on supply chain management capabilities should also be observed. Lastly, it is vital to note here that, in the future researchers should test the effects of this linkage between human resources and supply chain by conducting empirical research including qualitative, quantitative or mixed methods.

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CONCLUSION

In business life no organizations can survive without generating adaptation strategies and capabilities to changing demands and conditions. To achieve this, organizations look for ways to acquire strategic and valuable resources. Furthermore, in such a competitive market, organizations do not only need to survive, but they also need to have resources, capabilities and capacities which others do not possess. This is because, with such resources and assets, organizations will have competitive advantages. Resource-based view suggests that organizations will have competitive advantage when their resources are valuable, exceptional and unique.

In this chapter, human resources management and supply chain management functions are examined for providing sustainable competitive advantage from the perspective of resource-based view. Based on a conceptual framework with the help of previous studies it was understood that, human resources management functions and systems enhance supply chain management efficiency. The integration of these two business functions enhances sustainable competitive advantage for several ways. When employees are trained, developed and motivated for gaining competencies for effective supply chain practices, organizations gain advantage by building strong relationships with other organizations in the supply network, especially with the suppliers. Furthermore, with the help of human resources management, organizational support for creativeness and knowledge sharing becomes apparent. This is a vital factor for effectiveness in supply chain. Moreover, human resources practices and systems make it possible to manage talents of employees, empower them and demonstrate high performance in supply chain activities.

Consequently, when human resources of an organization are high-skilled, highly motivated and committed to knowledge creation and sharing, also with the help of human resources management systems, the flow of materials, knowledge and assets in the supply chain occurs perfectly. When materials are acquired, produced and distributed on right time, right quantity and at right quality, organizations gain competitive advantage. Additionally when these organizations share knowledge and enhance innovation, they attain sustainable competitive advantage.

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KEY TERMS AND DEFINITIONS

Human Resources: All of the resources related to the human side of organizations including the capabilities, skills, educational background, personality and behaviors of employees.

Human Resources Management: The organizational function in which employees are recruited, selected, placed, trained, developed, evaluated, and compensated.

Resource-Based View: A strategic and managerial concept generated for determining the most valuable, rare, and strategic resources to attain sustainable competitive advantage.

Supply Chain: A network in which organizations build strong relationships with suppliers and distributors to provide goods and services.

Supply Chain Management: An integrated system of flow of materials, money and knowledge so as to provide goods and services to customers effectively and efficiently.

Sustainable Competitive Advantage: Organizational abilities, assets and capacity which are valuable and inimitable by other organizations.

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Chapter 6
The Regulation of Agri-Food Safety by Regulations:
Utilising Traceability and Recalls in India and USA

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ABSTRACT

The majority of the nations around the world have become melting pots of civilization, leading to an increasing interconnectedness of the global food system. However, with the long-winded food supply chains there exists information asymmetry between the consumers and the food they consume, making them more vulnerable to the outbreaks of diseases caused by tainted food. As an assurance that food is acceptable for human and animal consumption, food safety averts any exposure to food frauds and foodborne illness outbreaks therefrom. For this reason, the law endows the food regulators and the food business operators (FBOs) with the "trace, alert, and recall" tools at all levels of a food supply chain to regulate the safety of both the domestic as well as the imported articles of food. As a risk assessment and management tool, traceability furthers the mandate of law enforcement in facilitating and targeting the recall or removal/withdrawal of articles of foods.

INTRODUCTION

Food systems have become global, linked through trade and sophisticated financial and insurance markets. The globalisation of agri-food markets has led to an increased movement of food products, information, and people between various nations. Consumers gain from this development due to the widespread availability of a variety of food products from other parts of the world in their local markets. Indeed, the emergence of transnational agri-food corporations, the development of food science and transportation expertise, and the institution of the World Trade Organisation (WTO) and its efforts at liberalisation have

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made possible the international sourcing of food ingredients (Lin C., 2020). The regulatory framework instituted by the WTO facilitates free and fair international food trade. As a result, the global food supply chain has grown extensively and fragmented, creating ample room for the existence and spread of foodborne risks/ diseases, economically motivated adulteration, and management inefficiencies.

Along the complex globalised agri-food supply chain, a slipup or regulatory failure at one point can spill over to the others, entailing serious public health and socio- economic consequences. In other words, with agri-food supply chains becoming more globalised, fragmented, and reliant on an increasing number of participants (Behnkea & Janssen, 2020), the identification, tracking and ensuring the safety of the articles of food has become extremely difficult. In this context, traceability and food recall procedures have become effective tools to ensure not only the safety aspect in the global agri-food supply chains but also transparency, regulatory compliance, improved understanding of the products' life cycle and conscientious consumption.

Food frauds, scandals, and foodborne illnesses from mismanagement and adulteration are well documented. The United States' (US) Centers for Disease Control and Prevention (CDC) estimate forty-eight million people in the United States of America (USA) contracting foodborne illnesses every year (CDC, 2011). The World Health Organisation (WHO) estimates that one in ten people suffers from food poisoning worldwide, with 4, 20,000 fatalities, annually (WHO, 2017). The enormous scale, pace and complexity of global food supply chains now create plenty opportunities for the conception and rapid distribution of adulterated or sub-standard or unsafe food (Ercsey-Ravasz et al., 2012). The costs of food fraud and adulteration are difficult to estimate but could exceed approx. USD 40 billion as per an estimate (PWC, 2016). The socio-economic impacts of supply chain failures are significant, for instance, Moyer et al. (2017) reflected that the cost of the horse meat scandal in the European Union (see O'mahony, 2013) was "*incalculable*". Globally, the United Nations (UN) Sustainable Development Goals (Goal 2- End hunger, achieve food security) recognise the need to reduce the incidence of foodborne disease(s) by observing: "*achieving food security and ensuring healthy lives, will depend in part on successful reduction of the burden of foodborne diseases*".

Recently, in India, in *Swami Achyutanand Tirth & Others Vs. Union of India & Others*, 2016, the Hon'ble Supreme Court of India (SC) issued directions to the concerned State Governments and Union of India to take effective measures for combating the sale of adulterated and synthetic milk. It was alleged that milk was being adulterated with hazardous substance like urea, detergent, refined oil, caustic soda, etc. which adversely affects the consumers' health. In *Raj Kumar Vs. the State of Uttar Pradesh,* 2019, the SC observed that non-compliance of milk, as a primary food, with a prescribed standard would render it to be treated as an adulterated article even if it is not rendered injurious to health. Even a marginal deviation from the prescribed standard cannot be ignored.

In the USA in 2018, there were 1,935 food recalls reported according to the Federal Food and Drug Administration (FDA, 2019). More than half of the food recalls were attributed to imported food, operational mistakes, including contamination, mislabelling, undeclared ingredient, biological causes, etc. Owing to such incidents, ensuring safety in agri-food supply chain has become a big issue for both developed and the developing countries. Such incidents underscore the importance of creation of an environment to effectively implement transparency and traceability systems in food industries. This is germane considering that providing consumers with safe food of the nature and substance both projected and expected, is a key and legally defined requirement for all the food business operators (FBOs) (Pearson et al, 2019). Ideally, assurances as to safety and quality of the articles of food necessitate complete traceability with respect to each ingredient and each participant in the food supply chain. This requirement

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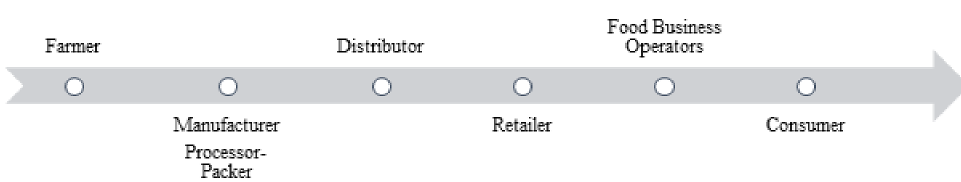
results in the need for the exchange of quality information between all the actors, in order to fulfill the increasing demand of consumers regarding safety, quality, and sustainability. Consumers' sensibility (Xiu & Klein, 2010) has also resulted in stricter national and international regulations and stricter food safety and quality controls (Behnkea & Janssen, 2020).

This research is galvanised around an appraisal of the food safety, traceability and recall regulation in India and the United States of America (U.S.A), along with an identification of the gaps, and recommendations for the way forward. Both the countries are democratic states, where food safety enjoys a pivotal status among the masses. They are leading agri-food trade markets for each other and have an independent, impartial, honest and efficient food safety regulator. The research paper is structured in the ensuing manner. To lay the groundwork, Part 1 discusses the constituents of a food supply chain. Part 2 theorises traceability and puts into discourse the importance of traceability and transparency in food supply chain grounded in review of recent literature and a definitional discourse. This is followed by a discussion of the vitality of technology enabled food traceability mechanisms and managerial implications of integrating traceability in agri-food supply chains. The discourse in Part 3 is focussed on the regulatory framework of food traceability mechanisms in India and the USA. Considering the importance of recall regulation to the execution of the rationale of traceability, Part 4 offers comparative insights into the regulatory mechanisms in India and the USA. The author winds up in Part V with conclusion and suggestions.

CONSTITUENTS OF A FOOD SUPPLY CHAIN

A food supply chain works on the precept of domino and two-way causality. It is a multi-actor, multi-product and multi-market contractual collaborative network. The actors trade either nationally or in a cross-border regulatory context, for making the articles of food available to the consumers. It links three main sectors of an economy i.e. the agricultural, the food processing, and the logistics/ distributors (Bukeviciute et al., 2009). Starting with a producer- farmer or cultivator, the supply chain comprises of various segments and intermediaries that perform different roles (See Figure 1).

Figure 1. Food supply chain



The Food and Agriculture Organisation (FAO) of the United Nations describes the primary and the secondary roles performed by various participants in a food supply chain as follows (FAO, 2017- *See Table 1*):

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Table 1. Participants in a food supply chain (FAO, 2017)

<table>
<tr><th>Sl. No.</th><th colspan="2">Role [Primary (P) or Secondary (S)]</th><th>Responsibilities</th><th>Examples</th></tr>
<tr><td>1.</td><td>Farmer/ Cultivator (P)
Supplier of seed/ plants/ livestock (S)
Supplier of farm inputs (S)</td><td rowspan="6">Third- party Logistics (S)
Road/ Railways/ Shipping/ Airlines</td><td>Crop production, Raising livestock, Harvest, Store, Sell, Ship</td><td>Farm, Poultry</td></tr>
<tr><td>2.</td><td>Produce Packer/ Re-packer (P)
Supplier of Packing Material (S)</td><td>Aggregate, Pack, Sell, Ship</td><td>Agricultural Cooperative/Pack House / Retail Pack House</td></tr>
<tr><td>3.</td><td>Distributor/ Trader</td><td>Store, Sell, Ship</td><td>Agricultural Cooperative/Retail or Foodservice Distribution Centre/Import and Export Warehouses/Wholesale/Terminal</td></tr>
<tr><td>4.</td><td>Manufacturer/ Processor</td><td>Process or Manufactures, Store, Pack, Sell, Ship</td><td>Condiments Manufacturer/Fish Processor / Poultry Processors / Nutmeg Processor / Cacao Processor</td></tr>
<tr><td>5.</td><td>Retail Stores</td><td>Receive, Store, Process, Pack/Label, and Display; Sell to Consumer</td><td>Supermarket / Grocery Store / grocery chains.</td></tr>
<tr><td>6.</td><td>Food Business or Service Operators (FBOs)</td><td>Store, Prepare, Sell to Consumer</td><td>Restaurant / Fast Food Restaurant chain</td></tr>
<tr><td>7.</td><td>Regulatory Organisations</td><td></td><td>Compliance and regulatory oversight</td><td>Customs, Food Regulators, Inspection Agencies, etc.</td></tr>
</table>

THE CONCEPT AND IMPORTANCE OF FOOD TRACEABILITY

Supply chain management is a key vehicle for helping to address food insecurity and contribute to public health issues. Traceability has become a popular concept in the supply chain management, regardless of the production regime and the type of product.[1] It provides a set of information about the source of raw material, process, and location of the product along the supply chain. It also acts as a tracking and communication tool to ensure information accessibility along the supply chain.

Within a complex food supply chain, an efficient traceability system can make significant contribution in food recall and public health. It can help the isolation of certain products and ingredients from the root of the problem swiftly to prevent further loss. It enables the participants in the food supply chain to trace and follow the products as they move from the farm to the fork and vice-versa. Major factors impacting the effectiveness of traceability are the structure and organisation of a supply chain. Adopting regulations and industry standards for traceability processes ensures agreement about identification of the traceable items. This supports the visibility and continuity of information across the supply chain.

Traceability is defined in a variegated manner by various authors, and a generic definition of traceability is given by Olsen and Borit (Haleem et al, 2019), ''The ability to access any or all information relating to that which is under consideration, throughout its entire lifecycle, using recorded identifications''. Traceability is a tool to find all information (such as origin, process, handling and associated activities) regarding the product during the supply chain stages and again at a later point. The main aim of a traceability system is to find the history of the product.

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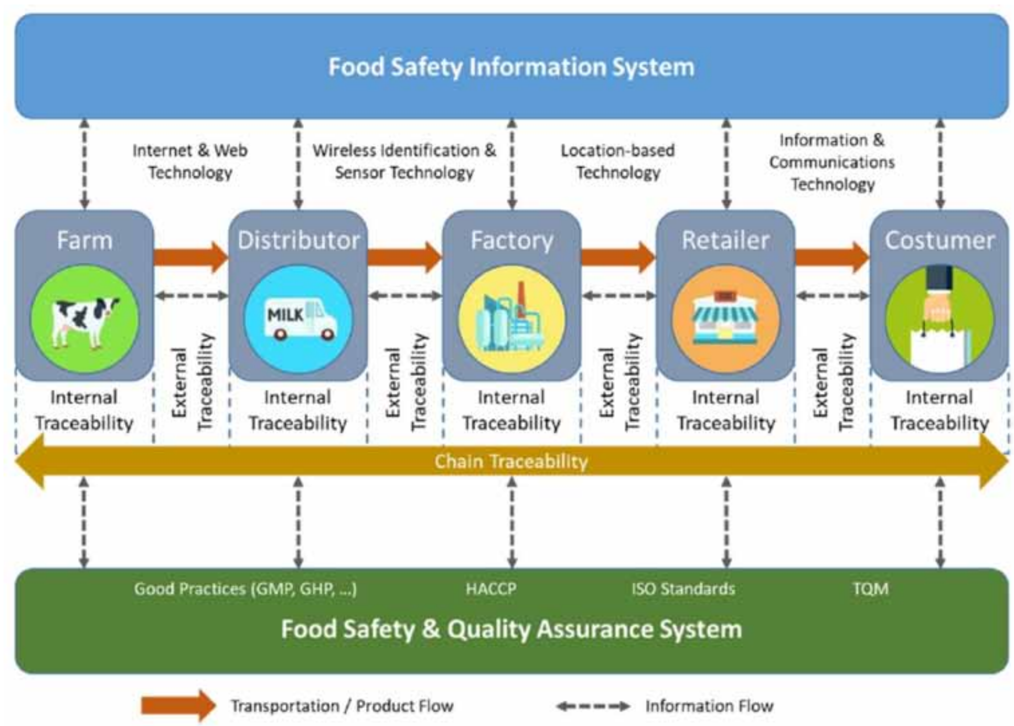
Traceability dates back to as early as the 1930s when some European countries wanted to prove the origin of high-quality food such as French champagne (ADBI, 2019). Over the past two decades, food safety related issues and various food scandals in the agribusiness sector, such as mad cow disease or the Asian bird influenza, have highlighted the importance of traceability. The need for traceability has also extended to other industries, due to issues of product quality, safety and security.

One of the biggest improvements in food safety laws in recent decades is surely the introduction and the strict implementation of traceability systems. Food safety traceability systems connects the production, inspection, supervision and consumption processes of foods in order to let the consumers know about the safety of the products (Berti and Semprebon, 2018). Food traceability, defined as the possibility to trace back the history of a food product, is a very important process from the point of view of ensuring food safety for the consumers all over the world (Walaszczyk, 2019). The safety of produced food can be maintained only when full traceability of raw materials, semi-finished products, and processes are ensured at all stages of the food chain. In practice, food traceability system are record keeping systems that show the path of a particular product from the suppliers through the intermediate steps reaching until the consumers (See Figure 2).

Figure 2.



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LITERATURE REVIEW

Pardo et al. (2015) emphasises that companies must acknowledge that today's consumers have become a lot more sophisticated and knowledgeable about the products they purchase. Thus, credible transparency appears inevitable. In a globalised world, where imports and exports are common practice, a global traceability and transparency system across borders is critical. Many different definitions of the term 'traceability' exist in the literature (see for an overview Bosona & Gebresenbet, 2013; Karlsen, Dreyer, Olsen, & Elvevoll, 2013; Olsen & Borit, 2013). These diverse definitions in the literature demonstrate that there is no universal definition of the term 'traceability'.

The earliest definition of 'traceability' was provided by the International Organisation for Standardisation (ISO) as meaning to "*trace the history, application and location of that which is under consideration, and for products this can include the origin of materials and parts, the processing history and the distribution and location of the product after delivery."* Furthermore, to trace is not simply limited to the physical tracing of the product(s) over the supply chain, from the starting point to the last stop and vice versa, but includes the providing of information regarding what they constitute and what have they undergone. These additional facets of traceability are vital in relation to food safety, quality and labelling." (ISO, 1994 and 2011) ISO 22005: 2007 specifies the principles and basic requirements for the design and implementation of a feed and food traceability system.

The majority of traceability standards (e.g. EU, 2002; ISO, 2007, 2018) (Behnke and Janssen, 2020) concentrate on explaining the capability to trail critical characteristics of a product from its origin (including ingredients) to the final steps of the process spreading throughout the supply chain. The scrutiny of Olsen and Borit (2013) shows that the several definitions of the term 'traceability' comprise two or more of the following four concepts: consistency and clarity in used terminology (e.g. 'tracking' vs. 'tracing'), backward and forward follow-up of the ingredients (tracing and tracking), and product history information during the movement through the supply chain.

Food traceability captures, stores and transmits adequate information about a food, feed, food-producing animal or substance at all stages in the food supply chain so that the product can be checked for safety and quality control, traced upward and tracked downward at any time, as stated by Aung and Chang (2014). It includes product, process, genetic, inputs, disease and pest and measurement traceability, as suggested by Zhu et al. (2018). There are three essential characteristics for traceability systems: i) identification of units/batches of all ingredients and products, ii) information on when and where they are moved and transformed, and iii) a system linking these data, as stated by Aung and Chang (2014). The food industry uses traceability systems for the improvement of the supply chain and the facilitation of the traceback for food safety and quality. Traceability is viewed as a strategic tool to improve food safety systems, the quality of raw materials, inventory management and as a source of competitive advantages, according to Dasaklis et al. (2019); Dasaklis and Casino (2019). Traceability systems help firms identify the cause and extent and resolve safety or quality control problems.

Effective traceability systems that minimise risk are recognised as a critical tool to assure food safety (Aung and Chang, 2014). International food traceability standards are set through the joint FAO and WHO Food Standards Programme – the Codex Alimentarius Commission. The principles of food traceability are laid out in CAC/GL 60–2006: Traceability/product tracing is defined by the Codex Alimentarius Commission (Codex) as: "*The ability to follow the movement of a food through specified stage(s) of production, processing and distribution*" (FAO & WHO, 2006) and "The traceability/product tracing tool should be able to identify at any specified stage of the food chain (from production to

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distribution) from where the food came (one step back) and to where the food went (one step forward), as appropriate to the objectives of the food inspection and certification system" (CAC, 2006). The FAO defines traceability as "*the ability to discern, identify and follow the movement of a food or substance intended to be or expected to be incorporated into a food, through all stages of production, processing and distribution*" (FAO, 2017).

The adoption of these principles is underpinned by national and international regulations. For instance, Regulation (EC) No. 178/2002 of the European Parliament and of the Council of European Union (EU) (January 28, 2002), defines 'traceability' in Article 3 (15) as "*ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution*".

The common denominators from these definitions emerge out as follows (the Author's analysis- See Table 2):

Table 2. Author's analysis of the definitions of 'traceability'

FOOD TRACEABILITY	**Task/ Function**	Trace (ISO and EU) the history, application and location (ISO); Origin of materials and parts, the processing history and the distribution and location of the product after delivery; and follow (FAO, EU, and Codex) the movement (FAO and Codex); Discern, identify and follow (FAO)
	Rationale	Provide information on what they are made of and what has happened to them (ISO)
	Coverage	Food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed; (FAO, Codex, and EU)
	Application	Through the distribution chain from origin to destination and vice versa (ISO); All stages of production, processing and distribution (FAO, Codex, and EU)
	Drivers/ Outcomes	Food safety, quality and labelling (ISO)

Technology Enabled Food Traceability

A traceability system is a repository of information sourced from different fronts. For the continual flow of authentic, relevant and rapidly available information, robust recordkeeping or documentation of the said data is paramount. Better recordkeeping requirements for the articles of food has been an essential issue for the last several years and has helped to protect the consumers against food adulteration, risks, and hazards. All the FBOs are able to ensure food safety by deploying transparent traceability systems (Olsen and Borit, 2018) facilitating an effective exchange of information.

Traditionally, the traceability system largely relied upon paper-based systems or internal computer systems (Aung & Chang, 2014). The data could be stored in a physical format like journals or paper registers containing an array of information about the food product. However, inefficient, time consuming, and disordered recordkeeping structures; human errors in the recording of the data during batching and transportation, and disparate information from the suppliers have led to problems and inaccuracies in traceability and the ability to identify and retrieve the implicated products (Newsome and others, 2011). Internal traceability can be of no utility to other organisations and cause complications in the integration of the stakeholders.

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In fact, it has been observed that the inability to efficiently trace products in the supply chain comes from the disparate record-keeping methods (Culp, 2013). The widely-accepted “one up, one down” (OUOD) approach whereby food supply chain participants know only the proximate supplier (one link upward in the chain) and the proximate customer (one link downward in the supply chain) for a product is simply inadequate. In suspected contaminations, investigators review paper documentation step by step. Erroneous or incomplete data can further delay their investigations. Multi-ingredient foods and bulk containers may include elements from a variety of sources and multiple countries and traceability gets even more complicated. As a precautionary step, entire shipments are thrown out under OUOD parameters (Blanchfield and Welt, 2012).

Basis the foregoing, technology is leveraging the supply chains to improve transparency therein. Technological innovations can provide a more efficient way to record and exchange information. Most recently, blockchain has drawn significant attention and presents a promising solution to the food traceability issues (J. Duan et al, 2020). With artificial intelligence (AI) permeating most aspects of modern existence, an increasing number of companies are using advanced options like a blockchain or distributed ledger technology/ internet of things (IoT)/ electronic/ computer-based data storage programmes for product tracing. Technologies already in use, such as Radio Frequency Identification (RFID), barcodes, smart tags, Wireless Sensor Network (WSN), and DNA based techniques are also simultaneously employed. By employing technology, such as blockchain, such food shipments “will be identified as being safe at a much earlier juncture,” while saving millions in sales as well as valuable human lives (Hodge, 2017).

The shift from paper-based traceability systems to blockchain or AI powered ones is hailed to promote efficiency and ensure infallibility (See Figure 3). In this period of transition with a pandemic in the form of COVID-19, the world is struggling to find the best solution to implement a ‘full traceability system’, the technological competition on the subject and the various experimentations have highlighted many interesting solutions that can help the traceability process. Digitisation of such value chains towards making food safe, trackable and of desired consumer quality needs to be accelerated and implemented at a faster pace than ever.

Among these technologies, a select few examples that are employed in India or the USA and are fascinating for their disruptive potential and/or for their adaptability to the global context are briefly discussed hereafter.

Barcodes

A Barcode in the form of a QR-Code (Quick Response Code) is a matrix barcode that was first designed in Japan in 1994. This technology consents to encode, store and present intricate data in a viable format, and is intelligible by majority of the programs and apps. Such codes can be valuable in manifold ways in improving food traceability. They assist in correct identification of the article of food and, easy for the consumers to comprehend the source of their food. Major Indian food processing companies including *Dabur*, Godrej, Amul, Hindustan Unilever, ITC, Mother Dairy (Dandage, 2016) use barcode and 2D quick response (QR) code techniques to develop an effective authentic product solution. Recently, GS1 standards were adopted by the Agriculture and Processed Food Export Development Authority (APEDA), and GS1’s product identifiers were utilised in barcoding in its traceability chains for Grapenet, Anarnet, and Tracenet.

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Table 3.

Operations Necessary for Implementation of Traceability System	Technologies Already Used	ICT Technologies Applied Recently
Identification of food	Stamping with ink	• Printing technology (inkjet printing, affixing printed labels) •
Data input	Handwritten or manual input	• Auto identification technology such as bar codes, two-dimensional bar codes (quick response [QR] codes), or the experimental\radio frequency identification (RFID) • Global positioning system (GPS) • Hand-held sensors to scan and record data
Data transfer	Fax	• Disclosing information to customers through websites • Exchanging data electronically among food business operators
Verification	Onsite visual inspection	• Software that automatically calculates and compares total volumes received and released • Examination technology such as DNA examination

RFID

RFID (Radio Frequency Identification) is an IoT device that allows automatic identification and its communication. Standards like RFID employs electromagnetic fields to automatically identify and track tags included on objects without touching them. The identification is done by storage of a serial number, and other vital information, on a microchip attached to an antenna (Kumperščak et al. 2019) RFID is considered to be a successor of the barcode with foreknown expansion not only in the agri-food sector, but also in other industrial sectors due to its environmental monitoring capabilities (temperature, relative humidity and luminosity), namely through wireless sensor networks (WSNs) and wireless sensor technology (WST) (Violino et al, 2020). The main issue with such technology is the high cost per unit. RFID technique is being utilised by several dairy industries, including Amul in India, which uses RFID tagging for milk yielding animals on their farms in *Anand* district in the State of Gujarat in India.

Distributed Ledger Technologies

Consumers' are increasingly exhibiting an attitude of distrust due to information asymmetry in the market for articles of food. Distributed Ledger Technologies (DLT, Walport, 2015; Maull et al., 2017), such as the various implementations that also comprise blockchain technology, where data resides on distributed ledgers (a record of transactions) but cryptographically linked in chains of blocks, is emerging as an additional solution to food safety regulatory challenges, allowing regulators, consumers and businesses potentially to instantly access the whole supply chain of any food and drink. A blockchain can be used to ensure the origin and authenticity of a product. All transactions, and each of the blocks

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in the chain, can be identified as an encrypted piece of information. Anyone connected to the network can add information in the blockchain if everyone in the network verifies the transaction, but no one can change or delete it without authorization (Abeyratne & Monfared, 2016).

Many pilot projects have been carried out investigating the possibilities for blockchain to increase traceability within supply chains. On October 4, 2019, the US retail titan Walmart Inc. made an announcement of piloting blockchain in India for seafood exports. The technology is aimed to establish end-to-end encrypted traceability of shrimp exports from the Indian State of Andhra Pradesh, the heartland of Indian aquaculture cultivation, to selected Sam's Club outlets in the U.S.

Managerial Implications of Food Traceability

Managers involved in implementing the traceability systems cannot focus on every driver of its implementation simultaneously. Thus, they need to focus on the highly influential drivers primarily and then at later stage low influential drivers can be considered. This research encourages the practitioners of the developing countries to take the initiative towards the implementation of traceability system in their highly perishable food supply chain (fruit and vegetables) to prevent a massive amount of food waste.

FOOD TRACEABILITY SYSTEMS IN INDIA AND THE USA

In India, the Food Safety and Standards Authority of India (FSSAI), together with the Commissioner of Food Safety of the State or Union Territory concerned are primarily entrusted with the responsibility of administering the food safety laws for all the articles of food. However, several other laws and agencies established by the Government of India assist the legislative mandate of the FSSAI. These include, the Office of Legal Metrology, Department of Consumer Affairs, the Directorate General of Foreign Trade (DGFT), the Ministry of Agriculture and Farmers' Welfare; and the Ministry of Fisheries, Animal Husbandry and Dairying.

Before 2006, food regulation was governed under the Prevention of Food Adulteration Act, 1954 (PFA) (37 of 1954) and several specific product orders like the Fruit Products Order, 1955, etc. In 2006, Indian food regulatory framework underwent a complete regulatory overhaul with the enactment of the Food Safety and Standards Act of 2006 (FSSA), which repealed and replaced the PFA and eight product orders (Second Schedule and Section 97, FSSA, 2006). FSSA regulates the entire process of supply chain from manufacturing, storage, distribution, packaging, labelling, sale and import and caters to the changing requirements of the food industry. It initiated harmonisation of the Indian food regulation as per the international standards (Statement of Object and Reasons, FSSA, 2006).

The United States (U.S.) food-safety regulation is mainly administered by the Food and Drug Administration (FDA) in the Department of Health and Human Services and the U.S. Department of Agriculture (USDA), although several other federal and State agencies play an important role. The FDA has been established under the Federal Food, Drug, and Cosmetic Act, 1938 (FFDCA), and regulates over most articles of food except meat, poultry, and processed egg products. The Food Safety Modernisation Act, signed into law in January, 2011, is a major reform of the food regulatory powers of the FDA since 1938. Its implementation has been hailed to have reoriented the role of the FDA from a responsive to a preventative structure regarding food safety.

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In the USA, the federal authorities tasked with steering food safety laws and enforcement actions for the respective food products under their jurisdiction are:

- The FDA, generally covers all domestic and imported food products except meat and meat food products [FFDCA, 1938, § 1002 (b)], poultry products and eggs products;
- The Food Safety and Inspection Service (FSIS) in the USDA- regulatory authority over the safety of meat, poultry and egg products;
- The Animal and Plant Health Inspection Service (APHIS) under the USDA implementing the animal disease traceability (ADT) programme;
- The Environmental Protection Agency (EPA) for the regulation of pesticide use.
- The Federal Bureau of Investigation (FBI) has investigative responsibility in cases of terrorism, life endangering tampering, and a false claim resulting in, serious injury to a product's reputation.

Furthermore, the Centers for Disease Control and Prevention (CDC) traces the distribution of hazardous products. It gathers three types of data: epidemiologic, traceback, and food and environmental testing and utilises three networks to disseminate health-related data *viz. Foodborne Diseases Active Surveillance Network (FoodNet), National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS), and National Molecular Subtyping Network for Foodborne Disease Surveillance (PulseNet)*. The Council to Improve Foodborne Outbreak Response (CIFOR) is another federal agency to improve methods to detect, investigate, control and prevent foodborne disease outbreaks.

In the USA, Section 414 (a) of the FFDCA, inserted by section 306(a) of the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (Bioterrorism Act), grants the FDA the access to and copy of all the records relating to any article of food which may be adulterated and presents a threat of SAHCODHA. Furthermore, in pursuance of the responsibility of regulating food safety and traceability it facilitates the identification of the immediate previous sources (one step back) and the immediate subsequent recipients of food (one step forward), including its packaging. In this regard, the persons who manufacture, process, pack, transport, distribute, receive, hold, or import food have been mandated to establish and maintain records for a period not longer than two years to address credible threats of SAHCODHA [FFDCA, 1938, § 414 (b)].

In India, Regulation 6 of the Food Safety and Standards (Food Recall Procedure) Regulations, 2017, stipulates comprehensive tracking of all the constituents of the food supply chain. In pursuance of the same, an FBO is mandated to maintain food distribution records which include granular details pertaining to the names and addresses of suppliers and customers, nature of food, date of purchase, date of delivery, lot number, batch code, pack size, brand name, date of manufacture, date of expiry and best before date. Such records are to be maintained for a period of one year from the best before date or the expiry date, as applicable. To tackle any deviance therefrom, section 27 of the Food Safety and Standards Act, 2006 (FSSA) affixes liability on the manufacturers, packers, wholesalers, distributors and sellers of the articles of food if they fail to meet the requirements of the law. Regulation 10 makes it obligatory for an FBO to maintain proper recording system consisting of accurate records of recovered food and of disposition, in consequence of a recall exercise.

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In the U.S.A, the Public Health Security and Bioterrorism Preparedness and Response Act, 2002 (Bioterrorism Act) has incorporated the recordkeeping requirements for imported food products. It was enacted to prevent, prepare for, and respond to any bio-terrorism threat to the nation's food supply. The legislation is directed at the safety of food imports and increased the powers of the U.S. FDA to ensure safe food supply in collaboration with the U.S. Customs and Border Protection (CBP). It introduced significant amendments to the FFDCA, the parent law on food safety and standards, to integrate record-keeping as a measure to ensure food traceability.

As far as combating bioterrorism in food supply chain is concerned, India does not have a comparable legislation mandating recordkeeping and traceability requirements for food products. However, Section 25 of the FSSA stipulates that no person shall import into India, *inter alia,* any unsafe or misbranded or sub-standard food or food containing extraneous matter. FSSAI regulates the import of articles of food so as to ensure their safety. The procedure and requirements for food imports are enumerated in the Food Safety and Standards (Import) Regulations, 2017 (FSSI, 2017).

Food Traceability Systems for Exports in India

The Agricultural and Processed Food Products Export Development Authority (APEDA) under the Ministry of Commerce and Industry, Government of India, has developed six web-based traceability systems for exports of certain food products. These are the Basmati.Net, GrapeNet, HortiNet, Meat.Net, Peanut.Net, and TraceNet (Danadage, 2016). All these are internet-based electronic services provided by the APEDA for the ease of doing business of the stakeholders in their respective product supply chains. Basmati.Net has been developed in furtherance of the legislative mandate contained in section 10A of the APEDA Act, 1985.

HortiNet is an integrated traceability system (Press Information Bureau, 2017) for horticulture products that include grapes, pomegranate (*anar)*, mango, betel leaves, citrus fruits and specified vegetables. Within HortiNet, GrapeNet is an end-to-end traceability system for grapes exported from India to the EU. It has been created to smoothen the registration of grapes farms, monitor the levels of pesticide residue, attain product standardisation and facilitate tracing back of exported grapes from the retail shelves to the farms of the Indian cultivator. This is achieved through the different stages of sampling, testing, certification and packing.

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Food Traceability Systems in the USA

Table 4.

Sl. No.	Legislation and Government Agency	Objective	Coverage	Recordkeeping Requirements
1.	Federal Meat Inspection Act (FMIA), enacted in 1906- amended in 1967 by the Wholesome Meat Act, 1967; Food Safety and Inspection Service (FSIS)	Prevention of adulterated or misbranded livestock and its food products from being traded as food; to safeguard that meat and meat food products-carcasses brought into slaughtering or packing and processed under hygienic conditions.	Livestock, meat, meat products, poultry and poultry products, and eggs and egg products.	Fully and correctly disclose all transactions involved in the business; Afford access to their places of business and examination of the facilities, inventory, and records thereof, Certification of Imported meat (FMIA, 1967. Section 20), poultry and egg products to identify products by the country and plants of origin, destination, shipping marks, and amount; health certificate
2.	Poultry Inspection Act (PIA), enacted in 1957- amended in 1968- Wholesome Poultry Act, 1968; FSIS			
3.	Egg Products Inspection Act (EPIA), enacted in 1970; FSIS			
4.	Food Safety Modernisation Act- Section 204; U.S. FDA	Enhancing tracking and tracing of food and recordkeeping relates to traceability- to prevent or mitigate a foodborne illness outbreak	Food Products except meat, poultry and eggs	Rapidly and effectively- · identify recipients of food; · tracking and tracing of foods for facilities; Develop and demonstrate appropriate technologies, that enhance the tracking and tracing of food [FSMA, 2011, § 204 (a) (2)]; Establish within the FDA a product tracing system to receive information to track and trace food offered for import into the US; Additional recordkeeping requirements for high risk foods;
5.	Perishable Agricultural Commodities Act, 1930	Promotion of fair-trading practices in the fruit and vegetable sector	Fruit and vegetables	Complete and accurate recordkeeping and disclosure for shippers, brokers, and other first handlers of produce selling on behalf of growers;
6.	Farm Security and Rural Investment Act, 2002; country of origin labelling (COOL)	Provide consumers with more information- country of origin	Labelling of beef, pork, lamb, fish, shellfish, fresh fruit, vegetables, and peanuts	Retailers may use a label, stamp, mark, placard, or other clear and visible sign on the covered commodity; In a vertical supply chain, there must be a verifiable audit trail to ensure the integrity of the traceability system,

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RECALL REGULATION IN INDIA AND THE USA

Food producers use various controls to safeguard the safety of their products. Despite employing all the safety nets, however, sometimes unsafe articles of food, or those that do not meet legislative requisites, reach the market or with the consumers. When an unsafe or violative article of food has left the control of any of the actors in the food supply chain, it must be removed or withdrawn from the market. This process of removing or withdrawing the article of food from the market using traceability is called a 'recall authority/ procedure'. To 'recall' is not to remember, but to retrieve. A News headline that a food business recalls a significant number of adulterated or misbranded or unsafe articles of food is not an exercise in nostalgia: it is an imminent and pressing concern (Lambert, 1972).

Both India and the USA, did not have specific legal provisions regarding food recall procedures until the years 2006 and 2011, respectively. Till the enactment of the FSSA, a multiplicity of laws pervaded the Indian food sector. But none of these statutory instruments mentioned about the food recall procedures for unsafe articles of food. In 2006, with the enactment of the FSSA, the primary legislation on food safety and standards in India, food recall procedures were, for the first time, legislated in the Indian food regulatory framework (FSSA, 2006).

Similarly, in the USA, the FFDCA nowhere made any reference to a food recall procedure (except for infant formula under section 412). The recourse to the same was in the nature of an administrative action or an informal enforcement tool (Harper, 1981) under the specific provisions of the FFDCA (FFDCA, 1938, sections 306 and 705). In this scenario, the nature of recalls undertaken for adulterated or substandard or misbranded articles of food was purely 'voluntary' with no obligation- to undertake the same on the responsible party or the FBO concerned. It was only in 2011, with the enactment of the FSMA that amended the FFDCA, that the enforcement authority of the FDA was broadened. For the first time, the US FDA was legally endowed with a new and wide-ranging authority of initiating a mandatory recall for food products, with complete traceability and recordkeeping. However, this power has been scarcely utilised by the FDA and food recall largely remains a voluntary exercise in pursuit of self-regulatory goals.

Legal Basis of Food Recall Procedures

In India, section 28 of the FSSA governs the procedure for the initiation of a food recall. In the USA, section 423 of the FFDCA, inserted by means of section 206 of the FSMA deals with the mandatory recall authority of the FDA.

Furthermore, to implement and administer the requirements of the primary legislations (FSSA and FFDCA) delegated or subordinate legislations have been made in both the countries. India has exclusive food recall Regulations in place *viz.* the Food Safety and Standards (Food Recall Procedure) Regulations, 2017 (FSSR, 2017) explicating the recall procedure for the articles of food. Whereas, in the USA, the Code of Federal Regulations (CFR), Title 21, sections 7.10 to 7.59 (specifically, § 7.40- the "Recall Policy") comprise the existing federal regulatory reference for 'recall of products' generally. A 'Product' is defined in paragraph (d) of § 7.3 to mean '*an article subject to the jurisdiction of the Food and Drug Administration, including any food, drug, and device intended for human or animal use*,' (Emphasis supplied). Under 21 C.F.R §7.1, food recalls are one of the several other regulatory enforcement actions initiated by the FDA pursuant to the FFDCA (21 U.S.C. § 301 *et seq.*) and other laws that it administers to ensure the 'safety' aspect of food.

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Objectives of Food Recall Procedure

Regulation 3 of the FSSR stipulates the objectives of the food recall procedure. The primary objective being ensuring the removal of articles of food under recall from all the stages of the food chain in accordance with section 28 of the FSSA. Along with this, it underlines the dissemination of such information to the concerned consumers and the retrieval, destruction or reprocessing of the article of food under recall [FSSR, 2017, regulations 3 (2) and 3 (3)].

A recall plan is a preventive control in terms of section 418 (o) (3) of the FFDCA. Moreover, the enforcement policy in the form of 'food recalls' is promulgated to improve consumer protection (21 C.F.R §7.1). A recall forms part of the responsibility of food manufacturers and distributors for the protection of public health and well-being from goods that pose a risk of injury or gross deception or are otherwise sub-standard (21 C.F.R. §7.40).

Definition- 'Recall'

Clause (c) of regulation 2 of the FSSR, defines 'Food recall' as the action of removal of food from the market at any stage of the food chain, including when in the possession of the consumers. The FDA does not define a 'food recall' specifically, but defines a 'recall' generally in 21 C.F.R § 7.3 (g) as the removal or correction of a violative marketed product by a firm, against which it would initiate legal action, such as seizure. Recall does not include a market withdrawal or a stock recovery. Recall stands on a different footing from a market withdrawal. A market withdrawal is the removal or correction of a distributed product by the firm that involves a minor violation that would not be subject to legal action by the FDA [21 C.F.R. §7.3 (j)]

Furthermore, the FDA classifies 'recall' in three categories to indicate the relative degree of health hazard of the product being recalled or considered for recall by the FDA, *viz.* Class I, II and III [21 C. F. R. §7.41 (b)]. India does not have a recall classification system.

Scope of the Food Recall Procedure

In India, pursuant to regulation 4 of the FSSR, the recall procedures apply to food or food products. The basis of regulation is determination or prima facie consideration of a n article of food being unsafe and/ or as may be specified by the FSSAI. In the USA, the recall procedure applies to marketed violative food products intended for human or animal use.

Initiation of a Food Recall

In terms of section 28 of the FSSA read with regulation 5 of the FSSR, a recall shall be initiated by an FBO under the law, either *suo motu,* or on the direction of the authorities responsible [FSSA, 2006, section 29 read with FSSR, 2017, Regulation 5 (3)] for the enforcement of the FSSA or as a result of any report(s) or complaint(s) from any of the stakeholder(s) [FSSR, 2017, regulation 5 (4)] to that effect.

In the USA, before the enactment of the FSMA, the FDA relied on a responsible party (RP) to voluntarily recall violative articles of food (except recalls for infant formula which are dealt with under section 412 of the FFDCA). The FDA continues to rely on the RPs to voluntarily recall violative food

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products; however, the FSMA's mandatory recall authority allows the FDA to mandate a recall when an RP chooses not to conduct it of its own volition, when the criteria under § 423 of the FFDCA is satisfied.

It bears emphasis that a food recall under § 423 could be initiated by the FDA in respect of information concerning a 'reportable food' (RF) from the reportable food registry under § 417 or through any other means, regarding a 'reasonable probability' that:

an article of food (other than infant formula) is adulterated under section 402, FFDCA and/or misbranded under section 403(w), FFDCA; and the use of or exposure to such food would cause SAHCODHA.

In terms of § 417 (d) (1) of the FFDCA read with § 7.46 (Firm- initiated recall), on a determination by an RP that an article of food is an RF she shall, within twenty-four hours therefrom, submit a Report to the FDA through the electronic portal [established under § 417(b)(1)] including certain data elements [described in §417 (e)] regarding the identifiability of the impugned article of food and shall investigate the cause of adulteration if it may have originated with the RP. Similarly, under § 417 (d) (3), any Federal, State and local public health official(s) may submit a report about an RF to the FDA through the same electronic means, comprising the similar data elements [described in §417 (e)]. On submission of a report either under § 417 (d) (1)- by the RP or (3)- by the public health official(s), a 'unique number' shall be issued to the person submitting, through the electronic portal [FFDCA, 1938, § 417 (d) (4)].

A similar mechanism of reporting as contained in § 417 (d) (1) of the FFDCA, albeit through a physical means, is stipulated in regulation 6 (3) of the FSSR (India).

The mandatory recall authority of the FDA is exercised only when an RP refuses to or does not voluntarily cease the distribution or recall an impugned article of food. As a result of this refusal or failure to cease the distribution or undertake recall, a pre-hearing and a post-hearing recall order is passed by the Secretary under § 423 (b) and (d) respectively. The firm is also given an opportunity to argue against the impugned article being recalled.

Recall Plan

Notifying the affected stakeholders post the initiation of recall is of paramount importance to achieve the intended aims of averting any risk to the consumers. For this purpose, the FSSR mandates all the FBOs (except food retailers) to have a detailed recall plan (FSSR, 2017, regulation 7) as a part of their food safety management system [FSSR, 2017, regulation 7(3)]. The federal scheme insists on the development of a recall strategy (21 C.F.R. §7.42) for both the FDA initiated as well as a firm-initiated recall.

Recall Communication

The Federal Regulations provide that the format, content, and extent of the recall communication should be commensurate with the hazard of the article of food subject to recall [21 C.F.R. §7.49(a)]. Recall communications are informative in nature, and comprise details that, *inter alia,* identifies the product in question along with the reason(s) for the initiation and the hazard thereof [21 C.F.R. §7.49(a), (c)]. In a similar vein, a 'Food Recall Notice' is required to be issued by an FBO in India to notify the consumers in an affected area of the food recall [FSSR, 2017, Regulation 8 (4)].

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Monitoring and Auditing the Recall

Both the jurisdictions insist on monitoring the effectiveness of the recall as a legal responsibility of the recalling firm (FFDCA, 1938, §423). In India, such reports are required to be submitted to the CEO, FSSAI or the CFS (FSSR, 2017, regulation 9).

Termination of Recall

In both India and the USA, a recall may be terminated either on submission of a written request in this regard by the FBO or the RP concerned or by the FDA (21 C.F.R. § 7.55) or the FSSAI (FSSR, 2017, Regulation 12).

Publishing Food Recall Data

Section 423 (g) of the FFDCA mandates the issuance of public notification(s) regarding any food recall by the FDA. Such notifications could be in the form of Press Releases, Alerts and public notices to inform the relevant stakeholders *viz.,* the consumers and the retailers, of the incidence of recall, to whom such article may have been distributed. It must include, for a minimum, the name of the article of food along with a description of the risk; and if available, an image of the impugned article be published on the official website of the FDA.

In India, regulation 16 (2) of the FSSR, provides for the establishment of a web based 'Food Recall Portal' to be housed by the FSSAI on its website to assign a unique identification number to each recall, to provide information to the consumers about such recall. In consonance with the legislative scheme and efforts by the FSSAI (FSSAI, 2018), GS1 has developed a food recall portal for India.

Summation

The Indian legal framework, i.e. the FSSA and the FSSR for protecting the consumers from hazards in the articles of food are at an embryonic stage. Despite the presence of regulations, enforcement remains a key challenge. The Federal framework for traceability, recall, and imported food products in the form of, *inter alia,* the FFDCA as amended by the FSMA, on the other hand, exhibits a matured approach to ensuring food safety of the food products, well-equipped with transparent mechanisms for information sharing and trade related capacity building.

FUTURE RESEARCH DIRECTIONS

Further research could be undertaken to explore the risks associated with the authenticity, security, and integrity of data entered into the technology enabled food traceability systems. This could be scrutinised in light of the 'law lag' plaguing the regulatory systems in various economies of the world. This is especially relevant where fraudsters can fabricate the entire supply chain by integration of false data, thereby creating a misleading sense of trust. Thus, 'immutability of lies' needs to be regulated. Future

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research may be undertaken in the area of modernisation of food safety regulatory and control systems in other advanced jurisdictions. The present study can also be extended to cover specific case studies in India and the U.S.A. implementing the food traceability frameworks by utilising the IR 4.0.

CONCLUSION

Food safety is a shared responsibility. Food safety concerns have far-reaching implications- lowering the demand for certain food products, changing the patterns of food trade and limiting the market access. The law, therefore, makes the FBOs responsible for the safety of the food which they produce, manufacture, distribute, hold or sell. It is vital for the FBOs to effectively trace the suppliers of their food for its removal from the market and the consumers (i.e. one step back and one step forward).

Despite the increasing efforts to stricter regulate the required food control measures, regulatory frameworks between countries and regions diverge still widely and food safety issues and crisis situations still occur frequently on a global level. The food safety incidents and crisis situations have not only brought the regulators into action, but also created an increased awareness of consumers. Food traceability is nowadays regarded as an important aspect in ensuring the food safety and quality of the products and increases the level of trust, confidence, and leads to satisfaction of consumers.

In 2017, the World Economic Forum's Food System Initiative launched Innovation with a Purpose to harness the transformative power of the Fourth Industrial Revolution to better address food-system challenges The initiative launched a flagship report in January 2018 entitled Innovation with a Purpose: The role of technology innovation in accelerating food systems transformation that identified the "Transformative Twelve" – 12 technologies with the potential to positively affect food systems. The report states that if these technologies could scale, they could reduce the environmental footprint of agriculture, support small-scale producers (e.g. the report found that scaling mobile service delivery by 2030 could increase farmers' income by 3%–6% and reduce food loss by 2%–5%) and support healthier and more nutritious food systems

While blockchains and other technological appendages can document and connect complex global supply chains, the IT infrastructure required to operate and maintain the system might prevent access to markets for new users or food suppliers. The systems could, in effect, become a technical barrier to trade, thus reducing market competition and access (i.e., those that are not in the chain cannot participate). It would be unacceptable if "blockchain" effectively blocks and constrains access to the global food supply chain. This is a tangible issue for any smaller producers in both developed and developing countries who may wish to export product into global markets. Conversely resolution of these technical barriers provides an opportunity for new entrants, since food trust is enhanced. It is critical that access to blockchain technology be kept simple, low cost, and easy to implement and deploy. This requires global standards for data encryption, DLT architectures and access. Agreed standards are needed to enable the sharing of data across digital platforms and within supply chains.

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Chapter 7
Evaluating Significant Risks in International Trade of E7 Economies With AHP Methodology

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ABSTRACT

The purpose of this study is to evaluate the risks encountered in the international trade process. E7 economies are included in the study. For this purpose, six criteria that should be taken into consideration are determined by considering similar studies in the literature. In the analysis process of the study, AHP method is used to identify which type of risk encountered in the international trade process is more important. In this process, opinions are received from three different experts on the subject. It is concluded that the exchange rate risk is the most important in this process. In addition to this situation, political risk and payment risk are other important factors for this situation. On the other side, it is also determined that documentary risk and carriage risk have lower role in comparison with others. Accordingly, it is essential for companies to take the necessary measures. In this context, it is possible to decrease the exchange rate volatility by using financial derivative products.

INTRODUCTION

One of the main goals of a country is its economic development. The main reason for this is that in economically developed countries, people's quality of life is higher (Kramarz et al., 2020). In this context, countries determine and try to implement some policies for the development of their economies.

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For example, it is accepted that increasing investments in a country will positively affect economic growth (Mandelman and Waddle, 2020). As a result of increasing investments, the trade volume in the country will improve. This will create new job opportunities. In this way, it will be possible to reduce unemployment in the country (Zengin et al., 2018). As can be understood from the issues mentioned above, international trade has a very important role in economic growth. Therefore, it is vital to take the necessary actions to increase international trade. However, there are some risks in the international trade process (Ersin, 2018). If these risks are not managed effectively, effectiveness in the international trade process will decrease. This situation will negatively affect the economic development of the country (Yüksel et al., 2019).

Trade refers to the purchase or sale of goods or services. Buying or selling goods or services abroad is called international trade. International trade meets the goods and services needed. However, material return is obtained in exchange for goods and services. Countries improve their living conditions by doing international trade. In this regard, international trade is important (Goldberg and Tille, 2016). There are two parties exporting and importing in international trade. Exporting countries produce more goods and services. It sells the produced goods and services in the world market. It needs employment while producing these products. Thus, employment increases in the exporting country. However, foreign exchange is provided to an exporting country and allows countries to improve their technology. In this regard, exports are important in the economic development of countries (Egbetunde and Obamuyi, 2018). However, importing countries mostly buy goods and services. The resources to be used in the production of goods and services are obtained through foreign purchase. This situation is quite important for the development of these countries. However, imports are made to purchase goods and services directly. Buying the final good directly is detrimental to the national economy. Domestic production is not possible. However, countries cannot develop technologically. When all these issues are evaluated, international trade is important in the economic development of countries (Rahman and Mamun, 2016).

International trade transactions take place in many different ways. Exporter, importer, transportation and customs procedures are important in the international trade process. It is necessary to pay attention to some issues before the trading process. The importer and exporter must conduct market research and have knowledge of foreign trade legislation. This situation affects the international trade process (Gani, 2017). At the core of the system, the exporting country produces goods or services. It sells to the importer country in need of final goods or raw materials. Payment methods and delivery methods are determined depending on the contract prepared in this process. According to these figures, the responsibilities of the exporter or importer are obvious. During this period, he takes part in intermediary institutions such as banks. The parties fulfill their responsibilities. In this way, foreign trade is realized (Hoekman and Shingal, 2017).

Risk refers to the dangers that may occur. There are risks in every activity. International trade is important in the economic development of countries (Yüksel, 2017). Therefore, it is necessary to increase international trade. However, there are some risks in the international trade process (Dinçer et al., 2018a,b,c). Especially the risks that may arise during the transfer of goods and money affect the international trade process (Feinberg, 2015). The properties of the commodity, the foreign trade legislation of the exporting and importing countries, cultural differences, geographical features and the currency used affect the international trade process (Niepmann and Schmidt-Eisenlohr, 2017). There are risks such as exchange rate, transportation, document, price in the international trade process. Depending on the currency used, fluctuations in the exchange rate affect the importer and exporter differently (Qi et al., 2020). However, property damage may occur during the transportation and transportation of the goods.

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There may be some deficiencies in the contracts that the importer and exporter have agreed. Sometimes the importer cannot make the necessary payment. All these issues affect the international trade process. Countries should pay attention to these issues to ensure their economic development (Ito et al., 2016).

The risks encountered in the international trade process affect especially developing countries. Because developing countries are foreign dependent compared to developed countries. These countries import raw materials for use in production. This situation provides the economic development of developing countries (Makhdum et al., 2017). Because the countries that import raw materials bring it back to the market. However, countries that directly import the final good cannot develop in domestic production. Accordingly, countries cannot ensure their economic development (Whalley, 2016; Dinçer and Yüksel, 2019). Developing countries need to trade in order to strengthen their living standards. Because developing countries have to grow economically in order to develop. Accordingly, he tolerates facing certain risks by doing international trade. Developed countries are affected by the risks encountered in the trade process in the short term. However, developing countries are affected in the long term. In this regard, developing countries should take measures to reduce the effects of risks (Zahonogo, 2016).

In this study, it is aimed to analyze some risks encountered in the international trade process. E7 economies were included in the study in the study. In this regard, 6 criteria that should be taken into consideration were determined as a result of the literature review. In the analysis process of the study, AHP method was used to determine which type of risk encountered in the international trade process is more important. Using the AHP method provides more effective management of the identified risks (Dinçer, 2015; Hacioglu and Dincer, 2015). This study has many specificities compared to the studies in the literature. Firstly, in this study, it was proposed to identify the processes that pose a risk for the international trade process. At this stage, the criteria established for market, firm and environmental aspects constitute the originality of the study. In the study, it is also important to address E7 economies. However, using the AHP method strengthens the study. In this regard, it is thought that the determined dimensions and criteria will contribute to the literature.

There are 5 chapters in this study. This section is an introductory part and basic information about the subject is included. In the second part of the study, literature review will be done and similar studies in the literature will be explained. In the third part of the study, information about AHP will be given. In the fourth part of the study, however, an analysis will be made regarding the determined dimensions and criteria. In the last part of the study, the results obtained will be discussed and suggestions will be made.

LITERATURE REVIEW

International trade is important in the economic development of countries. Therefore, especially developing countries should promote international trade. However, a number of issues need to be focused on before promoting international trade. These issues are risks in the international trade process. There are many studies in the literature explaining the risks that arise in the international trade process. Bahmani-Oskooee and Saha (2019) investigated the effect of exchange rate volatility on trade transactions. In the related study, the USA and India were included in the scope of the study. As a result, it was determined that the fluctuations in the real exchange rate affected international trade positively and negatively. However, it was emphasized that the exporter was positively affected by the increase in the exchange rate. Fluctuations in the exchange rate affect importers and exporters in the short term. Countries are not affected much when the exchange rate fluctuation is minimum. However, countries that are dependent

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on imports are more affected by the exchange rate risk (Chen et al., 2019; Santana-Gallego and Pérez-Rodríguez, 2019).

In parallel with these studies, Asteriou et al. (2016) examined the effect of fluctuations in the exchange rate on trade volumes. In the relevant study, MINT countries were included in the scope of the examination. The study was tested with Granger causality analysis. As a result, exchange rate risk is determined to be important in determining trade volumes in MINT countries. In addition to these studies, some studies in the literature focused on price risk. In these studies, it is determined that the changes in the market interest rates generally affect the price of the goods subject to international trade (Zhang, 2015; Lustig et al., 2019). Unlike these studies, Zhang and Zheng (2016) evaluated the price risk in agriculture and fisheries exports in their study. In this study, China and the USA were included in the scope of the study. The study was analyzed by establishing an economic model. It was emphasized that price stability is important in promoting international trade. It has been determined that the relationships between price risk and trade transactions vary with commercial products. Many risks that arise in terms of exports affect imports. When the same product is exported to different countries, the import price of the product also changes (Feinberg, 2015).

The issue of payment is important in the international trade process. Developing countries are constantly importing. Therefore, developing countries face payment risk affects international trade. In the literature, the issue of payment risk has been addressed by many researchers. Niepmann and Schmidt-Eisenlohr (2017) investigated the effect of payment risk on international trade. In the study, the USA in the period of 2007-2009 was included in the scope of the examination. It is determined that the financial problems in developing countries affect the exporters the most. The importer and exporter are affected in different ways by the payment risk experienced in the international trade process. Failure of importer to pay affects the exporting country negatively. However, the trade registry of the importing country deteriorates when payment is not made (Taşbaşı et al., 2020; Joo and Pak, 2017). Unlike these studies, Hoefele et al. (2016) researched the issue of payment risk in international trade. Developing countries were included in the study in the study.

It is stated that there are many different forms of payment in international trade. It was emphasized that there are many risk situations in these payment methods. Documents issued for international trade are important. There are many studies on this subject in the literature. Jones (2018) evaluated the performance risks arising in the foreign trade process in his study. As a result, it was emphasized that document regulations are very important in preventing the problems experienced in the foreign trade process. It was stated that the lack of information in the documents adversely affected foreign trade. The lack of content in the contracts between the importer and the exporter adversely affects the foreign trade process. Therefore, documents should be carefully prepared and checked in the international trade process (Demir, 2020; Bhogal and Trivedi, 2019). Documents created specifically for tradable goods are important. The risks created by these goods can be brought under control with the documents issued. Therefore, the edited documents are important (Smyth, 2017).

The way of moving and delivering goods that are subject to international trade is important. There are many forms of delivery in international trade. Delivery forms provide information on the transportation of goods. One of the risks arising from the international trade process is the transportation risk. In the literature, this issue has been addressed by many researchers. In his study, Chou (2016) investigated the risks that arise in sea transportation. In the related study, Taiwan was included in the scope of the examination. The study was tested with fuzzy AHP. As a result, it was emphasized that there are many risks in sea transportation. It was determined that these risks affect international trade. Akbar et al.

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(2019) examined the risks that occur in road transport in its study. As a result, it was stated that many risks occur when transporting goods on the highway. It was emphasized that these risks vary depending on the type of goods. Tijan et al. (2019) and Şencan and Yavuz (2018) focused on the transportation risk arising in the international trade process. It was emphasized that transportation risk should be reduced in promoting international trade.

There are many studies in the literature emphasizing that political risk is important in the international trade process. Bilgin et al. (2018) investigated the political risk arising in foreign trade in his study. The relevant study has been tested with panel data analysis. In conclusion, it was emphasized that political risk is important in exports. It was determined that the political risks affected trade volumes. In addition to these studies, Alola et al. (2019) researched the effect of political risk on foreign trade. As a result, it was determined that political risks affect international trade revenues. Political events in countries affect foreign direct investment decisions. Investments are decreasing as a result of political events. In addition, international trade revenues are decreasing (Kumari and Sharma, 2017; Deseatnicov and Akiba, 2016).

According to the results of the literature review, it is seen that there are many risks encountered in the international trade process. In general, it is determined that there are risks such as exchange rate, price, payment, document, transportation and political in the international trade process. However, it was emphasized that these risks affect international trade volumes. In some of the relevant studies, one country was examined, while in others more than one country was examined. In these studies, mainly US, China and Turkey were discussed. In addition, the vast majority of studies have been tested by panel data analysis. The issue that is thought to be missing in the literature review is that there are few studies that determine which type of risk encountered in the international trade process is important. Therefore, it is thought that such a study will contribute to the literature. In this study, it is proposed to analyze the risks encountered in the international trade process. In addition, it is aimed to support the study with fuzzy AHP method. This analysis is thought to contribute to the literature.

EVALUATION OF THE RISKS IN INTERNATIONAL TRADE

In this study, the risks encountered in international trade were analyzed. In this context, an analysis has been carried out with the AHP method. The stages of the specified analysis process are listed below as subtitles.

Defining Criteria List

At the first stage of the analysis process, the types of risks encountered in international trade were tried to be determined. In this process, similar studies in the literature were examined in detail. As a result, the intended risk types are determined in detail. Details of these risks are shared in Table 1.

As can be seen from Table 1, 6 different types of risks to be encountered in international trade have been identified. Exchange rate risk is one of the most important types of risks that are effective in international trade (Broll and Wong, 2015; Ito et al., 2016). Since the payments in this trade are in foreign currency, excessive evaluation of the exchange rate poses a risk to the parties. Price is another type of risk that should be taken into account in this process (Zhang, 2015; Feinberg, 2015). A market where prices fluctuate enormously involves high risk for a company doing international trade. On the other hand, firm-based factors can also be effective in this process. For example, there is a risk that payment

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Table 1. Risk Factors in international trade

Dimensions	Criteria	Literature Background
Market-based Risks	Currency Risk (C1)	Broll and Mukherjee (2017); Broll and Wong (2015); Ito et al. (2016); Goldberg and Tille (2016); Tunc et al. (2018); Bahmani-Oskooee and Gelan (2018); Aftab and Rehman (2017)
	Price Risk (C2)	Lustig et al. (2019); Zhang (2015); Feinberg (2015); Broll et al. (2014)
Firm-based Risks	Payment Risk (C3)	Caballero et al. (2018); Taşbaşı et al. (2020); Joo and Pak (2017)
	Documentary Risk (C4)	Niepmann and Schmidt-Eisenlohr (2017); Meral (2018); Chang et al. (2015)
Environment-based Risks	Carriage Risk (C5)	Gervais (2018); Calatayud et al. (2017); Herrero and Xu (2017)
	Political Risk (C6)	Fang and Mei (2016); Bekaert et al. (2016); Martyanova (2017)

cannot be made on time (Taşbaşı et al., 2020; Joo and Pak, 2017). In addition, the risk of documentation exists in this process (Meral, 2018; Chang et al., 2015). In addition to the factors mentioned, there are environmental risks that international companies face. In this context, it is possible to experience some problems in the transportation process (Calatayud et al., 2017; Herrero and Xu, 2017). In addition, the political risk in the country may have an impact on the international trade process (Bekaert et al., 2016; Martyanova, 2017).

AHP Methodology

AHP method is preferred for determining the most important among the different alternatives affecting a purpose. In this process, firstly, different factors that affect this purpose are identified (Uzunkaya et al., 2019). This process can be considered as one of the most important stages of this analysis. After that, the values of the criteria are obtained. In this process, market data regarding the criteria can be used. In addition to the mentioned issue, evaluation opinions can be requested from the experts regarding the criteria (Dinçer, 2015). In this process, the experts make a comparative evaluation in order to determine the relationships between the criteria. In this way, pairwise comparison matrix is obtained (Dinçer and Görener, 2011). Then, the data in this matrix is normalized so that the data can be analyzed more clearly. As a result, it is possible to calculate the importance weights of the criteria. After performing the specified calculations, consistency check is performed to determine that these values are realistic.

Analysis Results

In this process, firstly, three different experts were asked to evaluate the risks in the international trade process. These experts consist of managers and academics with at least 10 years of experience in international trade. The evaluations of the mentioned experts are given in Tables 2-4.

By considering the evaluations of these 3 experts, pairwise comparison matrix is created. The details of this matrix are summarized in Table 5.

In the next step, this matrix is normalized. For this purpose, firstly, the sum of all columns is calculated. After that, all values in the matrix are divided to these sums. Finally, the normalized matrix can be created as in Table 6.

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Table 2. Evaluations of expert 1

	C1	C2	C3	C4	C5	C6
C1	1.00	6.00	5.00	8.00	9.00	3.00
C2	0.17	1.00	0.14	3.00	5.00	0.20
C3	0.20	7.00	1.00	3.00	6.00	0.33
C4	0.13	0.33	0.33	1.00	3.00	0.17
C5	0.11	0.20	0.17	0.33	1.00	0.14
C6	0.33	5.00	3.00	6.00	7.00	1.00

Table 3. Evaluations of Expert 2

Criteria	C1	C2	C3	C4	C5	C6
C1	1.00	5.00	4.00	7.00	9.00	2.00
C2	0.20	1.00	0.13	2.00	4.00	0.17
C3	0.25	8.00	1.00	4.00	7.00	0.50
C4	0.14	0.50	0.25	1.00	2.00	0.14
C5	0.11	0.25	0.14	0.50	1.00	0.13
C6	0.50	6.00	2.00	7.00	8.00	1.00

Table 4. Evaluations of expert 3

Criteria	C1	C2	C3	C4	C5	C6
C1	1.00	6.00	4.00	8.00	9.00	3.00
C2	0.17	1.00	0.13	2.00	4.00	0.17
C3	0.25	8.00	1.00	4.00	7.00	0.50
C4	0.13	0.50	0.25	1.00	2.00	0.17
C5	0.11	0.25	0.14	0.50	1.00	0.13
C6	0.33	6.00	2.00	6.00	8.00	1.00

Table 5. Pairwise comparison matrix

Criteria	C1	C2	C3	C4	C5	C6
C1	1.00	5.67	4.33	7.67	9.00	2.67
C2	0.18	1.00	0.13	2.33	4.33	0.18
C3	0.23	7.64	1.00	3.67	6.67	0.44
C4	0.13	0.43	0.27	1.00	2.33	0.16
C5	0.11	0.23	0.15	0.43	1.00	0.13
C6	0.38	5.63	2.25	6.30	7.64	1.00

Table 6. Normalized matrix

Criteria	C1	C2	C3	C4	C5	C6
C1	0.49	0.28	0.53	0.36	0.29	0.58
C2	0.09	0.05	0.02	0.11	0.14	0.04
C3	0.11	0.37	0.12	0.17	0.22	0.10
C4	0.06	0.02	0.03	0.05	0.08	0.03
C5	0.05	0.01	0.02	0.02	0.03	0.03
C6	0.19	0.27	0.28	0.29	0.25	0.22

Later on, the weights of the criteria are calculated by taking the average of the row values for each criterion. The weights of the criteria are given on Table 7.

In order to understand whether these weights are appropriate, consistency analysis has been performed. In this framework, firstly, all values in the pairwise matrix are multiplied with the criteria weights and their weights are calculated. The details are demonstrated on Table 8.

After that, lambda values are calculated by dividing weighted sum values to the criteria weights. The details are stated on Table 9.

Just then, average lambda value is calculated as 6.5680. This average value is considered in the calculation of the consistency index. In this process, equation (1) is taken into account. In this equation, n represents the number of criteria.

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$$Consistency\ Index(CI) = \frac{(Average\ Lambda\ Value - n)}{(n-1)} \quad (1)$$

With the help of the equation (1), the consistency index is calculated as 0.1136. In the final process, consistency ratio is calculated. For this purpose, consistency index value is divided by random consistency index value (RI). RI value is differed according to the number of the criteria. For 6 different criteria, this value is considered as 1.24. Hence, the consistency ratio is calculated as 0.0916. Because this value is lower than 0.10, it can be said that AHP results are consistent. Therefore, weights stated in Table 7 can be taken into consideration. It is understood that currency risk is the most significant risk in the international trade. In addition to this situation, political risk and payment risk are other important factors for this situation. On the other side, it is also determined that documentary risk and carriage risk have lower role in comparison with others.

Table 7. Weights of criteria

Criteria	Criteria Weights
Currency Risk (C1)	0.4222
Price Risk (C2)	0.0733
Payment Risk (C3)	0.1819
Documentary Risk (C4)	0.0459
Carriage Risk (C5)	0.0276
Political Risk (C6)	0.2491

Table 8. Consistency matrix

Criteria	C1	C2	C3	C4	C5	C6	Weighted Sum Values
C1	0.42	0.42	0.79	0.35	0.25	0.66	2.89
C2	0.07	0.07	0.02	0.11	0.12	0.04	0.44
C3	0.10	0.56	0.18	0.17	0.18	0.11	1.30
C4	0.06	0.03	0.05	0.05	0.06	0.04	0.29
C5	0.05	0.02	0.03	0.02	0.03	0.03	0.17
C6	0.16	0.41	0.41	0.29	0.21	0.25	1.73

Table 9. Lambda values

Criteria	Weighted Sum Values	Criteria Weights	Lambda Values
C1	2.89	0.42	6.85
C2	0.44	0.07	6.04
C3	1.30	0.18	7.16
C4	0.29	0.05	6.23
C5	0.17	0.03	6.20
C6	1.73	0.25	6.94

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SOLUTIONS AND RECOMMENDATIONS

In this study, it was tried to identify the most effective risks in international trade. For this purpose, an analysis was made using the AHP method. As a result of the analysis, it was determined that the exchange rate risk is the most important in this process. Accordingly, it is essential for companies to take the necessary measures. In this context, it is possible to decrease the exchange rate volatility by using financial derivative products. For example, it is possible to fix the exchange rate with the help of products such as future and forward. In this way, a possible exchange rate increase will not affect the international trading firm. In addition, political risk is of great importance in international trade. In this context, companies should pay attention to the political situation in the countries they will import and export. Otherwise, at a possible political tension, there is a risk that the sales volumes of these firms will fall significantly.

FUTURE RESEARCH DIRECTIONS

The most important limitation of this study is that it focuses only on risks in international trade. In this context, it was tried to reveal the important types of risks. However, no analysis has been made on how to manage these risks. A new study in the future may focus on identifying possible measures. On the other hand, another limitation in this study was analyzed only by AHP method. This method takes into account the hierarchical relationship between variables. However, a more comprehensive analysis can be carried out by considering this method with fuzzy logic. In addition to the issues mentioned, different multi-criteria decision-making techniques such as ANP and DEMATEL can also be used in the analysis process. In this way, it will be possible to make a comparative evaluation.

CONCLUSION

In this study, the risks faced by companies in the international trade process were analyzed. In this context, primarily, similar studies in the literature were examined and 6 different risk types were identified. Then, an analysis was carried out with AHP method in order to determine which of these risks are more important. In this process, opinions were received from 3 different experts on the subject. According to the analysis results obtained, the exchange rate risk was found to be the most important problem. In addition to the aforementioned issue, it was understood that political risks have a very important role. On the other hand, the risk of carriage and documentation is determined to be less important than others. When the results are taken into consideration, it is understood that the companies should take appropriate measures for exchange rate and political risk. In this context, it is important to control volatility in the exchange rate by using financial derivative products. In addition, companies should periodically check the political situation in the countries where they export and import.

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KEY TERMS AND DEFINITIONS

AHP: Analytical hierarchy process.
ANP: Analytical network process.
DEMATEL: The decision-making trial and evaluation laboratory.

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Chapter 8
The Negative Role of Environmental Pollution on International Trade:
Strategy Recommendation to Solve This Problem

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ABSTRACT

The purpose of this study is to determine the main causes behind companies causing carbon emissions. In this way, the main reasons for companies to make carbon emissions have been explored. For this purpose, six different variables that are thought to be effective on this issue were determined. After that, an examination was made with fuzzy DEMATEL method in order to determine which of these factors are more important. The findings indicate that legal deficiency is the main reason for companies to cause carbon emissions. In this situation, it is a must to take necessary measures for the solution of this problem. In order for overcome legal deficiency problem, it is understood that the legal infrastructure should be adapted to this process. In order to increase the international trade volume, it is necessary to impose penal sanctions on companies and to regularly inspect these companies. In addition to these, incentives can be given to companies that are in competitive sectors and to create an awareness on this subject, governments can facilitate training programs.

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INTRODUCTION

In today's economies, it has become important to increase the trade volumes of countries and to cooperate with mutual and maximum benefit in trade. At this point, international trade takes an important place (Borchert and Yotov, 2017). International trade includes product and service exchanges between countries. The two most important pillars of international trade are import and export. Both multinational or international businesses and world countries are trying to trade with different practices in the field of economic cooperation and increase their trade volumes. While these practices increase the trade volume, the balance factor in the foreign trade volumes of the countries also comes to the fore. Every country wants to balance export and import in foreign trade volume and even increase its export. The increase in exports means excess foreign currency and directly affects the country's budgets, growth and GDP directly (Yüksel, 2017). As a result, the brand value of countries increases and begins to take an active and active role in world politics. We are in an economy world where globalization is increasingly felt. Globalization has led to the disappearance of borders between countries. This situation gives world trade different dimensions day by day.

Economic globalization, which means integration of the national economies, can also cause some damage to the national economies with the intensification of commercial activities (Zhou et al., 2016). One of the most negative aspects of globalization is that the markets deepening day by day become integrated and complex with each other. This complexity can multiply the impact of the crisis, especially in times of crisis (Kalkavan and Ersin, 2019). A crisis that started in today's world, where capital flows are quite and instantaneous, does not stay in the countries where it took place, as can be seen from previous examples, and can turn into a crisis that provides stagnation all over the world in a very short time. In contrast to these, globalization has pushed many companies, especially companies operating internationally, to implement new strategies (Dinçer et al., 2019).

Many companies are now at the stage of being affected by events in the outside world as well as their own countries. Therefore, businesses that want to survive must be well adapted to the phenomenon of globalization and at the same time be constantly sensitive to the opportunities and threats posed by globalization (Ersin and Baş, 2019). Globalization has enabled many companies to open up to other countries and has facilitated some of their business. However, with the globalization, a competitive environment has been created in many markets. Companies that could not keep up with this competitive environment and cannot stay up to date have become doomed over time (Kalkavan, 2020). The ability of businesses to compete and sustain their existence in the global market depends on how well they adapt to globalization, to what extent they can use their superiority and to improve their competitiveness. Undoubtedly, they need to analyze the benefits and threats of globalization well (Eti et al., 2020).

If companies succeed in improve and adapt themselves to changing conditions in the world, countries can get benefit from this situation. Companies that become qualified and have a strong position in foreign markets make it possible to create new markets and employment areas for their countries (Bretos and Marcuello, 2017). This makes a positive contribution to countries in both the medium and long term. In developing countries, the economy also improves, and the economic growth is sustained. For this reason, international trade needs to be developed accurately and efficiently. In this process, ways to get rid of the obstacles facing international trade should be sought. Economic crises, social turmoil, political tensions and environmental problems are some of the factors that prevent international trade from developing in a sustainable manner. Environmental problems, which are one of the factors affecting international trade, have become a very popular subject especially in recent times. Environmental issues have become one

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of the most important agenda items in the trade sector, with the increasing environmental awareness and the fact that nature cannot keep silent for global warming anymore.

When environmental issues and trade are considered together, the first thing that comes to mind is carbon emission. With the agreements such as Kyoto, which brings sensitivity to green and restrictions to countries, carbon emission for international companies has now managed to be among the considered items. Carbon emission means the release of carbon gas from the energy production into the atmosphere (Qiu et al., 2020). This situation causes both air and water pollution. This situation damages the country both socially and economically. From a social perspective, the number of sick people in the country is increasing as a result of carbon emissions. This situation does not decrease the quality of life in the country (Yüksel and Ubay, 2020). On the other hand, these health expenditures will also affect the country's budget negatively. As a result, the country will become more fragile in the macroeconomic sense (Yüksel et al., 2019). Another problem caused by carbon emissions is for international trade. The carbon emission problem has become an important problem all over the world. As a result, countries have started to take some measures to reduce this problem (Liu et al., 2017). On the other hand, awareness of the carbon emission problem has increased worldwide.

Companies have started to prefer not to trade with countries with high carbon emissions (Arce et al., 2016). Therefore, it is thought that carbon emissions will negatively affect the country's international trade in the long run. Due to these problems, countries should take action on the carbon emission problem. However, the solution of this problem is not easy at all. The main reason for this is the problem of carbon emissions caused by thousands of small and large companies. Therefore, it would not be a very reasonable solution to wait for each company to take action at the same time. On the other hand, practices to prevent carbon emissions involve a number of costs. Therefore, especially small companies will not be willing to implement these solutions.

Many international companies are now reluctant to invest in countries with high carbon emissions. Both today and in the future, failure to solve the carbon emission problem will create a negative environment for both countries and companies. For this reason, it is a very important issue to wrap up the event and see why companies emit carbon emissions (Bento et al., 2016). At this point, high cost can be cited as the first reason companies cannot stop or say no to carbon emissions (Liu et al., 2016). Many companies have factories to produce and it may not be possible to reset carbon emissions in the first place. However, using carbon capture technology, it is possible to grab the resulting carbon gas and bury it in the ground (Zou et al., 2017). But at this point, carbon capture technology brings high costs to companies as it requires both high engineering and has just started to be used.

For this reason, companies whose main purpose is to make profit may not prevent carbon emissions mostly to escape at these costs. Apart from the high cost, another reason that companies do not prevent carbon emissions is that they do not have sufficient awareness in this regard (Yang and Chen, 2018). Unless the company employees and managers have sufficient knowledge of carbon emissions, the problem of carbon emissions will be constantly ignored. In addition, the lack of adequate technological infrastructure is one of the most important obstacles to reducing carbon emissions (Lee et al., 2017). Although such companies are aware of the issue, they will not be able to stop carbon emissions because there are not enough infrastructure resources (Zhou et al., 2019).

The purpose of this study is to determine the factors that prevent companies from reducing their carbon emissions in order to determine how to correct carbon emissions that negatively affect international trade. At this point, with the literature review, 6 factors that will prevent carbon emission reduction have been determined and these factors have been weighted. At the end of the study, a comparative analysis

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was made using both DEMATEL alone and within the framework of fuzzy logic. At this point, it is possible to mention many advantages of this study. First of all, there are many studies on the negative consequences of carbon emission, as can be seen from the literature reviews. However, there are very few studies on why companies cause carbon emissions. Therefore, with this study, the basis of the problem has been reached and strategies have been determined to solve this problem completely.

In addition, using DEMATEL and fuzzy logic in a single frame were included in the work in non-numerical data and more clear and precise results were achieved (Lin et al., 2018; Dinçer and Yüksel, 2018). Thanks to the analysis results to be obtained, the main factors causing the enterprises to emit carbon will be determined. In this way, it will be possible to take necessary measures for the solution of this problem. This situation may contribute to solving this problem more easily. Thanks to these strategies, an increase may occur in the investments to be made by international companies. In other words, due to the high carbon emission problem, commercial embargoes that international companies will put in the countries can be prevented. Increasing international trade will also contribute to the economic development of countries. In the first part of the study, information is given about carbon emission, which is one of the factors that will affect international trade. In the second part, a large literature review and examples are presented. In the continuation of the study, a comparative analysis was made, and the results of this analysis were discussed in the fourth section. In the last section, an overview of the study is given.

LITERATURE REVIEW

There are many studies in literature about factors that affect carbon dioxide emission and the difficulty of applications to prevent carbon dioxide emissions. From a different point of view in this literature, we will address the challenges faced in carbon dioxide prevention applications by presenting the seven variables specified. Order is inevitable in the world, so the legal system exists in all countries. Legal system and state policies are a requirement for the solution of environmental problems. When looking at the studies on this subject, it can be seen that the reason for not preventing carbon dioxide emission is the legal deficiency. As Ali et al. (2019) studied the factors that causing carbon dioxide emission in Nigeria, they found that the world creates global environmental problems such as piercing ozone and increasing global warmings day by day and there is the need to explore alternative energy consumption modes (e.g., green energy) as a suggestion to prevent these problems. When they examine the factors that increase carbon emission it is found that legal deficiencies are outstanding. Their findings suggest that the government should emphasize programs and policies that reduce carbon dioxide emissions. In another study that takes place in China, it is mentioned that the need to provide control in carbon dioxide reduction is a must for countries, and these reveal legal deficiencies (Zhou and Liu, 2016). Similar to these studies, Apergis and Payne (2017) also made a research about this topic in America. In the study, they focus sectors that create high carbon emission such as residential, commercial, industrial, transportation, and electrical power. As a conclusion they suggested that state control and sanctions are important for low carbon emissions per capita. Additionally, Lu (2018), by examining 12 Asian countries, stated that government policies would be supportive in this direction. Besides these, Kumaş et al. (2019) studied carbon dioxide emission in Isparta, Turkey. As a result, they concluded that carbon emissions have a great negative impact on the environment and that Turkey's lack of a plan to reduce emissions by 2020. In order to reduce this problem, the government should take actions.

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With the development of science, many alternatives have been found in carbon dioxide prevention. While companies, countries or individuals try more and more to prevent Co2 emissions, unfortunately there are some obstacles. High costs are one of those obstacles to overcome. In today's world many companies hesitate to switch to renewable energy in order to reduce carbon emissions. Because using renewable energy sources is a high cost challenge for companies (Stram, 2016). As Apergis et al. (2018) studied in Sub-Saharan Africa, there is a relationship between health expenditures and carbon dioxide emission. If health spending increases, economic growth increases. Economic growth increases carbon dioxide emissions. Renewable energy is recommended in healthcare facilities, but there are some challenges in providing a renewable, energy services. The main ones are cash constraints, and supply infrastructure. In other study, Bilan et al. (2019) studied the challenges of renewable energy, CO2 emissions and economic growth in European Union members. The author emphasized the importance of the government's monetary incentive for sustainable development and companies alone cannot deal with these additional costs. According to Zhang et al. (2019) entrepreneurial management of many costs, material costs, management costs, waste costs, recycling costs and carbon emission costs for companies.

Besides legal deficiency and high cost, technological infrastructure is also an important factor. As Green and Stern (2017) studied in China the technology needs to be adapted to lower carbon dioxide emissions. A global understanding of the extent and pace of change in China should encourage reassessment trends projected in future global emissions, trends projected at relative prices of commodities and low / affected by structural changes in China zero carbon technology and services are recommended. In another study, Gabriel and Kirkwood (2016) focused on the business model includes product, customer insight, infrastructure management and financial management by examining developing countries. As a result, they concluded that there is the absence of renewable energy technology (RET) market facility support, and without that technology companies cannot handle carbon emission. According to Kırlı and Fahrioğlu (2018), for a sustainable development of carbon capture, utilization and technology in developing a low-scale storage and specialization should be developed for Turkey. Clean carbon technology should be developed. As a result of Toro and Harsá (2019)'s study that take place in Europe, technology specific policies and investment conditions should be developed for reducing CO2 emissions and for sustainable agriculture. Moustakas et al. (2019) support this idea in their study by emphasizing the importance of interacting with technology for a sustainable energy system. Besides them, Lin and Agyeman (2019) made a study on this subject. Their study that examining Ganana concluded that technology needs to be improved for an effective energy use.

Being sensitive to environmental problems requires awareness. Awareness is individual, of course, but heavy industries are the primary producers emitting carbon emissions. Awareness is the company's culture. As Sung et al. (2018) studied in China, business owners tend to invest their production activities in economic assets only. They think about the environment in decisions regarding production activities, thus, carbon dioxide emission increases and environmental quality decreases. It can be deduced that the environmental awareness of some businesses is low. This idea is supported by Shue (2017). According to the study, to leave our descendants a livable world is not an act of kindness, generosity, or benevolence, or even the fulfillment of a positive responsibility, positively contributes to its creation an energy regime that will be safe for people to live with the awareness so many environmental threats can be overcame. In another study that made by Biresselioglu (2016) in Turkey, complex policy making for environmental energy requires stakeholder participation. These stakeholders are society, industry sector, especially energy, and electricity consumers. Raising awareness of industrial companies with energy will be valuable in reducing carbon emissions. In addition to this, according to Sen and Ganguly (2017), for

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technical achievements, training-skilled human resources are needed, and institutional awareness needs to be created. Pata (2018) Turkey and Yousefi-Sahzabi et al. (2017) made some researches in Turkey. As a conclusion they found that its economy is developing rapidly grow and began the fight against carbon dioxide emissions. It recommended the development of public awareness, social acceptance, educational program, and institutional training.

Lack of qualified personnel is also an important factor for companies to hesitate to reduce carbon emissions. As Liang (2016) mentioned the technical knowledge of difficulties on the renewable energy screen is so popular. These difficulties are due to the inefficiency of the personnel, and the lack of technology knowledge. Additionally, as Kılkış (2016) studied, low-carbon emission, pollution control, clean production and bio design are required for a sustainable environment. Therefore, qualified personnel are important in order to companies to adapt these trends. Competitiveness in a sector can also be a challenge for companies to adapt to carbon-reducing policies. As Brummer (2018) studied in Germany, Britain and the United States, having a large energy companies attracts small investors because competitiveness decreases. Preventing full carbon dioxide emissions may not be due to these barriers. This idea supported by Tian et al. (2017) in their study, where they examined China's situation.

AN APPLICATION ON FACTORS BEHIND COMPANIES CAUSING CARBON EMISSIONS

In this analysis, the factors that cause companies not to take necessary steps for reducing carbon emission are examined. In this context, by using 6 different criteria, an analysis in fuzzy DEMATEL method framework is conducted.

DEMATEL Analysis

The DEMATEL method is one of the multi-criteria decision-making methods that helped make decisions under uncertain and complex situations in the 1970s. The DEMATEL method is also used with fuzzy logic where non-numerical data is taken into account. Within the scope of the DEMATEL analysis; it is possible to express relationships between criteria (Dinçer et al., 2019). The DEMATEL method is used to determine which are the most important criteria that affect our purpose. The most important advantage of this approach compared to others is that the effect-relationship analysis between variables can be made. In other words, in the DEMATEL method, it can be understood which variables affect others (Büyüközkan and Çifçi 2012; Patil and Kant 2014). In DEMATEL method, the steps are as follows:

Firstly, a committee of experts are formed, and the assessments about direct affect between each pair of elements are acquired. Fuzzy DEMATEL is a multi-criteria decision-making method which intends to rank different alternatives according to their importance (Dinçer et al., 2017).

Later on, these linguistic assessments are converted into crisp values with the help of Table 1, as a result, the direct-relation matrix (Z) can be generated. (1)

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$$\tilde{Z}=\begin{bmatrix} 0 & \tilde{z}_{12} & \cdots & \cdots & \tilde{z}_{1n} \\ \tilde{z}_{21} & 0 & \cdots & \cdots & \tilde{z}_{2n} \\ \vdots & \vdots & \ddots & \cdots & \cdots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \tilde{z}_{n1} & \tilde{z}_{n2} & \cdots & \cdots & 0 \end{bmatrix} \tag{1}$$

In this process, average values of these evaluations are considered, and the details are shown in the equation (2) (Yüksel et al., 2017).

$$\tilde{Z}=\frac{\tilde{Z}^1+\tilde{Z}^2+\tilde{Z}^3+\ldots\tilde{Z}^n}{n} \tag{2}$$

After that, normalized direct-relation matrix X is occurred by considering the equations (3)-(5).

$$\tilde{X}=\begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \cdots & \cdots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \cdots & \cdots & \tilde{x}_{2n} \\ \vdots & \vdots & \ddots & \cdots & \cdots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \tilde{x}_{n1} & \tilde{x}_{n2} & \cdots & \cdots & \tilde{x}_{nn} \end{bmatrix} \tag{3}$$

$$\tilde{x}_{ij}=\frac{\tilde{z}_{ij}}{r}=\left(\left(\frac{Z_{a_{ij}}}{r},\frac{Z_{b_{ij}}}{r},\frac{Z_{c_{ij}}}{r},\frac{Z_{d_{ij}}}{r};H_1\left(z_{ij}^U\right),H_2\left(z_{ij}^U\right)\right),\left(\frac{Z_{e_{ij}}}{r},\frac{Z_{f_{ij}}}{r},\frac{Z_{g_{ij}}}{r},\frac{Z_{h_{ij}}}{r};H_1\left(z_{ij}^L\right),H_2\left(z_{ij}^L\right)\right)\right) \tag{4}$$

$$r=max\left(max_{1\le i\le n}\sum_{j=1}^{n}Z_{d_{ij}},max_{1\le i\le n}\sum_{j=1}^{n}Z_{d_{ij}}\right) \tag{5}$$

Once the normalized direct-relation X is created, the total-relation matrix T can be calculated as follows (6)-(10).

$$X_{\dot{a}}=\begin{bmatrix} 0 & a'_{12} & \cdots & \cdots & a'_{1n} \\ a'_{21} & 0 & \cdots & \cdots & a'_{2n} \\ \vdots & \vdots & \ddots & \cdots & \cdots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a'_{n1} & a'_{n2} & \cdots & \cdots & 0 \end{bmatrix} \tag{6}$$

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$$\tilde{T} = \lim_{k \to \infty} \tilde{X} + \tilde{X}^2 + \ldots + \tilde{X}^k \tag{7}$$

$$\tilde{T} = \begin{bmatrix} \tilde{t}_{11} & \tilde{t}_{12} & \cdots & \cdots & \tilde{t}_{1n} \\ \tilde{t}_{21} & \tilde{t}_{22} & \cdots & \cdots & \tilde{t}_{2n} \\ \vdots & \vdots & \ddots & \cdots & \cdots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \tilde{t}_{n1} & \tilde{t}_{n2} & \cdots & \cdots & \tilde{t}_{nn} \end{bmatrix} \tag{8}$$

$$\tilde{t}_{ij} = \left(a''_{ij}, b''_{ij}, c''_{ij}, d''_{ij}; H_1\left(\tilde{t}_{ij}^{\,U}\right), H_2\left(\tilde{t}_{ij}^{\,U}\right)\right), \left(e''_{ij}, f''_{ij}, g''_{ij}, h''_{ij}; H_1\left(\tilde{t}_{ij}^{\,L}\right), H_2\left(\tilde{t}_{ij}^{\,L}\right)\right) \tag{9}$$

$$\left[a''_{ij}\right] = X_{a} \times \left(I - X_{a}\right)^{-1}, \ldots, \left[h''_{ij}\right] = X_{h} \times \left(I - X_{h}\right)^{-1} \tag{10}$$

After that, defuzzification process is implemented and as a result, the sum of rows and the sum of columns are denoted as vector $(\widetilde{D}_i)$ and vector $(\tilde{R}_i)$ respectively. The horizontal axis vector $\left(\tilde{D}_i + \tilde{R}_i\right)$ is created by adding $(\widetilde{D}_i)$ to $\left(\tilde{R}_i\right)$, which expresses how much the criterion important is. When $\left(\tilde{D}_i + \tilde{R}_i\right)$ is higher, it means that the factor is closer to the central point (11)-(12).

$$\tilde{D}_i = \left[\sum_{j=1}^{n} \tilde{t}_{ij}\right]_{n \times 1} \tag{11}$$

$$\tilde{R}_i = \left[\sum_{i=1}^{n} \tilde{t}_{ij}\right]'_{1 \times n} \tag{12}$$

Analysis Results

In the analysis process of this study, firstly, factors that prevent companies to reduce carbon emission are determined. In this context, up to date studies on this subject in the literature are scanned. As a result of the analysis, 6 different criteria were determined, and these six criteria are evaluated including: Legal Deficiency (C1), High Cost (C2), Lack of Technological Knowledge (C3), Lack of Awareness (C4), Competition (C5), Lack of Qualified Personnel (C6).

Table 1 indicates that the investment selection criteria determined are subjected to linguistic evaluations in 2020. Firstly, evaluations of three different experts which are academicians or high-level managers are acquired. These people have at least 15-year experience in the area of this study. These experts made their evaluations by considering 6 different scales and these evaluations are converted into fuzzy numbers. These calculations are made on Microsoft Excel program. Table 2 shows linguistic scale and

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Table 1. List of factors that prevent companies from reducing their carbon emissions

Criteria	Literature Background
Legal Deficiency (C1)	(Ali et al, 2019; Apergis and Payne, 2017)
High Cost (C2)	(Stram, 2016; Apergis et al., 2018)
Lack of Technological Knowledge (C3)	(Green and Stern, 2017; Gabriel and Kirkwood, 2016)
Lack of Awareness (C4)	(Sung et al., 2018; Yousefi-Sahzabi et al., 2017)
Competition (C5)	(Brummer, 2018; Tian et al., 2017)
Lack of Qualified Personnel (C6)	(Liang, 2016; Kılkış, 2016)

Table 2. Linguistic evaluations and fuzzy numbers for the alternatives

Linguistic Scales	Linguistic Value
Very High Influence (VH)	(0.75,1.0,1.0)
High Influence (H)	(0.5,0.75,1.0)
Medium Influence (M)	(0.25,0.5,0.75)
Low Influence (L)	(0,0.25,0.5)
No Influence (N)	(0,0,0.25)

fuzzy number equivalents that measure the degree of interaction between variables. The respondents were asked to evaluate the interrelationship of each criterion using five scores in linguistic term: 1 (no influence), 2 (low influence), 3 (medium influence), 4 (high influence) and 5 (very high influence).

The analysis results obtained from the decision-making team are defined in the fuzzy effect matrix as seen in Table 3. The values obtained in Table 3 reflect the average results of the experts.

Table 3. Initial direct-relation fuzzy matrix

Criteria	C1			C2			C3			C4			C5			C6		
C1	0,00	0,00	0,00	0,58	0,83	1,00	0,75	1,00	1,00	0,50	0,75	0,92	0,58	0,83	1,00	0,75	1,00	1,00
C2	0,00	0,17	0,42	0,00	0,00	0,00	0,33	0,58	0,83	0,17	0,33	0,58	0,25	0,50	0,75	0,58	0,83	1,00
C3	0,00	0,08	0,33	0,00	0,25	0,50	0,00	0,00	0,00	0,08	0,17	0,42	0,00	0,25	0,50	0,33	0,58	0,83
C4	0,17	0,42	0,67	0,42	0,67	0,83	0,58	0,83	0,92	0,00	0,00	0,00	0,42	0,67	0,83	0,58	0,83	0,92
C5	0,08	0,25	0,50	0,25	0,50	0,75	0,42	0,67	0,92	0,25	0,42	0,58	0,00	0,00	0,00	0,50	0,75	1,00
C6	0,00	0,08	0,33	0,00	0,25	0,50	0,17	0,42	0,67	0,00	0,08	0,33	0,00	0,25	0,50	0,00	0,00	0,00

After that step, this matrix is normalized, and new matrix is given on Table 4.

Then as seen in Table 5, total relation matrix is created.

In the next step, the defuzzification process is occurred and the weights of the criteria have been identified. The details are given on Table 6.

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Table 4. Normalized direct-relation fuzzy matrix

Criteria	C1			C2			C3			C4			C5			C6		
C1	0,00	0,00	0,00	0,12	0,17	0,20	0,15	0,20	0,20	0,10	0,15	0,19	0,12	0,17	0,20	0,15	0,20	0,20
C2	0,00	0,03	0,08	0,00	0,00	0,00	0,07	0,12	0,17	0,03	0,07	0,12	0,05	0,10	0,15	0,12	0,17	0,20
C3	0,00	0,02	0,07	0,00	0,05	0,10	0,00	0,00	0,00	0,02	0,03	0,08	0,00	0,05	0,10	0,07	0,12	0,17
C4	0,03	0,08	0,14	0,08	0,14	0,17	0,12	0,17	0,19	0,00	0,00	0,00	0,08	0,14	0,17	0,12	0,17	0,19
C5	0,02	0,05	0,10	0,05	0,10	0,15	0,08	0,14	0,19	0,05	0,08	0,12	0,00	0,00	0,00	0,10	0,15	0,20
C6	0,00	0,02	0,07	0,00	0,05	0,10	0,03	0,08	0,14	0,00	0,02	0,07	0,00	0,05	0,10	0,00	0,00	0,00

Table 5. Total-Relation fuzzy matrix

Criteria	C1			C2			C3			C4			C5			C6		
C1	0,01	0,05	0,25	0,14	0,27	0,55	0,20	0,35	0,63	0,12	0,22	0,46	0,14	0,27	0,55	0,21	0,38	0,67
C2	0,00	0,06	0,26	0,01	0,06	0,27	0,08	0,20	0,48	0,04	0,11	0,32	0,05	0,16	0,41	0,14	0,26	0,54
C3	0,00	0,03	0,20	0,00	0,08	0,30	0,00	0,05	0,25	0,02	0,06	0,24	0,00	0,08	0,30	0,07	0,17	0,42
C4	0,04	0,12	0,34	0,10	0,22	0,47	0,15	0,29	0,55	0,01	0,07	0,26	0,10	0,22	0,47	0,16	0,31	0,59
C5	0,02	0,08	0,28	0,06	0,16	0,42	0,10	0,22	0,51	0,06	0,13	0,34	0,01	0,07	0,29	0,13	0,26	0,55
C6	0,00	0,03	0,19	0,00	0,08	0,28	0,03	0,12	0,35	0,00	0,04	0,22	0,00	0,08	0,28	0,00	0,05	0,25

Table 6. Effect-relationship degree results and weight values

Criteria	Di	Ri	Di+Ri	Di-Ri	Criteria No	Weights
Legal Deficiency	1,714	0,560	2,274	1,154	C1	0,1753
High Cost	1,040	1,070	2,110	-0,029	C2	0,1626
Lack of Technological Knowledge	0,661	1,403	2,064	-0,742	C3	0,1591
Lack of Awareness	1,378	0,807	2,185	0,572	C4	0,1684
Competition	1,116	1,070	2,186	0,047	C5	0,1685
Lack of Qualified Personnel	0,575	1,576	2,152	-1,001	C6	0,1659

According to the results of Table 7, while C1 is the most influencing criterion, C6 is defined as the most affected factor. In addition, while C1 is the most important criterion among other factors, C3 turns out to have a relatively low weight. In this process, the negative value of $\boldsymbol{Di}$ - $\boldsymbol{Ri}$ indicates that the criterion is an affected criterion. On the other hand, if this value is positive, the mentioned criterion is called as affecting.

SOLUTIONS AND RECOMMENDATIONS

In this study, it is investigated that why companies insist on carbon emission problem. In other words, the research question of the study is what the main reasons behind companies which are causing carbon

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emissions. In this context, a large-scale literature review was first performed. In this way, the main reasons for companies to make carbon emissions have been explored. According to the analysis results obtained, 6 different variables that are thought to be effective on this issue were determined. After that, an examination was made with fuzzy DEMATEL method in order to determine which of these factors are more important. As a result of analysis, it is concluded that legal deficiency (C1) is the most important criteria. In addition to this issue, it is also identified that competition in the sector (C5) also play a key role for companies that want to reduce their carbon emission. On the other side, it is also determined that lack of technological knowledge (C3) and high cost (C2) take place on the last ranks.

The results of the study illustrate that policymakers should take necessary steps in order to provide legal sanctions for preventing carbon emission. As a result of the analyzes, it has been understood that this problem cannot be solved without consolidating the legal infrastructure. Bringing a penalty mechanism to companies and the sector is one of the best solutions to reduce carbon emissions and increase trade volume. Many companies will not attempt to install filters, use carbon capture technology or choose renewable energy sources unless a legal basis is established. For this reason, the legal system should be strictly supervised in this regard, and even conditions such as carbon emission quota should be introduced in new company opening attempts. In addition, the mechanism to implement this penalty system and inspections should be determined and followed up regularly with municipalities, etc. In cases where these measures are not taken, the amount of carbon emissions in the country continues day by day. Nowadays, when the world is becoming more environmentally friendly, this creates a negative effect on the image of the countries and may have bad consequences such as commercial embargoes and product restrictions. For this reason, if there is no company-based intervention, it will spread to all sectors, which will adversely affect international trade in the future.

Competition and lack of information are also important issues in this regard. Competition in the sector may cause companies to put their policies on reducing carbon emissions as a second priority. To solve this situation, although competition in the sector cannot be reduced, companies can be helped by providing privileges to those who take financial support or measures to reduce carbon emissions. Both state and various professional groups should be involved in order to raise awareness on this issue. Companies that are culturally unfamiliar with this issue do not know in the future that this will have a significant impact on disrupting their business transactions. For this reason, both government and professional groups can raise awareness by raising awareness of companies on this issue through various seminars, trainings and briefings.

FUTURE RESEARCH DIRECTIONS

There are some limitations in this study. As a first, in this study, the main reasons behind companies causing carbon emissions are discussed in order to its possible effect on international trade. However, this situation can also have negative impacts on other sectors such as health. For this reason, in the future researches, different sectors can be taken into account. In the other hand, in analysis process of this study, DEMATEL method in fuzzy framework is used. In the future, these analyses can be conducted with other methods such as fuzzy-AHP, fuzzy ANP and so on. In that case, more accurate results can be obtained. Besides these, the study does not have a specific scope, it is made on general base. So, in following studies, it can be very beneficial if it can implement to different countries or country groups. With this way, country-based strategies can be formed, and more efficient results can be acquired.

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CONCLUSION

In today's world, it is very important to use trade volume efficiently in order to get maximum efficiency from trade. At this point, international trade plays an important role. With both import and export, countries can have the advantage of developing their own economies and being stronger in the international arena. For this, they need to use strategies that will benefit them in international trade. The world focuses more on the concept of globalization day by day. With the gradual disappearance of the borders between the countries, the course of international trade is being reshaped every day. This situation can cause both positive and negative effects on companies. Many institutions and organizations are becoming more integrated day by day. This means that many transactions at the international level become more complex. Companies or governments that do not have a solid structure in such incidents may fail to manage the process and suffer losses. Especially in times of crisis, economies with vulnerabilities can have a difficult time due to the fact that crises no longer remain in the country of origin and spread rapidly to many countries. However, globalization can be an advantage among local companies. An international market means many companies and a competitive environment. This competitive environment compels local companies in the country to be better to compete with others. For this reason, such companies can develop day by day and contribute to the country's economies. The current situation contributes to creating new job opportunities and new markets for countries. Therefore, factors that adversely affect international trade should be minimized in order to develop international trade effectively.

Environmental problems are one of these factors. Especially with the increasing environmental awareness in recent years, they have turned their policies green in the countries and opened some restrictive agreements against carbon emission, which is one of the most important indicators of environmental problems. At this point, it has been revealed that the main reason for carbon emissions in countries is companies. For this reason, in this study, it is aimed to find reasons for why companies do not reduce carbon emission and strategy suggestions for eliminating these reasons are presented. According to the results of analysis performed on 6 criteria with the Fuzzy DEMATEL method, the legal gap emerged as the most important reason for companies not reducing carbon emissions. In addition, the lack of technological infrastructure and competitive environment in the sector are among the factors that deter companies from taking measures to reduce carbon emissions.

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KEY TERMS AND DEFINITIONS

AHP: Analytical hierarchy process.
ANP: Analytical network process.
DEMATEL: The decision-making trial and evaluation laboratory.

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Chapter 9
Examination of Vocational Schools as Sustainable Human Resources in Supply Chain Management:
The Case of Turkey and South Korea

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ABSTRACT

In today's business world, having talented, educated, and qualified employees who can use technological developments has become an important advantage. Maintaining this superiority can be done with employees who are technically business-oriented. Economic uncertainty in the global markets enables countries to attach importance to vocational education, which will make their youth a part of the current economic process. The aim of this study is to reveal the necessity of vocational education in vocational high schools and vocational schools of higher education in our country to sustainably meet the global workforce needs of supply chain management. In this context, South Korea has been selected on global scale, which is thought to play an important role in the vocational education policies implemented in her development, and the general and vocational education system examined has been compared with the situation in Turkey.

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INTRODUCTION

Societies, which have struggled to survive in harsh environmental conditions through thousands of years of human history, have always wanted to possess beneficial resources and have always used them against their rivals as a means of superiority. Historically, it has been observed that these resources within the scope of limited riches have caused economic strifes and even wars since they could not be shared among developing nations in time. In this context, the superiority of societies to each other in these struggles was achieved mostly by human beings as the most important resource. As in the past, in the age we live, societies are competing to survive. Struggles for superiority such as the wars with all-out weapons that were experienced more frequently in the past have been replaced by economic wars in international trade today. In the age we live in, societies that reach better living conditions by using their resources effectively should have the goal of leaving a more livable world for future generations.

The rapid developments in information technologies, the rise of globalized communication, and the removal of the borders of international trade have led to the evolution of trade in local markets to trade in global markets. As in all areas, with this evolution in today's market conditions, the competition between economic businesses has reached the highest level. While the sustainability of the superiority of the competition between businesses depends on the different resources in the sectors in which businesses operate, it can be said that it is basically based on human beings in the context of resources. The human being in the context of resources emerges as the main factor in the management, production, marketing, human resources, supply chain, financing, accounting, public relations, and research and development functions of businesses. Sustainable competitiveness is addressed in strategic human resources management, which emphasizes human resources through a resource-based approach. Strategic human resources include activities aimed at human resources management strategies that will give macro-scale organizations competitive superiority (Budak, 2013: 25-26, Esen, 2018: 92).

Instead of being seen as an element of cost, the human being is positioned as a long-term investment tool and capital in strategic human resources management. According to Barney, who has greatly contributed to the resource-based approach in strategic human resources management, in the human resources as the third main resource in addition to the material and organizational resources of a company, there are factors such as the education, experience, intelligence, social relationships, individual judgements. Barney (1991: 105-111), claims that within the resource-based approach the human-being provides superiority in competition in terms of value, rarity, non-imitability, and non-substitutability (Bal, 2010: 270-272). Moreover, the unique human resources in an organization need to be effectively guided by appropriate leadership styles. Effective leadership styles provide basis for increasing capabilities of employees while providing them to create social value in organizations (Doğru, 2020).

According to this approach, it is accepted that the contributions of human resources to the business with their knowledge, interest, ability, and skill based on their knowledge, interest, ability, and nature increase their superiority against their competitors. Today, the need for qualified workers in different sectors in the business world is increasing. However, due to demographic changes in countries caused by global crises, areas of diversified activity and technological developments, there are problems finding personnel with a level of knowledge and skills compatible with working conditions that are ambiguous due to continuous changes. Businesses are in the search to employ the right human resource, a strategic asset, to maintain their assets and maintain their competitive edge based on the growing uncertainties in the markets in which they operate and the increasingly difficult competitive conditions they have entered into.

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At the beginning of the last century, developments occurred in the scientific field as well as in many fields. As a result of these developments, two world wars happened between nations within a period in between that could be considered very short based on reasons based on resources that provide economic benefits. The efforts of the countries, especially during World War II, which had a very important place in the history of the world, to be superior against each other, have created new needs and multifaceted developments that also affect the post-war.

The spread of the World War II geography to wide areas, the willingness of warring countries to be close to the resources needed has brought about lack of management in issues such as the production of the resources in the desired amounts, delivery of the needs to the desired places with transportation vehicles in a short time, and storing the desired amount. In general, the logistics sector, mostly known as military terminology, which covers the transportation of a final product from one place to another, has been found to be insufficient and a search of a new sector to meet the needs has started. Because of the global oil crisis of the 1970s, with movements of businesses for minimizing their increasing distribution costs and determining priorities to increase efficiency, this need has been called the supply chain. With the need to operate this concept as a whole, it was required to manage it in the organizational sense.

The concept of the supply chain has been shaped in the scope of logistics; nevertheless, it has transformed with the macro coevolution (McKelvey, 1997 ; Sözen and Basım, 2017) between sectors that happened with the effect of environmental factors and has become a sector which also encapsulates logistics. The supply chain, which seems to be intellectually new as a concept, has been used as a sub-component of logistics until its importance was recognized. The supply chain is the process through which raw materials to be used in production, auxiliary materials and production tools are brought together and supplied under optimal cost and conditions to production points, production activities for achieving effectiveness in production processes are supported, and the product is delivered to the ultimate consumer with best conditions and cost. In this respect, apart from supply chain production processes, the main activity can be defined as the general name of the efforts to support production and to continue operating under the best conditions (Görçün, 2016: 1). Businesses operating in this sector with a broader conceptual and transactional framework compared to logistics have tried to address their shortcomings by interacting with each other in accordance with their needs. They need qualified personnel to move from resource dependency to an autonomous structure with the cost of processing they have to endure that occurs in the practical relationships of businesses with each other.

The human being that is an efficient resource when used efficiently gains qualifications through education. Well-educated individuals provide gains in different sectors to the society in which they live and also help the healthy development of society. Countries trying to overcome the problems created by the global economic shrinkage are observed to develop educational policies that will enable their young population to be part of the current economic process. When the developed countries are examined today, it is seen that vocational education is important and that this training is supported by different policies. Vocational education is important for the sustainability of human resources. However, vocational education school graduates who receive training for low value-added business sectors which does not consider the economic and social needs of the society can become unemployed.

When it is accepted that the most important element (natural resources, labor, entrepreneur, and capital) is the human being at every stage of the production factors, qualified technical personnel who can convert their knowledge into skills and use it effectively with experience are needed even during the Industrial 4.0 period in which we live. Vocational education, which is thought to exist to meet this need, is less preferable than general education because of the guidance of families in Turkey as in many

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countries and concerns about students' qualified career prospects. In our country in which the 15,8% of the population is made up of young people aged 15-24 with 12.971.396 people according to 2018 TUIK data, it is required to plan educational programs towards the production of technological products which have high added value in the scope of 2023 national goals which are very close ahead.

The purpose of this study is to attract attention to supply chain management whose importance is increasing by providing high gain to businesses in international markets and to pave the way for providing personnel to both national and international businesses by giving integrated education in Turkish vocational high schools and vocational schools in higher education to meet the global need for personnel in a sustainable way. Accordingly, in the scope of the study, since supply chain management that is a relatively new concept in terms of concept and usage has production focused elements that lead the economy and that industry and service sectors exist together, by comparing the vocational education in Turkey to vocational education in South Korea which is known to have reached its current economic development thanks to the importance it has given to vocational education, it is aimed at comprehending their condition and position in this subject. In the study, by touching on the subjects of supply chain, sustainability and human resources management conceptually, in this scope, the necessity of education at vocational high schools and vocational schools at higher education is examined by comparing vocational education in Turkey and South Korea.

BACKGROUND

The Concept of Supply Chain Management

According to the current Turkish dictionary of the Turkish Language Association, while the concept of supply is used in three different ways as research, provisioning, acquisition and preparation, it could also be defined as the purchase of the product needed in businesses at the most affordable price at the right place and time in order to be delivered to the customer on time. The concept which first started to take its shape within the scope of logistics started to be called supply chain with the determination of priorities to reduce distribution costs of businesses which increased with the global oil crisis after World War II (the 1970s) and to increase productivity. Supply chain represents the processes of supplying raw materials, auxiliary materials and production tools to production points by bringing them together with the most appropriate cost and conditions, supporting production activities to ensure effectiveness in the in-production processes, and the delivery of the product to the final customers with the best conditions and cost (Görçün, 2016: 1).

Today, although logistics and supply chain concepts are used interchangeably, logistics is functionally a subcomponent of the supply chain. Logistics, which is older than the concept of supply chain, comes from the word "logisticos", which means arithmetic association for any reason, or capable of calculating in ancient Greek. Logistics in military terminology, which has a great impact on the emergence and development of the current use conceptually, is defined as the determination of the need and developing the system, equipment and materials necessary for the operation of the armed forces, supplying, storing and delivering them (Acar and Köseoğlu, 2016: 2-3).

According to the Council of Supply Chain Management Professionals, logistics is the process that encompasses the effective and efficient planning, implementation and control of the forward and backward flows of goods, services, and related information between production point and consumption points to

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meet customer needs. As can be understood from this definition, goods, services or information ordered in logistics are delivered to the customer from the point of manufacture.

In supply chain management, that is clearly separated from logistics in its conceptual homeland, the U.S., many intermediate businesses are involved in the process when strategic decisions are being taken and businesses are spending effort to increase their profit margins to outdo their competitors (https://www.michiganstateuniversityonline.com/). In this context, the difference between logistics and supply chain is the processes that the ordered product follows from raw materials to the customer. The orientation of the processes made up of information flow, physical distribution and the performed operations as a whole within a system is called supply chain management. Supply chain management is the effective management of supply chain activities to maximize customer value and gain a sustainable competitive advantage. Supply chain activities include information systems needed to coordinate activities that cover everything from product development, supply and production to logistics. All goods and services produced in the global market reach the consumer by multiple businesses working in harmony. Collectively, these businesses make up the supply chain (http://cscmp.org).

The main objectives of supply chain management are simply to identify the supply chain structure and scope that will prevail in competition, to expose problems that slow down the flow of information, products and services, identify the right processes to deliver the desired products to the customer just in time, and empower the right person to successfully perform all these tasks (Acar and Köseoğlu, 2016: 52). According to supply chain characteristics, it is in the form of a single and multi-stage supply chain with internal and external supply. Internal supply chain; is a supply chain system within the boundaries of a business. This is especially true in large international businesses. External supply chain on the other hand is the structure of suppliers and customers both between companies and within the scope of the supply chain outside the business. However, according to P.J. Metz (1998), there are single-stage and multi-stage supply chains based on the increasing complexity. The Single Phase Supply Chain combines the tasks of acquiring raw materials, production and material flow within distribution. In this kind of supply chain, there are many information processing and decision-making tasks. Multi-Stage Supply Chains, on the other hand, are multi-company supply chains of single-stage supply chains in multiple states. Automakers are a good example of the multi-stage supply chain.

There is also no standard supply chain structure because businesses serve in different areas. In this structure, which varies by business, the processes vary, but in the general form are customer relations management, supplier relations management, customer service management, demand management, order fulfillment process, production flow management, product development and commercialization, return management (Acar and Köseoğlu, 2016: 62).

The functions of all components that form the chain in supply chain management must also be integrated. It is aimed to perform specific tasks consisting of a range of functions such as demand and order management, purchasing, planning, inventory (stock) management, warehouse management and shipment (transport) in the in the delivery of products from supplier to consumer (Altuntaş, 2005; Eymen, 2007; Ada, 2010; Görçün, 2016). With supply chain management, businesses want to achieve the highest benefit by minimizing the costs imposed while meeting customer demands through analyses and plans. With increased customer satisfaction, inputs are provided to ensure the continuity of production; by increasing quality, demands are met in the best way, and it is ensured that changes in the market are responded as soon as possible. In this context, with supply chain management, by working in harmony with all members in the chain, businesses provide healthy flow of news, track production, make inventory control healthier, keep suppliers under control, enable regular and better communication by improving

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customer service, can respond to orders quickly and accurately, increase the reputation of the brand in the market, reduce shipping, storage and packaging costs, use refunds and recall management well, and ensure higher revenue.

In addition to the advantages mentioned, implementing supply chain management can be very expensive for businesses, their strategies can be copied by competing businesses, appropriate skills and experience may be needed to succeed, management of various functions can be difficult and resistance of those who work in supply chain management can occur. Businesses will increase their preferability in the face of their competitors as well as holding on to the market with demand-supply-oriented production focused on customer demands. The size of the product offered, speed to respond to demand, product variety, level of service to be accepted, product price and new product expectation determine the customers' demands (Görçün, 2016: 43-45).

Sustainable Human Resources Management

Sustainability, which is a frequently encountered concept today, is used as much for the economic field as it is used to specify the condition of the resources required for the continuation of the human race. The concept sustainable (or that can be continued) whose meaning in the current Turkish dictionary of the Turkish Language Association is to resume, has emerged with the report prepared by United Nations World Environment and Development Commission in 1978 titled "Our Common Future", also known as the Bruntland Report, seeking solutions in line with sustainable development goals such as eradication of poverty, equal distribution of benefit from natural resources, population control and development of environmentally friendly technologies and has started to be used frequently. With its most common use; the first official use of sustainability in history, which is meeting the needs of today's generations without jeopardizing the opportunities for future generations to meet their own needs, was seen in the 1713 thesis of German tax treasurer Hans Carl von Carlowitz on sustainable forestry titled "Sustainable Forestry, Sylvicultura Oeconomica" (Thatcher, 2013). The concept used in different sources and subjects has gained popularity with the concept of "Sustainable Development", which is an economic definition. This concept, which is used for the continuity of environmental factors within the scope of economic development, social and environmental outcomes, is a kind of limitation for businesses that are constantly growing and bringing natural resources to the point of extiction in order to get a share of world trade in the economic race, where countries are struggling. For this reason, today's businesses are trying to reassure their customers by publishing sustainability policies and increase their preferability. Also, there is an organic relationship between employees and their organizations in sustainability. In order to be successful in sustainability, employees should be guided and supported by their managers in a way to foster their creative and innovative behaviors (Doğru, 2018). This is essential for sustainability in organizations.

The sustainability emphasis of businesses is to move away from temporariness and to achieve longevity. Of course, in our planet, where natural resources are not infinite, the resources that we can benefit from today can also be used in the future with measures to be taken. All these efforts are meant for future generations to benefit from the same resources. As knowledge evolves, the concept of sustainability is enriched and its scope widens. Sustainability should be evaluated not only for the use of natural resources, but also for the consumption of resources in general. Of course, one of the most valuable sources of businesses is people who are talented and educated, who can use knowledge. The human being, who provides sustainable competitiveness to businesses, has been emphasized in resource-based approach

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to strategic human resources management as a source. With this approach, the human being is not an element that creates costs for businesses, but rather a long-term investment tool, a capital.

The concept of sustainability that is being discussed in this study is the provision of trained human resources that is employment continuity, which is the most important element for businesses to continue their existence under increasing competitive pressure. Employment continuity can be realized by the concept of corporate sustainability, which we can consider as the management of environment, humans, governance, ethics and financial performance. The concept refers to the continuity of commercial enterprises that include only a fraction of sustainable development, especially the economic units responsible for production.

According to Kuşat (2012: 229), corporate sustainability is a management approach that aims to transfer institutions within a country with an economic purpose to the future in a healthier way by minimizing all kinds of material or incorporeal risks developed as an alternative to traditional growth theories. In order for businesses to achieve corporate sustainable development, according to Bansal (2005), businesses have to reflect the principles of environmental integrity, social justice and economic prosperity to their products, policies and applications. Conceptually, corporate sustainability is considered the last point in the evolution of human resources management (HRM). According to Ehnert (2009), the evolution of human resources management can be systematized in five key stages: installation of personnel unit, personnel management, human resources management, strategic human resources management and human resources as the basis of organizational sustainability.

At this stage, HR is at the heart of organizational sustainability (Freitas et al., 2011). While sustainability was a concept used for natural and physical resources in the general sense, according to a report released by the UN World Commission on Environment and Development in 1987, American Business theorist Jeffrey Pfeffer highlighted the role of the human element for sustainable governance in his work "Establishing Sustainable Organizations: The Human Factor" (2010). The sustainability of human resources management, in other words, sustainable human resources management is defined as activities or long-term conceptual approaches aiming at social interest and economic benefit, recruitment and selection of priority personnel, placement in work, development and if needed layoffs. The aim of sustainable human resources management is to create the human resource infrastructure that will ensure the organization's goals, and when that is achieved, organizations will be able to improve their performance (Thom and Zaugg, 2004: 215-245). In the literature, it has been found that some resources use the concepts of sustainable human resource management and strategic human resources management in the same sense. Although these two concepts resemble each other, they have differences.

Strategic human resources management is constantly making necessary changes to human resources action, policies and practices to support and develop the operational and strategic objectives and goals of an institution, according to Peynes (2009). According to Bingöl (2014), strategic human resources management has been defined similarly as all decisions and actions for managing employees at all levels of the company and implementing strategies that will create competitive superiority. As understood from these two definitions, strategic human resources management is an effort to regulate an HRM for long-term goals of enterprises, while sustainable human resources management also attaches importance to social and environmental purposes in addition to its scope for strategic human resources management for economic benefit.

Talent management is one of the key factors in achieving success in sustainable human resources management. The contributions of those employees whose talents are well-managed will maximise their contribution to businesses. Proportionate to this, educated employees with sufficient capacity will

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improve the survival and competitiveness power of the businesses in the face of their competitors. One of the most important resources that institutions and businesses need to have in order to achieve their goals is undoubtedly human resources. The human resources in an institution and business are as important as the gears on the wheels that make a machine work. Both the source and target of goods and services produced in institutions and businesses is human beings. Good management of human resources is important in terms of employing the right employees to the right jobs in businesses and institutions, gaining superiority to competitors with the effective use of skilled employees, increasing preferability by customers, and adding added value to the business and institution.

It cannot be expected to establish an organization for production purposes without labor and entrepreneur, which is the human resource of the production factors. Henry Ford, a renowned American industrialist, has emphasized the importance of human resource workforce by saying in an interview that "you can buy my factories, you can demolish my buildings, but if you give my employees back, I'll build it back just as it is." Compared to other elements, one which is a cost cutting and which even has the highest return of investment is the feeling that people are valued in the business where they work since this causes their motivation to increase and to be more attached and loyal to their jobs. Therefore, human resources management is a very important issue for business life due to the positive thoughts created in product, service and quality understanding, which causes productivity to increase (Güney, 2014: 25). The main purpose of human resources management is to enable employees to use their knowledge and skills in the best way, to maximize their contributions to the business, to improve the quality of their work life and to enjoy what they do in a healthy and safe environment.

The concept of human resources management emerged as personnel management as a result of the industrial revolution, when people working in their homes in the agricultural community started working based on production in factories. During this period, it became mandatory for those involved in the production process to have a certain expertise, thus the importance of education for expertise has emerged. The first human resources practices were followed by the personnel department between 1910 and 1911, starting with Frederick W. Taylor's scientific management approach. Between 1930 and 1970, the role of the workers in the decisions to be taken, absence from work, the high speed of employee turnover, trade union activities coming to the forefront have brought about personnel matters to be handled in a scientific manner. In addition, the laws regarding personnel put into effect after 1970 emphasized the importance of personnel and the concept of human resources management was introduced after 1980 (Güney, 2014: 27). According to Can et al. (2012: 13), the planning of human resources including employment, development, pricing and integration functions within the period starting from the involvement of an employee until he/she leaves the job and according to Rothwell and Kazanas (2003: 2) it is an informed activity that is used to obtain the personnel at the appropriate number and quality at the appropriate time and place to achieve the future objectives of the organization in an efficient manner. Although it varies according to the goods and services offered by businesses, it has two types: usually short and long term (Can et al. 2012: 154-155).

Concepts Related to Vocational Education and Historical Development of Vocational Education in Turkey

The profession, which allows a person to be accepted in society, and provides financial gain to meet vital needs is defined according to the current Turkish dictionary of the Turkish Language Institution as the work carried out to produce useful goods for people, to provide services and to make money within

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specified rules based on systemic knowledge and skills earned by a certain education. What we will pay attention to here is that the profession has been acquired through education. Profession that is passed on from father to son or learned in the master apprentice relationship has further improved and evolved with the industrialization realized as a result of mechanization with the new inventions in Europe in 18th and 19th centuries and the invention of Hargreaves' Spinning-jenny in England in the 18th century. In order to meet the people's needs that have differentiated and changed by new inventions and evolving technology, the necessity of training and specialization has emerged in professions. In the process of professional development, which entails psychological and social factors that affect each other, the decision of individuals to choose professions emerges as a combination of many characteristics and conditions. According to Kuzgun (2006: 21) these include abilities, skills, interests, professional values, expectation of competence, risk taking, psychological needs, socio-economic level, family relationships, and gender.

When economically developed countries are considered, it is seen that they have employee training programs equipped with the technological developments of the age, with work discipline, the competence and skills that can guide the professions, and that can provide added value. Countries that carry out education as state policy in professions that affect the world's business markets reinforce their wealth with technically well-trained human resources. According to Alkan et al. (1991: 10), vocational training based on production and service in different business areas meets social, economic and cultural needs in the individual's life by showing individual and macro economic effects. However, vocational education is more global compared to education shaped by national culture and causes development-oriented production to be understood as a collective phenomenon (MTEPDB, 1982: 15).

Vocational education in our country, which is still in the process of development compared to its contemporaries, started with the Ahi order that was also seen in the Seljuk State in our history and developed under the monopoly of Muslims until the early 17th century in the Ottoman Empire. Apprenticeship training, which constitutes the main body of vocational education, has been successfully continued for a long time within the holistic training approach of the Ahi order. With the weakening period of the Ottoman Empire, as all institutional structures, this system lost power and the Ahi Order that was carried out by Muslim and non-Muslim traders together until the 18th century, was replaced by the guild and the gedik (Ottoman monopoly of trade rights system) systems (Gemici, 2010: 79-80).

Unable to keep up with the technology of the West developed by the industrial revolution with its unqualified work force, the Ottoman Empire thought that modernization was to thrive in military fields because of the defeats it took in wars, and set the policies of vocational education in this direction. As a result, starting from late 18th century and early 19th century, respectively technical schools such as Mühendishane-i Bahr-i Hümâyûn" (established in 1773 under the reign of Sultan Mustafa III to develop the dockyards and the navy and to train dockyard workers) and "Mühendishane-i Berr-i Hümâyun" (established for cartography, shipbuilding, civil engineering and ballistics teaching in 1795 under the reign of Sultan Selim III) "can be shown as examples (Koçer, 1991: 28; Selek and Şahin, 2011: 2). Starting from 1913, by developing regulations and programs a more disciplined approach has been followed in vocational schools. However, in these schools, which do not have a unified curriculum, a curriculum was implemented based on the needs of the city where the school was located and the capacity for teaching, and a vocational education curriculum that responded relatively to the local labour market was implemented (Alkan et al., 1991: 66). In short, there has been no transition from local to general.

With the founding of the Republic, the reports for vocational and technical education prepared by educators, each of whom were experts in their fields invited by Atatürk from foreign countries for the construction of modern Turkey and the observations and suggestions of famous Turkish educators of the

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period such as Ziya Gökalp, Ismail Hakki Baltacıoğlu, Ismail Hakki Tonguç and Mehmet Rüştü Uzel contributed to the development of the system (Demir and Şen, 2009: 43).

Schools that developed within the General Directorate of Vocational and Technical Education established in 1933 and the Undersecretariat of Vocational and Technical Education established in 1941 to provide formal education to male and female students for different purposes were planned to create the workforce needed in economic values and to ensure the most effective use of the population (Yörük et al., 2002: 301). With these schools, apprenticeships schools were opened and the system continued to be maintained traditionally.

After the World War II, migration from rural areas to cities that started with the acceleration of global trade and the search for answers to the need for workforce from industrialization, increased population surplus exceeding demand and created the unemployment problem. These developments have increased the importance of vocational high schools in order to meet the need for qualified workforce and caused them to be preferred. In 1977, the Apprentice, Foreman and Mastership Law No. 2089 was made and it was bound for rule that it would be applied to the apprentices, foremen and masters working in workplaces registered in professional organizations established in accordance with the Tradesmen and Craftsmen Law No. 507. In addition, the status of apprentices was detailed for the first time and apprenticeship was detracted from being subject to the general provisions of the Law on Debts (Serter, 1993: 101).

In the plans from the fourth five-year development plan covering the years 1979-1983 to plans including a seventh five-year development plan covering the years 1996-2000, emphasis was placed upon creating training programs in accordance with the needs of the industry, the necessity of private sector contribution to the development of vocational and technical education in addition to the state power, improving the mechanism of common education to the level of World standards as soon as possible, creating an institutional identity for vocational and technical education in solving problems in the transition from school to work and in this direction the necessity of switching to modular system is given weight (Yıldırım and Şahin, 2015: 89).

MAIN FOCUS OF THE CHAPTER

Brief Information About Turkey and South Korea and the Examination of Supply Chain Management Within the Scope of Vocational Training in Both Countries

The form of governance of both countries, which have a long history, is the republic and its political structure is the Presidency, which is centralized by similar administration. Both countries are peninsulas. While Turkey's area is 783.562 square kilometers, Korea's is 99,538 square kilometers. According to 2018 data, Turkey's population was 82,003,882 people, while South Korea's population was 51,251,239. Capital of Turkey is Ankara, and the capital Korea is Seoul (http://www.mfa.gov.tr/, https://www.tccb.gov.tr/, https://www.dunyaatlasi.com/, https://www.worldometers.info/, https://www.tuik.gov.tr/).

According to 2018 data, with approximately $784 billion national income in Turkey is the 18th national economy in the world, and the national income per capita is $9,632. South Korea's national income is about $1.693.246 billion, the world's twelfth national economy, and the national income per capita is about $32,774 (https://www.imf.org/). For the workforce of Turkey consisting of 32,295,000 people, the unemployment rate is 12.3% between the ages of 15 and above. The unemployment rate in

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the young population aged 15-24 was 23.6%, while the employment rate was 46.5% (TÜİK, 2018). On the other hand, for the workforce of South Korea consisting of 27,748,000 people, the unemployment rate is 3.7% for the 15 years of age and older (https://data.oecd.org/). The unemployment rate in the young population aged 15-24 is 10.3%, while the employment rate is 30.3%. Among those employed in Turkey 17.7% were in agriculture, 20% were in the industry and 55.8% were in the service sector (TÜİK, 2018). Among those employed in South Korea, 4.8% were in agriculture, 24.6% were in industry and 70.6% were in the service sector (https://www.cia.gov/). The share of education expenditures in Turkey in Gross Domestic Product (GDP) is 5.7%, while the share of R&D expenditures is 0.96% (TÜİK, 2017). The share of education expenditures in South Korea in Gross Domestic Product (GDP) is 5.25%, while the share of R&D expenditures is 4.3% (https://countryeconomy.com/, http://uis.unesco.org/). When we look at the factors affecting the economy of Turkey and South Korea, the following situation arises.

Table 1. National income, labor, unemployment, employment status of Turkey and South Korea

	Turkey	South Korea
National Income	$ 784 billion	$ 1,693.246 billion
National Income Per Person	$ 9.632	$ 32.774
Workforce	32.295.000 people	27.748.000 people
Unemployment Rate (15 and above)	12,30%	3,70%
Unemployment Rate (15 and 24)	23,60%	10,30%
Employment Rate	46,50%	30,30%
Sectoral Employment Rates	17,7% Agriculture, 20% Industry, 55,8% Service	4,8% Agriculture, 24,6% Industry, 70,6% Service
Education Spending Rate (from GDP)	5,70%	5,25%
R&D Spending Rate (from GDP)	0,96%	4,30%

Source: (Compiled from 2014,2015,2016,2017,2018 IMF, OECD, CIA, TUIK, country economy, UNESCO data)

When we examine the table, the amount of workforce in Turkey according to its population is quite low compared to South Korea. The number of labor, which is half the population of South Korea, is explained by unemployment and employment rates. Unemployment and employment rates, which are important indicators of the country's development level, also reveal the nature of education in that country. Although Turkey's rate of education from GDP seems to be higher than South Korea, it is assessed that the expenditure rate is mainly evaluated towards the number of institutions in education with the expenditure rate of R&D studies that diversify production in the economy, direct markets with different and improved products.

One of the most important issues in industrialization, which is an indicator of the economic development of a country, is the qualified education of workforce. The knowledge and skill of the workforce created with people trained in the areas of need brings economic success. Vocational education within the education system contributes to preventing unemployment, increasing employment and economic development. In the twelve year compulsory formal education in the form of 4+4+4+2/4 in Turkey which includes first (primary school) and second level (secondary school) and general secondary education

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(high school), high school-level vocational education has been involved in the last four years together with general secondary schools. Vocational Schools in which vocational high schools graduates are placed with Higher Education Institutions Exam (HIE) are two year programs (National Education Statistics, Formal Education, 2016/2017). On the other hand, in South Korea, where the education system is in the form of 6+3+3+2/4, high school level vocational education after nine year compulsory formal education including primary school and lower-level secondary education (secondary school) is in the scope of non-mandatory senior secondary education (high school) schools. Those who want to continue their education in higher education level after vocational high schools usually receive 2 years of education in Vocational Schools although it varies with to the program, according to their success in the high school education success, academic achievement exam, interview and talent examinations and "Korean College Scholastic Ability Test" (KRIVET, 2012).

In Turkey, there are five kinds of schools giving vocational education; namely Vocational and Technical Anatolian High School (Anatolian Vocational Program, Anatolian Technical Program and Mastery Program), Multi-Program Anatolian High School (Vocational and Technical Anatolian High School, Anatolian High School, Anatolian Imam-Hatip High School and Mastery Program), Vocational Education Centers (Mastery Program), Fine Arts High School and Sports High School. While placement into Anatolian technical programs are done by central exam, Anatolian professional programs admit students without exams and through local placement. In Turkey, the age of starting vocational education is fourteen (https://mtegm.meb.gov.tr/). In South Korea, there are 3 different types of vocational training schools: Specialized High School, Meister High School and Comprehensive High School. Placement into these schools is done with exams. The age of starting high schools in South Korea is fifteen (Ji-Yeon, 2015: 6). In Turkey, while vocational training is mostly for the service sector (labor intensive), in South Korea, vocational training is mostly for the information technology and industrial sector (technology intensive) (Ji-Yeon, 2015: 8). Students who graduate from technical high schools in Turkey are given "Workplace Opening Certificate" with the authority responsibilities of master's certificate, and their employment is provided with the title of "Technician" (Çaglar, 2017: 25). In South Korea, those who finish vocational education high schools graduate with a vocational high school diploma whose original name is "Silopgye Kodng Hakkyo Choeupchung" (KRIVET, 2012).

In vocational education high schools in Turkey, in the first year (9th grade) the same curriculum with the other high schools is applied, while field education is given in the second year (10th grade) basic and common qualifications education, and branch education is given in the remaining two years (11th and 12th grades) depending on the preferred vocational training area. In high schools in South Korea in the first year (10th grade) the same curriculum as other high schools is applied while appropriate training is provided in the other two years (11th and 12th grades) according to the preferred vocational training area (KRIVET, 2000). Vocational education at high school level in Turkey continues under the responsibility of the General Directorate of Vocational and Technical Education under the MONE and according to the Vocational Education Law No. 3308 (changed in 2001 from Apprenticeship and Vocational Education Law amended in 2001). In South Korea, high school-level vocational training continues under the responsibility of the Ministry of Labour and according to the Employment Insurance Act (amended in 1995 from the Basic Vocational Education Act) (Lee and Jeon, 2009: 4, Çevik, 2015: 78). The general status of Vocational Secondary Education in the Education System of Turkey and South Korea is as follows.

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Table 2. Turkey and South Korea's Education System, Vocational Educational Institutions, Related Law conditions

	Turkey	South Korea
Education System	4+4+4+2/4	6+3+3+2/4
Compulsory Education Time	12 Years	9 Years
Vocational Secondary Education Time	4 Years (Within the Scope of Compulsory Education)	3 Years (Out of Compulsory Education)
Vocational Secondary School Type	Vocational and Technical Anatolian High School (Anatolian Vocational Program, Anatolian Technical Program and Mastery Program), Multi-Program Anatolian High School (Vocational and Technical Anatolian High School, Anatolian High School, Anatolian İmam-Hatip High School and Mastery Program) Vocational Education Centers (Mastery Program), Fine Arts High School and Sports High School	Specialized High School, Meister High School and Multi-Program High School (Comprehensive High School)
Age of Starting Vocational Education	14	15
Transition to Vocational Secondary Education	Central Exam	Central Exam
Training Type	Labor Intensive	Technology Intensive
Post-Graduation Facilities	Workplace Opening Certificate and the title of Technician are given	Vocational High School Diploma (Silopgye Kodung Hakkyo Choeupchung) is given
Institution to which Vocational Secondary Education is Bounded to	General Directorate of Vocational and Technical Education under MONE	Ministry of Labor
Related Law	Occupational Education Law No. 3308	Employment Insurance Law

Source:(Data compiled from 2000, 2012, 2016, 2017, 2018 MONE, national education statistics, krivet, mtegm, Lee and Jeon, 2009, Çevik, 2015 and Çağlar, 2017)

When we examine the table, vocational education schools in South Korea are more pronounced and less diverse than their counterparts in Turkey. Vocational education schools in Turkey give education in more labor-based service areas that are not effective in the development of the country, while in South Korea, education is given in the fields of industry for production, where technology is used effectively. Schools providing vocational education in South Korea are affiliated with the Ministry of Labor due to the workforce they directly contribute to the country's economy, and are under the General Directorate of Vocational and Technical Education under the Ministry of National Education in Turkey. This indicates that vocational training is planned in line with production targets in South Korea, while suggesting that it is evaluated within the scope of education diversity in Turkey. Vocational education in both countries is guided by a law.

When we examine the number of schools in the data of the last three academic years for the two countries, it can be seen that in Vocational and Technical Secondary Education in Turkey, education was given in 5.239 schools in the 2015/2016 academic year, 5.851 schools in the 2016/2017 academic year, and in 3.636 schools in the 2017/2018 academic year (National Education Statistics, Formal Education, 2015/2016, 2016/2017 and 2017/2018).

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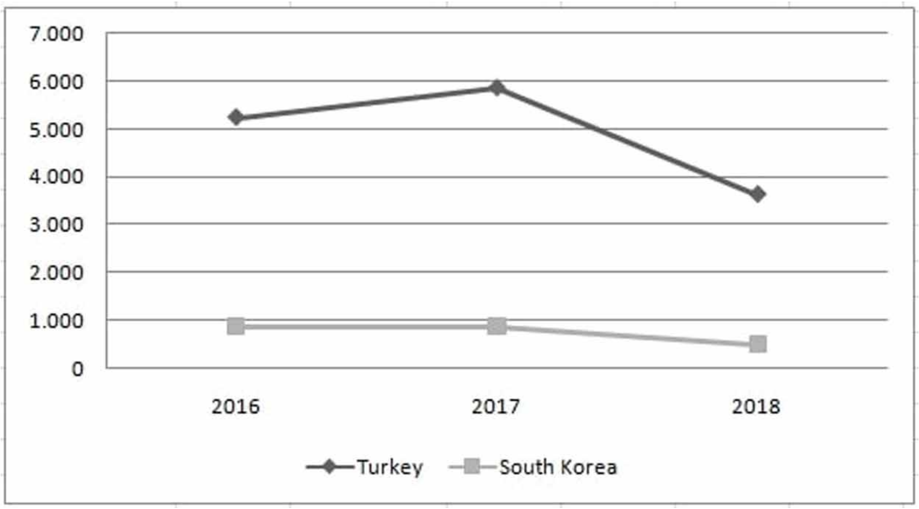
According to the 2017/2018 academic year data, the proportion of schools providing vocational and technical education was 31% of the total secondary schools. In vocational and Technical Secondary Education in South Korea, education was given in 861 schools in the 2015/2016 academic year, 866 schools in the 2016/2017 academic year, and 497 schools in the 2017/2018 academic year (KEDI, 2016, 2017). According to the 2017/2018 academic year data, the ratio of vocational and technical education schools to the total secondary schools was 19%. Based on the data obtained, the number of schools providing vocational and technical education between 2016 and 2018 is as follows.

Figure 1. Number of vocational and technical schools of the countries in 2016-2018
Source: (Created using National Education Statistics and KEDI Data)



When we examine the number of students in the last three academic year data of the two countries, in Vocational and Technical Secondary Education in Turkey, it was seen that 2.760.140 students in the 2015/2016 academic year, 2.713.530 students in the 2016/2017 academic year, 1.660.115 students in the 2017/2018 academic year took education (National Education Statistics, Formal Education, 2015/2016, 2016/2017 and 2017/2018). According to the 2017/2018 academic year data, the proportion of students studying in vocational and technical education schools to the total of students studying in secondary education of was 29%. In Vocational and Technical Secondary Education in South Korea, the number of students who took education in the 2015/2016 academic year were 505.476, in the 2016/2017 academic year it was 484.960, in the 2017/2018 academic year it was 252.912 (KEDI, 2016, 2017, 2018). According to the 2017/2018 academic year data, the proportion of students studying in vocational and technical education schools to the total of students studying in secondary education was 16%. Based on the data obtained, the number of students in vocational and technical education schools in the two countries between 2016 and 2018 is as follows.

When the secondary education vocational and technical education schools and the number of students studying in these schools is viewed comparatively in Turkey and South Korea between 2016-2018; it can be seen that Turkey, which is larger in geography and population, has more schools and students than South Korea.

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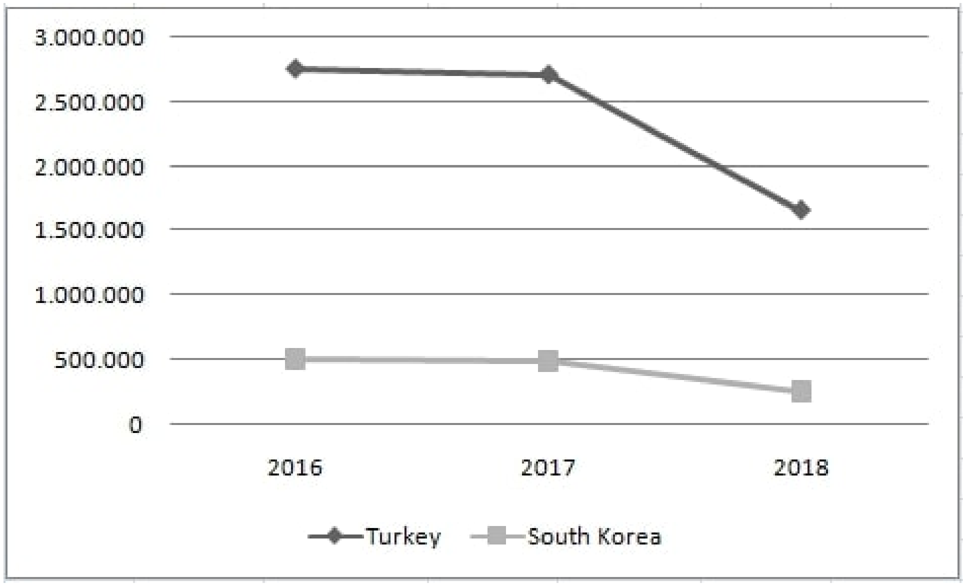
Figure 2. Number of Students in Vocational and Technical Schools in 2016-2018 in the Countries
Source: (Created using National Education Statistics and KEDI data)



Throughout the years, in Turkey, the number of students in the schools dropped after developments such as the restructuring of 22 school types which were excessive in number but provided similar education with different names with the regulation made in 2014 under the names Vocational and Technical Anatolian High School and Multi-program Anatolian High School (https://mtegm.meb.gov.tr) and ending education in the areas that have lost their effectiveness through the studies carried out. Similarly, the numerical decline is seen in South Korea.

Vocational schools of higher education (VHE) are available at the higher education level of vocational education. In both countries, these schools are excluded from compulsory education and admissions are done by a national examination after high school. In Turkey, VHEs are the responsibility of the Council of Higher Education (CHE) as the connection of the faculty or university, and the duration of education is two years. VHEs 89% public schools although they operate within state and private universities (https://www.yok.gov.tr/). In South Korea, VHEs are under the responsibility of the Ministry of Education under the name “Junior College” and the duration of education is two or three years depending on the program. 80% of VHEs depend on private universities due to the fact that higher education is paid in the country (İpek, 2011: 213-224). In VHEs in Turkey, with technical and social training being in the lead, training is provided in the fields of health, tourism, civil aviation, justice, mining, automotive, art and transportation (https://www.yok.gov.tr/). In South Korea education is provided in areas such as arts and physical education, natural sciences, education and humanities, with engineering, social sciences and health and pharmaceutical sciences in the lead (KEDI, MOE, 2018). The age of starting higher education in vocational education in both countries is eighteen. VHE students who have successfully completed two years of education in both countries can switch to universities that provide four-year undergraduate education with the Vertical Transition Exam (VTE) if they wish. The general status of Vocational Higher Education in the Education System of Turkey and South Korea is as follows.

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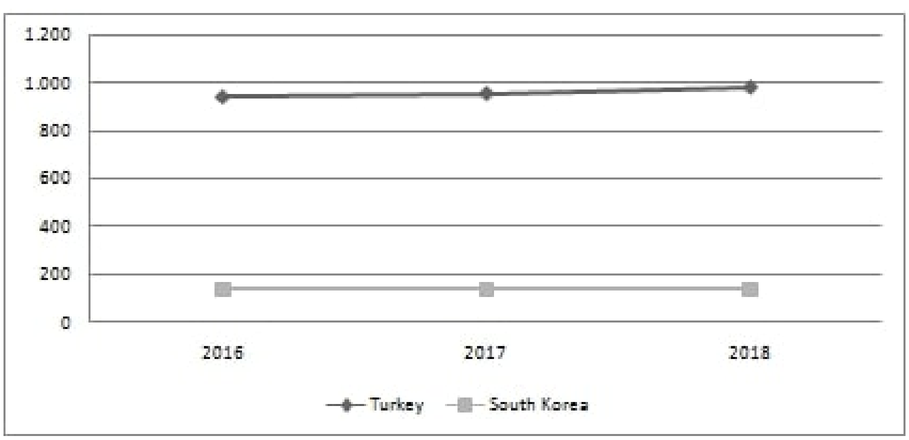
Table 3. Vocational Higher Education status of Turkey and South Korea

	Turkey	South Korea
Higher Education Institution	Vocational School of Higher Education (VHE)	Junior College
Education Time	2 Years	2 or 3 Years
Status	89 Public%	80 private%
Transfer to Higher Education	With Exam (Higher Education Institutions Exam)	With Exam (Korean College Scholastic Ability Test)
Age of Starting Vocational Education	18	18
Type of Education	Labor Intensive	Technology Intensive
Opportunities after Graduation	Transition to four year universities with Vertical Transition Exam (VTE)	Transition to four year universities with Vertical Transition Exam (VTE)

Source:(Compiled from 2018 CHE, KEDI, Moe, İpek 2011 data)

When we examined the number of schools in the last three academic year data of the two countries; it was seen that in the Higher Education in Turkey, training was provided in 940 VHEs in the 2015/2016 academic year, in 955 VHEs in the 2016/2017 academic year, and 981 VHEs in the 2017/2018 academic year (https://istatistik.yok.gov.tr/). According to 2017/2018 academic year data, the ratio of VHEs to the total number of Higher Education institutions in Turkey was realized as 29%. In Higher Education in South Korea, training was provided in 138 VHEs (Junior College) in the academic years of 2015/2016 and 2016/2017, and in 137 VHEs (Junior College) in the academic years of 2017/2018 (KEDI, 2016,2017, 2018). According to 2017/2018 academic year data, the total proportion of VHEs (Junior College) to the total number of Higher Education Institutions in South Korea was 32%. Based on the data obtained, the number of Vocational Schools of Higher Education (VHE) of the two countries between 2016 and 2018 is as follows.

Figure 3. Number of Vocational Schools of Higher Education in the Countries (VHE) for 2016- 2018
Source: (Created using Higher Education Statistics and KEDI data)



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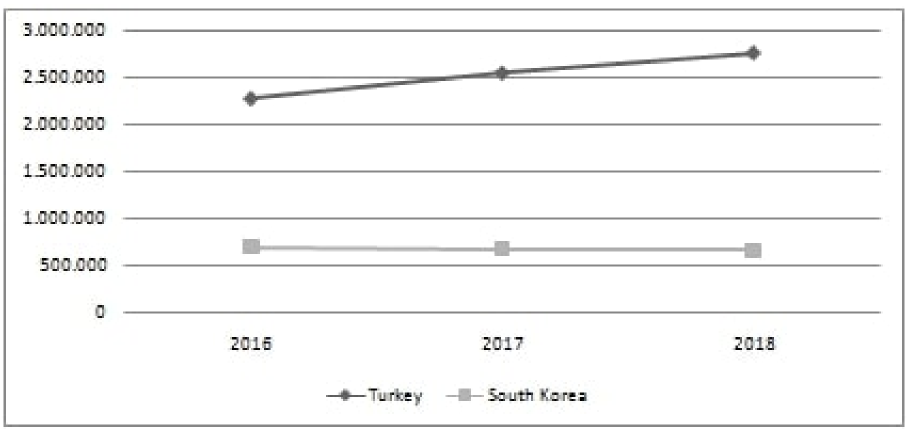
When we examined the number of students in the last three academic year data of the two countries; it was seen that in the 2015/2016 academic year, 2.285.406 students; in the 2016/2017 academic year, 2.555.926 students, and in the 2017/2018 academic year, 2.768.757 students were given training respectively (https://istatistik.yok.gov.tr/). The proportion of students studying in higher education was 37%. In Higher Education in South Korea, 697.214 students in the 2015/2016 academic year; 677.721 students in the 2016/2017 academic year, and 659.232 students in the 2017/2018 academic year were given training respectively (KEDI, 2016, 2017). According to 2017/2018 academic year data, the proportion of students studying in VHEs to the total number of students studying in Higher Education was 20% (KEDI,2016, 2017, 2018). Based on the data obtained, the number of students in VHEs between 2016 and 2018 is as follows.

Figure 4. Number of students in Vocational Schools in Higher Education (VHE) in 2016-2018 in the Countries
Source:(Created using Higher Education Statistics and KEDI data)



When the number VHEs and the number of students having received training at VHEs between 2016-2018 is examined comparatively, it is seen that although the number of VHEs in both countries is seen to have similar values in proportion to all higher education schools, numerically VHEs are on the rise in Turkey. It is also noted that the situation in Turkey has shown an increase as similar to that in the number of students in Turkey and a slight decrease in South Korea. While in Turkey, this situation is interpreted as an increase in the interest towards Vocational schools since the necessity of vocational education for development has been noticed in the recent years, in South Korea it can be thought that the number of students in VHEs have dropped because the preference has increased towards schools that provide 4-year education at university level instead of two-year vocational schools and since the number of Vocational Courses that give certificates about the work to be done under the name "vocational skill development" used in place of the term "vocational education" due to the Employment Insurance Law (Çevik, 2015: 77).

Generally speaking, the trend in vocational education of both countries, which have a similarity in economic development programs, is of different weight. South Korea has a small number of but qualified schools equipped with the technical infrastructure needed by providing state support in the development

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policies pursued since the 1960s, with economic goals for imported substitution production in general; despite launching economic development programs almost in the same period as South Korea, Turkey has more number of schools affected by system changes away from meeting the needs of the business world that are preferred by families who are not in good socio-economic situation to provide jobs for their children as soon as possible (Çevik, 2015: 70-90; Koç Aytekin ve Işık Tertemiz, 2018: 116). The fact that the number of schools giving production-oriented qualified education with their technological infrastructure, is small, causes that the number of qualified workforce is small in proportion. The unqualified workforce is creating increased cost for businesses that influence the economic power of the country and negatively affect the desired performance in production. This reveals the assessment that countries it is associated with commodity export rates to international markets that influence economic development levels. The figures for the export and import of goods belonging to the two countries between 2008 and 2018 are shown in Figure 5 and 6 comparatively.

Figure 5. Export of goods by years in Turkey and South Korea (Billion USD)
Source: (Created using oecd.org and tuik.gov.tr *data)*

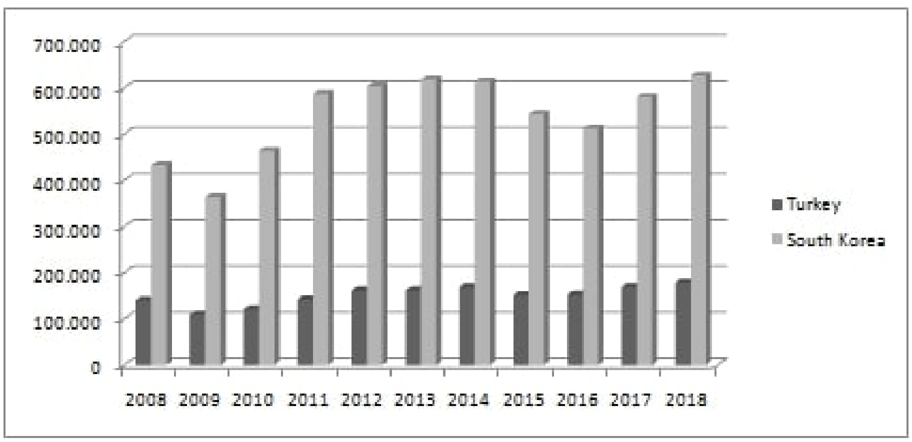
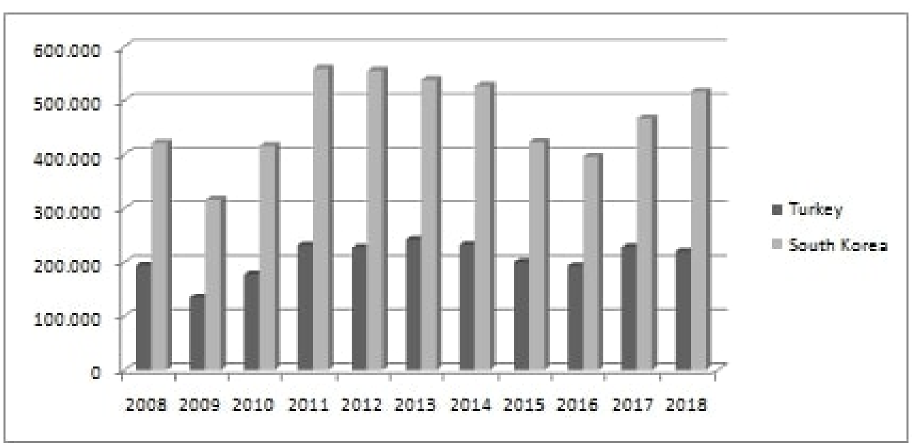


Figure 6. Imports of goods in Turkey and South Korea by year (Billion USD)
Source:(Created using oecd.org and tuik.gov.tr *data)*



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As the figures suggest, South Korea has a significant volume of business in the export and import of goods compared to Turkey. Today, each country is interconnected in production in global markets, which requires it to import goods or auxiliary goods that it cannot produce with its own underground and aboveground resources. What stands out in the figures is that the volume of imports of both countries is greater than exports. However, although Turkey has more underground and aboveground resources wealth and workforce compared to South Korea, it has less business volume in export figures of production-based goods. South Korea, which has an export economy, has significant high technological production power in sectors such as automotive, machinery, shipbuilding, petrochemical and robotics, which are preferred in global markets. This makes it regarded as a regional economic power that has successfully overcome the economic crises it has experienced periodically. This power has provided the opportunity to South Korea to become is a founding member of the APEC and East Asia Summit (Koç Aytekin, 2015: 68).

FUTURE RESEARCH DIRECTIONS

In this study, it is suggested that being successful in supply chain management, which has become the backbone of international trade, can be achieved with vocational education schools. It is known that vocational education is important for economically developed countries. Good management of the supply chain is considered as the key to development. The scope of the study can be reconsidered according to other developed countries and business areas.

CONCLUSION

In the post-World War II period, the new requirements and rising unemployment rates in the global trade level have led countries to make a breakthrough in the industry that creates the scale economy. During this period, Turkey and South Korea, which have historical similarities due to their geopolitical positions, have tried to develop by implementing similar economic models. Accordingly, South Korea has implemented eight five-year economic development plans with the import- substitution approach under U.S. auspices and support since 1962. In these plans, South Korea, which does not have many underground and above ground resources that are needed in industry compared to Turkey, has primarily acted with the purpose of empowering the public in terms of socio-economic conditions and education and secondly has aimed to improve its industry. Turkey, on the other hand, began to implement five-year economic development plans at the same time as South Korea, and implemented even shorter-term development plans with crisis-induced target deviations, and has headed towards an installation industry due to failing to create sufficient technological infrastructure for production as much as South Korea and became more affected by global economic crises (Koç Aytekin ve Işık Tertemiz, 2018: 117). It can be understood from the GDP and resources it has allocated for R&D that South Korea has provided state support focused on economic development and with the vocational education it has updated to meet periodic needs, it has spent the necessary effort to develop the human resources to have the qualifications to design, produce and develop products with high technology despite its inadequate underground and above ground resources (https://data.oecd.org/). Similarly, Turkey is in its eleventh economic development plan today in addition to many programs affecting development, with the program of developing basic and professional skills, aims at preparing the human resources for working life by providing the

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necessary professional skills and basic skills needed for increasing productivity in work life and for faster adaptation to changing business environment requirements (http://onbirinciplan.gov.tr/).

The two countries' understanding and direction in vocational education is clearly emerging from the export and import figures with the comparative review. South Korea and Turkey, which implement an export-based economic development model, have similar approaches in vocational education but differ structurally. Vocational education is within the scope of the Ministry of National Education in terms of prefer ability within the compulsory education system in Turkey, while in South Korea, it is covered by the Ministry of Labor with state support. This is important in terms of showing the motivation in vocational education policies. It has been observed that in both countries, which provide vocational training to create sustainable human resources for the need for qualified work force in different lines of business there are no high school or higher education level school that provides vocational education in the scope of supply chain management which has a business volume in line with changing market conditions changing from the direction of supply-oriented scale economy towards the demand-oriented diversity economy (Olgun, 2018: 155). However, in Turkey, 94 Vocational and Technical Anatolian High Schools and 21 Multi-Program Anatolian High Schools are providing training in transportation services at secondary school level within the concept of logistics which is one of the supply chain management subcomponents currently used interchangeably as a concept (http://mtegm.meb.gov.tr). On the other hand, in South Korea there is no logistics training in secondary school level vocational schools. Logistical training is provided in VHEs in both countries

(Olgun, 2018: 155).

In global markets, including south Korea's customer loyalty brands, the need for qualified trained workforce in the business lines, which is in the integrity of supply chain management, is an opportunity in terms of human resource presentation for countries like Turkey with foreign dependence. Through a visionary point of view, with the steps to be taken in this direction and the infrastructure to be created, it is considered to be for the interest of the country to establish six year Technical Colleges which show continuation within a holistic undivided structure of vocational formal education combining four year high school education and two year higher education levels and in which foreign language education is also effectively provided. In addition to this, providing training for supply chain management, which has work fields besides the industry and service work fields, outside of the existing logistics education with a more holistic approach in an applied way in these colleges within an international certification program is assessed to have the potential to contribute quite greatly to the economy of the country by being a pioneering step in meeting the global human resources in a sustainable way.

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KEY TERMS AND DEFINITIONS

Supply Chain Management: It is the efficient management of all processes in the delivery of products from raw materials to consumers as final goods and services.

Sustainability: The continuation of existence or ability to be permanent.

Vocational High Schools: High schools that provide applied vocational education to train workforce for various business fields at secondary education level. Graduates can continue their studies at Vocational Schools or Universities.

Vocational Schools of Higher Education: The two-year higher education institutions that train professional practitioner workforce. An associate degree diploma is given to graduates.

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Chapter 10
Fuzzy Goal Programming With Interval Type-2 for Solving Multi-Objective Sustainable Supplier Selection Problems

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ABSTRACT

Supply chain management is going on changing and developing in line with the needs of the growing global supply chain. Performance of supply chain, considered as a whole so that businesses can accommodate these evolvements and change, needs to be improved in the long run. Actually, businesses work with suppliers complying with their policies from past to present. However, other dimensions of sustainability should be considered, as well as economic criteria when selecting suppliers. With the right supplier selection made in this respect, by contributing to the efficient functioning of the supply chain, it will increase customer satisfaction, and therefore, the enterprises will reach the goals they set. The solution of the multi-objective sustainable supplier selection problem has been realized by using the "satisfied optimal supplier design" algorithm, also called fuzzy goal programming, with de novo-based interval type-2 proposed in this study.

INTRODUCTION

Biological systems that are developing evolve through a process of change over time as required by the mission of their assets, and they reach the most suitable structure for their structure. In this process, with the effect of environmental conditions, they change through developing in time. This change and development process is an inevitable fact, and organizations in the manufacturing and service sectors try to achieve their goals under some constraints by following similar development processes. Due to the global competition in the present day, businesses should consider synchronously many processes from planning to purchasing, from reaching the customer to after-sales service, and from environment-friendly

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production to the development of social responsibility capability to achieve the maximum benefit on their part. Because of the developing technology, the communication/transportation problem between the countries has been solved, which has made it possible to meet the demands of people in different places in a short time. Therefore, businesses must create an efficient supply chain and manage this chain at an optimum level to have sustainability.

Supply Chain Management (SCM) is integrated management that includes the flow of materials, information, and money that enables the customer to reach the right product at the right time, in the right place, at the right price for the entire supply chain at the lowest possible cost. In other words, it is to create strategies and business models to increase customer satisfaction by integrating the basic business processes in the chain (Uçal Sarı et al., 2017). As a natural result of increased customer satisfaction, it will lead to performance enhancement along the supply chain. In this context, businesses should be more sensitive in establishing a trust relationship throughout the supply chain and pay more attention to establishing a trust relationship with their suppliers and customers in the cooperation process (Cengiz & Aksoy,2017). SCM has become one of the businesses' chief means of managing costs and improving economic efficiency as they face the highly competitive market these days (Hong et al.,2018). With the concept of sustainability, there has been a change in recent years from considering purely economic and business criteria for the selection of suppliers, to include environmental criteria. It is important to remember that the goal is not and should not be to substitute the economic and business criteria with environmental criteria, but rather to find the environmental criteria together with the economic and business criteria (Rezaei, 2019).

Over the past decade, sustainability in supply chains has gained much attention owing to the tremendous attention provided to economic, social, and corporate responsibility by governments and non-governmental organizations. Thus supply chains are gradually implementing practices of sustainability (Ansari & Qureshi, 2015). Sustainable Supply Chain Management (SSCM) is SCM in a manner that incorporates the sustainability goals and requirements identified by the business, suppliers, customers, and external stakeholders (e.g., consumers, policymakers, associations). Such sustainability goals include economic, social, environmental, and ethical goals which all supply chain members must achieve to make the supply chain sustainable (Fritz, 2019). Sustainable supply chain activities not only have a beneficial impact on the natural environment and community but also result in long-term economic benefits and strategic benefits across the entire chain (Masoumik et al., 2014). In sustainable supply chains, while competitiveness is required to be preserved by meeting consumer needs and related economic criteria, members must meet environmental and social criteria to stay within the supply chain (Seuring & Müller, 2008). The SCM sector has an inherent connection to sustainability, and it has been recognized that the idea of sustainability applies to both the organizational drivers of productivity and their relationship with the people and the world in which we all live. This natural connection provides exciting opportunities to supply chain researchers through their work to create a profound societal difference. As the principles and theories relating to sustainable supply chains continue to evolve, future-oriented strategies should be developed (Winter & Knemeyer, 2013).

Overview of Sustainable Supply Chain Management

With the "Triple Bottom Line" approach created by Elkington (1994), SSCM pays equal attention to the three dimensions of sustainability. Sustainability has been defined across various terms and methods by industry and literature. The common theme emerging from the various concepts of sustainability

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proposed by professional organizations and researchers, however, is the continuous approach in its three performance dimensions: economic, environmental, and social (Sánchez-Flores et al., 2020). Management of a sustainable supply chain is a messy and complicated process. Supply chains will be more complicated in the future, but despite this complicatedness, the sustainable development paradigm will be effectively implemented thanks to the active participation of top management and all supply chain (Zimon et al., 2020).

The aim of the traditional supply chain is to balance the benefits of shareholders, increase business efficiency in the manufacturing process, and maximize the profitability of processes/activities. On the other hand, it is a priority that considering social responsibilities, as well as environmental concerns and economic gains in sustainable supply chains (Zhang, 2011). Businesses aiming sustainability need to perform also in long-term economic, social, and environmental activities instead of short-term financial goals (Elkington, 1998). The economic dimension of the Triple Bottom Line (TBL) framework points to the effects of business practices on the economic system in which the business operates (Elkington, 1997). The social dimension of the TBL framework represents the requirements of labor, human capital, and execution of applications that are beneficial and fair for society (Alhaddi, 2015). Sustainability's social dimension deals with a wide range of issues, such as safety, equality, diversity, governance, human health, labor rights, and justice (Sutherland et al., 2016). The TBL principle implies that businesses need to participate not only in conduct that is socially and environmentally acceptable but also that positive financial benefits can be made in the process (Gimenez et al., 2012). The TBL is a sustainability framework that emerged in the business community and is now commonly used in policy discourse. The framework claims that there is a certain "bottom line" to be met for each imperative — environmental, social, and economic — with equal focus, in theory, on each one (Coffman &Umemoto, 2010).

Decisions on the sustainable supply chain are wider in content, process, and impact. The positions of environmental personnel, third party auditors, and external stakeholders may not play a role in supplier selection or production in a traditional decision-making setting but may do so in sustainability-oriented decisions (Sarkis & Dhavale, 2015). Managing products in the sense of SSCM includes the systematic implementation of different processes, instruments, techniques, and systems to ensure an economically, environmentally, and socially productive flow through the supply chain of raw materials, semi-fished goods, and final products (Cetinkaya, 2011). Without satisfactory vendors, it is impossible to successfully produce low cost, high-quality products in today's competitive operating environment. Therefore, the selection and management of a competent group of suppliers are one of the essential purchasing decisions. Selecting a good set of suppliers to work with is vital to the success of a business. Two issues are of particular interest in supplier selection decisions. One is what criteria to use, and the other, what methods to compare suppliers can be used (Deshmukh & Chaudhari, 2011).

Brandenburg et al., (2014), in the study where 134 articles deal with sustainability aspects with content analysis, detected that the environmental dimension of 30.597%, the environmental and economic dimension of 45.5224%, the social and environmental dimension of 1.4925%, the economic and social dimension of 0.7463%, the social dimension of 0.7463%, and 20.8955% of them included three sustainability dimensions. According to Kannan (2018), more businesses began to think about incorporating environmental dimensions into their traditional method of selecting suppliers. Although reviewing sustainable supplier selection, most literature works did not find all three dimensions for sustainability achievement (economic, environmental, and social). Instead, they only discussed "economic and financial" or "climate, and social," or "political" or "social". According to Shou et al., (2019), sustainable supply management practices have different impacts on TBL: sustainable supply management practices

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are positively correlated with environmental and social performance but have no major impact on economic performance.

IMPORTANCE OF SUSTAINABLE SUPPLIER SELECTION CRITERIA

One of the most important decisions for any supply chain network is selecting suitable suppliers. Suppliers procure and distribute raw materials or other tools for carrying out supply chain functions. The traditional selection of suppliers is based on price, quality, and lead times which does not fit into the current market environment (Roy et al., 2019). A sound set of criteria will always be used to determine to position a certain volume of business with a supplier. The art of successful supply management is to make as sound as possible the logic behind the decision. Traditionally this decision was driven by the study of the ability of the manufacturer to achieve satisfactory quality, quantity, delivery, price/cost, and service goals. Some of the more important supplier characteristics correlated with these prime requirements can include historical background, facilities, and technical ability, financial stability, organization and management, credibility, processes, operational enforcement, communications, labor relations, and location (Leenders, et al., 2010). According to Rezaei (2019), supplier selection is one of the strategic decisions in the sense of supply chain management, and turning supply chain management into sustainability requires the decision to select suppliers. Sustainable supplier selection can be characterized as the process of identifying, evaluating and selecting the most suitable supplier(s), taking into account the ability and willingness of the suppliers to cooperate, the characteristics of the supply and other factors of contemplation in the light of the three dimensions of sustainability, that is, economic, environmental and social.

Businesses are well aware of the value of the responsibility of their partners to sustainability in their development, and the environmental sustainability of any organization is impossible without incorporating SSCM applications. Suppliers are the main drivers of the sustainable supply chain. Therefore, when selecting suppliers, businesses not only take into account the traditional economic requirements but also have to give priority to the other sustainability aspects (Özçelik & Öztürk, 2014). Sustainable suppliers are very effective in achieving the industry's sustainability objectives. The challenge before DM's is how to assess the performance of the supplier on the economic, environmental, and social dimension and select the best supplier (Jain & Singh, 2020). The selection of suppliers is very important for improving performance in the supply chain. Business organizations thus need a systematic and sustainability-focused assessment framework for selecting suppliers (Luthra et al., 2017). Two things are very relevant in the field of sustainable supplier selection: Firstly, the criteria and sub-criteria to be used for performance assessment and secondly, the method to be applied to select the best supplier (Fallahpour et al., 2017).

Scientific studies in which the criteria that may be used for sustainable supplier selection are dealt with are pretty much in literature. Kara et al., (2016), Govindan et al., (2017), Luthra et al., (2017), Garg and Sharma (2018), Ghoushchi et al., (2018), Roy et al., (2019), and KhanMohammadi et al., (2020), are new studies in which sustainable supplier selection criteria are handled since 2016. Certainly, in present conditions, many constraints like geographic positions of countries, development level, global socio-economic change, and goals of businesses will lead these criteria to change and/or develop. The most important element in specifying supplier selection criteria is the goals of businesses. For this reason, businesses will be able to choose the criteria that will reach their targets correctly, to the extent that they are aware of their goals and responsibilities.

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Formulation of Multi-Objective Supplier Selection Problems

The Supplier Selection Problem (SSP) is a problem of procurement decision-making, which consists of identifying methods and models to assess and measure the performance of a group of suppliers to increase the competitiveness of the customer. This decision is more complicated since the variety of quantitative and qualitative criteria assigns to the process of evaluation and decision-making (Aouadni et al., 2019). When viewed from this aspect, supplier selection is a question of multi-criteria decision-making processes involving a wide number of quantitative and qualitative variables in a hierarchical system within the business structure (Akbaş & Dalkılıc, 2018). That supplier selection problems can be organized based on the Linear Programming model was proposed by Moore and Fearon (1973) for the first time, and its mathematical model was formulated by Gaballa (1974). In literature, Weber and Current (1993), Ghodsypour and O'Brien (2001), Ravindran and Wadhwa (2009), Amid et al., (2011), and Umarusman (2019) arranged the mathematical model of the Multi-Objective SSP considering different objective functions. In this study, De novo-based Multi-Objective SSP proposed by Umarusman and Hacıvelioğulları (2020) was used. This model is as follows:

$$Max\ Z_1(x) = \sum_{i=1}^{n} c_i^1 x_i$$

$$Max\ Z_2(x) = \sum_{i=1}^{n} c_i^2 x_i$$

$$Max\ Z_3(x) = \sum_{i=1}^{n} c_i^3 x_i$$

Subject to ...... (M1)

$$\sum_{i=1}^{n} x_i \geq D_1$$

$$\sum_{i=1}^{n} x_i \leq D_2$$

$$\sum_{i=1}^{n} x_i p_i \otimes B$$

$$x_i \geq C_{1i}$$

$$x_i \leq C_{2i}$$

where;

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x_i: The product amount to be received from ith supplier,
D_1: Minimum total demand amount,
D_2: Maximum total demand amount,
C_{1i}: Minimum amount to purchased from i-th supplier,
C_{2i}: Maximum amount to be purchased from i-th supplier,
p_i: Cost of the product to be purchased from i-th supplier,
B: Budget.

In the model proposed by Umarusman and Hacıvelioğulları (2020), optimal levels of amounts to be purchased from suppliers can be calculated. According to Tabucanon (1988), De Novo assumption enables a system design towards the most profitable product(s) in case of an unlimited demand for manufactured products. From this viewpoint, if $x_i \geq C_{1i}$ and $x_i \leq C_{2i}$ constraints are taken that indicate the amounts to be purchased from suppliers in (M1),

$$Max\ Z_1\left(x\right)=\sum\nolimits_{i=1}^{n}c_i^1x_i \tag{1}$$

$$Max\ Z_2\left(x\right)=\sum\nolimits_{i=1}^{n}c_i^2x_i \tag{2}$$

$$Max\ Z_3\left(x\right)=\sum\nolimits_{j=1}^{i}c_i^3x_i \tag{3}$$

Subject to ...... (M2)

$$\sum_{i=1}^{n}x_i \geq D_1 \tag{4}$$

$$\sum_{i=1}^{n}x_i \leq D_2\,. \tag{5}$$

$$\sum_{i=1}^{n}x_i p_i \otimes B \tag{6}$$

is obtained. In (M2), (4) and (5) show minimum and maximum amounts to be purchased in total from the suppliers. With these two constraints, the amounts that can be purchased in total are limited. Constraint (6) is the maximum budget allocated for the products to be purchased from suppliers. As the budget can be fully utilized, it is allowed to be used at a minimum level according to the product to be purchased in total with (5). On t other hand, the maximum and minimum product amounts to be purchased from each supplier were not used. Umarusman and Hacıvelioğulları (2020) stated that when the maximum

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and minimum product amounts to be purchased from the supplier are not added to the problem as a constraint, the ones with the highest individual contribution to the objective functions will be selected instead of purchasing products from one or more suppliers. In other words, suppliers whose contribution to goal functions is small are eliminated. As a result, using (M2) based on each goal function, both performance evaluation is made, and amounts to be purchased from the supplier(s) having the best performance are specified.

SUPPLIER SELECTION PROBLEMS IN TERMS OF TYPE-2 FUZZY SETS

There are studies conducted by different scientists on supplier selection problems in literature. In the studies done by Türk et al., (2014), Renganath and Suresh (2016), Simic et al., (2017), Ghorabaee et al.,(2017) and, Chai and Ngai (2019), it is possible to see the articles dealing with supplier selection problems in terms of type-2 fuzzy set. It is specified that MADM and type-2 fuzzy sets are more used in these articles. The summary of literature in which supplier selection and its evaluation were handled in terms of "MADM, MODM, and type-2 fuzzy sets" between 2014-2020 is given below.

Kahraman et al., (2014) along with a new ranking method for type-2 fuzzy sets, developed an interval type-2 fuzzy AHP method and implemented the proposed method to a problem of supplier selection. Ghorabaee et al., (2014) proposed a multiple criteria group decision-making method for the problem of supplier selection in the sense of interval type-2 fuzzy sets. Chen (2014) created an ELECTRE-based outranking method for multiple criteria group decision-making in the type-2-fuzzy interval sets context. Chen (2015) suggested a type-2 fuzzy LINMAP interval method with approximate ideal solutions for the selection of suppliers for multiple criteria decisions. Turk et al., (2015) developed a supply chain management problem combining supplier selection and inventory preparation and suggested a two-stage approach process based on a Type-2 Fuzzy Interval system and simulated annealing. Sang and Liu (2016) suggested a TODIM method based on the IT2 FSs to resolve green supplier selection problems. Ayvaz and Kuşakcı (2017) offered a TOPSIS-based trapezoidal type-2 fuzzy multi-criteria decision-making method for the problem of supplier selection. Abdullah and Otheman (2017) suggested TOPSIS, an updated preference method based on the IT2 FS approach to solve the problem of supplier selection. Qin et al., (2017) proposed the TODIM technique for solving MCGDM problems for Green SSP in the sense of type-2 fuzzy interval sets. For sustainable supplier selection, Liu et al., (2018) suggested an integrated methodology, including ANP-VIKOR, with the base of interval type-2 fuzzy sets. Çalık (2018) proposed an integrated method for evaluating the performances of green suppliers' by using interval type-2 fuzzy analytic hierarchy process method and fuzzy multiobjective linear programming model. Wu et al., (2019) developed an integrated green supplier selection approach focused on the best-worst and extended VIKOR methods in type-2 fuzzy intervals. Using an interval type-2 fuzzy rule-based AHP approach, Paksoy and Öztürk (2019) made supplier selection. Xu et al., (2019) proposed the use of the AHP Sort II sorting method for a Sustainable SSP in a fuzzy setting with type-2 fuzzy interval sets. Ecer (2020) used an extension to the analytical hierarchy process under the interval type-2 fuzzy setting (IT2FAHP) model to cope better with complexity and vagueness to solve the question of supplier selection considering green concepts. Özbek and Yıldız (2020) suggested a type-2 fuzzy TOPSIS interval method to pick the best supplier among some Industry 4.0 digitized suppliers for a business that operates in the garment industry.

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This literature summary has shown that although there are scientific studies in which MADM methods and type-2 fuzzy sets are used together in the supplier selection process, it is determined that any MODM method developed in terms of "type-2 fuzzy sets" is not used in the supplier selection process. According to the literature summary given above, the criteria used in supplier selection are shown in Table 1.

Table 1. Supplier Selection Criteria In Terms of Type-2 Fuzzy Sets

Author and year of publication	Criteria
Kahraman et al.,(2014)	Price, Quality, Delivery And Capacity
Ghorabaee et al., (2014)	Responsiveness, Cost, Defect Rate, Delivery Reliability, Flexibility
Chen (2015)	Financial Factors, Generalized Cost, Technical Capacity, Organizational Culture And Strategy
Turk et al., (2015)	Quality, Delivery, Costs And Service
Sang and Liu (2016)	Price, Quality, Delivery On Time, Service, Capability, Reputation, Technology
Keshavarz Ghorabaee et al., (2016)	Defect Rate, Cost, Delivery Reliability, Responsiveness, Flexibility
Ayvaz and Kuşakcı (2017)	Quality, Purchasing Cost, Delivery Performance, Customer Relationships, Payment Options, Technical Capability, References
Abdullah and Otheman (2017)	Product Quality, On-Time Delivery, Price/Cost, Supplier's Technological Level, Flexibility
Qin et al.,(2017)	Green Product Innovation, Green Image, Use Of Environmentally Friendly Technology, Resource Consumption,: Green Competencies, Environment Management, Quality Management, Total Product Life Cycle Cost, Pollution Production, Staff Environmental Training
Liu et al., (2018)	Price Of Product, Profit on Product, Transportation Cost, Waste Management, Green Manufacturing, Green Packing And Labeling, Occupational Health and Safety Systems, Information Disclosure
Çalık (2018)	Cost, Pollution Production, CO_2 Emission, Late Delivery, Use of Environment-Friendly Material
Paksoy and Öztürk (2019)	Quality, Delivery On Time, Cost
Xu et al. (2019	Price, Profit, Transportation Cost, Energy Conservation, Pollution Control, Information Disclosure, Safety Audit and Assessment
Wu et al., (2019)	Green Product Innovation, Environmental Regime, Use Of Green Technology, Product Quality Management, Total Green Product Cost, Resource Consumption, Environmental Pollution Of Production
Ecer (2020)	Green Cost, Green Technology, Green Manufacturing, Green Management
Özbek and Yıldız (2020)	Digital Production Systems, Information and Communication Technologies, Intelligent Logistics and Inventory Systems, Maintenance And Repair Systems, Management Systems

GOAL PROGRAMMING

The ultimate aim of Goal Programming is to reduce the deviations between the achievement of the goals and their target; that is, to minimize the undesirable deviation variables (Romero, 1997). While Goal Programming can be correctly interpreted as a generalization of linear programming, it is also a technique of decision-making that is bona fide multi-criteria (Jones & Tamiz, 2010). The first study on Goal Programming was started by Charnes, Cooper, and Ferguson (1955), and Charnes and Cooper (1961) made the formulation. Mathematical model of Goal Programming is as follows (Charnes & Cooper, 1977):

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$$Minimize\ Z = \sum_{i=1}^{m} \left(d_i^{+} + d_i^{-} \right)$$

Subject to ...... (M3)

$$\sum_{j=1}^{n} a_{ij} x_j + d_i^{-} + d_i^{+} = b_i$$

$$x_j \geq 0,\ d_i^{+}, d_i^{-} \geq 0,\ i = 1, 2, \ldots m,\ j = 1, \ldots, n.$$

where;

d_i^{-} : negative deviation variable,
d_i^{+} : positive deviation variable,

In Goal Programming that investigates the minimization of deviation from target values, minimization process is realized through three different approaches. These were formulated by Archimedean Goal Programming Ijiri (1965) by considering priority and weight factors together. Afterward, Charnes and Cooper (1977) proposed an Archimedean Goal Programming, including only weight factors. Charnes and Cooper (1977) suggested Lexicographic Goal Programming in which there is an order of priority for each goal by removing weight factors from the model proposed by Ijiri (1965). Chebyshev Goal Programming, developed by Flavell (1976), is also known as Minmax Goal Programming. Unlike weighted and priority structures, this approach explores the minimization of the maximum deviation instead of minimizing the sum of the deviating variables.

Strategic decision-making in the real world also requires harmonizing various needs and desires or balancing conflicting criteria. A significant way of modeling these problems is by using a goal programming approach, which can combine optimization with the DM's ability to simultaneously achieve multiple goals (Colapinto et al., 2020). The traditional Goal Programming question has to precisely define the target level that the decision-makers are to achieve. This is also difficult for decision-makers and expensive. The fuzzy set theory provides decision-makers to surmount this challenge (Yücesan & Zengin, 2019). A fuzzy alternative allows the DM more leeway than the crisp one, allowing the alternatives considered by DM to be imprecision and/or vagueness (Ramik, 2000).

TYPE-1 FUZZY GOAL PROGRAMMING

After Fuzzy Set Theory was founded by Zadeh (1965), with the process of decision-making in a fuzzy set proposed by Bellman and Zadeh (1970), many scientists handled Goal Programming in the fuzzy set. Narasimhan (1980), who proposed a Fuzzy Goal Programming model in which both the multiple goals and the equal weights are treated as fuzzy variables, started the primary studies on Fuzzy Goal Programming. Hannan (1981a) demonstrated that a single goal programming problem with fuzzy goals (all of which have the same priority) could be solved. Hannan (1981b) provided with preemptive priorities for the use of fuzzy Goal Programming, with Archimedean weights, and with the minimum goal

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of optimizing the membership function. In his proposed approach, Narasimhan (1980) was the first to use fuzzy priorities. Within A Goal Programming problem, Rubin and Narasimhan (1984) suggested a new approach to formulating fuzzy priorities. Tiwari et al., (1986) presented the Goal Programming lexicographic order and this provides an effective computational algorithm to solve Fuzzy Goal Programming. Tiwari et al., (1987) also proposed an additive model for the Fuzzy Goal Programming solution. Sasaki et al., (1990) proposed an interactive sequential goal programming (ISGP) that combines the method of displaced ideal (MDI) with a fuzzy set theory to solve MODM problems interactively. Yang et al., (1991) developed a new model for the solution of Fuzzy Goal Programming problems by using a triangular linear membership function. In addition to these listed approaches, there are many Fuzzy Goal Programming approaches in the literature, but Yaghoobi and Tamiz (2007) believe that these approaches are extensions of the approaches proposed by Narasimhan (1980) and Hannan (1981a).

Based on goal functions' type in Fuzzy Goal Programming, fuzzy goals are formed. Generally, the technological coefficients of the goal functions are crisp, and the desired levels of the goal functions are made up of fuzzy numbers (Tiwari et al., 1986). In Fuzzy Goal Programming, fuzzy goals are stated in three different forms based on the type of the goal (Chanas & Gupta, 2002).

$$Fuzzy\ Goal : \left(Ax\right)_k = \sum_{i=1}^{k} a_{ij} x_{ij} \begin{Bmatrix} \tilde{\leq} \\ \tilde{\cong} \\ \tilde{\geq} \end{Bmatrix} b_i ; j = 1,2,\ldots,n \tag{7}$$

or

$$Fuzzy\ Goal : \left(Ax\right)_k = \sum_{i=1}^{k} a_{ij} x_{ij} \begin{Bmatrix} \leq \\ = \\ \geq \end{Bmatrix} \tilde{b}_i ; j = 1,2,\ldots,n \tag{8}$$

Here, "~" means that the desired level (b_i) of the i-th target consists of fuzzy numbers. Similarly, in (8), $\tilde{b}_i$ means that the desired level of the i-th target consists of fuzzy numbers. Different fuzzy numbers are used depending on the direction of inequality in (7) and (8). Narasimhan (1980) suggested using triangular membership function for goal functions of type "≅".

$$\mu_k\left(Ax\right) \begin{cases} 0 & if \quad \left(Ax\right)_k \geq b_k + d_{k2} \\ 1 - \dfrac{\left(Ax\right)_k - b_k}{d_{k2}} & if \quad b_k \leq \left(Ax\right)_k \leq b_k + d_{k2} \\ 1 - \dfrac{b_k - \left(Ax\right)_k}{d_{k1}} & if \quad b_k - d_{k1} \leq \left(Ax\right)_k \leq b_k \\ 0 & if \quad otherwise \end{cases} . \tag{9}$$

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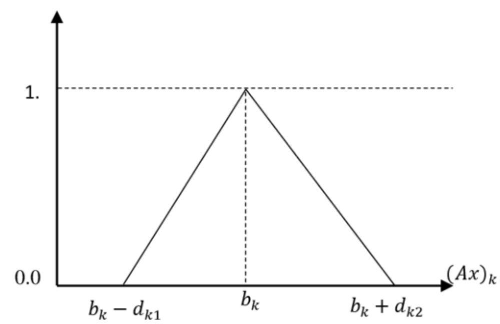
Triangular membership function is shown in Figure1.

Figure 1. Triangular Membership Function



TYPE-2 FUZZY GOAL PROGRAMMING

Fuzzy Set Theory proposed by Zadeh (1965) constitutes a turning point in reevaluating the uncertainty concept. Fuzzy Sets theory has gained significant benets in both social sciences and natural sciences, with the ability to gradually explain the transition from membership to non-membership. Type-2 fuzzy sets, an extension of classical fuzzy sets that are also named as Type-1 fuzzy sets, was proposed by Zadeh (1965). Elements' in Type-1 fuzzy sets Type-2 fuzzy sets membership degree of sets is between [0;1]. In Type-2 fuzzy sets, membership degree of an element belonging to the set is expressed by membership functions that indicate that it is a fuzzy sets. The basic definition of Type-2 Fuzzy Sets is briefly explained below (Mendel & John, 2002), (Wu & Mendel, 2007),(Qin & Liu, 2014):

Definition: Let *X* be the universe of discourse, a type-2 fuzzy sets can be represented by type-2 membership function $\mu_{\tilde{A}}(x,u)$ as follows;

$$\tilde{A} = \{(x,u), \mu_{\tilde{A}}(x,u) : \forall x \in X, u \in j_x, 0 \le \mu_{\tilde{A}}(x,u) \le 1\}$$

Type-2 Fuzzy Sets $\tilde{A}$ aşağıdaki gibi ifade edilir.

$$\tilde{A} = \int_{x \in X} \int_{u \in j_x} 1/(x,u), j_x \subseteq [0;1]$$

where, $u \in j_x \subseteq [0;1]$ is primary membership function at *x*.

$$\int_{u \in j_x} \mu_{\tilde{A}}(x,u)/(x,u)$$

indicates the second membership function at *x*. Uncertainty about $\tilde{A}$ is conveyed by the union all of the primary membersips, called foofprint of uncertainty of $\tilde{A}[FOU(\tilde{A})]$, i.e.

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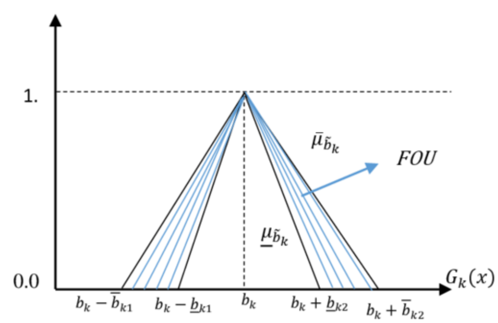
$$FOU\left(\tilde{A}\right)=\cup_{x\in X}\, j_x\,.$$

The FOU is shown as the shaded region. It is bounded by an upper MF (UMF) $\bar{\mu}_{\tilde{A}}\left(x\right)$ an a lower MF (LMF) $\underline{\mu}_{\tilde{A}}\left(x\right)$, both of which are type-1 Fuzzy Sets; consequently, the membership function grade of each element of an IT2 FS i an interval $\left[\underline{\mu}_{\tilde{A}}\left(x\right),\bar{\mu}_{\tilde{A}}\left(x\right)\right]$.

Goal programming in terms of Type-2 fuzzy sets was dealt with in three different scientific studies by Patiño-Callejas et al., (2015a), (2015b), (2015c). In this study, the approach proposed by Patiño-Callejas et al. (2015a) using Interval Type-2 fuzzy sets is used. The approach proposed by Patiño-Callejas et al., (2015a) is based on Yang et al., (1991)'s approach. In the approach proposed by Patiño-Callejas et al., (2015a), firstly, interval type-2 Fuzzy Goals are defined.

Figure 2. Interval Type-2 Fuzzy goal



In real situations, the conflict between people involved in decision making is a common problem. Some people are pessimistic about different goals, while others are optimistic. This results in different perceptions coming from various experts, so we use two LMF and UMF functions that are described as follows:

$$UMF\equiv\bar{\mu}_{\tilde{b}_k}=\begin{cases}1-\dfrac{G_k\left(x\right)-b_k}{\bar{b}_{k2}} & if \quad b_k\leq G_k\left(x\right)\leq b_k+\bar{b}_{k2}\\ 1 & if \quad G_k\left(x\right)=b_k\\ 1-\dfrac{b_k-G_k\left(x\right)}{\bar{b}_{k1}} & if \quad b_k-\bar{b}_{k1}\leq G_k\left(x\right)\leq b_k\\ 0 & , \quad otherwise\end{cases}\tag{10}$$

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$$LMF \equiv \underline{\mu}_{\tilde{b}_k} = \begin{cases} 1 - \dfrac{G_k(x) - b_k}{\underline{b}_{k2}} & if \quad b_k \leq G_k(x) \leq b_k + \underline{b}_{k2} \\ 1 & if \quad G_k(x) = b_k \\ 1 - \dfrac{b_k - G_k(x)}{\underline{b}_{k1}} & if \quad b_k - \underline{b}_{k1} \leq G_k(x) \leq b_k \\ 0 & , \quad otherwise \end{cases} \tag{11}$$

Fuzzy Goal Programming approach created from the Fuzzy Goal perspective by using membership functions above is given below. According to this approach, two different λ will be obtained for $\underline{\mu}_{\tilde{b}_k}$ and $\bar{\mu}_{\tilde{b}_k}$. In other words, Patiño-Callejas et al., (2015a) extended the proposal of Yang et al., (1991) to a Interval Type-2 fuzzy model using a two-step method that finds two different λ values, one for $\bar{\mu}_{\tilde{b}_k}$ and one for $\bar{\mu}_{\tilde{b}_k}$.

$$\max \bar{\lambda}$$

Subject to ...... (M4)

$$1 - \frac{G_k(x) - b_k}{\bar{b}_{k2}} \geq \bar{\lambda}$$

$$1 - \frac{b_k - G_k(x)}{\bar{b}_{k1}} \geq \bar{\lambda}$$

$$\bar{\lambda} \in [0;1], x \geq 0, \forall k \in \mathbb{N}.$$

and

$$\max \underline{\lambda}$$

Subject to ...... (M5)

$$1 - \frac{G_k(x) - b_k}{\underline{b}_{k2}} \geq \underline{\lambda}$$

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$$1-\frac{b_k-G_k(x)}{\underline{b}_{k1}}\geq\underline{\lambda}$$

$$\underline{\lambda}\in[0;1], x\geq 0, \forall k\in\mathbb{N}$$

where $\overline{\lambda}$ is overall upper satisfaction degree of the goals, and $\underline{\lambda}$ is the overall lower satisfaction degree of goals. $G_k(x)$ is the k-th goal, and $\overline{b}_{k1}, \underline{b}_{k1}, \overline{b}_{k2}, \underline{b}_{k2}$ are the admissible deviations from b_k. Patiño-Callejas et al., (2015a)'s approach find two values: $min\{\underline{\lambda}\}=\underline{\lambda}^*$ and $max\{\overline{\lambda}\}=\overline{\lambda}^*$ the repersent pessimistic and optimistic perceptions about b_k, and alsı compose $[\underline{\lambda}^*, \overline{\lambda}^*]=\{\lambda^*\in[0;1]:\underline{\lambda}^*\leq\lambda^*\leq\overline{\lambda}^*\}$ of satisfaction of all experts. $\overline{\lambda}$ and $\underline{\lambda}$ describes overall optimistic and pessimistic degrees of satisfaction with the different system experts. This method gives the model flexibility in finding other approaches in situations where the system doesn't have the resources to achieve all goals. Additionally, global satisfaction degrees, which means that all three goals are satisfied at the same level.

Based on the formulations above, steps of the algorithm named as "Satisfied Optimal Supplier Design" in this study are given below.

Step 1: Firstly, in (M2), a positive ideal solution set and a negative ideal solution set are specified for each goal function.
Step 2: Subject to the positive and negative ideal solutions, for each goal function, "interval type-2 fuzzy aspiration levels" are defined based on decision-maker's choices.
Step 3: LMF and UMF are created for each goal function.
Step 4: Using (M4) and (M5), models named as "Satisfied Optimal Supplier Design" are formed. Variable values for $\underline{\lambda}$ and λ are determined using these models.

$$\max\ \overline{\lambda}$$

Subject to ...... (M6)

$$1-\frac{Z_k(x)-b_k}{\overline{b}_{k2}}\geq\overline{\lambda}$$

$$1-\frac{b_k-Z_k(x)}{\overline{b}_{k1}}\geq\overline{\lambda}$$

$$\sum_{i=1}^{n}x_i\geq D_1$$

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$$\sum_{i=1}^{n} x_i \leq D_2$$

$$\sum_{i=1}^{n} x_i p_i \otimes B$$

$$\overline{\lambda} \in [0;1], x \geq 0, \forall k \in \mathbb{N}$$

and

$$\max \underline{\lambda}$$

Subject to ...... (M7)

$$1 - \frac{G_k(x) - b_k}{\underline{b}_{k2}} \geq \underline{\lambda}$$

$$1 - \frac{b_k - G_k(x)}{\underline{b}_{k1}} \geq \underline{\lambda}$$

$$\sum_{i=1}^{n} x_i \geq D_1$$

$$\sum_{i=1}^{n} x_i \leq D_2$$

$$\sum_{i=1}^{n} x_i p_i \otimes B$$

$$\underline{\lambda} \in [0;1], x \geq 0, \forall k \in \mathbb{N}$$

The constraint functions of (M2) have been added to (M4) and (M5). In these two models, the budget shows that both models are novo-based. Decision variables obtained from these two models and their values are the same.

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APPLICATION

The business called BetaMix Mixer Company that is subject to the research was established in 1986, Ostim Industrial Zone, Ankara to manufacture concrete pump and spare parts, it went on manufacturing for a while, and have started working for truck mixer manufacturing since 2001. The business aims at meeting needs across the sector, performing the best service in assembly and after-sales service stages, and ensuring customer satisfaction at a maximum level. In accordance with this purpose; the hydraulic pump parts to be used in the production of concrete mixers must also support its product quality and increase the competitive power in the market. For this reason, it wants to supply hydraulic pumps among the five companies that manufacture worldwide, become brands, and compete with each other, produce hydraulic pump parts.

As a result of a face-to-face meeting with the vice general manager of the business, within the frame of sustainability to be used in supplier selection, criteria have been specified from the criteria in Table 1. These criteria are Product Quality Level (%), Pollution Control Level (%), Performance Measurement of After-Sale Service (%), and Relationship with Customers (%).Using the business's previous period information, based on these criteria, the measure of performance of suppliers is given in Table 2.

Table 2. Performance information of suppliers

	Product Quality Level (%)	Pollution Control Level (%)	Performance Measurement of After-Sale Service (%)	Relationship with Customers (%)
Supplier-1 (x_1)	60	55	75	70
Supplier-2 (x_2)	90	90	40	60
Supplier-3 (x_3)	80	90	60	70
Supplier-4 (x_4)	65	60	45	60
Supplier-5 (x_5)	55	50	35	75

Due to the decrease in demands due to the Covid-19 outbreak and the decrease in production accordingly, the business planned its monthly production capacity as minimum 1200 and maximum 2500. Planlanan üretim için satın alma bütçesi €2192500'dır. Prices of the hydraulic pump to be purchased from suppliers are, respectively, €650, €1050, €950, €850, and €780. Using this information, the Multi-Objective Sustainable SSP is created as follows considering (M2).

Quality: Max Z_1: $0.6x_1 + 0.9x_2 + 0.8x_3 + 0.65x_4 + 0.55x_5$

Pollution Control: Max Z_2: $0.55x_1 + 0.9x_2 + 0.9x_3 + 0.6x_4 + 0.5x_5$

Service: Max Z_3: $0.75x_1 + 0.4x_2 + 0.6x_3 + 0.45x_4 + 0.35x_5$

Customer Relationship Max Z_4: $0.7x_1 + 0.6x_2 + 0.7x_3 + 0.6x_4 + 0.75x_5$

Subject to ...... (P1)

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$x_1 + x_2 + x_3 + x_4 + x_5 \geq 1200$

$x_1 + x_2 + x_3 + x_4 + x_5 \leq 2500$

$650x_1 + 1050x_2 + 950x_3 + 850x_4 + 780x_5 \leq 2192500$

$x_1, x_2, x_3, x_4, x_5 \geq 0$ and *integer.*

where, x_i, ith supplier, i=1,2,3,4,5. Budget constraint is defined as "≤" .

Using the "Satisfied Optimal Supplier Design" algorithm, solution steps of (P1) are given below.

Step 1: Determination of positive and negative ideal solutions obtained from the solution made for each goal function in (P1)

$$x^{1*}:\{1081;1418;1;0;0\};Z_1^*=1925.6 \text{ and } x^{1-}:\{0;0;0;0;1200\};Z_1^-=660$$

$$x^{2*}:\{0;0;2307;1;0\};Z_2^*=2076.9 \text{ and } x^{2-}:\{0;0;0;0;1200\};Z_2^-=600$$

$$x^{3*}:\{2500;0;0;0;0\};Z_3^*=1875 \text{ and } x^{3-}:\{0;0;0;0;1200\};Z_3^-=420$$

$$x^{4*}:\{0;0;0;0;2500\};Z_4^*=1875 \text{ and } x^{4-}:\{0;1200;0;0;0\};Z_4^-=720$$

In regard to these results, the solution for (P1) has not been obtained. This is because each goal function has been realized at different values of the variables. Arrangements below have been made for each goal function by using the solutions determined. (%) value has been calculated for each goal function.

$$Z_1^*=1925.6 \Rightarrow Z_1^*=\frac{1925.6}{1081+1418+1}=0.77024$$

$$Z_2^*=2076.9 \Rightarrow Z_1^*=\frac{2076.9}{2307+1}=0.89987$$

$$Z_3^*=1875 \Rightarrow Z_1^*=\frac{1875}{2500}=0.75$$

$$Z_4^*=1875 \Rightarrow Z_1^*=\frac{1875}{2500}=0.75$$

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These values show the best performance value of each goal function. Similar processes can be determined based on negative ideal solutions.

$$Z_1^- = 660 \Rightarrow Z_1^- = \frac{660}{1200} = 0.55$$

$$Z_2^- = 600 \Rightarrow Z_2^- = \frac{600}{1200} = 0.5$$

$$Z_3^- = 420 \Rightarrow Z_3^- = 1200 = 0.35$$

$$Z_4^- = 720 \Rightarrow Z_5^- = \frac{720}{1200} = 0.6$$

For these calculations, a comment can be made as follows: for goal Z_1, the best performance is 77.024%, and the worst performance is 55%. In the final solution, to be made from the perspective of "Goal Programming with interval type-2" for (P1), 55%≤Z_1≤77.024% will be obtained. Similar comments can be made for other goal functions.

Step 2 ve Step 3: Arrangements for both these steps are given below.

As a result of the meetings with the vice general manager of the business, interval type-2 fuzzy aspiration levels has been determined for each goal function. While creating fuzzy type-2 membership function, optimistic and pessimistic aspiration levels for each goal have been demanded. These information is given in Table 3. The symmetric triangular number has been used while creating membership functions.

Table 3. Interval Type-2 Fuzzy Aspiration Levels for Goals

$b_k - \overline{b}_{k1}$	$b_k - \underline{b}_{k1}$	b_k	$b_k + \underline{b}_{k2}$	$b_k + \overline{b}_{k2}$
1500	1606,4	1712,8	1819,2	1925,6
1800	1869,225	1938,45	2007,675	2076,9
1200	1368,75	1537,5	1706,25	1875
1300	1443,75	1587,5	1731,25	1875

Arrangements made by using the information in Table 1923 are given below.

Goal 1: Z_1: $0.6x_1 + 0.9x_2 + 0.8x_3 + 0.65x_4 + 0.55x_5 \cong 1712.8$

$$\overline{b}_{11} = 212.8, \underline{b}_{11} = 106.4, \underline{b}_{12} = 106.4, \overline{b}_{12} = 212.8$$

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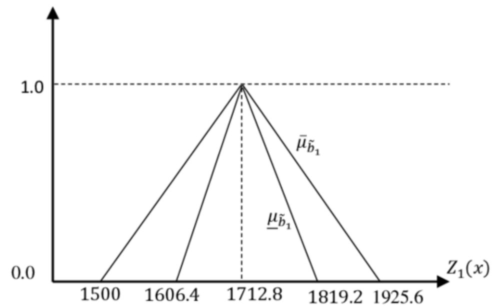
Interval Type-2 Fuzzy Goal 1 is shown in Figure 3.

Figure 3. Interval Type-2 Fuzzy Goal 1



LMF and UMF are defined for Interval Type-2 Fuzzy Goal 1.

$$UMF \equiv \bar{\mu}_{\tilde{b}_1} = \begin{cases} 1 - \dfrac{Z_1(x) - 1712.8}{212.8} & if \quad 1712.8 \le Z_k(x) \le 1925.6 \\ 1 \quad if & Z_1(x) = 1712.8 \\ 1 - \dfrac{1712.8 - Z_k(x)}{212.8} & if \quad 1500 \le Z_1(x) \le 1712.8 \\ 0 \quad , & otherwise \end{cases}$$

and

$$LMF \equiv \underline{\mu}_{\tilde{b}_1} = \begin{cases} 1 - \dfrac{Z_1(x) - 1712.8}{106.4} & if \quad 1712.8 \le Z_1(x) \le 1819.2 \\ 1 \quad if & Z_1(x) = 1712.8 \\ 1 - \dfrac{1712.8 - Z_1(x)}{106.4} & if \quad 1606.4 \le Z_1(x) \le 1712.8 \\ 0 \quad , & otherwise \end{cases}$$

LMF and UMF are defined below for Interval Type-2 Fuzzy Goal 2.

Goal 2: Z_2: $0.55x_1 + 0.9x_2 + 0.9x_3 + 0.6x_4 + 0.5x_5 \cong 1938.45$

$$\bar{b}_{21} = 138.45, \underline{b}_{21} = 69.225, \underline{b}_{22} = 69.225, \bar{b}_{22} = 138.45$$

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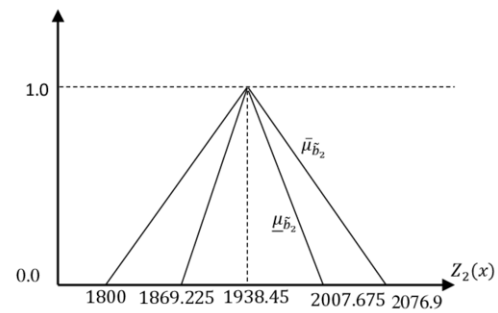
Figure 4. Interval Type-2 Fuzzy Goal 2



$$UMF \equiv \bar{\mu}_{\tilde{b}_2} = \begin{cases} 1-\dfrac{Z_2(x)-1938.45}{138.45} & if \quad 1938.45 \le Z_2(x) \le 2076.9 \\ 1 \quad if & Z_2(x) = 1938.45 \\ 1-\dfrac{1938.45-Z_2(x)}{138.45} & if \quad 1800 \le Z_2(x) \le 1938.45 \\ 0 \quad , & otherwise \end{cases}$$

and

$$LMF \equiv \underline{\mu}_{\tilde{b}_2} = \begin{cases} 1-\dfrac{Z_2(x)-1938.45}{69.225} & if \quad 1938.45 \le Z_2(x) \le 2007.675 \\ 1 \quad if & Z_2(x) = 1712.8 \\ 1-\dfrac{1938.45-Z_2(x)}{69.225} & if \quad 1869.225 \le Z_2(x) \le 1938.45 \\ 0 \quad , & otherwise \end{cases}$$

LMF and UMF are defined below for Interval Type-2 Fuzzy Goal 3.

Goal 3: Max Z_3: $0.75x_1 + 0.4x_2 + 0.6x_3 + 0.45x_4 + 0.35x_5 \cong 1537.5$

$\bar{b}_{31} = 337.5, \underline{b}_{31} = 168.75, \underline{b}_{32} = 168.75, \bar{b}_{32} = 337.5$

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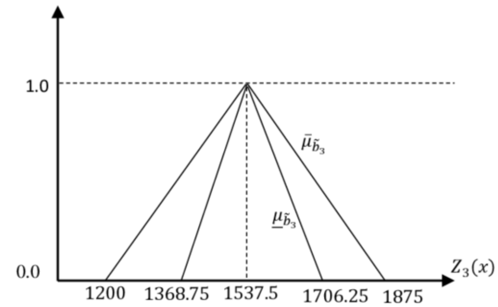
Figure 5. Interval Type-2 Fuzzy Goal 3



$$UMF \equiv \bar{\mu}_{\tilde{b}_3} = \begin{cases} 1-\dfrac{Z_3(x)-1875}{337.5} & if \quad 1567.5 \le Z_3(x) \le 1875 \\ 1 & if \quad Z_3(x) = 1537.5 \\ 1-\dfrac{1875-Z_3(x)}{337.5} & if \quad 1200 \le Z_3(x) \le 1875 \\ 0 & , \quad otherwise \end{cases}$$

and

$$LMF \equiv \underline{\mu}_{\tilde{b}_3} = \begin{cases} 1-\dfrac{Z_3(x)-1875}{168.75} & if \quad 1537.5 \le Z_3(x) \le 1706.25 \\ 1 & if \quad Z_3(x) = 1537.5 \\ 1-\dfrac{1875-Z_3(x)}{168.75} & if \quad 1368.75 \le Z_3(x) \le 1537.5 \\ 0 & , \quad otherwise \end{cases}$$

LMF and UMF are defined below for Interval Type-2 Fuzzy Goal 4.

Goal 4: Z_4: $0.7x_1 + 0.6x_2 + 0.7x_3 + 0.6x_4 + 0.75x_5 \cong 1587.5$

$\bar{b}_{41} = 287.5, \underline{b}_{41} = 143.75, \underline{b}_{42} = 287.5, \bar{b}_{42} = 143.75,$

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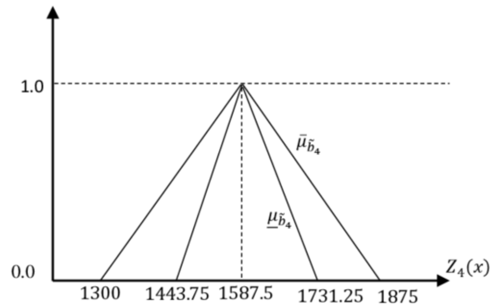
Figure 6. Interval Type-2 Fuzzy Goal 4



$$UMF \equiv \bar{\mu}_{\tilde{b}_4} = \begin{cases} 1 - \dfrac{Z_4(x) - 1587.5}{287.5} & if \quad 1587.5 \leq Z_4(x) \leq 1875 \\ 1 \quad if & Z_4(x) = 1587.5 \\ 1 - \dfrac{1587.5 - Z_4(x)}{287.5} & if \quad 1300 \leq Z_4(x) \leq 1587.5 \\ 0 \quad , & otherwise \end{cases}$$

and

$$LMF \equiv \underline{\mu}_{\tilde{b}_4} = \begin{cases} 1 - \dfrac{Z_4(x) - 1587.5}{143.75} & if \quad 1587.5 \leq Z_4(x) \leq 1731.25 \\ 1 \quad if & Z_4(x) = 1587.5 \\ 1 - \dfrac{1587.5 - Z_4(x)}{143.75} & if \quad 1443.75 \leq Z_4(x) \leq 1578.5 \\ 0 \quad , & otherwise \end{cases}$$

Step 4: Using the membership functions above, (P1) is arranged as two linear programming problems as below according to (M6) and (M7).

max $\bar{\lambda}$

Subject to ...... (P1a)

$$1 - \frac{Z_1(x) - 1712.8}{212.8} \geq \bar{\lambda}; 1 - \frac{1712.8 - Z_1(x)}{212.8} \geq \bar{\lambda}$$

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$$1-\frac{Z_2(x)-1938.45}{138.45}\geq\overline{\lambda};1-\frac{1938.45-Z_2(x)}{138.45}\geq\overline{\lambda}$$

$$1-\frac{Z_3(x)-1875}{337.5}\geq\overline{\lambda};1-\frac{1875-Z_3(x)}{337.5}\geq\overline{\lambda}$$

$$1-\frac{Z_4(x)-1587.5}{287.5}\geq\overline{\lambda};1-\frac{1587.5-Z_4(x)}{287.5}\geq\overline{\lambda}$$

$x_1+x_2+x_3+x_4+x_5\geq 1200$

$x_1+x_2+x_3+x_4+x_5\leq 2500$

$650x_1+1050x_2+950x_3+850x_4+780x_5\leq 2192500$

$x_1, x_2, x_3, x_4, x_5\geq 0$ and *integer.*

and

$\max\ \underline{\lambda}$

Subject to ...... (P1b)

$$1-\frac{Z_1(x)-1712.8}{106.4}\geq\underline{\lambda};1-\frac{1712.8-Z_1(x)}{106.4}\geq\underline{\lambda}$$

$$1-\frac{Z_2(x)-1938.45}{69.225}\geq\underline{\lambda};1-\frac{1938.45-Z_2(x)}{69.225}\geq\underline{\lambda}$$

$$1-\frac{Z_3(x)-1875}{168.75}\geq\underline{\lambda};1-\frac{1875-Z_3(x)}{168.75}\geq\underline{\lambda}$$

$$1-\frac{Z_4(x)-1587.5}{143.75}\geq\underline{\lambda};1-\frac{1587.5-Z_4(x)}{143.75}\geq\underline{\lambda}$$

$x_1+x_2+x_3+x_4+x_5\geq 1200$

$x_1+x_2+x_3+x_4+x_5\leq 2500$

$650x_1+1050x_2+950x_3+850x_4+780x_5\leq 2192500$

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$x_1, x_2, x_3, x_4, x_5 \geq 0$ and *integer.*

Results obtained from the solutions of (P1a) and (P1b) are given in Table 4

Table 4. Solutions of (P1a) and (P1b)

	UMF				LMF			
	Z_1	Z_2	Z_3	Z_4	Z_1	Z_2	Z_3	Z_4
x_1	511	511	511	511	511	511	511	511
x_2	0	0	0	0	0	0	0	0
x_3	1811	1811	1811	1811	1811	1811	1811	1811
x_4	0	0	0	0	0	0	0	0
x_5	0	0	0	0	0	0	0	0
Objective Function Value	1755,4	1910,95	1469,85	1625,4	1755,4	1910,95	1469,85	1625,4
	75,6%	82,3%	63,3%	70%	75,6%	82,3%	63,3%	70%
Satisfaction Degree	$\bar{\lambda} = 0.7995557$				$\underline{\lambda} = 0.5991114$			

According to the results in Table 4, decision variables for UMF and LMF and their values are the same. $\bar{\lambda} = 0.7995557$ shows optimistic satisfaction degree, $\underline{\lambda} = 0.5991114$ pessimistic satisfaction degree. Considering the results that the proposed algorithm gives, the business will only increase performance percentage of goals by purchasing from only Supplier-1 and Supplier-3. On the other hand, because contributions of Supplier-2, Supplier-4 and Supplier-5 to goals are low, these suppliers have been eliminated from purchase plan thanks to Satisfied Optimal Supplier Design. Both suppliers who have high contributions to goals and the amount to be purchased from these suppliers have been specified. Goals of the business determined by the vice general manager of the business will be satisfied between the range of $\left[\underline{\lambda} = 0.5991114; \bar{\lambda} = 0.7995557\right]$.

In supplier selection problems, assigning the method used in the solution of problem as well as the criteria appears as two important situations. While the criteria show a change on a sectoral basis, it is usually defined according to business needs. On the other hand, methods are designated based on preferences of decision-maker. Although Mathematical Programming methods are frequently used in supplier selection problems, integrated methods that include these methods come into prominence. Actually, the most important functions in supplier selection problems that are accepted as an extension of Multi-Objective Linear Programming problems are constraint functions because goals/objectives realize within the frame of constraint functions. Therefore, the success of mathematical programing problems arises with the correct setting of constraint functions. In supplier selection problems, constraint functions are limited by the budget, and the quantities to be purchased from suppliers are determined in a way not to exceed the total budget. According to the result of literature research, Fuzzy Type-2 Goal Programming models have not completed their development process yet. With new approaches to be developed, it can be contributed to supplier selection processes. In particular, fuzzy type-2 budget constrained approaches will provide a different perspective to supplier selection problems.

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CONCLUSION

The main goal in supplier selection is to designate the supplier(s) that can meet businesses' needs at a reasonable cost and in the long run. Moreover, selected supplier(s) need(s) to have high potential and contribute to ensuring sustainability. With selecting such suppliers, customer satisfaction will increase while purchase cost decreases, so the competitive power of the business will rise. In supplier selection processes, two factors directly influence results. These are the methods that are supplier selection criteria and are used in the solution of the problem created based on these criteria. Supplier selection criteria realize within the frame of the general policy of businesses usually subject to application. In other words, businesses set out their goals in terms of the sustainability of their suppliers and ask to realize them, especially in sustainable supplier selection processes. After determining criteria, another process appears, depending on the goals and constraints of the business, and supplier constraints. Actually, in this process, constraints are important rather than goals because it should not be forgotten that goals realize within the frame of constraints and decision variables. In this process, more than one situations show up. The first thing is the evaluation of existing/new suppliers, the second one is designating the amount to be purchased from the supplier(s) that are in accordance with its goals. In general, integrated methods are used to overcome these two situations.

In this study, the transition process from Goal Programming to Fuzzy Goal Programming with Interval Type-2 can be briefly given as follows: 100% satisfaction of goals is almost impossible in Goal Programming founded on satisfactoriness philosophy. Therefore, deviation from the goal is an expected situation. Tolerance values determined by decision-makers and by using Fuzzy Goal Programming for goals enable controlling desirable and undesirable deviation. The result achieved with Fuzzy Goal Programming can be explained as determining the decision variables that will increase the satisfaction to the maximum level by minimizing the deviation from the goals. The reason why Fuzzy Goal Programming with Interval Type-2 determining the final solution of the proposed algorithm and developed by Patiño-Callejas et al., (2015a) has been selected is that it is an extension of Yang et al., (1991)'s approach. This case shows that Patiño-Callejas et al., (2015a)'s approach was founded on an approach that has philosophic bases. The most important feature of Patiño-Callejas et al., (2015a)'s approach is that the approach gives the model flexibility to consider other solutions in situations where the design does not have the resources to achieve all of the goals. According to this approach, a lower satisfaction degree and upper satisfaction degree of the goals occur in the values of the same decision variables.

In this study, the amounts to be purchased from the high performing supplier (s) that will benefit most of the business objectives have been designated by the "Satisfied Optimal Supplier Design" algorithm. This algorithm can be also named as Fuzzy Goal programming with Interval Type-2 with de novo basis. In the study, firstly, within the frame of Goal Programming, desirable levels of goal functions have been determined according to positive and negative ideal solutions obtained from (M2). Considering the ideal solutions, naming the best and worst performances of goal functions in (M2), for example, satisfied solution for goal function Z_1 takes place in the range [55%; 77.024%]. Then, as a result of the face-to-face meeting with the vice general manager of the business, interval type-2 fuzzy aspiration levels have been determined for each goal using the ranges obtained from ideal solutions for the objectives. When determining these aspiration levels, Covid-19's influences in the market have been considered as well as previous period information. Information about goals is given in Table 2. The decision variable values obtained at the end of the solution of (P1a) and (P1b) established according to this information are the same in both models. Considering these decision variables, the business should purchase hydraulic

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pumps from supplier-1 and supplier-3, which have the highest contribution to the goals. According to these results, all goals have been satisfied at the same level.

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KEY TERMS AND DEFINITIONS

De Novo Programming: It realizes optimal system design instead of optimization of the system based on budget constraint.

Fuzzy Goal Programming With Interval Type-2: It is a Fuzzy Goal Programming approach modelled using Type-2 Fuzzy Set.

Multi-Objective Sustainable Supplier Selection Problem: Supplier selection problems that are an extension of Multi-Objective Linear Programming. Such problems assign the amount to be purchased from suppliers.

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Chapter 11
Managing Transportation in Supply Chain:
Metaheuristics for Solving a Capacitated Fixed-Charge Transportation Problem

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ABSTRACT

Supply chain management is the managing of all processes of goods, services, and information from suppliers to customers. Transportation network design is an important part of effective supply chain management. This chapter presents the two-stage fixed-charge transportation problem in a supply chain to minimize the total cost containing the opening cost of distribution centers, transportation cost from manufacture to distribution centers and from distribution centers to customers, and fixed cost for transportation from distribution centers to customers. There are the capacity constraints on distribution centers in order to consider real life situations in this chapter. A constructive based algorithm and a population-based algorithm are proposed to solve this complex optimization problem. Taguchi experimental design is applied for determining the best combinations of parameters. The experimental studies are conducted to compare the performance of the proposed algorithms according to solution quality.

INTRODUCTION

In the early 1980s, supply chain management (SCM) was introduced with increasing competition among companies (Oliver and Webber, 1982). With the increasing number of companies in the following years, the importance of managing operations with integrated supply chain management approach was understood and the use of supply chain management expanded instead of managing operations separately. Sunil and Peter (2013) pointed that 'A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but

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also transporters, warehouses, retailers, and customers themselves. Within each organization, such as a manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance, and customer service.' The Council of Supply Chain Management Professionals defined SCM to be "The process of planning, implementing and controlling the operations of the supply chain in an efficient way." To reach the aim of managing supply chain effectively, companies coordinate production, inventory, location, transportation participants in a supply chain. A supply chain is 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. Ghiani, Laporte and Musmanno (2004) defined SCM as "a complex logistics system in which raw materials are converted into finished products and then distributed to final users (consumers or companies)." And conversely, Hugos (2011) depicted that some differences exist between logistics management and SCM. SCM includes logistics management and logistics management is as the art of bringing the right amount of the right product to the right place at the right time (Tilanus, 1997). SCM considers other operations such as marketing, customer relationship, and finance as well. As can be seen from the difference between SCM and logistics management, logistics costs make up a large percentage of the total cost. Companies focus on reducing transportation costs through determining optimal routes with the aim of minimizing time, cost, and time, while maintaining their quality level and meeting due date in a global environment. A change in our distribution system will result in the customer not being delivered on time and customer dissatisfaction. Transportation has become much more strategic for organizations in determining their ability to compete in the growing and complex global marketplace. Using different modes of transportation and location of facilities (manufacturers, distribution centers, suppliers, customers) in a supply chain, designing routes and networks for moving parts are really important factor to provide desired profit rate and timely delivery. For this reason, the transportation network design is very crucial in supply chain management to determine the transportation / logistics activities that can give the least cost. Hitchcock (1941) introduced a well-known transportation network design. Typically, transportation network design problem is the core problem used for making strategic transportation network investments. The objective is to determine the best way of transporting raw materials, semi-products, and products from a number of destinations to final destinations for minimizing the total cost. Determining the best location of distribution centers which are opened regarding to satisfy customer demands at minimum opening cost, transportation cost and fixed cost is one of factors affect the efficiency of logistics system.

In this paper, two stage fixed-charge transportation problem is considered. The main aim of this problem is to design transportation network to meet customer demands at minimum cost subject to distribution centers capacity. There are candidate distribution centers which are supplied demands of customers from manufacturer and each distribution center to serve customers. To more realistic, each potential distribution center has a specific and different capacity to store. This problem is minimizing of total cost. Total cost includes transportation cost from manufacturers to distribution centers, opening cost for candidate distribution center, transportation cost from distribution centers to customers, and fixed cost for transportation from distribution centers to customers. Two different algorithms are proposed to find the best solution.

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Background

Hirsch and Dantzig (1954) formulated first the fixed charge problem. Balinski (1961) investigated the fixed charge transportation problem and proposed an approximate method for solving the fixed charge transportation problem. Murty (1968), Palekar et al. (1990), and Sandrock (1988) developed solution methodologies for single stage fixed-charge transportation problems. Sun et al. (1998) proposed tabu search and the proposed method obtained optimal or near optimal solution faster than exact solution algorithms. Adlakha and Kowalski (2003) presented a simple heuristic algorithm for small size fixed-charge problems. Kundu et al. (2014) considered fixed-charge transportation problem with type-2 fuzzy parameters. Zhao et al. (2018) presented a strong formulation based on lagrangian decomposition and column generation. Sadeghi-Moghaddam (2019) suggested metaheuristics to solve fixed charge transportation problem under fuzzy environment and analyzed the performance of the metaheuristics.

The first paper for solving two stage distribution problem was introduced by Geoffrion and Graves (1974). They solved the multi-commodity distribution problem by using Benders' partitioning procedure. Amiri (2006) addressed the distribution network design problem in a supply chain system that involves locating production plants and distribution warehouses, and determining the best strategy for distributing the product from the plants to the warehouses and from the warehouses to the customers. The researcher considered multiple levels of capacities for plants and distribution centers. A mixed integer programming model and an efficient solution approach were proposed. Gen et al. (2006) studied on an extension version of two stage transportation problem to minimized total logistic cost involving the opening cost of distribution centers and shipping cost form plants to distribution centers and from distribution centers to customers. They developed priority based genetic algorithm and a new crossover operator. They tested the proposed approaches and compared this approach with genetic algorithm based on different representation methods. Jawahar and Balaji (2009) proposed a genetic algorithm to solve a two-stage distribution problem of a supply chain that is associated with a fixed charge. They considered transportation cost between a source and destination and fixed charge cost for transportation form a source to destination. The results of proposed algorithm are better than the lower bound solutions. Zavardehi et al. (2011) presented two metaheuristics, namely genetic algorithm and artificial immune algorithm. They applied Prüfer number presentation that is a popular tree encoding schemes. The main objective function of the paper was to minimize the total cost that varies according to the demands of the customers by considering the capacity of the distribution centers. They applied Taguchi experimental method to set the best value of genetic algorithm and artificial immune algorithm parameters. The performance of artificial immune algorithm outperformed the performance of genetic algorithm. Raj and Rajendran (2012) proposed a genetic algorithm for two stage transportation problem under two different scenarios. The proposed algorithm performed better than existing algorithms. Pintea et al. (2012) used some hybrid variant of Nearest Neighbour search algorithm. The efficient version was obtained based on the result of the experimental results. Panicker et al. (2013) developed an ant colony optimization based heuristic for the fixed-charge problem in two-stage supply chain and compared the proposed algorithm with genetic algorithm-based heuristic. Kannan et al. (2014) proposed artificial immune system and sheep flock algorithms for solving two stage fixed charge transportation problem. In 2015, Pintea and Pop proposed a hybrid algorithm combining the Nearest Neighbour search heuristic with local search procedure. Pramanik et al. (2015) discussed two-stage capacitated fixed charge transportation problem in Gaussian type-2 environments. Two mathematical model was proposed to solve the imprecise problem. Genetic algorithm and particle swarm optimization were used to solve the

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deterministic models. Calvete et al. (2016) developed a hybrid evolutionary algorithm and examined the performance of the proposed algorithm. A hybrid heuristic approach for solving two-stage capacitated fixed charge transportation problem was introduced by Pop et al. (2016). The proposed approach was combined the genetic algorithm with local search procedure. The performed computation experiments showed that the proposed approach obtained better results than the state of the art algorithms. Calvete et al. (2018) developed a matheuristic for two stage fixed-charge transportation problem. The proposed algorithm was competitive than the algorithms introduced in literature. Cosma et al. (2020) proposed a hybrid algorithm combines linear programming optimization problem into genetic algorithm. It is seen in the literature review that the number of research papers addressing the problem of two-stage transportation network design that takes into account the capacity is limited and a feasible solution was obtained by using population-based approaches in general. As a result of the literature review, it seems that there is scope for efficient metaheuristic development to solve two-stage transportation problems, taking into account the fixed cost associated with each route, the cost of opening a distribution center, transportation costs (from manufacturer to distributor, from distributor to customer) and the capacity of distribution centers. This paper has considered a constructive based algorithm for two stage capacitated fixed charge transportation problem.

TWO-STAGE FIXED CHARGE TRANSPORTATION PROBLEMS

Definition of the Problem and Mathematical Model

The fixed-charge transportation problem in a two-stage supply chain network is considered. In this problem, there are a manufacturer, a set of m potential distribution centers (DC's), and n customers. The manufacturer can ship to potential DC's at transportation cost c_i ($i \in \{1,\ldots,m\}$). Each DC can ship any customer demand at transportation cost, c_{ij} (unit cost for shipping from DC i ($i \in \{1,\ldots,m\}$) to customer j ($j \in \{1,\ldots,n\}$)) plus a fixed cost f_{ij} for transportation from DC's i ($i \in \{1,\ldots,m\}$) to the customers j ($j \in \{1,\ldots,n\}$). The quantity to be transported from DC's i ($i \in \{1,\ldots,m\}$) to customer j ($j \in \{1,\ldots,n\}$) is denoted by x_{ij}. Also, there are an opening cost f_i ($i \in \{1,\ldots,m\}$) for a potential DC i ($i \in \{1,\ldots,m\}$). Each DC i ($i \in \{1,\ldots,m\}$ has different storage capacity a_i. Each customer j ($j \in \{1,\ldots,n\}$) has a demand b_j. There are some assumptions: The total supply of all plants is at least equal to the total demand of all customers. The capacity of the distribution centers is equal to or greater than the total demand of all customers. With these assumptions, we see that customer demands may encounter with all distribution centers (Jawahar and Balaji, 2009). The main objective is to establish which distribution centers are opened according to the capacity of DC's and which customer demands are delivered from opened distribution centers for meeting the customer demands with the minimum total cost. Figure 1 indicates two stage supply chain network problem. The standard mathematical model of the discussed problem is presented as follows.

$$\min Z = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(c_{ij}x_{ij} + f_{ij}y_{ij}\right) + \sum_{i=1}^{m} c_i\left(\sum_{j=1}^{n} x_{ij}\right) + \sum_{i=1}^{m} f_i y_i \qquad (1)$$

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$$\text{s.t. } \sum_{i=1}^{m} x_{ij} = b_j; \quad j = 1, \ldots\ldots, n \tag{2}$$

$$\sum_{j=1}^{n} x_{ij} \le a_i; \quad i = 1, \ldots\ldots\ldots, m \tag{3}$$

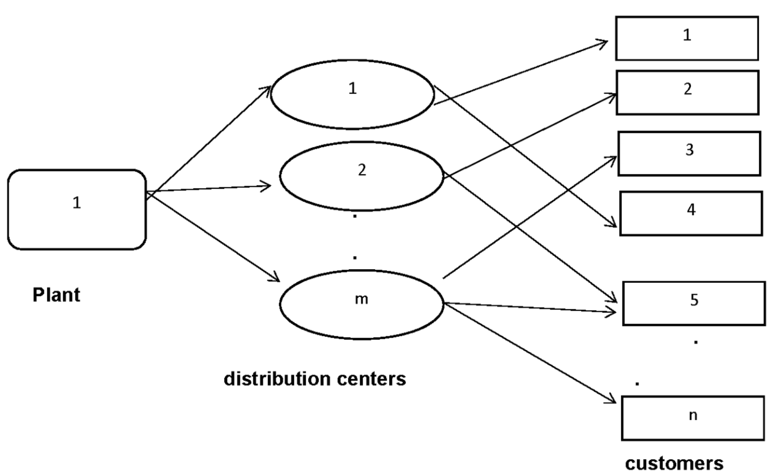
$$x_{ij} \ge ; \forall i.j \tag{4}$$

$$y_{ij} = \begin{cases} 1 & x_{ij} > 0 \\ 0 & x_{ij} = 0 \end{cases} \quad \forall i, j \tag{5}$$

$$y_i = \begin{cases} 1 & \sum_{j=1}^{n} x_{ij} \ge 0 \\ 0 & \sum_{j=1}^{n} x_{ij} = 0 \end{cases} \quad \forall i \tag{6}$$

Objective function (1) minimizes the total cost including fixed costs, opening costs, and transportation costs. Constraint (2) ensures that total quantity to be transported from DC's to customer does not exceed the customer demand. Constraint (3) provides that the quantity to be transported from DC's is less than or equal to the available capacity. Constraint (4) is non-negativity constraint of decision variables. Constraint (5) and (6) correspond to necessary conditions.

Figure 1. Example of two stage transportation network



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Metaheuristics for Solving Transportation Problem

The complexity of the real world problem increases due to the fact that there are many variables and constraints in real life problems. It is observed that conventional methods are limited in solving problems with mathematical programming model. The fixed charge network flow problem is NP-hard (Kim and Pardalos, 1999). Metaheuristics have been presented in the past to solve multi-stage transportation problem (Balaji and Jawahar, 2010; Gen et al., 2006; Jawadar and Balaji, 2009). Blum and Roli (2003) classify metaheuristics considering some specific features: nature-inspried vs. non-nature inspired; population based vs. single point search; dynamic vs. static objective function; one vs. various neighborhood structure; memory usage vs. memory-less methods. As can be seen in the literature review, the problem solution in the related literature is mostly dealt with genetic algorithm. In this paper, both a population-based approach and an approach based on single point research are proposed for two-stage capacitated fixed charge transportation problem. Population based metaheuristics consist of evolutionary computation, genetic algorithms and particle swarm optimization. Single solution metaheuristics include simulated annealing, variable neighborhood search, greedy randomized adaptive search procedure, and iterated local search. The main difference between two approaches is the number of initial solutions. While population-based approaches start with more than one solution and improve multiple candidate solutions using population characteristics, single solution approaches only begin with one solution and modify single candidate solution.

Genetic Algorithm

Genetic Algorithms are a powerful solution technique based on biological evolution inspiration (Bremermann, 1958; Holland, 1975) in computer science and operations research. Genetic algorithm (GA) employed to solve many real-life problems (Gen and Cheng, 2000; Dhanalakshmi et al., 2009; Rajesh et al., 2013; Chatterjee et al., 2018). An initial population creation is the first step of GA. After determining encoding mechanism and fitness evaluation measure, the initial population of candidate solutions is generated randomly. In each population, there are more than one individual (chromosome). Chromosomes are used to encode a candidate solution. Then fitness values of candidate solutions are evaluated at each iteration and chromosomes compete each other. The solutions have better fitness values are selected by using one selection procedure (roulette-wheel selection, stochastic universal selection, tournament selection) to eliminate bad solutions in a population, while population size is constant. The selection mechanism does not guarantee generating a new solution in the population. Two recombination operators: crossover and mutation are applied to generate a new population and keep improving the current solution over time. The primary idea of crossover to keep in mind is that the offspring under crossover will not be identical to any particular parent and will instead combine parental traits in a novel manner (Goldberg, 2013). Mutation operator modifies a solution. The offspring population generated by operators updated the original population using replacement technique (elitist replacement, steady-state replacement). The new population is assessed again and this process is repeated until termination criterion is determined (Edmund and Graham, 2005). The overall procedure is outlined as follows:

```
Procedure: GA for two-stage network design problem
Input: data, GA parameters
Begin
```


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```
        t←1
        Initialize by encoding mechanism
        Fitness evaluation
                While do
                        Crossover
                        Mutation
                        Fitness evaluation
                        Select one individual from Population by roulette
wheel selection
                        t←t+1
                End
        Output minimum total cost
        End
```

Representation

Various encoding methods have been used to obtain effective application of GA. Tree-based representation is applied to represent network problems. Edge-based encoding, vertex-based encoding, edge and vertex based encoding are three types of encoding tree (Gen and Cheng, 1997). Matrix-based representation is used to solve linear and non-linear transportation/distribution problems (Michalewicz et al., 1991). Spanning tree-based representation was introduced by Gen and Cheng (1997, 2000). Prüfer number embedded into spanning tree-based representation mechanism. However it needs repairing mechanism to obtain feasible solution. Gen and Cheng (1997) introduced a new presentation type named as priority-based encoding to escape from repair mechanism. In a chromosome, each number indicates the distribution center that will serve the customer corresponding to the sequence of chromosomes. Table 1 represents the parameter and values of an example. In Figure 2, chromosome for one feasible solution is given. For given chromosome, demands of customers (from customer1 to customer 5) are supplied by distribution center 2, 2, 3, 3, and 3, respectively and total cost is 5775. The construction procedure of initial solution is given follows:

Procedure: Construction procedure of initial solution
Input: D: set of DCs, J: set of customer demands,

c_i: transportation cost of one unit from manufacturer to DC i, $\forall \mathbf{i} \in \mathbf{D}$,
c_{ij}: shipping cost of one unit from DCs i, to customer j, $\forall \mathbf{i} \in \mathbf{D}, \forall \mathbf{j} \in \mathbf{J}$,
f_{ij}: fixed cost from DCs i, to customer j, $\forall \mathbf{i} \in \mathbf{D}$, $\forall \mathbf{j} \in \mathbf{J}$,
f_i: opening cost for DC i, $\forall \mathbf{i} \in \mathbf{D}$
a_i: capacity of DCs i, $\forall \mathbf{i} \in \mathbf{D}$
b_j: demand on customer j, $\forall \mathbf{j} \in \mathbf{J}$

Output: x_{ij}: the amount of product transported from DS i, to customer j, $\forall \mathbf{i} \in \mathbf{D}, \forall \mathbf{j} \in \mathbf{J}$,

v(j): chromosome, $\forall \mathbf{j} \in \mathbf{J}$,
totalcost= total cost for a chromosome

Step 1. j=j+1 and Build L list which includes the total cost of each DC for customer j considering capacity of DCs.

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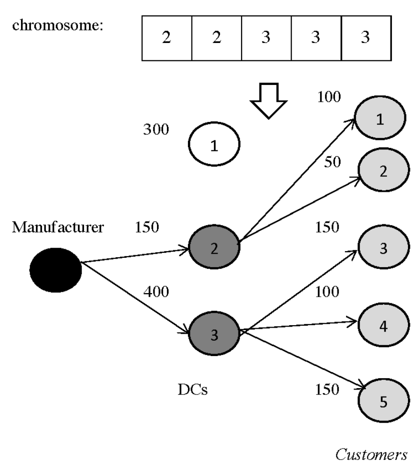
Step 2. Select one DC from L randomly .
Step 3. Add selected DC to v(j) and update capacity of DCs.
Step 4. If j≤total number of customers go to Step 1; else go to Step 5.
Step 5. Output x_{ij} and totalcost.

Table 1. An example of transportation problem

				Customers	1	2	3	4	5		1	2	3	4	5
DC	*fi*	c_i	a_i	**Shipping cost c_{ij}**						**Fixed cost f_{ij}**					
1	500	5	300		3	5	4	6	7		100	150	200	220	250
2	300	3	150		5	1	6	4	3		50	200	250	70	100
3	400	4	400		6	2	5	5	4		70	100	150	100	125
				b_j	100	50	150	100	150						

Figure 2. An example of chromosome and transportation graph



Genetic Operators

Crossover

Crossover generates two offspring by using features of two chromosomes. The main aim is to explore new solution space and obtain better offspring. Single point crossover and two point crossover are employed. In one point crossover, a random cutting point is selected and parts of parents after potting point is swapped to produce new offsprings. In two-point crossover, two crossover points are determined randomly from the parent chromosomes. The parts between the two points are swapped between the parent chromosomes. As it seen in Figure 3 and 4, crossover operator yields new offspring after crossover operation.

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Figure 3. Illustration of one point crossover procedure

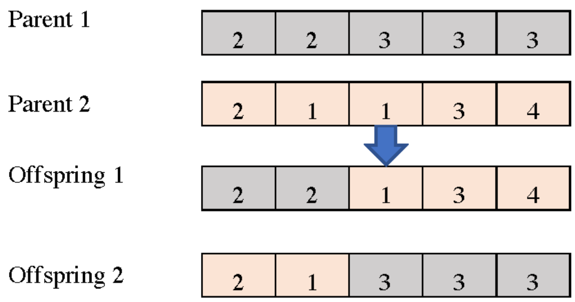
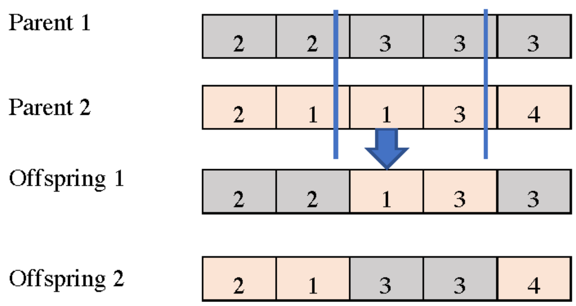


Figure 4. Illustration of two point crossover procedure



Mutation

Mutation is used to prevent the premature convergence and explore new solution space. Mutation operator rearranges only one chromosome at each time. Two mutation operators are employed; namely swap mutation, insert mutation. In swap mutation shown in Figure 5, two genes are selected at random and then swap the relative genes of construct to generate a new offspring. Figure 6 illustrates insert mutation operator. We select one gen randomly and insert it in a random position.

Figure 5. Illustration of swap mutation operator

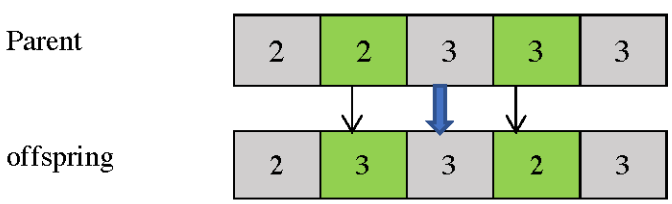


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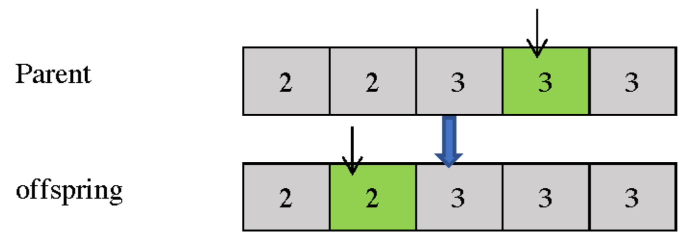
Figure 6. Illustration of insert mutation operator



Evaluation and Selection

Each chromosome has a fitness value to reflect the goodness of each chromosome. The evaluation procedure forces chromosomes to compare each other. In this paper, minimization of total cost is objective function and fitness value has been taken as inverse objective function. Roulette wheel selection with elitist strategy is employed as a selection mechanism.

Constructive Based Algorithm

Greedy Randomized Adaptive Search Procedure (GRASP) was introduced by Feo and Resende (1989). GRASP is a multi-start, iterative metaheuristic to solve combinatorial problems (Feo and Resende, 1995). It begins to generation process with a single solution and improves initial solution iteratively. There are two phases in GRASP. First phase is construction of initial solution. If this solution is not feasible, a repair mechanism is applied to achieve feasibility. After bulding a feasible solution, we continue to second step. Second phase is local search phase to improve the constructed solution. The result is the best overall solution.

Greedy randomized adaptive search procedure based on the same principle pure greedy algorithms. Randomization is used to construct a solution at each run. Figure 7 presents the steps of construction phase. In the construction phase, one element is added to current partial solution without destroying feasibility according to a greedy evaluation function. A greedy parameter (α) is experimentally determined and its value ranges from zero to one. Restricted candidate list is created by evaluation of candidate elements according to a greedy function. One element is selected randomly from the restricted candidate list and incorporated into the partial solution. This process is repeated until one feasible solution is constructed. The construction steps of the given example in Table 1 are given as follows:

$S \leftarrow \emptyset$

$C = \{1, 2, 3, 4, 5\}$

$\alpha = 0.4$

$fi = [500, 300, 400]$

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Figure 7. Construction phase of GRASP

```
procedure GreedyRandomizedConstruction(α, Seed)
    S ← ∅;
    Initialize the candidate set: C ← E;
    Evaluate the incremental cost c(e) for all e ∈ C;
    while C ≠ ∅ do
        c^min ← min{c(e) | e ∈ C};
        c^max ← max{c(e) | e ∈ C};
        Build the restricted candidate list: RCL ← {e ∈ C | c(e) ≤ c^min + α(c^max − c^min)};
        Choose s at random from RCL;
        Incorporate s into solution: S ← S ∪ {s};
        Update the candidate set C;
        Reevaluate the incremental cost c(e) for all e ∈ C;
    end;
    return S;
end.
```

Iteration 1

Selected customer is 3 and c={2050, 1900, 1900} and RCL={DC2,DC3} select DC3
S={0,0,3,0,0}, fi=[300, 150,250], C ={1, 2, 4, 5}

Iteration2

Selected customer is 4 and c={1820, 1070, 1000} and RCL={DC2,DC3} select DC3
S={0,0,3,3,0}, fi=[300, 150,150], C ={1, 2, 5}

Iteration 3

Selected customer is 1 and c={1400, 1150, 1070} and RCL={DC2,DC3} select DC2
S={2,0,3,3,0}, fi=[300, 50,150], C ={ 2, 5}

Iteration 4

Selected customer is 2 and c={1150, 400, 400} and RCL={DC2,DC3} select DC2
S={2,2,3,3,0}, fi=[300, 0,150], C ={ 5}

Iteration 4

Selected customer is 5 and c={2550, 0, 1325} and RCL={DC3} select DC3
S={2,2,3,3,3}, fi=[300, 0,0], C = Ø

Total cost=1900+1000+1150+400+1325=5775

The constructed solution does not guarantee optimality and the local search procedures are employed to improve solution in an iterative fashion. Figure 8 illustrates a basic local search algorithm for this problem. At each local search iteration, if obtained new solution is better than current solution, we replace current solution with a better solution in the neighborhood of current solution and the objective value function is updated. The local search phase consists of four local search procedures: Select one customer and change the distribution center of this customer with another one which was not opened. Select one distribution center *m*, close this distribution center *m* and select another distribution center *n* which was not opened, distribution center n supply all demand of distribution m. Select two distribution centers *i,j* and interchange all customers of distribution center *i* with the customers of distribution center *j*. Select two customers *k* and *l* served by distribution center *i* and *j* and reassign the customer *k* to distribution center *j* and the customer *l* to distribution center *j*.

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Figure 8. Local search phase of GRASP

```
procedure LocalSearch(S)
    while S is not locally optimal do
        Find S' ∈ N(S) with f(S') < f(S);
        S ← S';
    end;
    return S;
end.
```

COMPUTATIONAL EXPERIMENTS

Computational experiments are conducted to test the performance of two algorithms for solving two-stage capacitated fixed-charge transportation problem. Since there are no test problems in the related literature, 28 test problems are generated randomly. The values of the parameters are taken from Molla-Alizad-Zavardehi et al. (2011). There are seven problems. The problem size is determined by considering the number of distribution centers and the number of customers. The numbers of distribution centers vary between 10 and 50. The numbers of customers vary between 10 and 200 and variable costs range from 3 to 8. After specifying the problem size, considering the significant effect of fixed costs and opening cost to solution, each problem has four levels (A-D) of difficulty. The range of fixed costs, and opening costs determines the levels of each problem. The fixed costs for transportation from DCs to customers range from 50 to 1600. The opening cost for DCs differ from 150 to 4800. The problem size, total supply and demand, and the costs are presented in Table 2.

Table 2. Test problems information

Problem size	Total supply	Total demand	Problem type	Variable costs		Fixed costs		Opening costs	
				L*	U*	L	U	L	U
10x10	30.000	10.000	A	3	8	50	200	150	600
10x20	45.000	15.000	B	3	8	100	400	300	1200
10x30	45.000	15.000	C	3	8	200	800	600	2400
15x15	45.000	15.000	D	3	8	400	1600	1200	4800
50x50	150.000	50.000							
30x100	90.000	30.000							
50x200	150.000	50.000							

*L=lower limit; U=upper limit

It is known that changes in parameter values affect the performance of algorithms. Each algorithm has several parameters. Parameter design is carried out to set the parameter values. The full factor design consists of all possible combinations of levels for all factors. This becomes difficult with the increasing number of factors and the level of each factor. In GA, there are four parameters: population size, generation number, crossover rate and mutation rate. Table 3 lists the factors and the levels of each factor in GA. In GA, there are 28 problems, four 3-level factors, in which problems runs five times. Therefore, 28

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x 3^4 x 5 = 11340 results are examined in GA. In the proposed algorithm, there are three parameters, global search, local search and alfa. The parameters value of each parameter is given in Table 4. 28 x 3^3 x 5 = 3780 results are examined in the proposed algorithm. An optimal combination of parameters is obtained by conducting numerous experiments. The experimental design methods are used to calibrate the parameters and get the optimal combination of parameters by reducing the number of experiments. Taguchi method is one of the experimental design methods that are successfully adapted to optimization problems (Taguchi, 1986). The Taguchi design of experiments (DOE) is applied to test the varied combinations of factors. The Taguchi method operates orthogonal array to set an experimental design. This method cut down the number of experiments, and conforms for the real life situations. The orthogonal array is utilized for identifying all factors about the small number of experiments in Taguchi method. Taguchi classified factors into two parts: controllable and noise (uncontrollable) factors. Controllable factors are variables and their levels don't change after setting, whereas the levels of the noise factor vary during the process, and unwanted changes are seen in the results. Because of the negligence of the noise factors, the Taguchi minimizes the impact of noise and finds the optimal level of controllable factors on robust design (Tsai, Ho, Liu and Chou, 2007). Furthermore, Taguchi establishes the relative effect of each factor to performance of the algorithm. Taguchi developed a transformation of the repetition data to another value which is the measure of variation. Robust design (Phadke, 1989) is realized through the transformation of the signal/noise (S/N) ratio. This ratio indicates the amount of variation present in the response variable. In Taguchi, the S/N ratio of the minimization objective is as such (Phadke, 1989): S/N ratio = -10log10(objective)^2.

The total degree of freedom is calculated for selection of the proper orthogonal array of proposed algorithm. The summation of two degree of freedom for three factors (2+2+2=6) is six. Thus, the proper orthogonal array must have at least six rows. L9 is a proper array that that includes the factor level combinations for proposed algorithm. For GA, the total degree of freedom for three factors with three levels is (2+2+2+2=8) eight. The proper array must have eight rows. L27 is selected as a proposed orthogonal array. The computational experiments on proposed algorithm and GA are predicated on L9(3^3) and L27 (3^4) orthogonal array. Five replications are performed for each trial owing to stochastic structure of these algorithms. The relative percentage deviation (RPD) is utilized to compare the performance of the algorithms. RPD is calculated by:

$$\mathrm{RPD} = \frac{\mathrm{Alg_s} - \mathrm{Best_s}}{\mathrm{Best_s}} \mathrm{x}100$$

where Alg_s is acquired the objective value for each run and the best objective value is denoted by $Best_s$. After converting the objective values to RPD, the mean RPD is obtained for each factor design set. The obtained results are transformed into S/N ratio. The computational experiments of GRASP are conducted to determine the optimal level of the factors for two algorithms. The mean response deviations at each level of factors are given in Table 5. Further, the mean response deviation results are plotted in Figure 9. The response tables depict the mean RPD of each factor level, Delta statistics and rank of each factor. Delta values compare the relative magnitude of effects. Rank values are assigned based on Delta values and indicate the importance level of each factor to the responses. The relative importance ranking of factors of proposed algorithms are alfa (α), local iteration number (local) and global iteration number (global), respectively. This signifies that the most important factor which impact on the performance

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of the proposed algorithm is alfa. Average S/N ratios at each level are shown in Table 6 and Figure 10. These values confirm the same results as the RPD values. As shown in figure and table, the values of parameter set in the proposed algorithm are 40, 150, and 0.3, respectively. Similar to GA, the mean RPD values are presented in Table 7 and Figure 11. Table 8 and Figure 12 show the S/N ratios of each factor level in GA. The best parameters for GA defined as 20, 0.5, 0.05, and 100, respectively.

To compare the performance of two algorithms, 28 problems are solved by using the determined appropriate parameters. Each problem runs ten times. RPD measurement is used to evaluate the results of two algorithms. Analysis of variance method is applied to verify and analyze the results. Figure 13 depicts means plot for two algorithms. The performance of GRASP is getting better, while problem size increases. It also demonstrates that the performance of GRASP is better than the performance of GA.

Table 3. Factors and levels of factors in genetic algorithm

Factors	Factor Levels
Population size	20-30-40
Crossover rate	50%- 60%-70%
Mutation rate	5%-10%-15%
Generation number	100-150-200

Table 4. Factors and levels of factors in the proposed algorithm

Factors	Factor Levels
Global search	20-30-40
Local search	100-150-200
Alfa	0.3-0.5-0.7

Table 5. Mean RPD responses in GRASP

Level	global	local	alfa
1	5,7162	6,6981	0,5776
2	5,9933	5,6690	6,2390
3	6,0838	5,4262	10,9767
Delta	0,3676	1,2719	10,3990
Rank	3	2	1

FUTURE RESEARCH DIRECTIONS

For future research, it will be interesting to develop other metaheuristics such as ant colony optimization, variable neighborhood search, particle swarm optimization, bat algorithm etc.. Furthermore, the proposed constructive algorithm is applied to other transportation problems. The response surface methodology can be used to tune the parameters of algorithms.

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Table 6. Mean S/N ratio responses in GRASP

Level	global	local	alfa
1	-8,965	-9,307	7,356
2	-8,117	-7,443	-14,281
3	-7,453	-7,785	-17,610
Delta	1,512	1,864	24,965
Rank	3	2	1

Table 7. Mean RPD responses in GA

Level	popsize	crossrate	mutationrate	generationnum
1	6,202	6,551	6,479	6,433
2	6,740	5,669	6,097	5,844
3	5,511	6,233	5,877	6,176
Delta	1,229	0,883	0,602	0,590
Rank	1	2	3	4

Table 8. Mean S/N ratio responses in GA

Level	popsize	crossrate	mutationrate	generationnum
1	-11,18	-11,64	-11,61	-10,12
2	-11,47	-12,29	-12,33	-10,39
3	-13,05	-11,78	-11,77	-15,20
Delta	1,87	0,65	0,72	5,08
Rank	2	4	3	1

Figure 9. Main effects plot for RPD each level of the factors in GRASP

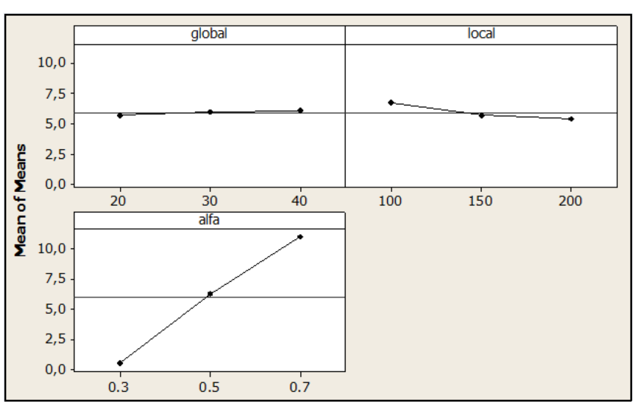

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Figure 10. Main effects plot for S/N ratio each level of the factors in GRASP

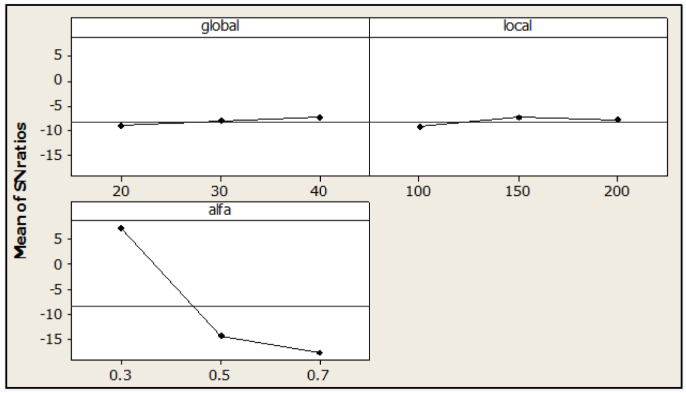

Figure 11. Main effects plot for RPD each level of the factors in GA

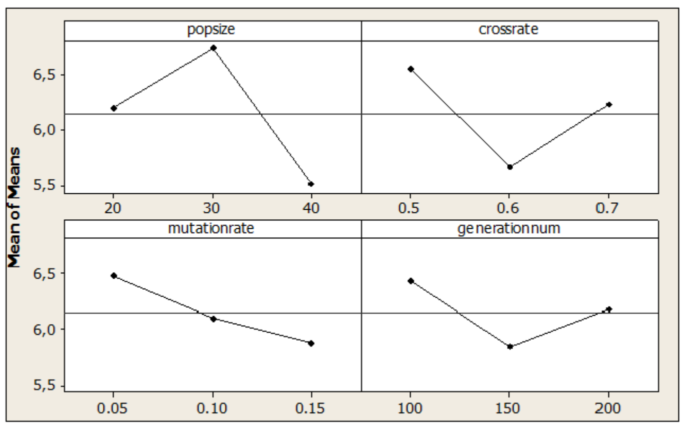

Figure 12. Main effects plot for S/N ratio each level of the factors in GA

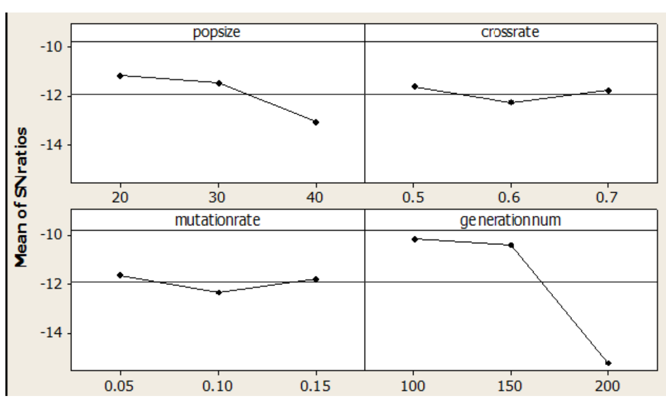

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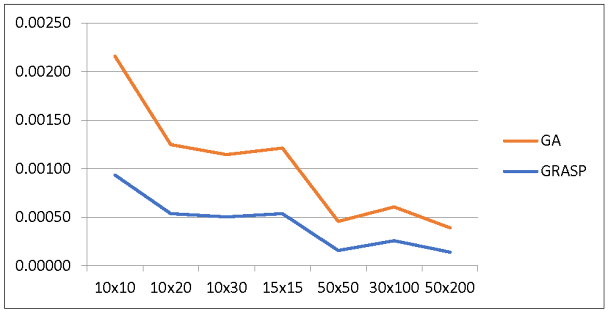
Figure 13. Means plot for interaction between each algorithm and problem size.



CONCLUSION

This paper has considered two-stage fixed-charge transportation network problem in supply chain. The problem has been made more real-life by addressing the capacity of distribution centers. The presented problem minimize the total cost as some distribution centers are selected in order to supply demands of all customers. The literature review in this specific field is surveyed and the most used solution approach is highlighted to emphasize the difference of the proposed approach. The fixed charge transportation problem encountered in real life environment is NP-hard problem. This paper presents genetic algorithm (GA) and greedy randomized adaptive search procedure (GRASP) to solve such a hard problem. However, the parameter setting affects the performance of the algorithms. The experimental design is conducted to adjust the paramaters of algorithms. The extensive computational experiments on benchmark instances depict that GRASP is competitive in comparison with GA.

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KEY TERMS AND DEFINITIONS

Distribution Center: A building where the products are stored before being distributed to the end customers or retailers or wholesalers.

Mathematical Model: Defining systems using mathematical concept.

Metaheuristic: An approach that can provide near optimal solutions within an acceptable time for large-scale optimization problems.

Optimization: The collection of transactions that find the best results among the alternative solutions.

Parameter: Any characters used to describe a system.

Supply Chain Management: The management of the process from receiving the order from the customer to the delivery of the order to the customer.

Transportation: Moving people, animals and goods from one place to another.

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Chapter 12
Selection of The Best Supplier in Furniture Industry by Using Fuzzy Analytic Hierarchy Process Method

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ABSTRACT

Considering the globalization and the global economy, companies need to make strategic decisions in the furniture sector, as in many other sectors. In today's competitive conditions, supply chain management plays a major role in the success of firms and ensuring their sustainability in the sector. Therefore, companies need to work with suitable suppliers to be successful in supply chain management. There are many different methods used in the literature for evaluating suppliers. Fuzzy analytic hierarchy process (FAHP) method, which is one of the multi-criteria decision-making (MCDM) methods, is widely used in supplier selection problems. This study aimed to determine the best suppliers of a furniture production company in Turkey using the FAHP. In the study, four suppliers of the company were evaluated according to price, quality, delivery, innovativeness, and reliability criteria. As a result of the application, the ranking of the suppliers was made, and the best supplier selected.

INTRODUCTION

In today's world, where competitive conditions are increasing, businesses need to cooperate with their suppliers to provide quality and sustainable service. Given the supply chain, the importance of working with suitable suppliers for the success of businesses is even better understood. For these reasons, the decision to choose suppliers for companies is a strategically important decision that can affect the entire supply chain (Tekez and Bark, 2016). Sustainable supplier selection aims to identify and evaluate

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the suitable supplier that performs best in the supply chain economically, socially and environmentally (Suraraksa and Shin, 2019).

Supply chain management provides a sustainable competitive advantage for businesses. The supplier selection process is an important part of the purchasing procedure. Therefore, businesses have become increasingly dependent on suppliers to supply previously provided services. The supplier selection process plays an important role in reducing costs and improving quality, and firms often misjudge the supplier selection problem as a single criteria decision-making problem, taking into account only cost factors (Taherdoost and Brard, 2019). A systematic approach is required to choose from a list of potential suppliers. The adequacy of suppliers should be measured based on several criteria (Davras and Karaatlı, 2014).

Supplier selection problems have gained importance in the literature in recent years (Chaharsooghi and Ashrafi, 2014; Davras and Karaatlı, 2014; Aouadni, Aouadni and Rebai, 2019; Suraraksa and Shin, 2019). There are many criteria and alternatives to be considered in the decision making process in such selection problems. When it comes to evaluating multiple criteria together in a decision problem, such decision making problems are expressed as a multi-criteria decision making problem (Öztürk and Başkaya, 2012). Dickson (1966) has prepared a ranking list of 23 criteria regarding supplier selection and has shed light on future researchers with this study.

In the study, it was aimed to select the best supplier of a furniture company in Turkey using the fuzzy AHP method, which is one of the MCDM methods. The company where the application is carried out in the study is a furniture manufacturer company in the Central Anatolia region. The rest of the study is organized as follows. In the second part, it is given to the literature review on supplier selection. The third section is the methodology section. This section includes the fuzzy logic and fuzzy AHP method. The fourth part of the study consists of the application phase where the criteria weights are calculated and the suppliers are ranked. In the fifth, in the last part, a general evaluation of the study has been made.

LITERATURE REVIEW

There are many methods for supplier selection in the literature (Kuo et al., 2010; Mardani et al., 2015). MCDM methods are widely used in supplier selection (Mardani et al, 2015; Supçiller and Deligoz, 2018). In the literature, it is possible to come across studies using MCDM methods in supplier selection (Tam and Tummala, 2001; Hou and Su, 2006; Kang and Lee, 2010; Chen, Pai and Hung, 2010; Chen, 2011; Bruno et al, 2012; Kuo and Lin, 2012; Rezai and Ortt, 2013; Kasirian and Yusuff, 2013; Dou, Zhu and Sarkis, 2014, Mardani et al., 2015 Kara, Köleoğlu and Gürol, 2016; Amindoust and Saghafinia, 2017). It is possible to find out many studies in which suppliers are selected in different sectors. Some of these studies carried out using the FAHP method are given in Table 1.

METHODOLOGY

Fuzzy Logic

The concept of fuzzy logic was first introduced by Zadeh (1965) with the study called Fuzzy Sets that published in the journal Information and Control (Zadeh, 1965). In this study put forward by Zadeh, the

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Table 1. The studies carried out using FAHP in different sectors

Author (s)	Sector (Industry)	Criteria
Aktepe and Ersöz, 2011	Shoe production	Cost, reputation, quality, delivery
Shaw et al., 2012	Textile industry	Cost, quality, lead time, demand, greenhouse gas emission
Parsei et al., 2012	Vehicle belt production	Rate of profitability, importance of client, production simplicity, importance of the ordered goods
Tayyar, 2012	Plastic bottle production	Cost, transportation cost, payment options, delivery on time, customer relationship, reliability, mouth straightness, defective rate, weight
Şengül, Eren and Shiraz, 2013	Transportation	Cost, passenger capacity, fuel consumed, engine type, warranty, engine power, brand value, economic life
Mokhtari et al., 2013	Textile industry	Quality, cost, location, delivery, trust
Ayhan, 2013	Gearmotor production	Quality, origin, cost, delivery, after sales
Özfırat et al., 2014	Textile industry	Quality, lead time, delivery performance, capacity
Sultana, Ahmed and Azeem, 2015	Battery production	Production quality, lead time, price, supplier flexibility, financial stability, after sales service, compliance with due time, compliance with quantity, location, communication systems, technical expertise, spare parts availability, research and development
Rabbani and Sarkar, 2015	Furniture industry	Quality, pricing, lead time, supply capability, payment term, country of origin, uncertain demand capability, conduct media
Acar et al., 2016	Textile industry	Quality, cost, delivery, service, pollution control, environmental management, green product, strategic alliance
Galankashi, Helmi and Hashemzahi, 2016	Automotive industry	Price of product, quality of product, distance to manufacturer, economic value added, service and delivery, reputation, supply chain collaboration level, market share, rate of sales return, technical capability, production capability, flexibility, inventory turnover, productivity, competitiveness, employee satisfaction, knowledge sharing, health and safety issue level, standards consideration
Allouche and Jouili, 2017	Computer and office meterials industry	Quality, geographical location, flexibility, delivery, after sales service
Stevic et al., 2017	Furniture industry	Quality of material, price of material, certification of products, delivery time, reputation, volume discounts, warranty period, reliability and method of payment
Jain et al, 2018	Automotive industry	Product quality, cost, quality of relationship, manufacturing capability, warranty, on-time delivery, environmental performance, brand name
Djunaidi et al., 2019	Furniture industry	Price, quality, flexibility, delivery, warranty, service

Source: Own processing

blurry of human thought has been mentioned and it is stated that the binary logic system represented by 0 and 1 is insufficient to explain human thoughts (Şengül, Eren and Shiraz, 2012).

Fuzzy logic is a computer logic revolution that helps computers with logical applications, similar to human behavior, and allows systems to work in a way that a person can solve. One of the most important features of fuzzy logic is that it is not objective but personal (Kıyak and Kahvecioğlu, 2003). An important difference of fuzzy logic from other logic systems is that it allows the use of verbal variables. Verbal variables allow the concepts that cannot be clearly expressed to be approximately qualified. Thus, verbal variables become a tool that requires the use of fuzzy sets to be able to express verbal expressions mathematically. A fuzzy set is a set whose boundary conditions are flexibly defined. Fuzzy set theory

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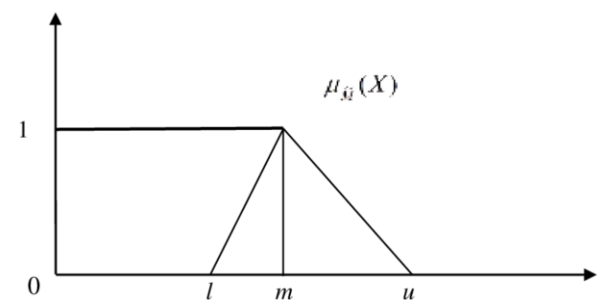
expands traditional set theory by allowing partial membership and accepts any value in the range [0,1] for cluster membership. Fuzzy clusters have unsharp boundaries (Şengül, Eren and Shiraz, 2012).

In fuzzy cluster logic, the degree of cluster ownership is indicated by (μ) and takes a value between 0 and 1. The value of "0" indicates not strictly belong to the cluster, while the value of "1" indicates strictly belongs to the cluster, which is a membership. Usually, decision makers prefer the triangular membership function due to its convenience for the cluster's degree of ownership (Davras and Karaatlı, 2014). The triangular fuzzy number simply as (l/*m, m/u)* or (l*, m, u)*. The parameters l*;* smallest possible value, m*;* the most promising value, u*;* the largest possible value that describes a fuzzy event (Kahraman, Cebeci and Ruan, 2004; Başlıgil, 2005). Figure 1 shows the functions of a triangular fuzzy number.

Figure 1. A triangular fuzzy number, (μ).
Source: Kahraman, Cebeci and Ulukan, 2003; Kargın, 2010.



The linear representation of a triangular fuzzy number according to the right and left membership values are as in equation (1) (Kahraman, Cebeci and Ruan, 2004; Başlıgil, 2005; Kargın, 2010):

$$\mu\left(x/\tilde{M}\right)=\begin{cases} 0 & x<1 \\ (x-l)/(m-l) & l\leq x\leq m \\ (u-x)/(u-m) & m\leq x\leq u \\ 0 & x>u \end{cases} \tag{1}$$

Fuzzy AHP

AHP is one of the MCDM methods used in a wide area. AHP is a measurement theory based on the priority values obtained by pairwise comparison of alternatives according to a common criteria (Duke and Hyde, 2002; Özguven, 2011). AHP is a simple and powerful technique, because of this feature it is a traditional MCDM method that is generally recommended for solving complex problems. However, AHP still cannot reflect the human thinking style. Fuzzy logic and AHP are combined and FAHP has been developed because of that AHP is not entirely suitable for making decisions in case of uncertainty. (Başlıgil, 2005; Wichapa and Khokhajaikiat, 2017).

There are many FAHP applications in the literature. The first study on FAHP was compared by fuzzy rates defined by triangle membership functions by Van Laarhoven and Pedrycz (1983). Later, Buckley (1985) determined the priorities of comparison rates with the trapezoidal membership function. Chang

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(1996) introduced a new approach to FAHP using triangular fuzzy numbers in comparisons. (Kahraman, Cebeci and Ruan, 2004; Başlıgil, 2005). The most advantageous aspect of this method is that it has fewer calculation requirements and does not require additional processing by following the steps of classical AHP (Şengül, Eren, and Shiraz, 2012).

Chang's fuzzy AHP method was used in this study. Chang's fuzzy AHP method is described in detail below.

Let $X=\{x_1,x_2,\ldots,x_n\}$ be an object set, and $U=\{u_1,u_2,\ldots,u_m\}$ be goal set. Each object is taken and extent analysis for each goal, g_i, is performed, respectively according to the method of Chang's (1992) extent analysis. Therefore, m extent analysis values for each object can be derivable with the following signs:

$$M_{g_i}^1, M_{g_i}^2, ..., M_{g_i}^m, \qquad i=1, 2, ..., n, \tag{2}$$

Where all the $M_g^j, \ (j=1, 2, ..., m)$ are triangular fuzzy number (Chang, 1996; Kahraman, Cebeci and Ruan, 2004; Başlıgil, 2005).

The steps of Chang's extent analysis can be given as below (Chang, 1992; Chang, 1996; Kahraman, Cebeci and Ruan, 2004; Başlıgil, 2005):

Step 1**:** The value of a fuzzy synthetic extent for the ith object is defined as

$$S_i = \sum_{j=1}^{m} M_{g_i}^j \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j \right]^{-1} \tag{3}$$

To obtain $\sum_{j=i}^{m} M_{gi}^j$, perform the fuzzy addition operation of m extent analysis values for a particular matrix such that

$$\sum_{j=1}^{m} M_{g_0}^j = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j \right) \tag{4}$$

and to obtain $\left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{gi}^j \right]^{-1}$, perform the fuzzy addition operation of $M_{gi}^j \,(j=1, 2, ..., m)$ values such that

$$\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j = \left(\sum_{i=1}^{n} l_i, \ \sum_{i=1}^{n} m_i, \ \sum_{i=1}^{n} u_i \right) \tag{5}$$

and then compute the inverse of vector Eq. (5) such that

$$\left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i} \right) \tag{6}$$

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Step 2: The degree of possibility of $M_2=(l_2,m_2,u_2)\geq M_1(l_1,m_1,u_1)$ is expressed as

$$V(M_2 \geq M_1) = \sup_{y\geq x}\left\lfloor \min(\mu_{M_1}(x),\ \mu_{M_2}(y)) \right\rfloor \tag{7}$$

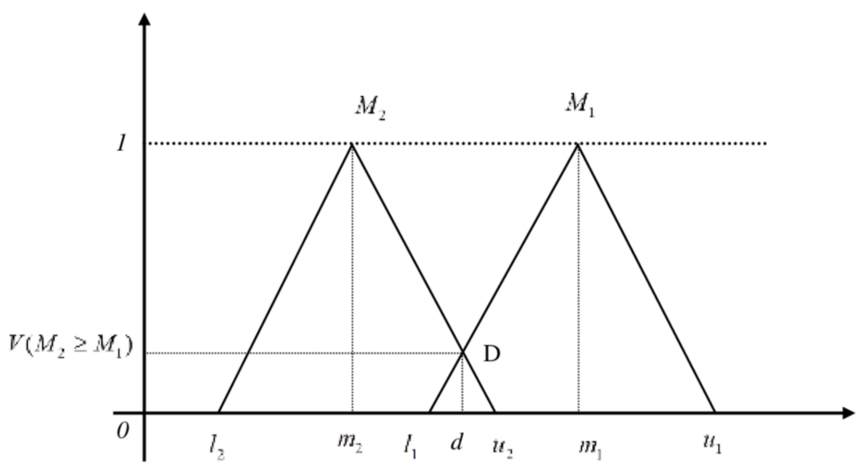
and can be equivalently defined as follow:

$$V(M_2 \geq M_1) = hgt(M_1 \cap M_2) = \mu_{M_2}(d) = \begin{cases} 1, & if\ \ m_2 \geq m_1, \\ 0, & if\ \ l_1 \geq u_2, \\ \dfrac{l_1 - u_2}{(m_2 - u_2)}, & otherwise, \end{cases} \tag{8}$$

Where d, is the ordinate of the highest intersection point D between μM_1 and $\mu M2$ (see fig. 2).

To compare M1 and M2, we need both the values of V(M$1 \geq$ M2) and V(M$2 \geq$ M1).

Figure 2. The intersection between M_1 and M_2.



Step 3: The degree possibility for a convex fuzzy number to be greater than k convex fuzzy numbers $M_i(i=1,2,\ldots,k)$ can be defined by

$$\begin{aligned} V(M \geq M_{1,}\ M_2, ..., M_k) &= V\left[\left(M \geq M_1\right)\ and\ (M \geq M_2)\,and\ ...\ and\ (M \geq M_k)\right] \\ &= \min V(M \geq M_i), \quad i = 1,\ 2,\ ....,\ k \end{aligned} \tag{9}$$

Assume that

$$d'(A_i) = \min\ V(S_i \geq S_k) \tag{10}$$

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for k=1,2,…,n; k≠i then the weight vector is given by

$$\Phi^{+}=\frac{1}{n-1}\sum\pi(A,x) \tag{11}$$

Where A_i(i=1,2,…,n) are n elements.

Step 4: Via normalization, the normalized weight vectors are

$$W'=\left(d(A_1),\ d(A_2),\ ....,d(A_n)\right)^T, \tag{12}$$

where W is a fuzzy number.

Validation of Consistency Ratio

Pairwise comparations in the AHP method involve subjective perceptions of decision makers. For a comparison matrix to be consistent, the largest eigenvalue ($\lambda m_{ax)}$ must be equal to the matrix size (n). Consistency Index (*CI)* and Consistency Ratio (*CR)* are calculated using equations (13) and (14), respectively (Saaty, 1994; Şengül, Eren and Shiraz, 2012; Iwaro et al., 2014; Özkan, Kocaoğlu and Özkan, 2018:). The scale developed by Saaty (1990) and shown in Table 2 is used to calculate the consistency index. The value of the Random Consistency Index (R*I)*, is derived from Table 3.

$$CI=\frac{\lambda_{\max}-n}{n-1} \tag{13}$$

$$CR=\frac{CI}{RI} \tag{14}$$

Table 2. Rating scale of saaty

Level of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one over another	Experience and judgment strongly favour one activity over another
5	Strong importance	Experience and judgment strongly favour one activity over another
7	Very strong importance	An activity is strongly favoured and its dominance demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values	When compromise is needed

Source: Saaty, 1990.

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Table 3. RI, Random consistency index

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Source: Saaty, 1994.

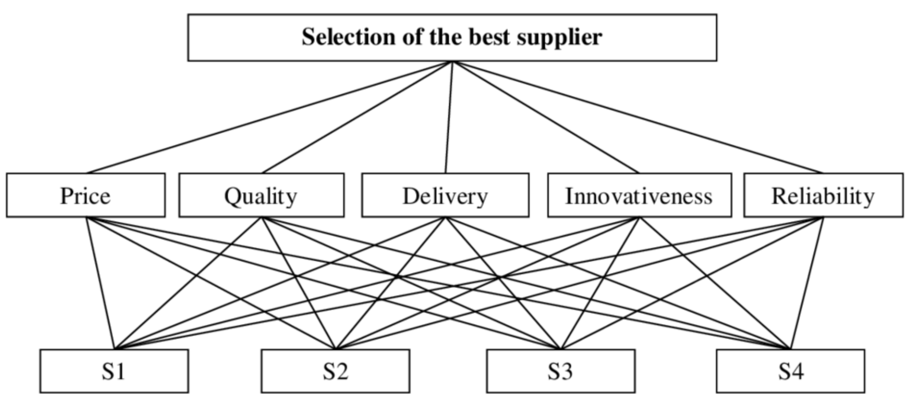
The acceptable upper limit for the *(CR)* in the comparisons is 0.10. In cases where the consistency rate is greater than 0.10, decision makers are asked to re-evaluate (Şengül, Eren and Shiraz, 2012; Garoma and Diriba, 2014; Polat and Eray, 2015).

Emprical Illustration

This study was applied in a furniture factory in the Central Anatolia region. Four suppliers of the firm were evaluated in line with the opinions of the manager and assistant manager of the purchasing department of the firm. There are many different criteria used in supplier evaluation in the literature (Ordoobadi, 2009; Ho, Xu and Dey, 2010; Aktepe and Ersöz, 2011; Sydani, Karbasi and Yekta, 2011; Tayyar, 2012; Tayyar and Arslan, 2013; Felice et al., 2015; Supçiller and Deligöz, 2018).

In this study, based on the literature review and the opinions of purchasing experts, delivery, price, quality, innovativeness and reliability criteria are determined as supplier evaluation criteria. The hierarchical structure of the study is given in figure 3. The suppliers are expressed as S1, S2, S3 and S4 respectively.

Figure 3. Hierarchical Structure for FAHP Model.



Comparison of Criteria According to Triangular Fuzzy Numbers Scale

The pairwise comparisons of the criteria were made according to the triangular fuzzy numbers scale given in Table 4. The comparison matrix for the criteria is given in Table 5.

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Table 4. Triangular fuzzy numbers scale

Linguistic	Triangular fuzzy number	Reciprocal
Just equal	(1, 1, 1)	(1/1, 1/1, 1/1)
Equally important	(1, 3, 5)	(1/5, 1/3, 1/1)
Weakly important	(3, 5, 7)	(1/7, 1/5, 1/3)
Moderately important	(5, 7, 9)	(1/9, 1/7, 1/5)
Strongly important	(7, 9, 9)	(1/9, 1/9, 1/7)

Source: Kaptanoğlu and Özok, 2006; Şengül, Eren and Shiraz, 2012.

Table 5. Pairwise comparison matrix of the criteria

	Price	Quality	Delivery	Yenilikçilik	Reliability
Price	(1, 1, 1)	(1/5, 1/3, 1)	(1, 3, 5)	(1, 3, 5)	(1, 3, 5)
Quality	(1, 3, 5)	(1, 1, 1)	(1, 3, 5)	(5, 7, 9)	(1, 3, 5)
Delivery	(1/5, 1/3, 1)	(1/5, 1/3, 1)	(1, 1, 1)	(1, 3, 5)	(1, 3, 5)
Innovativeness	(1/5, 1/3, 1)	(1/9, 1/7, 1/5)	(1/5, 1/3, 1)	(1, 1, 1)	(1/5, 1/3, 1)
Reliability	(1/5, 1/3, 1)	(1/5, 1/3, 1)	(1/5, 1/3, 1)	(1, 3, 5)	(1, 1, 1)

Calculation of Criteria Weights

Using the data in Table 5, Chang's (1996) Extended Analysis Method was used and the synthesis values for each criterion were calculated from equation (3) as follows.

Where, criteria are described as Price (P), Quality (Q), Delivery (D), Innovativeness (I) and Reliability (R).

S_P= (4.20, 10.33, 17.00) $\otimes$ (1/68.20, 1/42.14, 1/20.91) = (0.06, 0.25, 0.81)

S_Q= (9.00, 17.00, 25.00) $\otimes$ (1/68.20, 1/42.14, 1/20.91) = (0.13, 0.40, 1.20)

S_D= (3.40, 7.67, 13.00) $\otimes$ (1/68.20, 1/42.14, 1/20.91) = (0.05, 0.18, 0.62)

S_I= (1.71, 2.14, 4.20) $\otimes$ (1/68.20, 1/42.14, 1/20.91) = (0.03, 0.05, 0.20)

S_R= (2.60, 5.00, 9.00) $\otimes$ (1/68.20, 1/42.14, 1/20.91) = (0.04, 0.12, 0.43)

Where, using the equations (10) and (11), the weight vector is calculated as follows.

W= (0.819, 1, 0.690, 0.167, 0.517)

The weight vector was normalized from equation (12) and the criteria weights were obtained as in Table 6.

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Table 6. Weights of the criteria

Criteria	Weights	Ranking of the Criteria
Price	0,257	2
Quality	0,313	1
Delivery	0,216	3
Innovativeness	0,052	5
Reliability	0,162	4

Ranking of the Suppliers

The binary comparison of suppliers in terms of each criteria was made using the scale in Table 4 to rank the suppliers. Pairwise comparison matrices are given in Tables 7, 8, 9, 10 and 11.

The operations to calculate the criteria weights as in Table 6 were applied to Table 7, 8, 9, 10 and 11 and the priority values of the suppliers for each criteria were calculated as in Table 12.

The final priority value for each supplier was calculated as in Table 12 by multiplying the criteria weights in Table 6 and the priority values of the suppliers in Table 13.

When Table 13 is examined, it is understood that the best alternative is S3 with the priority value of 0, 439. The priority ranking of the suppliers is S3, S1, S4, S2 and shown in figure 4.

Table 7. Pairwise comparison of suppliers in terms of price criteria

	S1	S2	S3	S4
S1	(1, 1, 1)	(3, 5, 7)	(1, 1, 1)	(7, 9, 9)
S2	(1/7, 1/5, 1/3)	(1, 1, 1)	(1/7, 1/5, 1/3)	(3, 5, 7)
S3	(1, 1, 1)	(3, 5, 7)	(1, 1, 1)	(5, 7, 9)
S4	(1/9, 1/9, 1/7)	(1/7, 1/5, 1/3)	(1/9, 1/9, 1/7)	(1, 1, 1)
$\lambda m_{ax=}$4.182; CI=0.061; CR=0.068				

Table 8. Pairwise comparison of suppliers in terms of quality criteria

	S1	S2	S3	S4
S1	(1, 1, 1)	(1, 3, 5)	(1/5, 1/3, 1)	(1, 3, 5)
S2	(1/5, 1/3, 1)	(1, 1, 1)	(1/9, 1/7, 1/5)	(1/5, 1/3, 1)
S3	(1, 3, 5)	(5, 7, 9)	(1, 1, 1)	(3, 5, 7)
S4	(1/5, 1/3, 1)	(1, 3, 5)	(1/7, 1/5, 1/3)	(1, 1, 1)
$\lambda m_{ax=}$4.143; CI=0.048; CR=0.053				

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Table 9. Pairwise comparison of suppliers in terms of delivery criteria

	S1	S2	S3	S4
S1	(1, 1, 1)	(1, 3, 5)	(1, 1, 1)	(1, 3, 5)
S2	(1/5, 1/3, 1)	(1, 1, 1)	(1/7, 1/5, 1/3)	(1/5, 1/3, 1)
S3	(1, 1, 1)	(3, 5, 7)	(1, 1, 1)	(1, 3, 5)
S4	(1/5, 1/3, 1)	(1, 3, 5)	(1/5, 1/3, 1)	(1, 1, 1)
$\lambda m_{ax=}$4.117; C*I*=0.039; C*R*=0.044				

Table 10. Pairwise comparison of suppliers in terms of innovativeness criteria

	S1	S2	S3	S4
S1	(1, 1, 1)	(1, 3, 5)	(1/5, 1/3, 1)	(5, 7, 9)
S2	(1/5, 1/3, 1)	(1, 1, 1)	(1/7, 1/5, 1/3)	(1, 3, 5)
S3	(1, 3, 5)	(3, 5, 7)	(1, 1, 1)	(7, 9, 9)
S4	(1/9, 1/7, 1/5)	(1/5, 1/3, 1)	(1/9, 1/9, 1/7)	(1, 1, 1)
$\lambda m_{ax=}$4.088; C*I*=0.029; C*R*=0.033				

Table 11. Pairwise comparison of suppliers in terms of reliability criteria

	S1	S2	S3	S4
S1	(1, 1, 1)	(1, 3, 5)	(1/5, 1/3, 1)	(1, 3, 5)
S2	(1/5, 1/3, 1)	(1, 1, 1)	(1/7, 1/5, 1/3)	(1, 1, 1)
S3	(1, 3, 5)	(3, 5, 7)	(1, 1, 1)	(1, 3, 5)
S4	(1/5, 1/3, 1)	(1, 1, 1)	(1/5, 1/3, 1)	(1, 1, 1)
$\lambda m_{ax=}$4.116; C*I*=0.039; C*R*=0.043				

Table 12. Priority values of the suppliers for each criteria

Suppliers	Criteria				
	Price	Quality	Delivery	Innovativeness	Reliability
S1	0,48708	0,35295	0,32713	0,378292546	0,3556274
S2	0,08118	0	0,07113	0,083691388	0,0769625
S3	0,43173	0,47197	0,36452	0,538016066	0,4521549
S4	0	0,17508	0,23723	0	0,1152552

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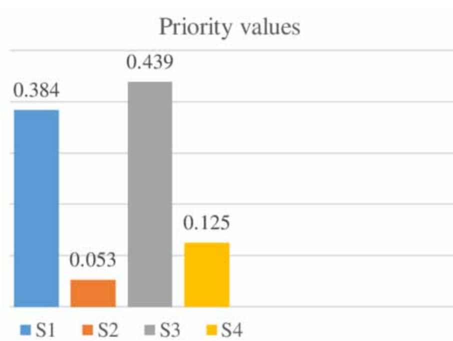
Table 13. Final priority values of the suppliers for each criteria

Suppliers	Price (0,257)	Quality (0,313)	Delivery (0,216)	Innovativeness (0,052)	Reliability (0,162	Final priority values
S1	0,12497	0,11053	0,0707	0,019743915	0,057603	0,384
S2	0,02083	0	0,01537	0,004368037	0,0124661	0,053
S3	0,11077	0,1478	0,07878	0,028080235	0,0732381	0,439
S4	0	0,05483	0,05127	0	0,0186685	0,125

Figure 4. Ranking of the suppliers



Calculation of Consistency Ratio (CR)

To calculate the consistency rate, five criteria were compared according to the scale developed by Saaty (1990) and shown in Table 2. The normalization process was performed after the binary comparison matrix was created. As a result of the normalization process, the priority values of the criteria were calculated as 0,243 for the price criteria, 0,432 for the quality criteria, 0,164 for the delivery criteria, 0,054 for the innovation criteria and 0,108 for the reliability criteria. λm_{ax} is calculated as follows using the priority values.

$\lambda m_{ax=}$ (5.613+ 5.440+ 5.326+ 5.352+ 5.085) = (26.817)/5 = 5.363

After calculation of $\lambda m_{ax,}$ Consistency Index (C*I)* was calculated as follows using equation (13).

$$CI = \frac{5.363 - 5}{5 - 1} = 0.091$$

Consistency Ratio (*CR*) was calculated as follows using the Random Consistency Index (*RI*) value in Table 2 and equation (14).

$$CR = \frac{0.091}{1.11} = 0.082$$

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If the Consistency Ratio *(CR)* is less than 0,10, it means that the results obtained are within acceptable limits. As can be seen from Tables 7, 8, 9, 10 and 11 the matrices were considered consistent because the consistency rates were less than 0,10.

FUTURE RESEARCH DIRECTIONS

Managers and purchasing specialists of the firm will able to organize their supplier relationships based on their results. In the future, researchers who are working on this subject can carry out studies using different criteria or different MCDM methods.

CONCLUSION

Companies need to manage many processes such as purchasing, production and marketing very well to be able to compete in global competition conditions and to ensure their continuity. When evaluated from this perspective, the importance of supply chain management becomes apparent. Evaluation of suppliers is very important for the good supply chain management. In this study, the FAHP method was used for supplier selection in a furniture production firm. In light of the information obtained from the literature review and the opinions of the purchasing department experts, four suppliers were evaluated according to the criteria of price, quality, delivery, innovativeness and reliability.

In the study, the suppliers were evaluated using Chang's (1996) extended analysis method and fuzzy numbers. In the study, criteria weights were determined by making the pairwise comparison of the criteria. As a result of the study, the criteria with the highest weight is the quality criteria with 0.332 and the criteria with the lowest weight is the innovativeness criteria with 0.052. Then, the priority values of suppliers were calculated by pairwise comparsion of suppliers for each criteria. Supplier ranking is made by multiplying the criteria weights and the priority values of the suppliers. As a result of the study, supplier number 3 was determined as the best supplier.

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KEY TERMS AND DEFINITIONS

Globalization: Globalization can be expressed as the concentration of the world. It can involve various political, economic, and socio-cultural changes.

Multi-Criteria Decision Making (MCDM): When it comes to evaluating multiple criteria together in a decision problem, such decision making problems are examined under the name of multi-criteria decision making problem. Multi-criteria decision-making methods are widely used in supplier selection.

Supplier Selection: It is defined as the selection of raw materials, equipment, and services from where and what amount in a service or product producing firm.

Supply Chain Management: It is defined as an integrated system that enables planning and management of the service and information flow as a whole during the production, logistics and marketing processes in a firm.

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Chapter 13
Applications of Radio Frequency Identification Technology and Security Issues in Supply Chain Management

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ABSTRACT

Supply chain management (SCM) systems provide the ability of information sharing and interpretation of contextual information to businesses and help their day-to-day operations. This chapter presents an introduction to radio frequency identification (RFID) technology and its applications in SCM. The chapter also describes the technical basics of RFID systems and examines several industry-specific applications of this technology to SCM to provide crucial implementation reviews. Next, the chapter emphasizes many inherent vulnerabilities of this pervasive computing technology in the context of security and privacy. This chapter presents a classification mechanism for risks that RFID networks come across by describing a categorization of RFID attacks, describing their main characteristics, and discussing possible countermeasures. The chapter aims to classify the existing weakness of RFID communication so that an appropriate understanding of RFID attacks can be realised, and subsequently, more effective procedures can be deployed to combat these attacks.

INTRODUCTION

The world is witnessing the tremendous influence of wireless communication technology on the working practice of global supply chain industries. Modern wireless telecommunication is heavily influenced by three world famous scientists. They are James Clerk Maxwell (Mahon, 2004), Jagadish Chandra Bose (Sarkar et al., 2006), and Tim Berners-Lee (Berners-Lee, 2000). James Clerk Maxwell provided the theoretical foundation of electromagnetic wave propagation; Jagadish Chandra Bose showed to his

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colleagues the transmission of millimeter waves by transmitting this new type of waves in Presidency College (Calcutta, India) laboratory, and Tim Berners-Lee created the World Wide Web at CERN (Geneva, Switzerland). Their inspirational research works are harnessing the ways of emerging type of data communication infrastructure for the global supply chain industries.

Radio Frequency Identification (RFID) technology and its networks are an emerging type of network that is poised to play an important role in this new wave of wireless communication. This represents an advancement in information and communication technology (ICT) and innovation connecting objects and devices through data communication networks (e.g. Internet, Intranet, Electronic Product Code – global EPC network). The network of objects (e.g. devices, vehicles, machines, containers), embedded with sensors and software has the potential to collect and communicate data over a computer network. RFID technologies thus facilitate "objects" to be identified, located, sensed, and controlled via the industry-specific global platforms. It is viewed as a progression of ICT (e.g. computers, enterprise resource planning – ERP software systems, bar code technology, intelligent data analytics, electronic mail, fax, and phone) applications that are helpful to capture and share data in a network of organizations on a real-time basis. This "*digital infrastructure*" of objects tracking via the computer networks generate added capabilities to its business operation. In this way, RFID systems technological capabilities may differ from previous ICT capabilities due to their ubiquity, intelligence, and autonomy.

Legacy-based conventional ICT software systems help to monitor supply chain functions such as purchasing, transportation, storage, distribution, sales and returns. With many other smart devices recently joined the list under the newly formed intelligent RFID solution umbrella of technologies, the potential to address the information capture and exchange in real-time has multiplied. Although the advances in RFID technology-based applications in the form of the sensor is expected to revolutionize retail sector (Kahlert, Constantinides, & de Varies, 2017), its acceptance and potential to integrate supply chain processes is largely under development both for theoretical and practical implications.

Although there have been several studies that have investigated the ICT-enabled supply chain process integration in improving the performance (Li et al., 2009) (Qrunfleh & Tarafdar, 2014) (Rai, Patnayakuni, & Seth, 2006) (Vanpoucke et al., 2017), few review works are presented to empirically assess the effect of emerging RFID technology adoption on supply chain integration (Pal, 2019a). Supply chain integration includes both inter- and intra-organizational integration across the entire supply chain through a collaborative mechanism (Alfalla-Luque, Medina-Lopez & Dey, 2013), that can generate greater customer value by offering superior services (Christopher & Towill, 2011). In a scenario of network-based competition, the strength of a supply chain is determined by how effective the flow of goods and services is, information exchange, and funds flow (Rai et al., 2006). RFID technology is perceived to strengthen the supply chain integration by connecting the objects through the Internet (Pin, Liu, Zhou, & Wang, 2011) (Tu, 2018). Adoption and use of RFID technology help organization building its capability. From an organizational capability theory perspective, RFID technology is likely to enhance the capability to integrate the suppliers, customers, and inter-organizational logistics processes.

RFID technology bridges the gap between the physical and digital world by synchronizing the information flow with the physical flow for greater supply chain integration (Ping et al., 2011). RFID capability is defined as additional capabilities gained by supply chains with everyday objects being embedded with technology that provides identifying, sensing, networking and processing capabilities to communicate with other devices and services over the Internet (Whitmore, Agarwal, & Da Xu, 2014).

Given that retail supply chains are primarily demand-driven, intense digital connectivity and coordination within the supply chain via the adoption of new technology can be considered as an intervention in

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service improvement (Fleisch & Tellkamp, 2005). The emerging RFID paradigm, therefore, may play a significant role in the retail industry to manage supply networks in response to customer demands (Yu, Subramanian, Ning, & Edwards, 2015). Moreover, the supply chain literature on RFID application is broadly rhetoric, technology and architecture focused and quite nascent (Mishra et al., 2016). Due to enthusiasm on technological adoption in data transparency and visibility to achieve supply chain process integration, the research on RFID within the context is timely (Ben-Daya, Hassini, & Bahroun, 2017) (Dubey et al., 2017) (Mishra et al., 2016) (Tu, 2018).

The use of RFID based technologies opens new opportunities in different operational activities of apparel manufacturing supply chain networks. With the evolution of new generation embedded computing hardware and related data communication network facility, the integration of these two technologies creates wide-scale autonomous information processing systems for manufacturing network. Also, RFID based information system encompasses hardware devices such as application-specific sensors as well as passive, semi-passive (or semi-active), and active RFID tags, and other electronic equipment which are connected over a data communication computer network. Together, these technologies can help different types of business activities, including functions such as sensing activity, movement, or temperature; actuating and collecting; processing, storing, and sharing business process-related data. For instance, the textile and apparel manufacturing activities are particularly sensitive to process environmental conditions (e.g., light, humidity, and temperature) during raw material transformation phase, transportation, and storage phase. In the precision-based industrial engineering for apparel and textile production process, time-temperature measurements with sensor devices connected to a wireless sensor network (WSN) can help to maintain the quality and safety of textile manufacturing activities and reduce the risk of spoilage. WANs in this context represents an interconnected data communication infrastructure of connected sensors that communicate to a base station using mobile networks and facilitates nearly real-time specific business information to the global manufacturing business partners. Upon receiving specific manufacturing process information, the operation managers can take an appropriate decision (e.g., acceptance or rejection) regarding intermediate or final product.

RFID based technology applications have gained huge interest from the textile and clothing industry, business practitioners, and academics in recent decades. Compared with other automatic identification technology, RFID technology has lots of merits, for example – it does not require the direct contact and line-of-sight, it can work effectively under extremely bad condition, tags can be used repeatedly and the information stored in them is much larger and can be reported easily, and tags can be recognized by the readers at the same time. On the one hand, just because of its merits, RFID applications are used in many areas of the apparel business. On the other hand, with the extensive application of RFID, a few issues are becoming increasingly apparent, which make people feel very uneasy. Among these issues, security and privacy problems are very prominent. There are many topics on RFID security such as forward security, backward security, denial of service (DoS) attack, eavesdropping attack, and so on. This chapter provides an overview of the well-known privacy and security threats in RFID-based information systems.

The remainder of this chapter consists of six sections. Section 2 presents the background information of RFID-based technology. Section 3 explains the relevance of RFID standards, which consists of an international standard organization (ISO) standards and EPC-based standards. Section 4 outlines the security and privacy-related issues in RFID-based apparel business. It also describes the physical layer of security issues. Sections 5 explains the research challenges in RFID applications security. Section 6 concludes with concluding remarks.

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SUPPLY CHAIN AND APPLICATIONs OF RFID TECHNOLOGY

Supply chains are an important part of every economy and every business (Pal, 2018). Supply Chain Management (SCM) aims at improving the allocation, management, and control of logistical resources. With its origins in manufacturing, SCM relies on business operations for achieving competitive advantage. This first signs of SCM were perceptible in Toyota Motor Manufacturing's Just-In-Time (JIT) procurement system (Pal, 2017). Particularly, JIT was used to control suppliers to the factory just in the right quantities, to the right location, and at the right time, to optimize system-wide costs and customer affordability. The main goal was to reduce inventory level drastically and to regulate the suppliers' interaction with the production line more effectively. It consisted of two distinct flows through the supply chain organizations: material and information. The scope of the supply chain begins with the source of supply and ends at the point of consumption. It extends much further than simply a concern with the physical movement of material. Equal emphasis is given to supplier management, purchasing, material management, manufacturing management, facility planning, customer service, information flow, transport, and physical distribution.

The sequence begins with raw materials purchase from selective suppliers and products are made at one or more manufacturing plants (Pal, 2019). Then these products are moved to intermediate collection points (e.g., warehouse, distribution centers) to store temporarily to move to next stage of supply chain and ultimately deliver the products to intermediate-users or retailers or customers (Pal, 2017) (Pal, 2019). The path from supplier to the customer can include several intermediaries – such as wholesalers, warehouse, and retailers, depending on the products and markets. Also, global supply chains becoming increasingly heterogeneous and complicated due to a growing need for inter-organizational and intra-organizational connectedness, which is enabled by advances in modern technologies and tightly coupled business processes. Hence, information has been an important strategic asset in retail business operational management. The business networks are also using the information systems to monitor the supply chain activities ((Pal & Ul-Haque, 2020).

Such systems should result in the seamless integration of retail business applications and exchange of information between applications within and across enterprise boundaries. The extraordinary growth of information and communication technologies (ICT) driven by technology companies, computer hardware and software systems has empowered all aspects of computing applications across retail enterprises. At the same time, the business environment is becoming more and more complex with functional units needing increasingly inter-functional data flow for decision-making, timely and efficient procurement of manufacturing parts, management of inventory, corporate accounting, human resources, and distribution of goods and services. In this circumstance, the retail business management team requires effective information systems to enhance competitiveness by cost reduction and improved logistics. It is universally recognized by large and small-to-medium-size retail enterprises (SME) that the ability to provide the right information at the right time brings huge rewards to retail supply chain management practices.

A retail manufacturing supply chain creates a complex business network. Given process decentralization, the efficient performance of an apparel supply chain requires a high degree of visibility – defined as the capability of sharing on time and accurate data throughout the entire supply chain, and coordination among supply chain partners. Radio Frequency Identification (RFID) tags, sensor technology, and relevant data communication networking provision form an effective means to access business processes operational information. Apparel supply chain operational managers can perform their analysis on nearly real-time information and can take appropriate strategic decisions. The RFID tag is often being used

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in automated information systems across apparel manufacturing supply chains with readers that are distributed across factories, warehouses, and retail outlets. In this way, RFID-based technology is used heavily in apparel manufacturing, inventory management, warehousing, and transportation of products from one operational facility to the others, automatic object tracking and supply chain management. For example, the finished apparel products, numerous design pieces and relevant supporting materials can be traced, and the progress of the garment making activities can be monitored. In processing and weaving, the fabric lots can be traced very comfortable with RFID enabled information systems. In spinning mills, the bales of cotton and the yarns can be traced easily. The mixing of different yarn lots that is a major problem in spinning mills can be avoided.

RFID technology consists of small inexpensive computational devices with wireless communication capabilities. A simple RFID system consists of three main components: a reader, several tags, and a backend database. The reader and the tags communicate with a radio frequency link, while the reader is connected to the backend database through a secure wired link. The data transmitted by the tag may provide identification or location information or specifics about the product tagged, such as price, colour, date of purchase, and so on.

In this way, RFID technology is posing itself as the next wave of evolution of computing power. Essentially, it is a technology that connects objects to the Internet or databases, so they can be tracked, and companies can share data about them. The concept is simple: place a transponder – a microchip with an antenna – on an item and then use a reader – a device with one or more antennas – to read data from the microchip using radio waves. The reader passes the information to different computer systems so that the data can be used to create business value.

The RFID technology can help improve data accuracy by tracking products through supply chains and by identifying products and items/objects at specific points through Automatic Identification (Auto-ID). The technology enables the detection and identification of tagged objects through the data it transmits. With RFID it is possible to read a tag through the packing or the product itself. The tag can be read independently of the orientation of the tag – it is not necessary to place the tag on a specific side as it is with the barcode label. Furthermore, a significant difference is the amount of labour required – with barcodes a person is required to scan each barcode manually, but RFID scanning is done by readers and does not require labour.

RFID is these days usually associated with the retailing and manufacturing industries, and it must also be admitted that these industries are driving development presently taking into account that major retailers – Walmart, TESCO, Metro, and so on – all have set up a huge strategy for their RFID technology deployment in the supply chain on pallets and cases. However, several industries have applications running and some have had that for a longer period. Some of the leading industries today in adopting RFID technology are retail and food industry, Pharmaceutical industry, Healthcare industry, and Garments / Apparel industry. All these industries are using RFID technology to manage their business activities.

Managing business activities involve numerous decisions for day-to-day work and these decisions rely heavily on operational information, effective logistics, availability of funds, and their coordination. Once all these constituent elements for business decision making processes put together in the context daily operations for effective control and monitoring purpose, which is generally known as supply chain management (SCM) system that helps the management team. In this way, SCM is a mechanism in connecting and smoothing business activities effectively and forming various types of business relationships (e.g. supplier relationship management (SRM), customer relationship management (CRM)) among other supply chain stakeholders. The main objective of these relationships is to enhance productivity by reduc-

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ing total inventory level and cycle time for orders. It is also important for supply chain business-partners to create a network that is agile and able to respond rapidly to unpredictable changes in demand.

BACKGROUND OF RFID-BASED TECHNOLOGY

RFID technology has its roots in radar, invented in 1935 by Sir Robert Alexander Watson-Watt to detect approaching aircraft, and it has been used extensively since the Second World War. Since the invention of RFID, the technology has been used to identify aircraft, collect a bridge-toll payment, deter theft, and track livestock, among many other applications. RFID systems identify tags to readers in an open environment, requiring neither visual nor physical contact for communication. Due to the low production costs and very small size of the tags, RFID system deployment is steadily increasing, thereby replacing traditional identification methods such as bar codes. This is particularly true in apparel supply chains where RFID tags permit a much more cost-effective and time-efficient tracing and management of a product than bar codes.

Later, the British army introduced a more sophisticated system called Identify Friend or Foe (IFF). Closer to current RFID systems, each plane was equipped with a transponder that modulated back the radar signal, thereby allowing identification of that aircraft as friendly. Due to its simplicity and resiliency, this technology is still being used by the aviation industry to keep airplanes tracked. However, a not friendly aircraft should be treated with care since there is no proof of it being an enemy. In this way, as advances in radio frequency communications systems and low-cost embedded computers continued through the 1950s, 1960s, and 1970s, several technologies related to radio waves were developed (e.g. the Electronic Article Surveillance application (ESA) designed to prevent shoplifting from retail stores). Nevertheless, the first patent for a passive, read-write RFID tag, was received by Mario Cardullo in 1973. This is considered the first true ancestor of modern RFID as it was a passive radio transponder with memory. Since then, RFID systems hardly seem recognizable. Modern RFID tags may be similar in size to a grain of rice; may have computational capabilities, Read-Only Memory (ROM), Electrically Erasable Programmable Read-Only Memory (EEPROM); may be active in the sense of using batteries rather than RFID readers' power, and so on.

Consequently, over the years, the number of solutions based on RFID has considerably grown. RFID systems are nowadays more related to business than with the military industry. In the 1980s and 1990s, RFID applications emerged in transport, access control, tracking inventory material in the manufacturing industry.

RFID Systems

An RFID system is supposed to identify and track objects by using radio waves. Like other identification systems such as barcodes, fingerprints or eyes' iris, the reader (RFID reader) reads from some source of identification data (RFID tag). Then, the identification data are usually processed by a data processing subsystem or server. However, RFID systems outstand from other identification systems because they may be nearly as cheap as barcode systems, use a wireless channel like GPS or GSM, and have some computational capabilities like magnetic cards. That is why more and more attention has been paid to this technology in recent years. In technical terms, an RFID system consists of three key elements:

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- The RFID tag, or *transponder*, that contains information and identification data.
- The RFID reader, or *transceiver*, that queries transponders for information stored on them. This information can range from a static identification number to user or sensory data.
- The *data processing subsystem* or *server*, which processes the data obtained from readers.

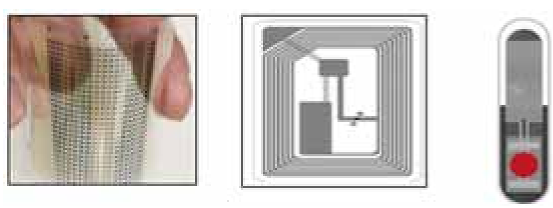
Intuitively, all objects to be identified shall be physically tagged with RFID tags. Then, RFID readers should be strategically distributed to interrogate tags where their data are required. Other properties, namely readers' interrogation field size, computation capabilities, and memory size of tags, vary from application to application.

RFID Tags

Typical *transponders* (*transmitters/responders*) or RFID tags, as shown in Figure 2 and Figure 3, consist of integrated circuits connected to an antenna. The memory element serves as writable and non-writable data storage, which can range between a few bytes up to several kilobytes. Tags can be designed to be read-only, write-once, read-many, or fully rewritable. Therefore, tag programming can take place at the manufacturing level or the application level. A tag can obtain power from the signal received from the reader, or it can have its internal source of power. The way tags get their power generally defines their category:

- **Passive tags** use power provided by the reader using electromagnetic waves. The lack of onboard power supply means that the device can be quite small and cheap.
- **Semi-passive tags** use a battery to run the microchip's circuitry but communicate by harvesting power from the reader signal.
- **Active tags** have their internal power source, usually, a battery, which is used to power the outgoing signal.

Figure 1. Pictures of some types of RFID tags



RFID tags may also be classified according to their processing power. A *dumb* tag has no significant processing power, while smart tags have onboard processors able to perform cryptographic operations. Dumb tags are considered the heart of RFID systems. Manufacturers and retailers claim that reducing tags' cost is indispensable for the success of RFID systems. Smart tags are used in those applications requiring some level of security and privacy, namely for inventory control, access control, transportation management in the manufacturing network.

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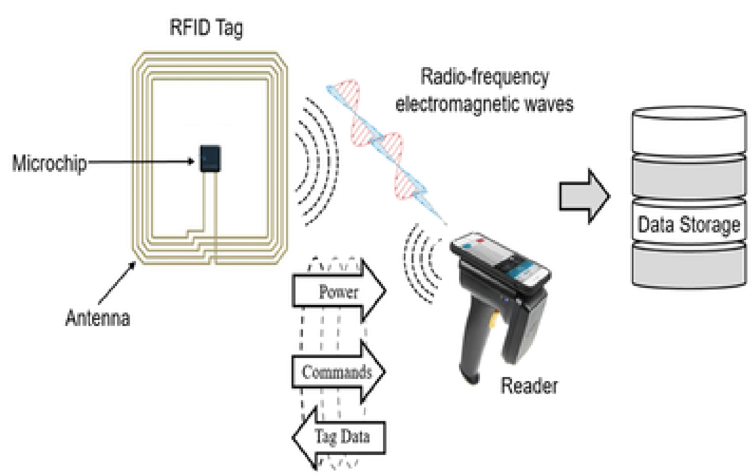
Table 1. RFID frequency bands and characteristics

Frequency Band	Operating Range	Applications
125 kHz to 134 kHz (LF)	≈ 0.5 Meter	Access control
13.56 MHz (HF)	≈ 1 Meter	Smart cards
860 MHz to 930 MHz (UHF)	≈ 3 Meters	Logistic and Parking access
2.4 GHz (Microwave)	≈ 10 Meters	Electronic gate control and Package tracking

RFID Readers

Typical *transceivers* or RFID readers, as shown in Figure 4, consist of a radio frequency module, a control unit, and a coupling element to interrogate RFID tags via radio frequency communication. Readers may issue two types of challenges: *multicast* and *unicast*. Multicast challenges are addressed to all tags in the range of reader whereas unicast challenges are addressed to specific tags. To keep readers as simple as possible, they have, in general, an interface that allows them to forward the received data to a *data processing subsystem*, *backend database* or *server*. By doing so, readers delegate most of the computational effort to other computationally more powerful devices.

Figure 2. A basic RFID tag and its interrogator



Data Processing Subsystem

The *data processing subsystem* or *server* is used to overcome the computational limitations of tags and readers. On the one hand, tags may not be able to store in their memory all the information required by readers. Thus, this information is usually stored in indexed databases. On the other hand, aimed at reducing the cost of RFID readers, cryptographic functions or processing data algorithms should rely on a data processing subsystem or server. A simple RFID-based data processing system solution consists of six main components as shown in Figure 5. These components are:

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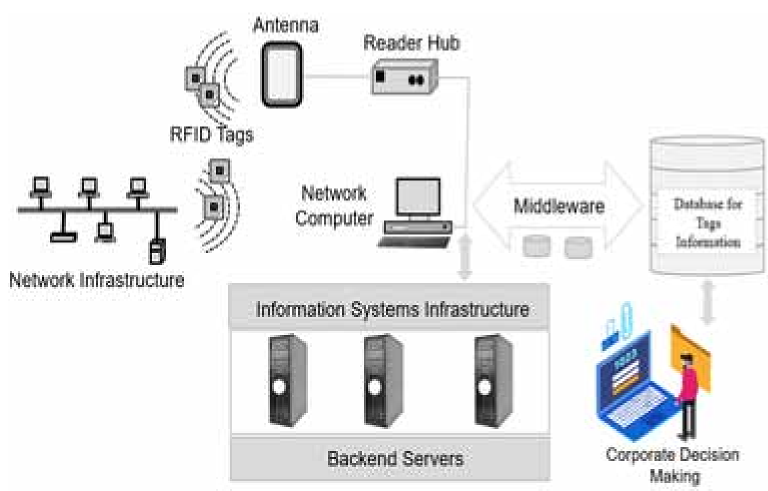
1. **Tag**: A tag is the data (or information) carrier part of RFID-based business solution. Generally, it contains a unique identification number, and specific *electronic product code* (EPC) programmed into the tag.
2. **Reader and Antenna**: A reader captures the data provided by the tag when tags come in the range of sensing area covered by the specific reader using its antenna (i.e. an electronic *signal receiving special circuit*).
3. **Middleware**: The middleware can be software as well as hardware dedicated to processing data captured by the *tag reader*, then dispatch this information to backend servers.
4. **Backend Servers**: The backend servers hold the data collected from RFID-based application systems for processing purpose.
5. **Network Infrastructure**: This part of RFID-based solution infrastructure is providing data communication provision. It plays a very important role in RFID-based system solutions security and privacy-related issues.
6. **Database for Tags Information**: This is the part of the enterprise information system.

In this way the enterprise information databases to store identification information. RFID readers are used to querying RFID tags (that can take a variety of embodiments), retrieve their information, and forward it to the backend through a wireless or wired channel, which is particularly important in RFID systems.

Figure 3. A basic RFID-based technology solution architecture



RFID STANDARDS

Industrial RFID applications are governed by standards. These define the minimum requirements of some technology to achieve interoperability, which is particularly important in RFID manufacturing applications. To illustrate the need for interoperability in the RFID technology it is important to understand the problem of manufacturing supply chains. It is worth to say that a manufacturing supply chain

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management begins in a mine or a farm and it ends on a recycling or garbage plant. In between, the initial material is modified or processed from stage to stage, it may change hands from one owner to another. In a globalized world, such material or item, presumably attached to an RFID tag, could travel around the world more than most people in their whole life (e.g. from manufacturers to warehouses, from warehouses to point of sale, from point of sale to retailers, from retailers to customers, from customers to customers or second-hand retailers). This means that RFID tags should be correctly read by everyone and everywhere, in the present and the future, and without any restricted access or implementation, i.e. RFID systems should be interoperable.

Table 3. RFID standards relevant to supply chain management

Specification	Description	Frequency	Sponsor
ePC HF Class I	EPC tag class	13.56 MHz	EPC Global
ePC HF Class II	EPC tag class	860-960 MHz	EPC Global
ePC HF Class IV	EPC tag class	860-960 MHz	EPC Global
ISO 14443/15693	Near Field	13.56 MHz	ISO
ISO 18000-3	RFID Air Interface	13.56 MHz	ISO
ISO 18000-4	RFID Air Interface	2.4 GHz	ISO
ISO 18000-6	RFID Air Interface	860-960 MHz	ISO

On the other hand, the International Organization for Standardization (ISO) has also created standards for RFID. Initially, there was some conflict between EPCglobal and ISO especially, due to the air interface protocol. At EPCglobal, the ISO UHF protocol was thought to be too complex and costly. That is why they developed their UHF protocol. Finally, in 2004, EPCglobal developed a second-generation protocol aimed at creating a single, global standard that would be closer to the ISO standards and lastly accepted by ISO. Undoubtedly, this new generation has been the cornerstone of a massive deployment and global adoption of the RFID technology.

Item management RFID tags play an important role in manufacturing and transport management systems in the supply chain. ISO 18000 defines the air interface, collision detection mechanism and the communication protocol for item tags in different frequency bands.

There are several existing ISO standards and proposed RFID standards (EPC – Electronic Product Code, Global) that deal with air interface protocol (how tag and readers communicate), data content (how data is organized and formatted), conformance (ways to test that products meet specifications) and applications (how standards are used on shipping labels, and so on). Table 3 shows a summary of RFID standards relevant for SCM applications. Each of these standards provides appropriate security and privacy-related implementation frameworks. The following section provides a general overview of RFID-based applications in the apparel supply chain management.

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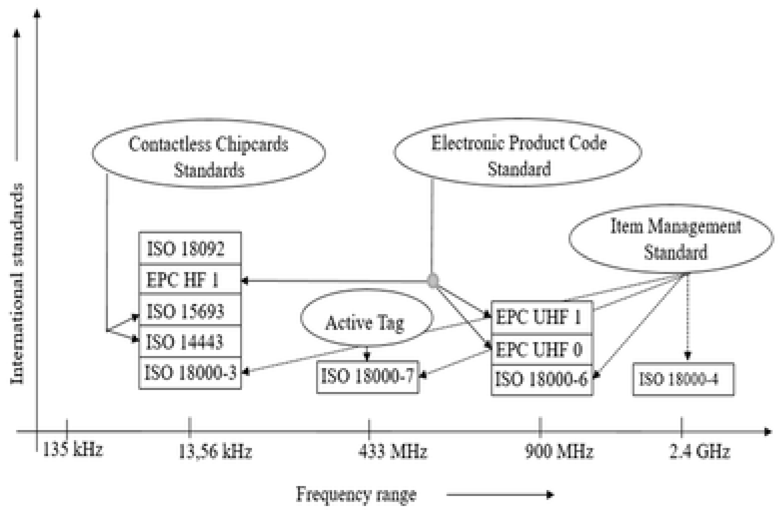
Figure 4. RFID technology standards and frequency bands



RFID APPLICATIONS IN RETAIL SUPPLY CHAIN

RFID technology seems to have an increasing potential in different business process automation applications that can make apparel manufacturing more efficient and more beneficial. For example, RFID technology allows the simultaneous identification of multiple RFID tags. The identification process is performed over a wireless channel without requiring line-of-sight alignment or physical contact between the RFID tag and the RFID reader. These features together with others like low deployment costs, being flexible and manageable are causing the RFID technology to be preferred to traditional options (e.g. barcode systems). Indeed, nowadays several RFID systems are massively deployed worldwide, namely for textile and clothing industries. For example, companies such as Zara, and Li & Fun have based their corporate strategy around achieving supply chain superiority over competitors (Capacino & Anderson, 2003). These global apparel companies have gained competitive advantages by effectively managing the complex web of supply chain process interactions that extend across continents and enterprises in product procurement, manufacturing, and distribution.

During the lifecycle of apparel product, as it flows in the value chain (from the production to consumption as shown in Figure 1) the data generated in every step can be documented as a transaction creating, and thus, a permanent history of the product. Among others, RFID-based technology can effectively contribute to (i) recording every single asset (from products to containers) as it flows through the manufacturing supply chain nodes, (ii) tracking orders, receipts, invoice, payment, and any other official document, and (iii) track digital assets (such as warranties, certification, copyright documents, licenses, serial numbers, barcodes) in a unified way and parallels with physical assets, and others. Moreover, the RFID-based technology can contribute effectively, through its distributed applications communication, in sharing information and the production process, delivery, and maintenance operations between suppliers and vendors, bringing new modality of collaboration in the global apparel business.

For example, an interesting application of RFID in the apparel retail business is the use of smart shelves and item-level tagging. Smart shelves are retail shelves that have RFID readers built in. The main purpose of smart shelves is to prevent out-of-stock situations from occurring at the shelf. An out

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of stock situation occurs at the shelf if a customer wants to buy a certain product, but the shelf is empty. Studies by Accenture and IBM consulting companies (Alexander et al, 2002) (Kambil & Brooks, 2002) suggest that in approximately thirty percentages of cases where the shelf is out of stock, there is actually product available in the backroom stocking location, but it just has not been put on the shelf yet. A timely alert to store personnel from a smart shelf could potentially prevent this out of a stock situation from occurring and thus prevent a sale from being lost.

Shelf replenishment from the backroom can be initiated by a notification from the shelf to the store personnel. Also, there could be RFID reader gates at the checkout lanes, between the inbound loading dock and the store backroom, as well as between the store backroom and the sales floor. By using these RFID gates, it is possible to keep track of all RFID-tagged merchandise within the apparel retail store. Apart from the inventory control and efficiency aspects of this RFID implementation, the advantages of RFID technology can be used in transportation and apparel warehousing operations.

RFID in Warehousing and Transportation

The benefits of RFID in logistics, transportation, and warehousing can be broadly categorized into (i) labour and timesaving, and (ii) benefits from increased visibility. The first benefits category has also been described using the notion of "the uninterrupted supply chain" (Supply Chain Digest, 2005). This is the idea that too large a percentage of a product's traversal time through a supply chain or a logistics system is spent waiting for the identification or the completion of some manual process such as counting cases related to identification and documentation activities. Hence, the flow of goods is interrupted by stopping points. A system that uses automated identification through RFID can potentially remove many of these stopping points, enabling the product to move through the system faster and at less cost. These purely operational cost savings will tend to be especially large if the product in the supply chain is specialized, i.e., a product where each case need to be identified instead of bulk identification per pallet. Serialized products include apparel dresses, clothing cutting equipment, and sewing machines, and so on. These are serialized products because, for example, each dress may have a different specification. This is different from dealing with a generic, non-customizable product such as garment washing-up liquids for example.

Another area where RFID can be a useful tool is in improving inventory accuracy. Inventory accuracy refers to the difference between logical and physical inventory. Logical inventory is the amount of inventory on record in the computerized information systems (e.g. warehouse management system, enterprise resource planning system); and physical inventory is what is really in stock. Ideally, the logical and physical inventory quantities are equal, but for a variety of reasons (shrinkage, input errors, loss of goods, misplaced items, and so on) these quantities may be quite different. Typically, logical inventory shown in computer systems is larger than physical inventory. RFID can help improve the logical inventory records due to automation of the scanning process.

While these relatively simple efficiency and accuracy improvements may be large enough to justify an RFID implementation, the lion's share of benefits is typically expected to be realized from increased visibility. Exact knowledge of the amount of inventory at each location in the supply chain in real-time is going to enable supply chain decision-makers to run a much more efficient supply chain. Knowing what is in the replenishment pipeline, and when it is expected to arrive, potentially allows safety stocks to be reduced while maintaining or increasing customer service levels.

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Besides, new and more flexible inventory control policies can be devised that make use of the added visibility. A group of researchers (Gaukler et al., 2005), for example, describe the timing of replenishment orders in the resupply channel to make decisions on placing additional orders from a different supplier if the existing orders are held-up for some reason.

RFID in Apparel Manufacturing

The apparel manufacturing industry generally operates in three major phases, i.e., producing raw materials, processing materials, and making garments. Phase one includes natural fiber production from animals or plants and man-made fiber production from the chemical industry. Phase two encompasses spinning, fabric production, dyeing, finishing, and printing procedures). Phase two provides the ready to use materials for phase 3, where the materials are cut, sewed, and further transformed into ready-made clothes.

Assembly and making of configurable products are apparel supply chain activities that offer much potential for the use of RFID technology. RFID tags can be used in a manufacturing setting to identify the product that is being assembled, as well as the constituent parts that are to be used into the final product. At the time of assembly, it is then possible to do an instant check to ascertain what parts need to be used in the product and whether the parts that are used are the correct parts. Thus, RFID technology has a role in assuring the quality of the end-product. This benefit is particularly valuable if the product is highly customizable. The benefit from an introduction of RFID in this scenario is two-fold: on the one hand, there are the labor-saving from automating the scanning/identification of main-components and other-parts, and on the other hand, there are the savings in rework cost due to fewer assembly errors.

RFID in Asset Tracking and Locating Objects

RFID technology can be used to prevent misplaced of items or to facilitate locating items. One way this can be done is to keep track of item movements in a database. For example, RFID readers can be installed at doors between rooms in a building. Evaluating the records of the RFID readers would then allow one to deduce in which room the item is located. It is worthwhile to note that this is typically not a good theft prevention method because RFID readers can easily be inhibited by placing the item in a metal-lined bag for instance. However, this system can work well in an environment where one is more concerned about the accidental misplacement of an item than about theft.

Another way of locating items is to use mobile hand-held RFID readers and RFID tags as a homing device. A variant of this method is to use information stored on RFID tags on a container to find out the contents of that container. In this way, RFID and supporting technologies have drastically increased inventory visibility both on the ground and in transit.

The RFID systems are rapidly emerging as one of the powerful technologies for the development of large-scale distributed applications for data acquisition in the supply chain network's business activities. The most important advantages of this technology are included its low cost and its broad applicability. However, the business applications of this technology have got many vulnerabilities. The following sections deal with some of the security and privacy-related issues in RFID systems.

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SECURITY AND PRIVACY ISSUES IN RFID-BASED APPAREL BUSINESS

The rapid proliferation of RFID solutions strongly supports the vision of ubiquitous computing, in which tags interacting with readers throughout day-to-day operations in retail supply chain network improve dynamic data-experiences for operational managers and provides effective customer experience. Consequently, in most applications, readers must be able to identify one or several tags among a set of the huge number of tags attached to the important objects. This scenario characterizes an important property that an RFID identification protocol should meet the issue of scalability of deployment.

As for most identification systems, being secure and private are two mandatory properties of RFID systems. These two properties are even more relevant in the RFID system context due to the insecure and easily accessible communication channel between tags and readers. In this way, security means that data stored in a tag's memory should be accessed only by authorized parties and that impersonating or counterfeiting a tag may be achieved just with a negligible probability. On the other hand, privacy-preservation may be defined as the ability of tags to generate uncorrelated identification messages.

Security

RFID systems are subject to plenty of attacks, from attacks operating on the physical layer to attacks exploiting weaknesses on those protocols executed at the application layer. Physical attacks may be as simple as wrapping an RFID tag in aluminum foil, which potentially causes the denial of services (DoS) because readers will be not able to communicate with such tag. Other physical attacks are more sophisticated (e.g. jamming attacks that permanently damage radio devices or side-channel attacks that obtain information from the physical implementation of cryptosystems). However, this chapter focuses on adversaries aimed at breaking the identification/authentication schemes by using the theoretical weakness of such algorithms. To do so, one can assume that the adversary can observe, block, modify, and inject messages in the communication between a tag and a reader. Furthermore, as tags are not tamper-resistant, one can assume an adversary able to clone and tamper with an RFID tag.

The most relevant attack to RFID systems is the so-called spoofing or impersonation attack. In this attack, an adversary can clone a tag without physically replicating it. By doing so, the adversary gains the privileges of such a tag, which is considered an important security threat for almost every RFID application. The worst situation occurs when the adversary can break the cryptosystem used during the authentication process (*total break*), i.e. the adversary gain knowledge of the authentication protocols and the secrets. In other cases, the adversary does not even need to spend too much time breaking the cryptographic protocol. Instead, the adversary could impersonate a tag by replaying and/or manipulating some tag's responses recorded from past transactions (*forgery*). Although these attacks have been successfully thwarted by a lightweight and symmetric key cryptography suitable for low-cost RFID tags, there still exist open issues when privacy and scalability must be also considered.

Privacy

There exist two main privacy concerns in RFID systems: information leakage and traceability. Information leakage is potentially dangerous because tags may reveal sensitive information about products (e.g. the name of drugs or the price of expensive products). Such data may be used for quick, easy, and low-cost profiling of individuals, or even for industrial espionage. The basic idea to prevent information leakage

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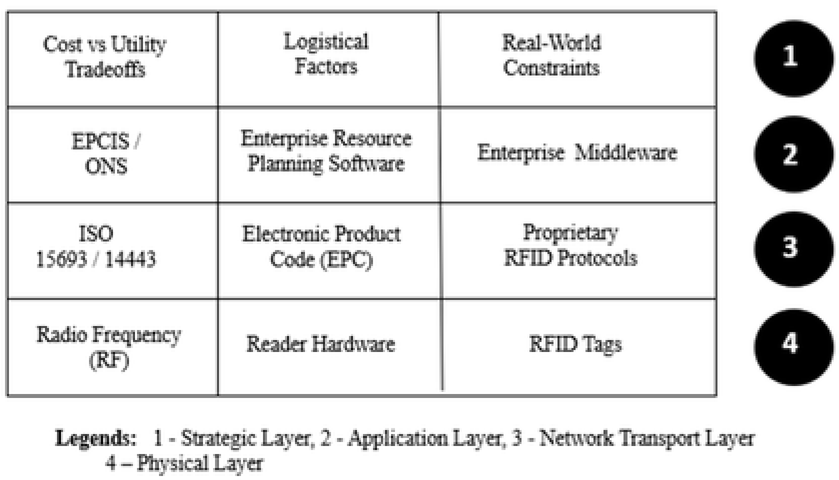
in RFID systems is to move all the tags' data to one or several servers. By doing so, only authorized parties may retrieve those data when required. However, this may not prevent traceability. For instance, a tag sending its unique identifier does not reveal trivial information about to object to which is attached, but it is traceable. To thwart traceability, readers and tags should exchange fresh information at each identification to make the response of two different tags *indistinguishable*.

The challenge is that indistinguishability is an application-dependent concept where the abilities of adversaries, tag's owners, physical constraints, must be considered to provide a fair privacy provision for RFID systems.

Physical Layer Security Issues in RFID Applications

In the RFID-based information system, security, and privacy play an important role. This section presents a classification of RFID security attacks based on a layered architecture, as shown in Figure 6.

Figure 5. A layered architecture for RFID-based application security issues



This layered architecture consists of four distinct layers: (i) physical layer, (ii) network and transport layer, (iii) application layer, and (iv) strategic layer. The physical layer includes the actual hardware parts that include an RFID tag, antennas, and readers. This layer provides the capability in monitoring physical layer components and supports the International Organization for Standardization (ISO) standard. The network and transport layer deals with the implementation of RFID application-specific protocols (e.g. ISO 15693/14443/1800 standards, the EPC Gen 2, etc.). The RFID application layer consists of enterprise information system applications (e.g. inventory management database, logistics traffic management database, other applications databases). The strategic layer deals with real-world business constraints related issues and decision factors for business sustainability. One can create a separate category of multilayer attacks, which use vulnerability from multiple layers. The detailed classification is shown in Table 2.

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Table 2. RFID security problems in different layers

Physical Layer	Network and Transport Layer	Application Layer	Strategic Layer
Permanently Disabling Tags and Readers 1. Tag and Reader Removal 2. Tag and Reader Destruction 3. Disablement command abuse	Tag Attacks 1. Cloning 2. Spoofing	Unauthorized Tag Reading	Competitive Espionage
Temporarily Disabling Physical Layer Hardware 1. Passive Interface 2. Active Jamming	Reader Attacks 1. Impression 2. Eavesdropping	Tag Modification	Social Engineering
Relay Attacks	Network Protocol Attacks	Application Middleware Attacks 1. Buffer Overflows 2. Malicious Code Injection	Privacy Threats
			Target Security Threats
Multilayer Attacks			
1. Covert Channels, 2. Denial of Service Attacks, 3. Traffic Analysis, 4. Crypto Attacks, 5. Side-Channel Attacks, and 6. Replay Attacks			

Physical Layer Security

Recently there has been significant interest in RFID-based supply chain applications security and signal processing to secure physical layer systems. Although the academic community has addressed many issues in understanding how the physical layer protect confidentiality and authentication; however, it is crucial to realize that different technical aspects need to be addressed if physical layer security is ever to be adopted by real-world apparel supply chain security systems. The physical layer in RFID-based apparel business communications is consists of a physical interface and the hardware. The adversary in this layer takes benefit of the wireless RFID communication channels, their physical security, and their inappropriate protection against physical manipulation. This layer deals with attacks by the adversaries, which temporarily or permanently disable RFID devices (tags and readers) as well as relay attacks. The physical security of these devices is usually not very efficient. Therefore, the devices in this layer are vulnerable to tampering and other physical attacks. In simple, there are three types of physical layer attacks: permanently disabling tags and readers, temporarily disabling tags and readers, and relay attacks.

Permanently Disabling Tags and Readers

Permanently disabling tags and readers may be caused to become permanently inoperable using removal or destruction. RFID tags and readers may also become irreversibly disabled if specific disablement commands are abused. Permanently disabling RFID hardware leads to permanent inoperability of tagged items and therefore to huge loss in an apparel manufacturing supply chain or a textile and clothing retail shop, depending on the scale to which this attack is accomplished. Possible ways of causing edge hardware (e.g. tag, reader) permanently inoperable are tag and reader removal, tag and reader destruction or using disablement command abuse (e.g. KILL command).

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Tag and Reader Removal

Since RFID tags that are not embedded or strongly attached to objects can easily be removed from an object and may subsequently attach to another one (just like *switching* price tags). A simple example of RFID tag change could be the unlawful intention of a thief in a clothing retail outlet to switch the tag of an expensive item with that of a cheaper one and pay less at point of sales. RFID tag removal is a serious threat, which can be easily performed without the requirement of specific technical skills. However, this kind of threat cannot be performed on a massive scale.

Tag and Reader Destruction

Based on the same concept of poor physical security, a tag may be physically destroyed intentionally even if there is no gain for the attacker. An RFID vandal who is just interested in annoying people or disrupting operation may easily destroy RFID tags with poor physical protection. Unattended RFID tags run the risk of being vandalized by malicious attackers through chemical exposure, application of increased pressure or even abrasion caused by rough handling. Moreover, active RFID tags can be made inoperable by removing or discharging their batteries. Also, RFID tags may be made deliberately inoperable by abusing privacy enforcing electro-mechanical devices (e.g. RFID Zapper). The operation of these devices is based on the generation of a high-power radiofrequency field, which induces huge current to burn out the RFID tag's internal component. RFID readers may undergo the same type of threats. Also, RFID readers often store important security signatures (i.e. encryption keys) and these credentials may become subject to physical destruction, particularly if they are not appropriately supervised or protected. An affected or unlawfully removed RFID reader may disrupt the RFID communication and create a problem for the RFID-based enterprise information system's availability.

Disablement Command Abuse

There are RFID tags with security features, which permanently disable or lock them. The Auto-ID centre and EPC global have created a command specification known as KILL, which can permanently make an RFID tag silent. In this process, individual RFID tag has a unique password which is described by the manufacturer of the tag and its use can render an RFID tag permanently inoperable. However, this characteristic can be used for privacy purposes in textile clothing retail outlets and it can be used by malicious adversaries to sabotage RFID-based information system's wireless communications. Many RFID standards use LOCK command to stop unauthorized writing to tags. In practice, a predefined password is utilized for authentication purpose; and locking itself can be temporary or permanent (e.g. "*permalink*" in EPC tags) basis. In textile and clothing retail business, often multiple RFID tags share a common password (i.e. all garments in the same retail outlet). This helps retail outlet password management. However, these features can be used for privacy-protection purposes, but it can also be abused to make RFID tags inoperable forever and creates the problem in RFID-based systems.

Temporarily Disabling Physical Layer Hardware

RFID-based information processing systems one of the main problems relates to RFID application layer hardware temporary disability by external environmental conditions (i.e. tags covered with water or ice),

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exhaustion of protocol resources or possible desynchronization attacks. For example, a shoplifter can use a bag equipped with the temporary disabling environment (i.e. an aluminum foiled bag that creates a simple Faraday Case) to block it from electromagnetic waves from the retail outlet security barrier readers and steal products that fit within the bag. RFID tags also run the risk of unintentional temporary disablement caused by environmental conditions (e.g. tags covered with ice or water). Moreover, temporarily disabling tags can also be a result of radio waves interference either passive or active.

Passive Interference

Interference is a key issue in RFID-based information systems in apparel supply chain networks. Precise characterization of the performance of a link/node under interference is important for the competent operation of many RFID-based system protocols such as congestion control, rate allocation, link/channel scheduling, and QoS-aware routing. RFID-based system networks are being increasingly used for data-intensive applications, such as understanding and mitigating interference among low-power RFID systems becomes an important issue. For example, considering the fact the RFID-based system networks operate in an inherently unstable and noisy environment their communication is created susceptible to possible interference and collisions from any source of radio interference (e.g. noisy electronic generators and power switching supplies). This interference prevents precise and competent communication between tags and readers.

Active Jamming

Active jamming of radio frequency signals is a physical means of shielding tags from RFID readers communication. The attacker could carry a device that actively broadcasts radio signals to block and/or disrupt the operation of any nearby RFID readers. Thus, an attacker may cause electromagnetic jamming by creating a signal in the same range as the reader to disrupt tags from communicating with readers.

Relay Attacks

In this type of attack, a harmful agent acts as a man-in-the-middle. A harmful device is secretly placed between a legitimate RFID tag and a reader to intercept (and possibly modify) the business communications between tag and reader. Tag and reader are baffled into thinking that they are communicating directly with each other. A large distance between a tag and a reader can be maintained by using two devices: one for the communication with the reader (the "*ghost*") and one for communication with the RFID tag (the "*leech*"). It is worth to note that these devices may operate at larger ranges than the *nominal read*, especially the "ghost" as it does not practically rely on power from the reader. In this way, a temporary connection is relayed from the legitimate tag/reader through the adversarial device to the legitimate reader/tag. To make this type of attack even more advanced, separate devices could be used, one for the communication with the reader and one for the communication with the RFID tag.

Relay attacks can be discriminated in two main types referred to as "*mafia fraud*" and "*terrorist fraud*". The concept of "*mafia fraud*" was first reported by a researcher (Desmedt, 2006) and it involves the existence of an illegitimate party that relays information between the legitimate two parties. The "*terrorist fraud*" is an extension of the "*mafia fraud*" and needs the cooperation of the legitimate tag

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with the relaying illegitimate third party to convince the reader that the dishonest but legitimate tag is close. The dishonest and legitimate tag does not share any secrets with the relaying illegitimate party.

Besides, technically it is proved that relay attacks may be successful even from a considerable distance. A master-degree student reported that the vulnerability of the Dutch public transport by performing a relay attack on the Dutch transit ticket operation activity (Tanenbaum, 2008). The student just implemented the “ghost and leech” model as described by a group of researchers (Kfir & Wool, 2005) and created great concerns for the $2 billion Dutch public transport system.

Defenses Against Physical Layer Attacks

In general, there are many ways of attacking RFID systems. There are also many ways of defending against the attacks. Defense mechanisms can either be implemented into the system or their utilization can be left to the user. Thus, one may talk about system-side countermeasures, that is, countermeasures implemented into the system, and user-side countermeasures, that is, security measures utilized by the user to protect him from threats not countered by the systems themselves. In this way, to protect RFID application systems against low-tech attacks such as permanently or temporarily disabling tags, traditional safeguarding mechanisms should be used, such as increased physical security with guards, appropriate protective fences or gates, locked doors, and cameras.

Any increase in reading distance greatly decreases the efforts necessary to successfully carry out a relay attack. Thus, the increases in reading distances proved possible by a group of researchers (Kirschenbaum & Wool, 2006) imply that relay attacks are much easier to perform than one might presume with the generally assumed a short distance (i.e. 10 cm) maximum reading distance.

Many RFID systems in use today have a low level of on-tag security measures. Users of such systems wanting to protect themselves from the unwanted reading of their tags may try physically shielding the tags. In general, physical shielding of tags is an extremely effective way of preventing both unauthorized readings of tags and tracking. This may add additional costs to a system, but the reward is greatly increasing the difficulty of performing tracking, one of the most feared threats to an RFID application.

Network and Transport Layer Security

All the attacks in this layer are based on the way the RFID applications communicate with each other and the way the information (or data) are exchanged between the related applications of an RFID network and items of interest (e.g. tags, readers). Broadly, these attacks can take place on the tags, reader attacks, and network operating protocol attacks. In this category, different types of attacks are as follows:

Cloning: In these attacks, the attacker clones or imitates the tags after skimming the tag’s information. Each RFID tag used for identification has a unique ID number. If the ID information is exposed by the attacker, the tag can easily be copied. Now that a lot of programmable read-write tags are put into use, cloning a tag is not challenging. This new tag can then act as the ordinary tag without being detected. Such cloned tags are used in counterfeiting and spoofing system-level attack.

Spoofing: Spoofing can be considered as a special type of tag cloning. The main difference is that spoofing does not need the physical replication of a tag. Also, spoofing attacks are not limited to tags since the identity of RFID readers can also be spoofed. To carry out this attack needs specialized machinery, which permits the replication of RFID tags or readers based on some data content. The attacker needs complete access to legitimate communication channels as well as knowledge of the protocols and

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secrets used in the authentication process if there is any. The main aim of the attacker is to replicate legitimate tags or readers illegally and elicit sensitive information and get unauthorized access to important business services.

Impersonation: In this type of attacks, attackers may easily counterfeit the identity of a legitimate reader or tag to elicit sensitive information or modify data on RFID tags. Through this attack, an adversary may gain access to restricted areas, sensitive information, and credentials.

Eavesdropping: The wireless nature of RFID makes eavesdropping one of the most serious and widely deployment threats in supply chain management applications. In eavesdropping an unauthorized individual uses an antenna to record communications between legitimate RFID tags and readers. This type of attack can be performed in both directions tag-to-reader and reader-to-tag. In simple, the communication between the reader and transponder via the air interface is monitored by intercepting and decoding the radio signals. The feasibility of this attack depends on many factors, such as the distance of the attacker from the legitimate RFID supply chain applications. This is one of the most important threats to RFID systems.

Exhaustion of Protocol Resources: RFID based applications are often connected with back-end databases and data communication networking devices on the enterprise backbone. Besides, these devices are susceptible to the same vulnerabilities of general-purpose networking devices. Flaws in the operating system and network protocols used can be used by malicious attackers to launch attacks and make the backend infrastructure compromise.

Also, some protocols permit a tag to only be read number of times or allow a certain number of unsuccessful reads before rendering it inactive (Ohkubo et al., 2004). Some protocols use counters or timestamps with a maximum value. When this value is reached, the tags become unreadable. Other protocols protect a tag from tracking, but only for a limited number of readers. An example is hash-chain protocols, which use hash-chains (pseudonyms) of fixed length stored on a tag. When these tags run out of pseudonyms, they once more become vulnerable to tracking attacks. The OSK (Ohkubo-Suzuki-Kinoshita) protocol (Ohkubo et al., 2003) is an example of a hash-chain protocol. Depleting the battery power of active tags and shortening their lifespan is another example of such attacks. Targeted attacks can cause tags to be "exhausted" and fail. In certain situations, this problem is recoverable, in many it is not. In either case, it may have a financial impact due to interrupted operations and the related financial burden with system recovery (Han et al., 2006).

Desynchronization Attack: Some protocol relies on a form of synchronization between tags and reader/server. This can be in the form of counters (number of reads), timestamps, or updated pseudonyms and keys. When the update does not take place on both sides, desynchronization can occur through adversarial reads or update prevention (e.g. protocol interruption). Unless the protocol is designed to handle this or recover from it, the server will no longer be able to read or recognize the tag. Even in protocols which allow a limited amount of desynchronization, attacks, or repeated errors (reads by other systems) can lead to desynchronization (Radomirovic & van Deursen, 2008).

Defenses Against Network-Transport Layer Attacks

It is possible to detect cloned RFID tags by using appropriate data collection technique. In another way, cloning attacks can be resolved by using appropriate authentication protocols. A researcher (Jules, 2005) has shown some mechanisms for advancing the resistance of EPC tags against cloning attacks, using PIN-based access to achieve challenge-response authentication. Spoofing and impersonation could be

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combated by using authentication protocols or the second form of authentication such as one-time password, PINs, or biometrics. Network protocol attacks could be countered by selecting appropriate way the components that support RFID communication, using secure operating systems, disabling insecure and unused network protocols, and configuring the protocols used with the least possible privileges.

Application Layer Security

This includes the group of security attacks that target information related to applications and the connecting between users and RFID tags. These attacks use unauthorized tag reading, modification of tag data, and attacks in the application middleware. Some of the application layer attacks are as follows:

Unauthorized Tag Reading: In this category of attack, RFID tags can be read without authorization and without any indication that they were read. Both eavesdropping and unauthorized tag reading are widely deployed attacks with considerable negative effects for the victim. These attacks, when performing for competitive espionage purpose may reveal secrets and sensitive information such as new market entry or new product launching strategies or availability of inventory items for strategic product manufacturing.

Tag Modification: RFID tags are in widespread use today employ user writeable memory, an attacker can exploit this to modify or delete valuable information.

Malicious Code Injection: RFID tags can be used to propagate hostile code that subsequently could infect other entities of the RFID network (reader and connecting networks). An attacker can use the RFID tags memory space of RFID tags to store and propagate the infecting viruses. However, in this category of attacks are not widespread in use. For example, in the middleware applications (where multiple scripting languages such as JavaScript, XML) an attacker may exploit this and inject malicious code to compromise the middleware systems.

Defenses Against Application Layer Attacks

Different approaches are proposed (e.g. metallic lined, encryption techniques, authentication protocols or access control) in different research projects (Fedhofer et al., 2004) (Kinoshita et al., 2003) (Molnar & Wagner, 2004). However, an important limitation on employing these schemes in RFID systems is that the latter have inherent vulnerabilities such as possible power interruptions or the disruption of wireless channels. Other simple measures include isolating the RFID middleware server so that in case it is compromised, access to the rest of the network will not be provided, checking the input data of the RFID middleware and eliminating special and suspicious characters.

Strategic Layer Security

Strategic layer security attacks target business organization and business applications, taking advantage of the careless design of infrastructures and applications. More specifically in this layer are included competitive espionage, social engineering, privacy, and targeted security threats. Some of the strategic layer security attacks are:

Competitive Espionage: This type of security problem is very common in real-world SCM operations. Business competition is the motivation of this espionage. In this way, adversaries may often have a business or industrial competition as a target. Using the capability to track and detect tagged items of interest, the businesses may collect crucial and confidential information to sabotage their competitors.

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Such information may include strategies of the target relating to changing prices, manufacturing plans and schedule, and market entry strategies. Such exploitation attacks to target companies can be accomplished by using eavesdropping, or by gaining unauthorized access to back-end databases.

Social Engineering: An adversary may even use social engineering skills to compromise an RFID based corporate information systems and get unauthorized access to secure corporate information. In social engineering, an attacker tries to manipulate people by friendship or other means (e.g. getting RFID badge of a genuine staff) to get entry to secure information storage.

Target Security Threats: An attacker can use the information collected by an association to struck malicious attacks or physical attacks. A typical example of this attack is targeting and robbing people who collect valuable goods (e.g. costly electronic item or jewelry) trucks or ships that carry valuable or costly items.

Defenses Against Strategic Layer Attacks

Strategic layer attacks can be defended by using preventative measures employed against attacks included in the other layers. Different technical solutions have been advocated, including killing or temporarily silencing tags, blocking access to unauthorized readers (Juels et al., 2003) (Rieback et al., 2005) relabeling (Inoue & Yasuura, 2003), and using encryption techniques (Fedhofer et al., 2004).

Multilayer Attacks

Many of the attacks, which target RFID communication are not confined to just a single layer. In this category encompasses attacks that affect multiple layers including the physical, the network-transport, the application, and the strategic layer. This layer includes covert channels attack, denial of service attack, traffic analysis attack, crypto and side-channel attacks. Some of these attacks are described below.

Covert Channels: In this attack, the attackers may exploit RFID tags to create unauthorized communication channels to transfer information covertly. Adversaries may take advantage of the unused memory storage of multiple RFID tags to securely transfer data in a manner that is difficult to detect.

Denial of Service Attacks: In this attack, deliberately blocked access, and subsequent denial of service for RFID tags may be caused by malicious users.

Side-Channel Attacks: In this type of attacks the information that is usually exploited includes timing information, power consumption or even electromagnetic fields. The efficient deployment of side-channel attacks requires deep knowledge of the internal system on which cryptographic algorithms are used.

Crypto Attacks: Sensitive data stored on RFID tags are usually protected by employing encryption techniques. However, a determined adversary could mount crypto attacks to break the used cryptographic algorithms and disclose or manipulate data. Targets of attack include password authentication schemes, cyphers, pseudo-random number generators, and hash functions.

RESEARCH CHALLENGES IN RFID SECURITY

There are many challenges associated with the deployment of RFID systems (e.g. false or missing reads due to radio wave corruption, scalability, security and privacy, antenna design, deployment cost, among others). However, other challenges may not seem so obvious. The introduction of a new order

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of things might create a maelstrom of uncertainty. For many industries, RFID deployment is changing their business process, forcing new investments on personal training, infrastructure, testing, and so on. Therefore, companies are requiring to carefully evaluate the economic viability of what may represent a big initial investment of money.

On the other hand, although an RFID system provides plenty of data essential to control and understand business processes, applications like supply chain management or real-time tracking may generate such a huge volume of information that could not be handled by traditional transactional databases. Therefore, software architectures and back-end databases should be rethought for the collection, correlation, filtering, and cleansing of RFID data.

Almost every object is likely to be attached to an RFID tag. Therefore, a huge number of tags will need to be managed efficiently and in a scalable way. On the other hand, due to the wireless nature and the computational constraints of RFID tags, guaranteeing the security of tags' data and the privacy of tags' bearers is a challenging task. The privacy threats grow if application designing team consider all personal data surrounding the huge amount of information collected from tags. If such data are not properly treated, sensitive information might be disclosed without the awareness of RFID's users. This means that the need for efficient and scalable privacy-preserving methods for microdata and trajectories increases with the massive deployment of RFID solutions.

Even though research on RFID security and privacy protection has advanced in recent years, but it is not still adequate. For practical deployment of RFID on a wide scale, many issues need to be resolved. Also, there are almost no works done for security in chip-less RFID. The followings are some of the research challenges in RFID security as noted by a group of researchers (Duc et al., 2009):

Cryptography plays the core role in security protocol as described above. There are very strong and well-proven cryptographic techniques for wired networks, and in recent times, cryptographic algorithms for wireless networks have been significantly improved. However, RFID tags have very limited processing power and therefore, for practical deployment, one need cryptographic algorithms that are lightweight and fast, but at the same time possess strong cryptographic properties. The lack of the study on lightweight cryptographic primitives includes the design of new primitives, analysis of the security of new primitives and their efficient implementation (Duc et al., 2009). Though few lightweight cryptographic algorithms are proposed in the literature, much research needs to be done to evaluate them through cryptanalysis and investigate new algorithms for strong protection. As new types of attacks are reported, research needs to focus to counter those attacks. Another important aspect that plays vital roles in cryptography is the regeneration of pseudorandom number so that its generation can be predicted.

CONCLUSION

The use of RFID technology has grown across a variety of core business processes in the supply chain industry. Although each application has its specific requirements, security vulnerability will be always a major concern when deploying RFID applications. Like the Internet or mobile telephony, RFID is a wireless network technology. While the non-contact and non-line-of-sight properties of RFID systems increase the convenience and efficiency of their applications, these properties also increase the system's vulnerability. This chapter presents a structure within the universe of possible security attacks that can affect RFID-based supply chain business.

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This chapter classifies RFID information system attacks based on the layer that each is taking place. Particularly, the chapter differentiated these attacks deployed in the physical layer, the application layer, the strategic layer, and multilayer attacks. It also points out the descriptions of some physical layer's attacks.

Moreover, risk varies according to the type of technology used to perform a specific function. RFID is an umbrella concept for a variety of technologies with distinctive characteristics. The risks mentioned above are theoretically applicable to all RFID systems. However, on a continuum of risks, the likeliness of certain risks is higher in some technical configurations than in others. Parameters such as the use of passive or active tags, of electromagnetic induction or radio-wave communications, of reading only or read-write capable memory influence the degree of likeliness that certain risks materialize.

A well-designed RFID policy can reduce the risk of attacks. When dealing with security and risk management, policy decisions also play a significant role in the security of an RFID system. An RFID security policy is a document that states how an organization plans to protect its physical RFID devices and information data assets. Since, eventually, new threats will appear, an RFID security policy should be considered a "living" document that needs to be continuously updated as the RFID technology and implementation requirements change. The policy also needs to consider how the users will be trained in the proper use of RFID and explain how security measures will be carried out and enforced.

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KEY TERMS AND DEFINITIONS

Active Tag: A tag with its battery that can initiate communications.

Auto-ID: Automatic Identification (Auto-ID) systems automatically identify physical objects through optical, electromagnetic, or chemical means.

EAS: Electronic Article Surveillance. A radiofrequency device that announces its presence but contains no unique identifying data. EAS tags are frequently attached to books or compact discs.

EPC: Electronic Product Code. A low-cost RFID tag designed for consumer products as a replacement for the UPC (Universal Product Code).

HF: High Frequency; 13.56 MHz.

LF: Low Frequency; 120-140 kHz.

Passive Tag: A tag with no on-board power source that harvests its energy from a reader-provided RF signal.

Reader: An RFID transceiver, providing real and possible write access to RFID tags.

RF: Radio frequency.

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RFID: Radio frequency identification. Describes a broad spectrum of devices and technologies and is used to refer both to individual tags and overall systems.

Skimming: An attack where an adversary wirelessly reads data from an RFID tag that enables forgery or cloning.

Supply Chain Management: A supply chain consists of a network of *key business processes* and facilities, involving end-users and suppliers that provide products, services, and information. In this chain management, improving the efficiency of the overall chain is an influential factor; and it needs at least four important strategic issues to be considered: supply chain network design, capacity planning, risk assessment and management, and performances monitoring and measurement. The coordination of these huge business processes and their performance improvement are the main objectives of a supply chain management system.

Tag: An RFID transponder, typically consisting of an RF coupling element and a microchip that carries identifying data. Tag functionality may range from simple identification to being able to form ad hoc networks.

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Chapter 14
Critical Success Factors for Effective Backhauling in Distribution Channels of British Supermarkets

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ABSTRACT

An effective backhaul in distribution may help organizations reduce their costs and increase operational efficiency. Effective backhauling can also help companies in their societal marketing facilities by reducing carbon emissions. The purpose of this study is to identify and rank critical success factors in effective backhauling. Analytical hierarchical process method is conducted on managers working in the distribution of supermarket retail chains in the UK. A total of six factors are identified based on the literature review and qualitative interviews with managers. According to overall results, the most important critical success factor is found to be effective delivery planning followed by effective communication with suppliers and demand forecasting. However, different groups in the sample have different rankings. According to third party logistics managers, the most important critical success factor is collaborative logistics.

INTRODUCTION

Distribution plays a central role in delivering the customer value (Kotler & Armstrong, 2012). In recent years, reverse logistics has also started to gain attention by firms especially considering its effectiveness to enhance sustainability of industrial marketing (Lee & Lam, 2012). However, particularly backhauling is currently one of the most underutilised areas of logistics, with organisations potentially missing out on crucial benefits due to inefficiency and ineffectiveness on this type of reverse logistics (Carlsson &

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Rönnqvist, 2007). Effective backhauling can be simply defined as exploiting the return movement of transport back to its the point of departure by carrying merchandise cargo, once the vehicle has completed its goal at its set destination (Marques et al., 2020). Successful backhaul is achieved by both minimising empty backhaul trips and non-profitable backhaul journeys (Demirel et al., 2010).

The use of backhauling presents a valuable opportunity to reduce unloaded traveling distance, which is one of the largest contributors to an organisation's logistical costs (Carlsson & Rönnqvist, 2007). The reduction of unloaded traveling distance is achieved through the optimisation of backhaul and has the potential to reduce costs for an organisation by up to 5.2% (Audy et al., 2012). Backhaul is also a significant opportunity for an organisation to reduce the amount of CO2 emissions (Pradenas et al., 2013). Backhauling can also be considered as an enhancer of societal marketing (Kotler & Armstrong, 2012) as it reduces the organizations' carbon footprint, which is an area consumers are becoming more concerned due to environmental issues. Apart from the expectations of consumers, governing bodies are also enforcing companies to further reduce their emissions (Li et al., 2019).

The literature indicates several factors by which empty backhaul can be minimized. In earlier years, Pederson et al. (1979) investigated determinants of backhauling exempt agricultural commodities and included average length of haul, regulatory class of the carrier, whether the trucks are leased or not, empty mileage, the region of delivery, size of the firm, and the time in the business as possible determinants. More recent studies involve contemporary possible solutions to backhaul problems. One of the ways to accomplish this is collaborative logistics. Trucking companies or shippers can collaborate and reduce empty backhaul (Bailey et al., 2011). Ferrell et al. (2020) indicate that horizontal collaboration can help gaining efficiency of firms through reducing empty backhaul. Delivery planning is also considered as the key for achieving effective backhaul (Palander et al., 2004). Using third part or fourth party logistics companies is studied as a possible solution to effective backhauling (Martin et al., 2011).

There exists proven advantages of backhauling such as cost minimization, reducing traffic congestion, and reducing greenhouse gas emissions. However, despite the existence of some studies discussing how to achieve effective backhaul, more studies need to be conducted to shed light on the critical success factors for effective backhaul. Particularly, there is a research gap in revealing which of those critical success factors are more effective for a successful backhaul implementation. Accordingly, this paper aims to identify and rank critical success factors for effective backhaul implementation. Conducting research about critical success factors of successful backhaul has the potential to give organisations a solid starting point, when looking into making backhaul operations more efficient.

LITERATURE REVIEW ON THE EMPTY BACKHAUL PROBLEM AND SOLUTIONS

Empty Backhaul Problem

Backhaul problem refers to the imbalance between the amount of goods that are traveling in two different directions (Ishikawa & Tarui, 2018). It is a well-known issue that has even been referred to as far back as 1954 by Paul Samuelson (1954), which occurs in both freight and passenger transport (Demirel et al., 2010). Empty backhaul problem occurs because of the imbalance in freight going in two different directions, which leads to an increase in cost and a decrease in customer satisfaction, for any organisation that has a backhaul problem (Li et al., 2019). The fact that vehicles need to travel empty without

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any cargo back from their delivery locations increases the unloaded traveling distance and the unloaded empty returns result in increased costs (Carlsson & Rönnqvist, 2007). This in turn may usually lead to the organisation needing to increase prices, because transport costs include the return to the carrier's original location.

The demand for transport is direction specific in most of the times (Demirel et al., 2010). This is one of the main reasons why it is challenging to implement successful backhaul. A good example of the backhaul problem in public transport is explored by Rietveld & Roson (2002) who discuss the imbalance in number of passengers that occur on trains going in and out of New York during morning 'rush hour'. As there is a significantly greater amount of demand for the train service going into New York at rush hours, compared to heading out. With the trains going into New York usually operating at full capacity, whilst the ones leaving New York being practically empty in comparison (Rietveld & Roson, 2002). In cargo transportation, the imbalances may occur due to several reasons such as a region being export oriented with lower level of imports or retail chain distributions that deliver products to stores and return empty to distribution centres.

For the average logistics company there is generally considered to be seven different cost factors, distance and time, type of product, economies of scale and energy, empty backhauls, infrastructures and modes, competition regulation, and subsidies, and finally surcharges taxes and tolls (Rodrigue et al., 2016). Juan et al. (2014) also indicated that firms can significantly minimize their distribution costs by effective backhauling through collaboration. The fact that empty backhauls is considered to be one of the seven cost items shows the importance of effective backhaul as a way to potentially decrease costs for an organisation. This is as since the majority of transport scenarios involve empty backhauls due to the backhaul problem, this is also the case for international trade where this imbalances between trade in this case imports and exports has an significant effect on transport costs particularly with container transportation (Rodrigue et al., 2016).

Another key challenge that comes up when researching backhaul is backhaul integration into the vehicle routing problem. The vehicle routing problem is the optimisation of the order in which the vehicles assignments are set. The optimal order depends on what the organisation is looking to achieve, whether that be cost reduction, or decreased environmental impact (Santos et al., 2020). This is a problem for backhaul for many different reasons, particularly working in backhaul's two biggest constraints which are the time constraint for the entire vehicles trip, and the capacity constraint regarding how many spaces are available on the vehicle (Yu & Dong, 2013). Vehicle routing is a challenging task to implement in backhaul, due to the fact that each vehicle utilized has a limitation on how much it is capable to deliver, which hopefully lines up with the requested deliveries, and requested backhaul loads (Yu & Dong, 2013). However, Li et al. (2019) concluded that vehicle routing can lead to greater opportunities to backhaul, as it allows for the collection of backhaul from multiple locations without the vehicle veering off route.

There are two main different types of route plans within the backhaul literature: Single trip with backhaul and multiple trip with backhaul. Single trip with backhaul is where the vehicle is planned to go to one singular location and then collect the backhaul load from nearby and then return to its starting location (Yu & Dong, 2013). Whilst a multiple trip route with backhaul is when the vehicle will perform multiple drops off throughout their journey and potentially have multiple different locations to collect backhaul from as well (Wassan et al., 2017). Single trip with backhaul, is mainly beneficial for the use in situations in which high amounts need to transport to one single location, this is prominent in most of the research in vehicle routing regarding backhaul (Dethloff, 2002). However even though this style is prominent in the literature, it is seen as limited by Wade & Salhi (2002) who suggest that this is limited

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as it does not allow organisations to fully utilise their resources in order to satisfy their customers. Suggesting that moving away from single trip with backhaul vehicle routing in most situations would be most beneficial (Wade & Salhi, 2002).

Whilst another way that backhaul could be improved going forward that appears within the literature is through more research being conducted into the Multiple Trip Vehicle routing problem format model, which is an extension of the classical vehicle routing problem model (Wassan et al, 2017). However, in this model, a vehicle may perform several trips within a given time period. This is as most of the research on the topic such as Yu & Dong (2013), Santos et al. (2019) and Li et al. (2019) which are some of the key literature on the topic, all use a single trip vehicle routing problem model. Which is unrealistic for most logistics companies, as drivers and trucks will do multiple trips, and so potentially multiple backhaul loads during a day. Meaning that the information provided by a Multiple Trip Vehicle routing problem model, would help the industry far more effectively.

Wade & Salhi (2002) investigated the use of what they referred to as a practical vehicle routing problem with backhaul problems, in which after each line haul customer has been serviced, backhauls would not necessarily take place each trip. This would be more realistic to a normal business environment in which backhaul would not be necessary or finally viable for an organisation for each trip that they make (Wade & Salhi, 2002). From this research Wade & Salhi (2002) found that a possible decrease in costs could be achieved through the incorporation of a control on the mix of customers, which would in turn lead to a practical solution to this problem.

Potential Solutions for Minimizing Empty Backhaul

It is suggested that one of the ways to close the gap in imbalances is to adjust shipping capacities and freight rates (Ishikawa & Tarui, 2018). Similar to Ishikawa and Taruni (2018), a solution suggested to attempt to solve the backhaul problem proposed by Rietveld and Roson (2002) is to use tactical price setting, which is the process of coming up with a price for a product or service to a customer in a such a way that it manipulates the level of demand for the product or service (Ingenbleek & van der Lans Ivo, 2013). This could be achieved through increasing the price of the high demand location, and decreasing the price of the low demand location, as this would theoretically decrease demand for the high demand location, and increase demand for the low demand location (Rietveld and Roson, 2002). Considering freight transportation, the tactical price setting seem to work in the container shipping market. For instance, an imbalance exists between North America – Far East route in favour of Far East location. The container lines usually have to carry empty containers back to Far East. To minimize the number of empty container returns, carriers apply lower freight for shipments from North America to Far East. In this way, shippers with lower cargo value per container, such as plastic and paper scrap shippers, exploit lowered freight levels.

Tactical price setting can be evaluated as a potential solution to backhaul problem within the lens of transport provider but it does not help significantly for distribution of retail stores. Moreover, since freight transportation is a derived demand, the demand elasticity of freight transportation is usually low. Accordingly, apart from the price setting tactics, recent studies have identified several methods to cope with the problem of empty backhaul. These solutions include several ones including collaborative logistics (Li et al., 2019), putting more emphasize in backhaul in vehicle routing (Santos et al., 2019), and the greater use of 3rd party logistics in backhaul. All these approaches can lead to effective backhaul in a cost-effective way.

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When looking into the critical success factors of successful backhaul, it is important to look at potential ways for backhaul to improve, especially moving into the future. One way that appears in the literature for backhaul to improve moving forward is implementing collaborative logistics in backhaul (Ferrell et al., 2020; Lin & Ng, 2012; Verdonck et al., 2013). This is as with the highly competitive nature of logistics; firms are being forced to come up with new and innovative ways to improve their efficiency and be able to decrease their costs (Bailey et al., 2011). By using collaborative logistics in different strategies, there appears to be a crucial opportunity for organisations (Bengtsson & Kock, 1999). Bengtsson and Kock (1999) suggest that by moving away from the normal rules of competition, there are many benefits to companies from being able to utilise each other's resources, such as a reduction in costs and a greater ability to meet demand due to the increased availability of resources that would be occur. Bailey et al. (2011) also suggested similar opinions, however the authors discussed in greater depth how it may be difficult to create the collaboration in certain markets, due to the nature of competitors.

Collaborative logistics is when different organisations and potentially competitors work together, sharing resources for them to serve the same customers or customers in similar locations for each other. This is very useful for organisations that are operating at the similar level of the supply chain. As well as those that are performing comparable logistics functions, that would be likely to cooperate horizontally to increase their productivity, which would improve their service level and enhance the organisations overall market position (Verdonck et al., 2013). The companies involved would also have the potential to reduce their operational costs through their shared utilisation of each other's resources and capacities (Lin & Ng, 2012).

It is suggested by Bailey et al. (2011) that through proper integration, that the organisations cooperating could see major cost savings. Their research suggests that the percentage of cost savings by using backhaul routes could be as high as 27%. Which would be very beneficial for any organisation, in such a competitive logistics environment. There are also other advantages identified in the literature, that collaborative logistics provides to backhaul, such as reducing carbon emissions. This is particularly prominent as governing bodies are predicted to crack down on carbon emissions, demanding companies to further reduce their carbon emissions in coming years. The collaborative backhaul model that was developed by Li et al. (2019) is predicted to reduce carbon emissions through a logistics network by between 3–20%. Thus, besides a decrease in operation costs, a significant amount of emission reduction can be achieved by effective backhaul supported by collaborative logistics. This was agreed with by Pradenas et al. (2013) who suggest that a cooperative approach by different transportation companies operating jointly, would result in decreased emissions as well as operating costs.

However, there is a significant disadvantage to collaborative logistics in backhaul for it to run effectively, which is that it requires a high level of information sharing as suggested by (Berger & Bierwirth, 2010). The comparison of collaborative profit under different degrees of information sharing shows that a significant positive relationship exists between the amount of information exchanged, and the attained benefit level of the cooperation. However, this is something that a lot of organisations will likely be against, as they consider sharing of information particularly with a competitor as a huge potential risk, and most organisations usually try to limit the information they share as much as possible (Lin & Ng, 2012). Another large hurdle is that companies will likely use different logistics and category management systems, which are unlikely to be able to communicate with each other, thus, resulting in the initial investment being high to implement collaborative logistics.

One topic that does not appear very often in the research on collaborative logistics is the barrier to entry to form a relationship between competitors and that is the profit allocation between the carriers

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(Dai & Chen, 2012). Dai & Chen (2012) found in their research that even though both companies could benefit through collaborative logistics, profit allocation was the biggest issue when companies came together to discuss collaborative logistics efforts., resulting in some. Overall, most of the literature that refers to the use of collaborative logistics in backhaul, discusses the positive's sides of the use and rarely delves into any negatives, in particularly the struggles in communication and the lack of willingness between companies to collaborate. This part of the collaborative logistics process needs to be further explored before companies can be confident with the implementation of collaborative logistics in their backhaul operations.

Another way that backhaul problem could be solved that is not fully investigated in depth in current research is the use of third party logistics, especially integrated with collaborative logistics. The use of a third party logistics company has a great potential to solve the issue of empty backhauling (Perotti et al., 2012). Collaborating with a 3rd party logistics company can be useful as other organisations in the collaboration and 3rd party logistics companies potentially have demand going in one of those directions used by the collaborating partners. This would allow increased backhaul opportunities to be seized upon, due to having a greater capacity to cope with backhaul demand (Perotti et al., 2012). A study conducted by Martin et al. (2011) also indicate that exploiting from the coordination provided by a fourth party logistics company would help as a catalyst to collaboration between grocery stores to minimize their empty backhauls.

Perotti et al. (2012) suggested that their research revealed that there was still a limited adoption of 3rd party logistics in the organisations they studied, whilst some have moved greater into the use of 3rd party logistics in backhaul to collect and delivery to what was unprofitable routes for the organisation. However a lot of organisations just seem to view the use of 3rd party logistics in backhaul as just a more costly and short term thinking versions of collaborative logistics in backhaul and would rather use 3rd party in the short term in terms of backhaul, but mainly as a short term fix before they can find another solution such as collaborative logistics (Perotti et al., 2012).

Looking at the literature on 3rd party logistics being used for solving the backhaul problem there is quite a clear narrative presented, that being one of even though there are definitely benefits to the use of 3rd party logistics in backhaul to enable more effective backhaul through the utilisation in scenarios where the route was not profitable for the original organisation. There is a consensus that it is more of a short-term solution to problems and the use of collaborative logistics and better vehicle routing is more beneficial for organisations to invest in in the long term.

The right choice of trailer type can also be considered as a way to minimize empty backhauling, which is only mentioned a few studies (Li et al., 2019; Wassan et al., 2017). A box trailer is a trailer in which all sides of the trailer are made out of solid materials that are fixed in place, with the doors at one end of trailer, meaning that goods can only be taken off and put on the trailer at that one point (Chari et al., 2016). Whilst in comparison a curtain sider trailer is similar to the box trailer, however on the 2 longest sides of the trailer instead of being made out of a solid material it is made of fabric, which can be pulled to one side of the trailer hence the name curtain sider. So, allowing goods to be taken off and put onto the trailer from multiple points, after the curtains have been pulled to one side (Chari et al., 2016). Because with box trailers, products can only be loaded and unloaded at the back of the trailer, there is very limited potential for backhaul to be collected anywhere, apart from the final delivery location in the vehicle routing plan. However, if curtain siders were used, it would have greater potential for backhaul, as the curtains can be raised, so stock is able to be taken from anywhere on the vehicle. This is crucial for vehicle routing in backhaul, as it allows for backhaul to be collected at any stop on the vehicle's

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delivery route. Rather than just on the final drop of a trucks route, due to it trapping in other products and providing issues for the customer, by having to move product around. This would probably lead to a decrease in customer satisfaction, and potentially have a negative financial effect on the organisation (Wassan et al., 2017). However, it would require good communication between the backhaul provider, and customers for it to work effectively. It cannot be used though on chill loads, due to having to keep the product at a certain temperature, so box style trailers are used.

Curtain siders also have potential to speed up the whole process of delivery and backhaul due to the fact the loading and unloading vehicles is with the correct infrastructure in place quicker than that of the alternative trailers such as a box trailer. This is important to note as there is no information on who this research was conducted for and combined with the fact that the report was conducted for profit, means this information should be taken with caution. However Wassan et al (2017) did suggest that due to the nature of a curtain sider being accessible at three different sides, that they have the potential for the loading and unloading to be quicker, so leading to less time waiting for delivery and collection points, speeding up the whole delivery and backhaul process.

METHODOLOGY

The purpose of this study is to identify critical success factors of effective backhaul implementation and find out relative importance of those factors in the achievement of an effective backhaul. The study conducts an Analytical Hierarchy Process (AHP) to be able to find out the relative importance of critical success factors. The research focuses on the distribution of leading supermarket chains in the United Kingdom. Total value of UK food and grocery market was approximately 190bn GBP in 2018. Some of the well-known and also largest supermarkets are Tesco, Morrisons, Asda, Sainsbury, Aldi, Lidl, Co-op, Marks and Spencer, Waitrose and Iceland.

The AHP is a multi-criteria decision method that implements a pair-wise comparison based on the judgement of experts to determine priority scales (Saaty, 2008). AHP is defined as "a theory of measurement through pair-wise comparisons and relies on the judgments of experts to derive priority scales" (Saaty, 2008; p: 83). We adopted a 9-point AHP scale in which a score of 1 in the analytic hierarchy process questionnaire would represent that the two different factors being compared have an equal importance to achieving effective backhaul. A score of 3 would represent that the factor is moderately more important to successful backhaul that the other factor, while a score of 5 would represent that the factor is strongly favoured over the other, a score of 7 that the factor is very strongly favoured over the other to be critical for successful backhaul and this is evident in practise, a score of 9 would represent that the factor is favoured to the highest possible level of affirmation over the other factor when it comes to critical success factors of successful backhaul. Finally scores 2,4,6 and 8 should be used in situations when one cannot decide between the score in the system indicated above and a compromise is necessary (Saaty, 2008).

Since AHP is a mathematically rigorous but simple to operate methodology, it is used in a wide variety of industries for its decision-making applications. It is also widely used in logistics and transportation studies including air transportation (Loh et al., 2020), logistics outsourcing (Peng, 2012), cruise port selection (Wang et al., 2014), and green supply chain (Mangla et al., 2015). It is widely used in reverse logistics studies as well (Bouzon et al., 2016; Divahar & Sudhahar, 2012; Jain & Khan, 2016; Zhang & Feng, 2007).

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Regarding which variables to utilize in our study, upon the review of literature in backhaul and reverse logistics, to be able to identify critical success factors, we have interviewed a total of five logistics managers working in supermarket industry in the UK. Based on the literature review and comments provided by industry experts, we have identified a total of six critical success factors. These factors are presented here.

Factor A: Effective communication with suppliers

Factor A was chosen to be in included in this AHP analysis due to the fact that from the authors experience communicating effectively with suppliers was always something that was heavily focused on when working with backhaul, this opinion was also echoed by Yu & Dong (2013) who suggest that the better the communication and relationship that an organisation has with its suppliers, the greater the scope for more profitable deliveries to take place for the organisation. Effective communication, according to interviewees, also plays a catalyst role affecting overall performance of the backhaul operations.

Factor B: Effective demand forecasting

This factor was chosen due to the initial research into the topic of backhaul, Wassan et al. (2017) and Dethloff (2002) both discuss how important the accurately planning future operations is for effective backhaul to take place. This idea was also a very prevalent one in industry from the authors experience. As the highest performing backhaul routes were the one which had a predictable demand allowing the times and locations to remain constant allowing for effective demand forecasting to take place. The interviewees also indicated effective demand forecasting plays a crucial role to minimize empty backhaul.

Factor C: Use of 3rd party logistics in backhaul

Factor C was chosen due to the fact in the author experience it was heavily used for backhauling to operate as effectively as possible. This idea was also further elaborated on by Ishikawa & Tarui (2018) who believe that the use of 3rd party logistics could be the best method for organisations to reduce the impact of the backhaul problem. The interviews also shared similar opinions.

Factor D: Logistics collaboration with other organisations in the industry

This factor was chosen due to the fact in the initial research into the field of backhaul, this area was seen to be one with a lot of recent research into, with articles such as Bailey et al. (2011), Verdonck et al. (2013) and Lin & Ng (2012) all conducting research which demonstrates that collaborative logistics has a high potential to improve the effectiveness of backhaul, so it would be interesting to see if this opinion is held by those who work within backhaul.

Factor E: Right choice of trailers

Factor E was chosen due to Li et al. (2019) and Wassan et al. (2017) suggesting that this is a common issue that limits the potential of backhaul operations and use of the right choice of trailers has the

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potential to improve backhaul. From the authors experience this was always that was an afterthought within the industry. It would be beneficial to know if this opinion is held across all industries.

Factor F: Effective delivery planning

This factor was chosen based on the comments of interviewees, as it was a key factor that lead to successful backhaul, as successful backhaul routes usually had timeslots which worked for both parties involved. Similar opinions in the literature on the topic from, authors Dethloff (2002) and Wade & Salhi (2002) who suggest that effective delivery demand planning is critical for the success of backhaul operations.

We have utilized judgemental sampling to identify our sample. We paid particular attention that the respondents must have at least five years of experience in the grocery distribution. We have included managers from supermarket chains, third party logistics companies serving in distribution of supermarkets, and food suppliers of supermarkets. A total of sixteen respondents were identified but we achieved a total of fifteen valid responses to the AHP questionnaire considering the consistency ratios. The profile of 15 responses are presented in Table 1.

Table 1 Profile of respondents

Company Type	Role within organisation	Years of experience in the sector
Supermarket	Backhaul Logistics Manager	5
Supermarket	Backhaul Planner	9
Supermarket	Transport Planner	6
Supermarket	Transport Planner	12
Supermarket	Transport Area Manager: North	31
Supermarket	Senior Transport Planner	19
3rd Party Logistics	Director of Logistics	28
3rd Party Logistics	Area Manager: North East	14
3rd Party Logistics	Transport Planner	5
3rd Party Logistics	Transport Planner	7
3rd Party Logistics	Logistics Operations Manager	10
Online Retailer	Logistics Planner	6
Soft Drinks Manufacturer	National Supply Planner	20
Soft Drinks Manufacturer	Warehouse Shift Manager	12
Health Food Manufacturer	Associate Director: Planning and Transport	22

RESULTS

Prior to presenting the results of AHP analysis, consistency ratio of the responses will be discussed. Consistency ratio determines the consistency of participant answers and their viability in research.

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Saaty (2008) states that responses with consistency ratios in excess of 0.1 or 10% should not be included because they are considered too random in judgment to be reliable. To find this ratio the consistency index for the participants judgment needs to be divided by the index for a random matrix (Konstantinos, 2011). Consistency ratio of one of responses was 18% and we did not include that answer in our study.

Table 2. AHP Analysis Overall Results

Priority Factors	Weightings	Rank
Effective communication with suppliers and planning	25.24%	2nd
Effective demand forecasting	15.43%	3rd
Use of 3rd party logistics in backhaul	8.24%	5th
Logistics collaboration with other organisations in the industry	11.60%	4th
Right choice of trailers	4.90%	6th
Effective delivery planning	34.59%	1st

The results that were gathered from the AHP research comes in the form of weightings. These weightings represent how important each factor is considered in comparison to each other. As shown in Table 2, the overall results indicate that “effective delivery planning” is found to be the most important factor followed by “effective communication with suppliers” and “effective demand forecasting”. The least important factor, on the other hand, is the “right choice of trailers”. Logistics collaboration is the fourth most important factor and use of 3PL is the fifth important one.

However, the results indicate that the ranking of the critical success factors in backhaul are heterogeneous between different industry groups. For instance, according to 3PL companies in our survey as shown in, collaboration with other organizations for backhaul is the most important criterion if a backhaul is to be successful. Table 3 illustrates the differences between the two major respondents in our AHP survey. The table results clearly indicate that these two industry groups have different opinions on the importance level of factors, except only one criterion (right choice of trailers). The largest gap between these industries exists on the collaborative logistics (5.13% to 31.56%).

Table 3. Comparison of Supermarkets and 3PL Companies

Priority Factors	Supermarkets		3PL Companies	
	Weighting	Rank	Weighting	Rank
Effective communication with suppliers and planning	24.95%	2nd	20.11%	2nd
Effective demand forecasting	18.05%	3rd	9.54%	5th
Use of 3rd party logistics in backhaul	5.82%	4th	16.06%	4th
Logistics collaboration with other organisations in the industry	5.13%	5th	31.56%	1st
Right choice of trailers	3.99%	6th	3.26%	6th
Effective delivery planning	42.06%	1st	19.47%	3rd

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DISCUSSION

From the AHP research conducted it is clear that the most critical success factor to achieve successful backhaul, was effective delivery planning with a weighting of 34.59%. The next highest weighting among the factors which is significantly lower was effective communication with supplier and planning with a weighting of 24.24%. This shows that effective delivery planning was by far the most important factor to achieving successful backhaul. The reason for this could be, that if an organisation is able to achieve effective delivery planning, it allows for other factors that take place during the backhaul process to be run smoother as this factor facilitates other critical success factors as well. For example, if effective supplier planning is taking place, the organisation has a greater amount of time after the planning process, to implement the delivery plan. This also allows time for more effective communication with suppliers and planning to take place, such as telling the supplier the delivery details, which allows them more time for a response and so more effective communication to takes place.

This opinion was also prevalent in the literature as Santos et al. (2019) described effective delivery planning as something that enables success throughout the transport operation of an organisation. Effective delivery planning being the most important factor to successful backhaul was also found by Gong et al. (2020) as their paper discovered the best way to optimise backhaul is through effective delivery slots resulting in a minimal amount of time being added to the journey through the collection of backhaul. This would be achieved through effective delivery planning.

Another interesting result that came from this research was the contrast between the results of the two largest industry participants of the survey. The most clear difference that can be seen between the two industries, is in how important they considered logistics collaboration with competitors, as the supermarket industry gave this factor a weighting of 5.13%, which was lower than when all the results was combined where it had a weighting of 11.60%. However, in the results that only included participants from 3rd party logistics as it was considered to be the most important critical success factor to successful backhaul, with a weighting of 31.56%. This result was expected due to the different cultures that are prevalent in the two industries.

As 3rd party logistics companies has a culture in which working with other companies is common, and from the authors experience, it was not uncommon for one 3rd party logistics company to pay another one to complete certain jobs that they were contracted for. The reasons behind this was either it was more profitable, or that they were unable to complete the contract at that point in time. This would likely encourage greater collaboration and better working relationships between organisations in the industry. This is in stark contrast to the supermarket industry, where there is fierce competition between companies in the UK market. This has led to in recent years with the added pressure from Aldi and Lidl entering the UK grocery market, for supermarkets to focus on trying to beat their competition to keep their market share. Which is likely why there is less collaboration between supermarkets, due to the culture of the industry.

This links into what was theorised by Bailey et al. (2011) that for logistic collaboration to work effectively, there needs to be effective communication and an ethos of working together between the two organisations. In this case it would be easier to set up logistics collaboration in the 3rd party logistic industry, rather than the supermarket industry. Verdonck et al. (2013) suggested that most collaborative logistic efforts by organisations stop at the negotiating stage, which is likely another reason why it is considered so poorly in the supermarket industry. This is due to the fact if the culture is against working with competitors, they will not be able to set up any collaborative logistics efforts, thus, will not be able

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to benefit from collaborative logistics. Our results indicate that there exists a significant space to develop collaborative logistics for a more effective backhaul in supermarket distribution. However, considering the fact that logistics is a source of competitive advantage and that the competition among supermarkets in the UK is keen, collaboration among supermarkets can be challenging. A more trusting environment supported by relevant technologies such as secure data sharing through blockchain usage in tracking and sourcing may help to improve collaborative logistics.

Overall, the data is very useful at helping this paper answer its main question, which was discovering what the critical success factors of successful backhaul are and confirming previous research found within the literature on this topic. These factors could also help organisations have a better understanding of what effective backhaul is and so be able to achieve the benefits, such as lower levels of CO2 and other greenhouse gases produced. The data helps to indicate that there are certain areas of the process that could be improved, however due to what was disused earlier there may be potential bias and inaccuracies within the data.

FUTURE RESEARCH DIRECTION

This book chapter has found out important factors for effective backhauling of supermarket retail distribution. The factors in the study - which were determined through qualitative interviews with experts in the industry – involve some vital criteria. However, future studies may investigate how these critical success factors can be achieved by organizations. For instance, it would be worthwhile to investigate the role of digitalization in successful backhauling operations. Utilization of information technologies and digital tools may help companies have a better communication with suppliers and planning which is found to be the second most important criterion in this book chapter. In fact, the communications can also be automated by the help artificial intelligence and internet of things technologies. By this way, a real-time delivery planning of distribution – the most important criterion – and also an effective demand planning – the third most important criterion in this research – can be better achieved by organizations. A future study can examine how these technologies can be utilized in backhauling of retail chain distributions. Another critical point that needs to be investigated in more detailed is collaborative logistics and its role in effective backhauling. Logistics collaboration is found to be the most important criterion by 3rd PL providers. However, it is not well known how this collaboration can be achieved among retail chains. Barriers and antecedents of collaborative logistics in the context of backhauling in retail distribution can be studied by a future study.

CONCLUSION

This study has investigated critical success factors in effective backhaul of supermarket distribution in the United Kingdom. Our study has identified a total of six factors for an effective backhauling through qualitative interviews with industry experts. Then, an AHP survey is implemented on the managers involved in the supermarket distribution in the UK. A total of fifteen valid responses have been received. According to overall results, the most important factor is the effective delivery planning and the least important one is the right choice of trailers. Our results also indicate that different groups involved in distribution of supermarket chains have some contrasting opinions on the factors, especially considering

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the importance level of collaborative logistics with competitors in the market. As opposed to retailers in the AHP survey, 3rd PL service providers found logistics collaboration with other organizations in the industry as the most important critical success factor.

An effective backhauling in distribution does not only help organizations minimize their costs and improve their efficiencies, but also helps reduction of carbon emissions. Despite its proven benefits, it is a challenging task for organizations to accomplish. This research helps organizations within this context by identifying critical success factors of effective backhauling in retail distribution. Identification of these factors may help retailers the critical points that they should focus on. However, a more detailed investigation is required with regard to how these success factors can be achieved. There exists a need for more research especially considering the role of inter-organizational trust, digitalization, and recent technologies and how they can be utilized for effective delivery planning, demand forecasting, collaborative logistics, and communication within and between organizations. Considering its importance in terms of sustainability, intra-organizational and inter-organizational actions should start to be taken in distribution channels of retailers.

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KEY TERMS AND DEFINITIONS

3rd Party Logistics: A logistics service offered by a third-party organization when a company outsource its logistics activities including transportation, warehousing, and value-added logistics activities.

Analytical Hierarchy Process: A multi-criteria decision method that implements a pair-wise comparison based on the judgement of experts to determine priority scales.

Backhauling: The return journey of a freight truck from its destination to point of origin.

Collaborative Logistics: The collaboration between two or more competing organizations to optimize their transportation and logistics facilities by means of sharing equipment, vehicles, and information.

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Delivery Planning: Planning of transporting products from its source such as warehouse or factory to destination locations such as stores or houses.

Distribution: The organization of movement and storage activities for delivering final goods to consumers.

Retailer: Organizations that sell final products through several distribution channels to large number of consumers.

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Chapter 15
The Impact of Strategic Orientation and Reverse Logistics Capabilities on Organizational Performance

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ABSTRACT

Organizations continuously look for ways to improve their performances in order to survive. This is why they generate strategies and try to strengthen their resources and capabilities. In this chapter, the effects of strategic orientation and reverse logistics capabilities on the organizational performance are aimed to reveal on a literature review basis. According to the evidence from literature, it is revealed that the more an organization is strategically oriented, the higher its economic, social, and environmental performance. Similarly, it is revealed in this chapter that gaining reverse logistics capabilities have positive effects on organizational performance by decreasing costs, increasing quality and customer satisfaction.

INTRODUCTION

Creating competitive advantage is vital for an organization's survival and its degree of attaining goals and objectives. In order to understand competitive advantage, basically an organization's internal strengths and weakness must be taken into consideration (Barney, 1995; Peteraf, 1993). This approach is based on the resource-based view (Wernerfelt, 1984; Barney, 1991). Providing an important basis for strategic management (Barney, Wright and Ketchen, 2001), resource-based view proposes that in order to gain sustainable competitive advantage, organizations must have *valuable, rare, imperfectly imitable and not substitutable* resources, capabilities and assets (Barney, 1991).

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In this chapter it is primarily aimed to present the effects of strategic orientation and reverse logistics capabilities on organizational performance based on the resource-based view. Strategic orientation has been realized to have vital impacts on generating competitive advantage (Wright, Kroll, Pray and Lado, 1995) and increasing organizational performance (Kasemsap, 2017). When organizations adopt strategic approaches and conduct both internal and external environmental scanning they are more likely to reinforce their resources to catch the opportunities and avoid from threats in the market. This process will help them both generate competitive advantages (Kraja and Osmani, 2015) and increase organizational performance (George, Walker and Monster, 2019). For this reason, as a valuable resource to obtain the sustainable competitive advantage, one of the vital factors in logistics management which is reverse logistics capability has been included also in the scope of this chapter.

Although there is an increasing interest on reverse logistics, there is a need for examining the concept of reverse logistics capability from a strategic perspective. Moreover, reverse logistics has been mostly linked to innovation (e.g. De Paula, De Campos, Pagani, Guarnieri and Kaviani, 2019; Richey, Chen, Genchev and Daugherty, 2005) and sustainability (e.g. Lee and Lam, 2012; Narayana, Pati and Padhi, 2019) but its effects on organizational performance has been underemphasized so far. Hence in this chapter after giving brief explanations of the concepts of strategic orientation, reverse logistics capability and organizational performance; the relationships among these constructs will be put forward. This will be achieved by a literature scanning and from a conceptual perspective.

BACKGROUND

The Strategic Orientation of an Organization

In the beginnings of 1980s, a new concept of strategic orientation was introduced to strategic management literature and this concept attracted many scholars (e.g. Acquaah, 2007; Day, 1990; Narver and Slater, 1990; Slater, Olson and Hult, 2006). Strategic orientation can be defined as an attitude and behavior demonstrating the strategic directions executed by an organization using its valuable resources to create sustainable competitive advantage (Narver and Slater, 1990; Wright et al., 2005).

Some scholars examined strategic orientation concept as a multi-dimensional construct. For example, with the contributions of Cooper (1984), Narver and Slater, (1990), Jaworski and Kohli (1993) strategic orientation was divided into three dimensions which are *customer orientation, competitive orientation and technological orientation* (Gatignon and Xuereb, 1997). Moreover Chan, Huff, Barclay and Copeland (1997) divided strategic orientation into two dimensions as *business strategic orientation* and *information systems strategic orientation.* Also Liu and Fu (2011) classified strategic orientation as *entrepreneurial orientation, marketing orientation* and *learning orientation*. Each of the dimensions have sub-dimensions which are *autonomy, proactiveness, aggressiveness, risk taking, innovativeness for entrepreneurial orientation* (Lumpkin and Dess, 1996), customer, competition and technological orientation (Narver and Slater, 1990) and *commitment to learning, shared vision and open mindedness for learning orientation* (Baker and Sinkula, 1999).

There are various studies analyzing the concept of strategic orientation and its applications in strategic management, marketing and supply chain management in the literature. Selected papers are given in Table 1.

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Table 1. Research on strategic orientation

About	Method	Findings	Author(s)
New product performance, innovation	Quantitative	Positive effect on new product and innovation	Gatignon and Xuereb (1997)
Dimensionality and measurement	Quantitative	Six dimensions of strategic orientation	Venkatraman (1989)
Firm performance	Quantitative	Positive (depends on the type of performance scale)	Voss and Voss (2000)
Control systems, top management vision	Qualitative	Different control tools	Simons (1991)
Strategy formation capability and performance	Quantitative	Moderating effect between strategy formation capability and performance	Slater, Olson and Hult (2006)
Knowledge management, innovativeness and performance	Quantitative	Positive relationships with variables	Ferraresi, Quandt, Dos santos, and Frega (2012)
Operational ambidexterity	Quantitative	Positive relationships	Sahi, Gupta and Cheng (2020)

Reverse Logistics

One of the eye-catching concepts in logistics and supply chain management comes the concept of reverse logistics. Developed in 1980s and emerged in the 1990s, reverse logistics has attracted attention due to its contributions to organizational efficiency and sustainable organizational strategies. Reverse logistics refers to the flow of already shipped products or their components from buyers to manufacturers for recycling, remanufacturing or elimination purposes (Dowlatshahi, 2000). In another definition, reverse logistics briefly explained as, “reverse movement of goods from a consumer towards a producer in a distribution channel” (Murphy and Poist, 1988). Reverse channels in reverse logistics are emerged in order to accumulate, transport and reprocess the goods or some parts of those goods to succeed recycling or transforming into a recycled product (Pohlen and Farris II, 1992). So reverse logistics can be linked to the emerging concepts of sustainability (Lee and Lam, 2012) and socially responsible logistics (Murphy and Poist, 2002).

Reverse logistics has been an important factor for competitiveness of an organization in the business environment because it provides customer satisfaction (Daugherty, Myers and Richey, 2002), cost reductions in products (Fassoula, 2005) and a cleaner environment (Sarkis, Helms and Hervani, 2010). Thus, reverse logistics capabilities are accepted among the valuable resources of organizations (Genchev, Landry, Daugherty and Roath, 2010). Reverse logistics capabilities matter especially in retail organizations. This is because retailers try to overcome low retail margins and they are more concentrated on storage costs, product recoverability and logistics channel partnerships (Daugherty, Richey, Genchev and Chen, 2005). To generate and improve reverse logistics capabilities organizations invest more in technology (Jack, Powers and Skinner, 2010). Moreover managers enhance a knowledge creation and sharing atmosphere in their organizations and emphasize more on employees’ improving skills and experience so as to sustain reverse logistics capabilities. With reverse logistics capabilities, organizations will achieve cost and input efficiency which in turn causes more profits and more quality for goods.

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Organizational Performance

Organizational performance is one of the most attractive topics for researchers in management. Organizational performance is defined as the degree to which an organization achieves its goals and objectives (Daft, 2006). It is distinguished from organizational effectiveness by being a narrower concept including financial performance (profit/loss, return on investment, return on assets, price to earnings ratio, revenues, costs, etc.), non-financial and marketing performance (customer satisfaction, customer loyalty, brand equity, product sales, market share, etc.) and shareholder return performance (total shareholder return, capital efficiency, etc.) (Clark, 1999; Richard, Devinney, Yip and Johnson, 2009).

Measuring organizational performance is a hard and controversial issue. In 1980s, organizational performance was measured on the basis of shareholder theory that used shareholder return. In 1990s broadening the scope of organizational performance, stakeholder theory dominated the measurement approaches from the perspectives of wider groups of stakeholders such as; suppliers, customers, government, unions, etc. Based on the stakeholder theory, the Balanced Scorecard and the Triple Bottom Line were developed in order to measure organizational performance (Hubbard, 2009).

In the Balanced Scorecard approach, organizational performance is measured generally by 14-16 measures consisting of for example sales growth, return on investment, number of new products developed, research and development expenditures, market share, number of new customers, employee turnover ratio, efficiency and etc. (Kaplan and Norton, 1992). According to the Triple Bottom Line technique social (e.g. sponsorship, education, customer satisfaction) and environmental criteria (e.g. spillages, wastewater reuse) are also important factors for measuring organizational performance added to the economic criterion (e.g. sales, profit, return on equity) (Elkington, 1997).

MAIN FOCUS OF THE CHAPTER

The Relationship Between Strategic Orientation and Organizational Performance

The effect of strategic orientation on organizational performance has attracted many scholars up to now (e.g. Aragón-Sánchez and Sánchez-Marín, 2005; Lee, Choi and Kwak, 2014; Voss and Voss, 2000). Strategic orientation necessitates resource-based view in action since both of them aim to have sustainable competitive advantage. In order to obtain sustainable competitive advantage organizations invest in technology and innovation (Bowonder, Dambal, Kumar and Shirodkar, 2010; Offstein, Morwick and Koskinen, 2010), human resources (Love and Singh, 2011), sustainability (Flint and Golicic, 2009), social relations and cooperation with other organizations (Duschek, 2004). These strategic practices result in better quality of goods and services; reduced cost, time and materials used in production process. Moreover this type of strategic orientation increases customer satisfaction, brand loyalty and as a result it causes revenues and profits to increase social (e.g. women employment) (Aytekin, 2019) and environmental performance of organizations. All of these consequences provide improvement in organizational performance.

In the literature there are enough evidences that strategic orientation positively effect organizational performance. Venkatraman (1989) found a positive correlation between business strategic orientation and organizational performance. Similarly, Day (1990) indicated that strategic orientation was an important

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antecedent of high organizational performance. Moreover Day and Lichtenstein (2006) examined the relationships between supply management practices and strategic orientation. And they obtained the same results about strategic orientation's positive effect on firm performance.

There are numerous studies analyzing the effects of strategic orientation on organizational performance. Information about selected papers are given in Table 2.

Table 2. Studies about the relationship between strategic orientation and organizational performance

Authors	Method	Sample	Findings
Aragón-Sánchez and Sánchez-Marín (2005)	Quantitative Research	1351 Spanish Small and Medium Enterprises	Strategic orientation has positive effects on organizational performance
Lee, Choi and Kwak (2014)	Quantitative Research	374 Korean Small and Medium Enterprises	Strategic orientation has positive effects on organizational performance
Campbell (2014)	Quantitative Research	134 South Carolina farmers' market vendors	Strategic orientation has positive effects on organizational performance
Chow, Teo and Chew (2013)	Quantitative Research	190 firms in Singapore	Strategic orientation plays a mediator role between human resources sytems and organizational performance

The Relationship Between Reverse Logistics Capabilities and Organizational Performance

There are numerous studies concentrating on the effects of reverse logistics capabilities and organizational performance. For example, Vlachos (2016) found a positive relationship between logistics capabilities and organizational performance and also with competitive advantage on the basis of resource-based view, transaction cost economics and institutional theory. Moreover, Ye, Zhao, Prahinski and Li (2013) have found a positive relationship between an organization's economic and environmental performance and product recovery in reverse logistics.

In the reverse logistics process, the return of products from customers to the domain organizations provides cost efficiency for companies. When the cost efficiency is applied on the prices of goods, customers' purchasing intentions are reinforced. From this perspective, reverse logistics capabilities help companies to generate competitive advantage and increase organizational performance (Stock, Speh and Shear, 2006). Similarly, reverse logistics capabilities include generating and sharing knowledge (Jack et al., 2010). With the help of knowledge sharing, the efficiency of reverse logistics can be increased by recycling, disposing or developing new product by taking customers' post-use into consideration (Hsiao, 2010). Knowledge generation and knowledge sharing is a key factor for product innovation and also other innovative actions in the process of reverse logistics (Richey, et al., 2005). As knowledge sharing and innovation strengthens the reverse logistics capabilities, they have also positive effects for organizational performance.

Furthermore, building strong relationships with the other organizations in the supply chain management enhance information transfer which in turn provides a better quality in the recycling, disposal or reproduction of products (Simpson, 2010). Also building strong relationships enhance radical innovations and these reinforce the reverse logistics capabilities of organizations (Ganesan, George, Jap, Palmatier and Weitz, 2009). It is now evident that reverse logistics capability improves organizational performance.

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FUTURE RESEARCH DIRECTIONS

In the future, researchers may investigate the effects of strategic orientation and reverse logistics capabilities on environmental performance rather than economic performance. Within the context of sustainability, there is especially a need for more research of empirical studies about strategic orientation. There may be added some other dimensions to the existing ones in strategic orientation, moving forward this vital concept.

Furthermore, the subjects of innovation, knowledge generation, knowledge sharing, information technologies, cost savings, quality management, customer satisfaction, and customer loyalty should be combined with reverse logistics capabilities empirically in related sectors. Lastly, strategies for effective management of distribution channels in reverse logistics should be examined.

CONCLUSION

Since organizations look for ways to increase their performance, this chapter attempted to suggest new approaches for increasing organizational performance. In this context, throughout this chapter, the effects of strategic orientation and reverse logistics capabilities on organizational performance were discussed. This was achieved by a detailed literature review. There are sufficient evidences in the literature suggesting that strategic orientation and some of its dimensions like technological orientation, entrepreneurial orientation, market orientation have positive effects on performance both on shareholders' and stakeholders' approach. It is because when organizations emphasize on gaining rare, valuable and imitable resources they gain sustainable competitive advantage. This type of advantage promotes organizational performance since it consists of high skilled and highly motivated employees, unique communication channels, organizational climate fostering innovative and creative behaviors and more investments on technology as examples.

In the same manner, in order to achieve reverse logistics, organizations need to develop some sort of skills. These reverse logistics capabilities make it possible for organizations to conduct certain activities successfully throughout the flow of products or some parts of those products from customers to the domain firms. Building strong relationships with the firms in the value chain and exchanging valuable knowledge about innovative solutions in recycling, transportation and disposal of products are typical examples of reverse logistics capabilities in firms. With these capabilities, they are able to generate sustainable competitive advantage and increase their organizational performance.

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KEY TERMS AND DEFINITIONS

Logistics: The process of acquiring, warehousing, and transportation of materials from source to the user.

Organizational Performance: The degree to which organizations attain their goals and objectives.

Reverse Logistics: The reverse flow of goods or parts of goods from customers to the final destination for recycling, reproduction, or disposal.

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Strategic Management: Formulation, implementation, and control process for achieving long-term plans, goals, and objectives.

Strategic Orientation: An organizational action in which valuable resources are brought together and used for creating sustainable competitive advantage.

Strategy: A broad and long-term plan for achieving organizational goals and objectives.

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Chapter 16
Evaluation of Innovation Performance With AHP and TOPSIS Integrated Approach:
An Application in Hazelnut Sector

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ABSTRACT

The aim of the study is to determine the most appropriate enterprises by revealing the innovation performances of the companies operating in the hazelnut sector in Ünye. In this study, weights of the criteria and sub-criteria, which are thought to have an effect on the innovation performance of the enterprises, were determined by analytical hierarchy process (AHP). TOPSIS method has been used to rank the alternatives. In this way, TOPSIS aims to establish a degree of importance for each alternative enterprise and to determine the highest degree of importance as the most appropriate enterprise in terms of innovation performance. As a result of the study, it was determined that the main criterion that most affects innovation performance in hazelnut sector is the financing function, which is followed by production function, R&D function, management function, and marketing function, respectively. According to the results obtained using the TOPSIS method, the best alternative was Enterprise 4 in terms of innovation performance and the worst alternative was Enterprise 1.

INTRODUCTION

Innovation, which refers to the development, creation and promotion of new processes, products or services successfully (Udwadia, 1990) is an important concept for businesses because it results in a competitive advantage. Technological skills, knowledge and experience in creating new products increase

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competitive advantage (Pla-Barber and Alegre, 2007). Innovation is a tool that increases productivity and profitability, reduces costs, improves the quality of products and services and facilitates entry into new markets (Özgür Güler and Kanber, 2011). Innovation is at the core of global competition, and therefore, should be understood, managed and supervised by businesses that actively seek growth in both domestic and international markets. Innovation, which plays a key role in increasing competitive advantage in the food industry, refers to the process in which new and creative ideas, processes, products or services are produced and introduced to target markets to meet customer expectations and to stand among the crowd. Hazelnut has always maintained its feature of being an important product among agricultural products in healthy nutrition, creating employment, supplying raw materials to other industrial branches and especially providing export income (Öztürk et al., 2019: 108). Hazelnut is a traditional export product of Turkey, covering about 15-20% of the total export of agricultural products. Turkey accounts for more than 80 percent of the world's hazelnut trade (Öztürk et al., 2017). Turkey needs value-added innovations to turn its global leadership in hazelnut exports into a major economic advantage. The city of Ordu accounted for 16.26% of total domestic hazelnut exports in Turkey in 2018 (Ordu Commodity Exchange, 2019). The aim of this study was, therefore, to analyze the innovation performance of companies operating in district of Ünye of Ordu and exporting hazelnuts to domestic and international markets. Analytic Hierarchy Process (AHP) were used to determine the weights of the criteria and sub-criteria which have an effect on the innovation performance of the companies. Alternatives were ranked in order of importance using TOPSIS method in order to determine which company had the highest importance, and hence, the best innovation performance. We believe that the results will help hazelnut companies identify and raise their awareness of the factors that play a key role in innovation in the hazelnut sector, and therefore, enable them to make a greater contribution to the national economy. To our knowledge, this is the first study to analyze the factors affecting the innovation performance of hazelnut companies.

THE CONCEPT OF INNOVATION

Innovation is an important concept that has attracted attention and become the subject of numerous studies in recent years. According to Lange (1943: 21), innovation is defined as changes in production function that provide enterprises with maximum net value under the current market conditions (in terms of production factor input and product output performance). Cumming (1998: 22) defines it as the first successful application of a product or process while Freeman and Engel (2007: 94) defines it as "a process that begins with a novel idea and concludes with market introduction". According to McDaniel (2000: 277), innovation is a functional key used by entrepreneurial people. According to Parthasarthy and Hammond (2002: 75), it is a new product developed through existing or new scientific and technological knowledge and marketed by a business. Kitanovic (2005: 19) defines it as information, technology, new information or combination of information used in production. Roberts (2007: 36) defines it with the equation of "innovation = invention + commercialization". According to Çetinkaya Bozkurt and Kalkan (2014: 189), innovation is the application of new ideas to create value for businesses.

The literature shows that there is no consensus on the definition of innovation. For some, innovation is the development and application of new concepts and ideas, while for others, it is the new or applied ideas themselves. Innovation is regarded not as a source of new ideas but as the benefit of successful applications arising out of those ideas (Naktiyok, 2007: 212).

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FACTORS AFFECTING INNOVATION PERFORMANCE

Innovative applications are important tools that help businesses achieve their goals. Businesses should take into account the factors that affect innovation performance before making strategic decisions. Managing innovative applications is influenced by both internal and external factors. These factors may increase or decrease innovation performance. Factors improving innovation performance should be determined to be able to manage them. There are numerous studies determining the factors that affect innovation.

In 2008, Boston Consulting Group (BCG) and Business Week asked 3000 global executives whether they were satisfied with the advantages of the innovation processes of their companies and what obstacles had to be overcome to create value in innovation investments? More than half of them reported dissatisfaction. The major obstacles were long development periods, a risk-avoiding culture, inefficient marketing and communication, poor coordination, and inability to prioritize ideas, choose the right ideas to commercialize and measure performance adequately (cited in Sehested and Sonnenberg, 2011).

Companies fail in their innovation efforts or fail to sustain it even if they succeed due to a number of reasons such as insufficient resources for innovation efforts, innovation depending on the ability of only a few employees or innovation arising out of coincidences (Güleş and Bülbül, 2004: 118). Perel (2002: 10) argues that the three requirements for success in innovation are an organizational culture that supports creativity and sustainability, encouraging the generation of new ideas, and encouraging incremental efforts and relying on pioneering creative champions.

Oturakçı (2018) used the AHP method to determine that employee characteristics, company (internal) characteristics and external characteristics affected companies' innovation activities and concluded that employee characteristics had the most significant effect on them of all subparameters, experience, education level and number, which were employee characteristics, were weighted as the most important parameters.

Çakın and Özdemir (2018) conducted a Fuzzy DEMATEL-Based Analytical Network Process analysis to determine the factors affecting innovation activities in SMEs and reported that cooperation with financial institutions and universities were the most important criteria while company age and organizational structure were the least important criteria.

Korkmaz et al. (2018) investigated approaches that might positively or negatively affect the innovation management capacities and processes of SMEs and reported that innovation performance was positively and moderately/highly correlated with the level of applications regarding strategy, culture and environment, leadership, election planning, idea management, personnel, collaboration, communication, performance and rewarding.

According to Çetin and Gedik (2017), the reasons for engaging in innovation activities are creating new markets, meeting customer demands and needs, improving product quality and production flexibility, reducing production costs, energy consumption and environmental damage, expanding the export market, branding, and increasing product range, market share, revenue and awareness whereas the barriers to innovation are high risk, high innovation costs, lack of financial resources, insufficient capital, insufficient number of qualified staff, customers' disinterest in innovation, senior managements' negative attitudes towards innovation and inadequate subsidy for R & D innovation.

Braslina et al. (2015) identified the factors affecting the innovation process of 128 companies operating in Latvia and reported company resources, the presence of informed, skilled and experienced staff, and attractive opportunities for investors as the most important factors affecting innovation.

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The study conducted by Chen (2014) included 121 investment projects that demonstrated innovative stimuli, innovation capacity and really important project performances. According to hierarchical regression results, technology management had a significantly positive impact on project performance data. The optimal model accounted for 34.2% of investment projects. Human factors were an important stimulus in innovation performance in the projects. Although the stimuli did not directly affect the performance of the investment projects, they had a direct effect on their innovation capacity.

Inauen and Schenker-Wicki (2011) investigated the effect of outside-in open innovation management strategies on the innovation performance of companies and focused especially on the adoption of the open innovation paradigm in practice and on expanding cooperation with stakeholders.

Lin (2006) analyzed the factors affecting innovation in logistics information systems used by logistics service providers in Taiwan and concluded that organizational incentives, human resources quality and subsidies affected innovation.

All in all, research shows that the innovation capacity of companies is affected by micro and macro or positive and negative factors (Oturakçı, 2018; Hu et al., 2014; Inauen and Schenker-Wicki, 2011; Naktiyok, 2007; Kavrakoğlu, 2006; OECD, 2006; Lambooy, 2005; Fagerberg, 2004; Perel, 2002; Keizer et al., 2002; White and Yazdani, 2000; Han et al., 1998). The factors affecting innovation are R & D work force, R & D activities, creativity, competence in teamwork or cooperation, the presence of a creative organizational climate, cooperation between universities and industries, senior executives' attitudes, constant and accurate communication, incentive systems, adequate resources, institutionalization, an organizational culture that promotes sustainability, accessible external and internal financial opportunities, access to capital, low real interest rates, stable macroeconomic conditions, cooperation with different stakeholders (suppliers, customers, sellers), qualified human resources, protection of intellectual property rights, resistance to change, attitudes towards risk, weak institutionalization, problems in superior-subordinate communication, uncertainty avoidance, short-term forecasts, a weak organizational culture, lack of outward looking vision, excessive bureaucracy and rational thinking, insufficient resources, shortage of qualified personnel, financing of innovation, problems with raw materials, patent and licensing policies, length of return on innovation, insufficient incentives, and, sometimes, market structure.

STRATEGIC IMPORTANCE OF INNOVATION

Financial and technological advances in recent years have changed how people perceive economic, political and cultural issues and in what way they approach economic activities in the new international context (Lambooy, 2005: 1137). Innovation is seen as an important element of economic growth and success in both macro and micro scale (Kasza, 2004: 1). According to Morris (2013: 6), innovation allows for the creation and sustainability of new advantages. Innovation, in a sense, means producing today's products and services.

Innovation makes a great difference in organizations of all types and sizes. Successful companies are those that focus on change and its sustainability. Whatever the nature of change, the main issue is how it has come about, that is, how it will be managed. Another advantage of innovation is that it is strongly linked to growth. Creating a competitive process depends on what companies offer (Bessant and Tidd, 2018).

According to Schumpeter (1947), competition results from new or improved products, a new production method, expanding into new markets, seeking access to new sources of raw materials, new technology,

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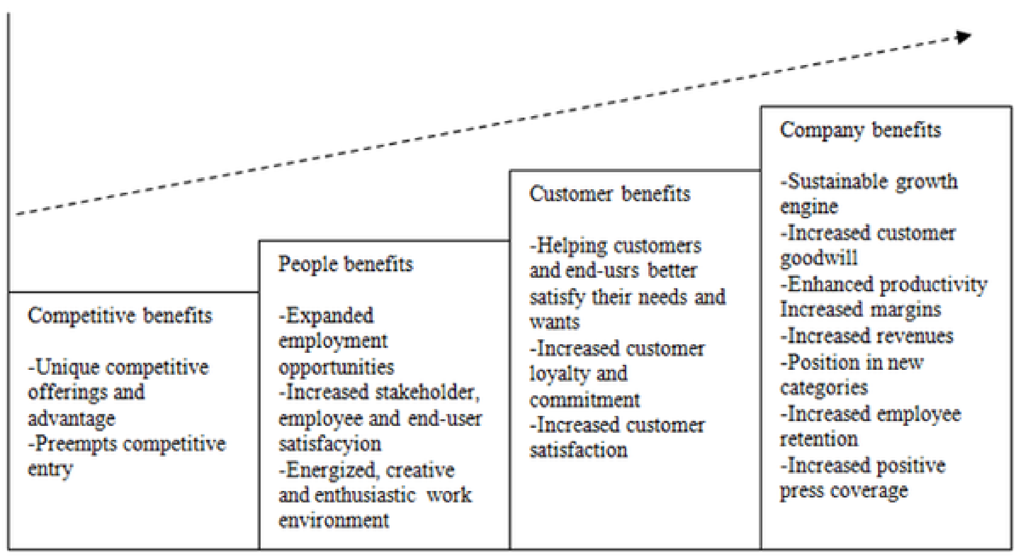
and new types of organizations. Such competition affects not only the outputs and profits of companies, but the whole. Companies should, therefore, focus on numerous - large and small and successful and unsuccessful - cases where they can find answers to the question "Can we manage innovation?"and analyze key messages presented in application (Bessant and Tidd, 2018: 16) in order to increase their competitive advantage.

- Exploring and understanding the dimensions of innovation (ways to change things)
- Carrying out innovation as a process
- Creating conditions that allow for the repetition of innovation capacity (building capacity)
- Focusing on that capacity to improve (innovation strategy)
- Building a dynamic capacity (Making approaches more robust and adapting to changing environmental conditions)

Sustainable success and risk/return maximization depend on the power of innovation (see Figure 1), which is achieved only by the development and promotion of innovative ideas (Davis 1997: 338).

Figure 1. Power of innovation
Source: (Davis, 1997: 338)



Innovation is a key element of competitive advantage and economic growth. Companies adopt innovation because they wish to build a strong presence in the market, keep up with the competition, meet their stakeholders' expectations, adapt to changing environmental conditions, keep up with advances in technology, integrate changes in managerial knowledge into their operations, increase efficiency and profitability, produce quality products and services with high added value and create customer value.

While most companies have relatively modest lifespans, some others have remained successful for at least one and sometimes several centuries."100 club" members –3M, Corning, Reuters, Procter and

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Gamble, Philips, Siemens and Rolls-Royce – owe their long lifespans to their tendency to constantly improve their innovation capacity (Bessant and Tidd, 2018: 16).

RESEARCH DESIGN

The aim of this study was to identify the criteria affecting the innovation performance of hazelnut companies and determine the best hazelnut company accordingly. The study sample consisted of 9 companies operating in district of Ünye of Ordu and exporting hazelnuts to domestic and international markets. First, the managers of the companies were informed about the purpose and procedure of the study prior to participation and then asked to complete a questionnaire to assess the innovation performance of their companies. Based on the micro elements in the literature and expert opinion, 5 main criteria (production function, marketing function, management function, financing function and R & D function) and 17 subcriteria were determined. The Analytic Hierarchy Process (AHP) was used to determine the weights of the criteria and subcriteria while the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was used to rank the alternatives to determine which company had the highest importance, and hence, the best innovation performance. Data were collected using face to face survey method. Data were analyzed using Microsoft Excel 2013.

Research Method

Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) is a widely used multi-criteria decision-making method developed by Thomas L. Saaty (1977) for the solution of complex problems. AHP makes pairwise comparisons and determines how important, preferable or dominant options and criteria are compared to each other (Özgörmüş et al., 2005: 112). It is a powerful and easy-to-understand method that allow groups and people to combine quantitative and qualitative factors in decision-making (Terzi et al., 2006: 44). The step-by-step solution hierarchy of a problem in AHP is as follows;

In the first step, the decision problem should be transformed into a hierarchical structure for clarity and ease of application. The main objective of decision problems is, therefore, to establish criteria, subcriteria and alternatives within a hierarchical structure (Asoğlu and Eren, 2018: 105).

In the second step, pairwise comparisons are made. Based on the assessment scores of decision makers, i.e., experts, criteria are compared with each other, and alternatives are compared among themselves based on the criteria. Saaty's 1-9 scale (1980) (see Table 1) is used in the pairwise comparisons. Once pairwise comparison matrices are obtained, normalized matrices are generated, and relative priorities are determined. The relative importance of criteria and alternatives is determined according to relative priorities (Küçük and Ecer, 2008: 439).

In the third step, It is determined whether or not the matrices are consistent in order to determine how much the relative priorities reflect the truth. In order for a comparison matrix to be consistent, its largest eigenvalue λmax must be equal to its matrix size (n) (Küçük and Ecer, 2008: 440). A consistency ratio (CR) is calculated using the equations (1) and (2). CI and RI refer to the coherence and random indicators, respectively.

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Table 1. Scale of preference

Intensity of Preference	Definition
1	Equally preferred
3	Moderately preferred
5	Strongly preferred
7	Very strongly preferred
9	Extremely preferred
2,4,6,8	Intermediate values between the two adjacent judgments when compromise is needed

$$\text{T.G} = (\lambda m_{ax-n})/(n-1) \tag{1}$$

$$\text{T.O} = \text{T.G} / R.\text{G} \tag{2}$$

RIs (see Table 2) are composed of constant RI values taking different values depending on the alternative amount of the matrix. Where n represents the size of the matrix.

CR < 0.1 indicates acceptable consistency (Saaty, 1994: 27).

Table 2. The average consistencies of random matrices

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.53	1.56	1.57	1.59

Source: (Saaty, 1980: 21)

In the final step, the product of the sum of the weight of each criterion and the relative importance of alternatives based on the criteria is the priority value (weight) of each alternative (Asoğlu and Eren, 2018: 106).

TOPSIS Method

Developed by Hwang and Yoon (1981), TOPSIS is a multi-criteria decision analysis method to determine positive and negative ideal solutions of decision making problems in order to select alternatives (Özcan et al., 2017: 209). TOPSIS consists of 6 steps (Uygurtürk and Korkmaz, 2012: 104-105; Asoğlu and Eren, 2018: 106-108).

Step 1: Constructing the decision matrix (A)

Alternatives and criteria are listed on the rows and columns, respectively. Matrix A is an initial matrix generated by experts.

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Step 2: Constructing the standard decision matrix (R)

It is calculated using the elements of matrix A and the following formula.

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}} \tag{3}$$

Step 3: Constructing the weighted standard decision matrix (*V*)

First, values (W_i) indicating weights associated with evaluation criteria are calculated ($\sum_{i=1}^{n} w_i = 1$).

Then, the values in each column of the matrix R are multiplied by W_i and the weighted standard matrix *V* is generated.

Step 4: Determining the positive *(A*)* and negative (A^-) ideal solutions

TOPSIS assumes that each criterion has a steadily increasing or decreasing trend. The positive ideal solution set is formed by selecting the weighted evaluation factors of the matrix *V*, that is, the maximum values of the column if they are maximum likelihood criteria while the minimum values of the column are selected if they are minimum likelihood criteria. Equation (4) is used to determine the positive ideal solution set $A^* = \left\{v_1^*, v_2^*, ..., v_n^*\right\}$. The negative ideal solution set is formed by selecting the weighted evaluation factors of the matrix *V*, that is, the minimum values of the column (maximum values of the assessment factor is a maximum likelihood criteria). Equation (5) is used to determine the negative ideal solution set.

$$A^* = \left\{ (\max_i v_{ij} \middle| j \in J), (\min_i v_{ij} \middle| j \in J' \right\} \tag{4}$$

$$A^- = \left\{ (\min_i v_{ij} \middle| j \in J), (\max_i v_{ij} \middle| j \in J' \right\} \tag{5}$$

$A^- = \left\{v_1^-, v_2^-, ..., v_n^-\right\}$ denotes the set calculated using equation (3).

In both equations, *J* is associated with benefit (maximization) criteria and J' is associated with cost (minimization) criteria. Both the ideal and negative ideal solution sets consist of the number of evaluation factors, that is, the m number of elements.

Step 5: Calculating the relative closeness to the ideal solution

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Euclidean distances of the evaluation factor value of each decision point from the positive and negative ideal solutions are calculated. Deviations are referred to as Ideal Separation (S_i^*) and Negative Ideal Separation (S_i^-). Equation (6) and (7) are used to calculate the Ideal Separation (S_i^*) and Negative Ideal Separation (S_i^-), respectively.

$$S_i^* = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^*)^2} \quad (6)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^-)^2} \quad (7)$$

Where the number of S_i^* and S_i^- is equal to the number of alternatives.

Step 6: Selecting the closest option to the ideal solution

Ideal and negative ideal separation measures are used to calculate the relative proximity (C_i^*) of each decision point to the ideal solution. The criterion here is the ratio of the negative ideal separation measure to the total separation measure. The relative proximity to the ideal solution is calculated using the following equation.

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \quad (8)$$

Where $0 \leq C_i^* \leq 1$, and $C_i^* = 1$ is the proximity of the decision point to the ideal solution w while $C_i^* = 0$ is the absolute proximity of the decision point to the negative ideal solution.

Application

Application of AHP

In the first step, the main objective, criteria, sub-criteria and alternatives of the decision problem were constructed within a hierarchical structure (see Figure 2). The main criteria were "production function," "marketing function," "management function", "financing function" and "R & D function". The subcriteria under the main criterion of "production function" were "new product development (PF1)", "obtaining high value-added products (PF2)" and "problems with the supply of quality raw materials (PF3). The subcriteria under the main criterion of "marketing function" were "market research and market testing (MF1)", "importance of packaging (MF2)" and "importance of branding and promotion (MF3). The subcriteria under the main criterion of "management function" were "institutionalization (MNF1)", "senior executives' attitudes (MNF2)","problems in superior-subordinate communication (MNF3)" and

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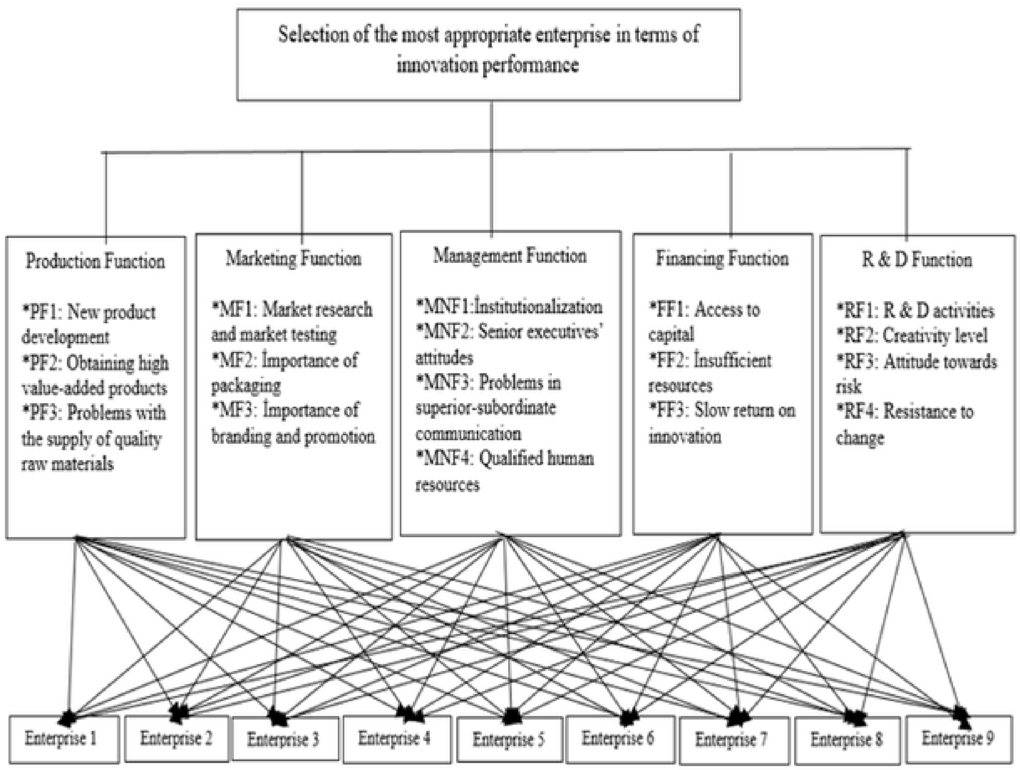
"qualified human resources (MF4)". The subcriteria under the main criterion of "financing function" were "access to capital (FF1)", "insufficient resources (FF2)" and "slow return on innovation (FF3)". The subcriteria under the main criterion of "R & D function" were "R & D activities (RF1)", "creativity level (RF2)", attitude towards risk (RF3)" and "resistance to change (RF4)".

Figure 2. Factors affecting innovation performance



In the second and third steps, pairwise comparison matrices were constructed, relative priorities were determined, and the consistency ratios of the matrices were calculated. The pairwise comparison results of the participants were combined by taking a geometric mean. The pairwise comparison of the main criteria showed that financing function (0.433) was the most important criterion, followed by production function (0.267), R & D function (0.189), management function (0.071) and marketing function (0.040). The consistency ratio of the pairwise comparison matrix was 0.00, indicating highly reliable evaluation (see Table 3).

Tables 4-8 show the paired comparisons, relative importance levels and consistency ratios of the sub-criteria. The most important subcriteria for production function, marketing function, management function, financing function and R & D function were "problems with the supply of quality raw materials (0.535)", "market research and market testing (0.524)", "qualified human resources (0.520)", "insufficient resources (0.508)" and "resistance to change (0.355)", respectively. The consistency ratio of all matrices was below 0.10.

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Table 3. Binary comparison matrix of main criteria

	Production function	Marketing function	Management function	Financing function	R & D function	Relative priority
Production function	1.00	8.33	4.00	0.65	1.00	0.267
Marketing function	0.12	1.00	0.42	0.13	0.25	0.040
Management function	0.25	2.38	1.00	0.14	0.33	0.071
Financing function	1.54	8.00	7.00	1.00	3.00	0.433
R & D function	1.00	4.00	3.00	0.33	1.00	0.189
Consistency Ratio: 0.00						

Table 4. Binary comparison matrix of production function criteria

	New product development	Obtaining high value-added products	Problems with the supply of quality raw materials	Relative priority
New product development	1.00	0.30	0.18	0.102
Obtaining high value-added products	3.33	1.00	0.72	0.363
Problems with the supply of quality raw materials	5.56	1.39	1.00	0.535
Consistency Ratio: 0.00				

Table 5. Binary comparison matrix of marketing function criteria

	Market research and market testing	Importance of packaging	Importance of branding and promotion	Relative priority
Market research and market testing	1.00	2.08	2.35	0.524
Importance of packaging	0.48	1.00	1.28	0.263
Importance of branding and promotion	0.43	0.78	1.00	0.214
Consistency Ratio: 0.00				

Table 6. Binary comparison matrix of management function criteria

	Institutionalization	Senior executives' attitudes	Problems in superior-subordinate communication	Qualified human resources	Relative priority
Institutionalization	1.00	0.40	0.17	0.11	0.055
Senior executives' attitudes	2.50	1.00	0.54	0.32	0.150
Problems in superior-subordinate communication	5.88	1.85	1.00	0.45	0.276
Qualified human resources	9.09	3.13	2.22	1.00	0.520
Consistency Ratio: 0.01					

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Table 7. Binary comparison matrix of financing function criteria

	Access to capital	Insufficient resources	Slow return on innovation	Relative priority
Access to capital	1.00	0.96	5.54	0.425
Insufficient resources	1.04	1.00	8.78	0.508
Slow return on innovation	0.18	0.11	1.00	0.067
Consistency Ratio: 0.01				

Table 8. Binary comparison matrix of R&D function criteria

	R & D activities	Creativity level	Attitude towards risk	Resistance to change	Relative priority
R & D activities	1.00	0.42	0.76	0.20	0.112
Creativity level	2.38	1.00	2.00	0.78	0.305
Attitude towards risk	1.32	0.50	1.00	0.50	0.167
Resistance to change	5.00	1.28	2.00	1.00	0.355
Consistency Ratio: 0.01					

The global weight value (GW) of each sub-criterion was calculated by multiplying the weight value of the sub-criteria obtained by the weight value of the criteria they are linked to in the hierarchical structure (see Table 9).

TOPSIS Procedure

TOPSIS was performed in six steps as follows:

Step 1: Constructing the decision matrix

The decision matrix based on the geometric mean of the scores (1 to 10) given by the decision makers for the alternatives, as shown in Table 10. Two experts were consulted as decision-makers.

Step 2: Normalizing the decision matrix

Each value in the columns was divided by the square root of the sum of the squares of all values in the column and reduced to a single denominator (see Table 11).

Step 3: Constructing the weighted decision matrix

The weighted decision matrix (see Table 13) was constructed by multiplying the normalized decision matrix values by the final weight coefficients (GW) (see Table 12) of the criteria obtained in AHP.

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Table 9. Weights of criteria and sub-criteria

Criteria	Weights	Sub-criteria	Weights	GW
Production Function	0.267	New product development	0.102	0.028
		Obtaining high value-added products	0.363	0.098
		Problems with the supply of quality raw materials	0.535	0.144
Marketing Function	0.040	Market research and market testing	0.524	0.021
		Importance of packaging	0.263	0.011
		Importance of branding and promotion	0.214	0.009
Management Function	0.070	Institutionalization	0.055	0.004
		Senior executives' attitudes	0.150	0.011
		Problems in superior-subordinate communication	0.276	0.019
		Qualified human resources	0.520	0.038
Financing Function	0.433	Access to capital	0.425	0.185
		Insufficient resources	0.508	0.221
		Slow return on innovation	0.067	0.030
R & D Function	0.189	R & D activities	0.112	0.021
		Creativity level	0.305	0.059
		Attitude towards risk	0.167	0.033
		Resistance to change	0.355	0.068

Table 10. Decision matrix

	PF1	PF2	PF3	MF1	MF2	MF3	MNF1	MNF2	MNF3	MNF4	FF1	FF2	FF3	RF1	RF2	RF3	RF4
Enterprise 1	1.50	1.00	5.50	4.50	5.00	5.50	1.00	2.50	2.00	3.00	2.00	2.00	1.00	1.00	2.00	1.00	9.00
Enterprise 2	1.50	1.00	5.00	4.50	6.00	5.00	1.00	2.50	3.00	2.00	3.00	2.00	1.00	1.00	2.00	1.00	9.00
Enterprise 3	4.50	2.50	3.50	6.00	5.50	7.00	1.00	5.50	3.00	4.00	5.50	3.50	1.00	1.00	3.00	1.00	9.00
Enterprise 4	7.50	7.50	2.50	9.00	10.00	10.00	3.00	9.00	2.00	5.50	6.50	4.00	1.00	2.00	4.50	3.50	7.00
Enterprise 5	1.50	1.00	5.00	4.50	7.00	8.00	1.00	3.50	2.00	2.00	3.00	2.00	1.00	1.00	2.00	1.00	9.00
Enterprise 6	8.50	8.50	2.50	9.00	10.00	10.00	4.00	9.00	1.00	7.50	6.50	5.00	1.00	1.00	4.00	2.00	8.00
Enterprise 7	9.00	9.00	1.50	9.00	10.00	10.00	3.00	10.00	1.00	6.00	6.50	5.00	2.00	2.00	5.50	4.00	6.00
Enterprise 8	7.50	6.50	2.50	8.50	9.00	8.50	4.00	8.50	2.00	5.00	5.00	4.00	1.00	1.00	4.00	3.50	7.00
Enterprise 9	1.50	1.00	5.50	6.50	6.50	5.00	2.00	4.50	2.50	3.00	3.00	2.00	1.00	1.00	2.00	1.00	9.00

Step 4: Determining the positive and negative ideal solutions

For the ideal solution from the relevant column of each criterion in the weighted decision matrix, negative ideal values for positive ideal and negative ideal solutions were selected, and ideal and negative ideal solution values were determined. The positive and negative ideal solution sets for each criterion, as shown in Table 14. The objective of TOPSIS is to maximize the benefit criteria and minimize the cost criteria by selecting the alternatives closest to the positive ideal solution. Of the criteria affecting

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the innovation of hazelnut companies, PF1, PF2, PF1, PF2, PF3, MF1, MF2, MF4, FF1, RF1, RF2 and RF3 were benefit criteria while PF3, MF3, FF2, FF3 and RF4 were cost criteria. The highest and lowest values for the benefit criteria were positive ideal and negative ideal solutions, respectively. The highest and lowest values for the cost criteria were negative ideal and positive ideal solutions, respectively

Step 5: Calculating the separation measures

Positive ideal and negative ideal values were subtracted from the values in the column of each criterion, and distances from the positive and negative ideal solutions were determined. The criterion values in the columns were subtracted from the highest values, and the results were squared to calculate the distances to the positive ideal solution, as shown in Table 15 and Table 16.

The criterion values the columns were subtracted from the lowest values, and the results were squared to calculate the distances to the negative ideal solution, as shown in Table 17 and Table 18.

Step 6: Calculating the relative closeness to the ideal solution

For each alternative value, the negative ideal solution value was divided by the sum of its own value and the positive ideal solution value of the same alternative (see Table 19). According to TOPSIS weights, Companies 4 and 1 ranked first and last, respectively.

Table 11. Normalizing the decision matrix

	PF1	PF2	PF3	MF1	MF2	MF3	MNF1	MNF2	MNF3	MNF4	FF1	FF2	FF3	RF1	RF2	RF3	RF4
Enterprise 1	0.09	0.06	0.46	0.21	0.21	0.23	0.13	0.12	0.31	0.22	0.14	0.19	0.29	0.26	0.19	0.14	0.37
Enterprise 2	0.09	0.06	0.42	0.21	0.25	0.21	0.13	0.12	0.46	0.15	0.21	0.19	0.29	0.26	0.19	0.14	0.37
Enterprise 3	0.26	0.15	0.29	0.28	0.23	0.29	0.13	0.27	0.46	0.29	0.38	0.33	0.29	0.26	0.29	0.14	0.37
Enterprise 4	0.44	0.46	0.21	0.42	0.42	0.42	0.39	0.44	0.31	0.40	0.45	0.38	0.29	0.52	0.43	0.50	0.29
Enterprise 5	0.09	0.06	0.42	0.21	0.29	0.34	0.13	0.17	0.31	0.15	0.21	0.19	0.29	0.26	0.19	0.14	0.37
Enterprise 6	0.49	0.53	0.21	0.42	0.42	0.42	0.53	0.44	0.15	0.54	0.45	0.48	0.29	0.26	0.39	0.28	0.33
Enterprise 7	0.52	0.56	0.13	0.42	0.42	0.42	0.39	0.49	0.15	0.44	0.45	0.48	0.58	0.52	0.53	0.57	0.24
Enterprise 8	0.44	0.40	0.21	0.40	0.38	0.36	0.53	0.42	0.31	0.36	0.34	0.38	0.29	0.26	0.39	0.50	0.29
Enterprise 9	0.09	0.06	0.46	0.30	0.27	0.21	0.26	0.22	0.38	0.22	0.21	0.19	0.29	0.26	0.19	0.14	0.37

Table 12 Values of criteria weights

	PF1	PF2	PF3	MF1	MF2	MF3	MNF1	MNF2	MNF3	MNF4	FF1	FF2	FF3	RF1	RF2	RF3	RF4
GW	0.028	0.098	0.144	0.021	0.011	0.009	0.004	0.011	0.019	0.038	0.185	0.221	0.030	0.021	0.059	0.033	0.068

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Table 13. Weighted decision matrix

	PF1	PF2	PF3	MF1	MF2	MF3	MNF1	MNF2	MNF3	MNF4	FF1	FF2	FF3	RF1	RF2	RF3	RF4
Enterprise 1	0.002	0.006	0.066	0.004	0.002	0.002	0.001	0.001	0.006	0.008	0.025	0.042	0.009	0.005	0.011	0.005	0.025
Enterprise 2	0.002	0.006	0.060	0.004	0.003	0.002	0.001	0.001	0.009	0.006	0.038	0.042	0.009	0.005	0.011	0.005	0.025
Enterprise 3	0.007	0.015	0.042	0.006	0.003	0.003	0.001	0.003	0.009	0.011	0.070	0.074	0.009	0.005	0.017	0.005	0.025
Enterprise 4	0.012	0.045	0.030	0.009	0.005	0.004	0.002	0.005	0.006	0.015	0.082	0.084	0.009	0.011	0.026	0.016	0.019
Enterprise 5	0.002	0.006	0.060	0.004	0.003	0.003	0.001	0.002	0.006	0.006	0.038	0.042	0.009	0.005	0.011	0.005	0.025
Enterprise 6	0.014	0.051	0.030	0.009	0.005	0.004	0.002	0.005	0.003	0.021	0.082	0.105	0.009	0.005	0.023	0.009	0.022
Enterprise 7	0.015	0.054	0.018	0.009	0.005	0.004	0.002	0.005	0.003	0.017	0.082	0.105	0.017	0.011	0.031	0.019	0.017
Enterprise 8	0.012	0.039	0.030	0.008	0.004	0.003	0.002	0.005	0.006	0.014	0.063	0.084	0.009	0.005	0.023	0.016	0.019
Enterprise 9	0.002	0.006	0.066	0.006	0.003	0.002	0.001	0.002	0.007	0.008	0.038	0.042	0.009	0.005	0.011	0.005	0.025

Table 14. Positive and negative ideal solution sets

	PF1	PF2	PF3	MF1	MF2	MF3	MNF1	MNF2	MNF3	MNF4	FF1	FF2	FF3	RF1	RF2	RF3	RF4
S*	0.015	0.054	0.018	0.004	0.002	0.002	0.001	0.001	0.006	0.015	0.082	0.042	0.009	0.011	0.031	0.019	0.017
S^-	0.002	0.006	0.066	0.009	0.005	0.004	0.002	0.005	0.009	0.006	0.025	0.105	0.017	0.005	0.011	0.005	0.025

Table 15. Distance to positive ideal solution

	PF1	PF2	PF3	MF1	MF2	MF3	MNF1	MNF2	MNF3	MNF4
Enterprise 1	0.00014949	0.00234601	0.00230800	0.00000000	0.00000000	0.00000003	0.00000000	0.00000000	0.00000000	0.00004762
Enterprise 2	0.00014949	0.00234601	0.00176706	0.00000000	0.00000021	0.00000000	0.00000000	0.00000000	0.00000854	0.00009334
Enterprise 3	0.00005481	0.00154873	0.00057700	0.00000218	0.00000005	0.00000057	0.00000000	0.00000265	0.00000854	0.00001714
Enterprise 4	0.00000698	0.00008247	0.00014425	0.00001965	0.00000536	0.00000358	0.00000110	0.00001248	0.00000000	0.00000000
Enterprise 5	0.00014949	0.00234601	0.00176706	0.00000000	0.00000085	0.00000128	0.00000000	0.00000029	0.00000000	0.00009334
Enterprise 6	0.00000066	0.00000916	0.00014425	0.00001965	0.00000536	0.00000358	0.00000248	0.00001248	0.00000854	0.00003048
Enterprise 7	0.00000000	0.00000000	0.00000000	0.00001965	0.00000536	0.00000358	0.00000110	0.00001662	0.00000854	0.00000190
Enterprise 8	0.00000598	0.00022910	0.00014425	0.00001553	0.00000343	0.00000175	0.00000248	0.00001063	0.00000000	0.00000190
Enterprise 9	0.00014949	0.00234601	0.00230800	0.00000388	0.00000048	0.00000000	0.00000027	0.00000118	0.00000213	0.00004762

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Table 16. Distance to positive ideal solution (continued).

	FF1	FF2	FF3	RF1	RF2	RF3	RF4	TOPLAM	KAREKÖKÜ	S*
Enterprise 1	0.00325378	0.00000000	0.00000000	0.00002940	0.00039667	0.00019800	0.00006901	0.00879804	0.09379790	S1
Enterprise 2	0.00196833	0.00000000	0.00000000	0.00002940	0.00039667	0.00019800	0.00006901	0.00702610	0.08382186	S2
Enterprise 3	0.00016068	0.00099675	0.00000000	0.00002940	0.00020238	0.00019800	0.00006901	0.00386695	0.06218480	S3
Enterprise 4	0.00000000	0.00177200	0.00000000	0.00000000	0.00003238	0.00000550	0.00000766	0.00209246	0.04574343	S4
Enterprise 5	0.00196833	0.00000000	0.00000000	0.00002940	0.00039667	0.00019800	0.00006901	0.00701979	0.08378418	S5
Enterprise 6	0.00000000	0.00398702	0.00000000	0.00002940	0.00007285	0.00008800	0.00003067	0.00444463	0.06666806	S6
Enterprise 7	0.00000000	0.00398702	0.00007500	0.00000000	0.00000000	0.00000000	0.00000000	0.00411880	0.06417789	S7
Enterprise 8	0.00036153	0.00177200	0.00000000	0.00002940	0.00007285	0.00000550	0.00000766	0.00266404	0.05161442	S8
Enterprise 9	0.00196833	0.00000000	0.00000000	0.00002940	0.00039667	0.00019800	0.00006901	0.00752052	0.08672096	S9

Table 17. Distance to negative ideal solution

	PF1	PF2	PF3	MF1	MF2	MF3	MNF1	MNF2	MNF3	MNF4
Enterprise 1	0.00000000	0.00000000	0.00000000	0.00001965	0.00000536	0.00000290	0.00000248	0.00001662	0.00000854	0.00000762
Enterprise 2	0.00000000	0.00000000	0.00003606	0.00001965	0.00000343	0.00000358	0.00000248	0.00001662	0.00000000	0.00000000
Enterprise 3	0.00002391	0.00008247	0.00057700	0.00000873	0.00000434	0.00000128	0.00000248	0.00000598	0.00000000	0.00003048
Enterprise 4	0.00009567	0.00154873	0.00129825	0.00000000	0.00000000	0.00000000	0.00000027	0.00000029	0.00000854	0.00009334
Enterprise 5	0.00000000	0.00000000	0.00003606	0.00001965	0.00000193	0.00000057	0.00000248	0.00001248	0.00000854	0.00000000
Enterprise 6	0.00013022	0.00206192	0.00129825	0.00000000	0.00000000	0.00000000	0.00000000	0.00000029	0.00003417	0.00023050
Enterprise 7	0.00014949	0.00234601	0.00230800	0.00000000	0.00000000	0.00000000	0.00000027	0.00000000	0.00003417	0.00012192
Enterprise 8	0.00009567	0.00110885	0.00129825	0.00000024	0.00000021	0.00000032	0.00000000	0.00000066	0.00000854	0.00006858
Enterprise 9	0.00000000	0.00000000	0.00000000	0.00000606	0.00000263	0.00000358	0.00000110	0.00000893	0.00000213	0.00000762

Table 18. Distance to negative ideal solution (continued).

	FF1	FF2	FF3	RF1	RF2	RF3	RF4	TOPLAM	KAREKÖKÜ	S*
Enterprise 1	0.00000000	0.00398702	0.00007500	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00398702	S1
Enterprise 2	0.00016068	0.00398702	0.00007500	0.00000000	0.00000000	0.00000000	0.00000000	0.00016068	0.00398702	S2
Enterprise 3	0.00196833	0.00099675	0.00007500	0.00000000	0.00003238	0.00000000	0.00000000	0.00196833	0.00099675	S3
Enterprise 4	0.00325378	0.00044300	0.00007500	0.00002940	0.00020238	0.00013750	0.00003067	0.00325378	0.00044300	S4
Enterprise 5	0.00016068	0.00398702	0.00007500	0.00000000	0.00000000	0.00000000	0.00000000	0.00016068	0.00398702	S5
Enterprise 6	0.00325378	0.00000000	0.00007500	0.00000000	0.00012952	0.00002200	0.00000766	0.00325378	0.00000000	S6
Enterprise 7	0.00325378	0.00000000	0.00000000	0.00002940	0.00039667	0.00019800	0.00006901	0.00325378	0.00000000	S7
Enterprise 8	0.00144612	0.00044300	0.00007500	0.00000000	0.00012952	0.00013750	0.00003067	0.00144612	0.00044300	S8
Enterprise 9	0.00016068	0.00398702	0.00007500	0.00000000	0.00000000	0.00000000	0.00000000	0.00016068	0.00398702	S9

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Table 19. Relative closeness to the ideal solution

C*		Sıralama	Hazelnut Enterprises
C^*_1	*0.406439*	*9*	Enterprise 1
C^*_2	0.439059	7	Enterprise 2
C^*_3	0.498119	5	Enterprise 3
C^*_4	*0.650000*	*1*	Enterprise 4
C^*_5	0.439167	6	Enterprise 5
C^*_6	0.560747	4	Enterprise6
C^*_7	0.595229	2	Enterprise7
C^*_8	0.574164	3	Enterprise8
C^*_9	0.429278	8	Enterprise9

CONCLUSION

Innovation is a complex process that creates value for companies, regions and countries. Companies that wish to sustain a competitive advantage in domestic and international markets should have a creative organizational climate for innovation and determine the factors that affect innovation in order to manage it (Hancıoğlu 2017; Hancıoğlu and Atay, 2017). Today, export is a very effective instrument for companies and countries to achieve added value. This makes not only international markets more attractive but also the quality of export products more important (Ayar and Erdil, 2018). The hazelnut companies in Turkey should convert hazelnuts into high value-added products to be able to gain a competitive advantage in international markets, which can only be achieved by innovation. Innovation helps companies reduce their external dependence and increase productivity and achieve success by using their resources efficiently, and therefore, guarantees long-term sustainable economic growth.

The aim of this study was to identify the criteria affecting the innovation performance of hazelnut companies and determine the best hazelnut company accordingly. AHP was used to determine the weights of the criteria and subcriteria, and then, TOPSIS was used to rank the alternatives. According to the AHP results, financing function (0.433) was the most important criterion, followed by production function (0.267), R & D function (0.189), management function (0.071) and marketing function (0.040). The most important subcriteria for production function, marketing function, management function, financing function and R & D function were "problems with the supply of quality raw materials (0.535)", "market research and market testing (0.524)", "qualified human resources (0.520)", "access to capital (0.425)" and "resistance to change (0.355)", respectively. According to the TOPSIS results, Company 4 had an index value of 0.65, and therefore, was the best alternative in terms of innovation performance.

The results indicate that financing sources are one of the most important factors affecting the innovation performance of hazelnut companies. They, however, have too limited access to capital to make innovative decisions and to increase their market shares. Another challenge faced by hazelnut companies interested in developing new products is shortage of supply of quality raw materials. Öztürk et al. (2017: 1657) reported that the main problem faced by the hazelnut exporting companies in Ordu was the decrease in product quality due to aflatoxin, invisible rot and rancimat. Therefore, public administration should take steps for more efficient pest and disease management in hazelnut orchards and raise producers' awareness

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and support them in that regard. R & D activities play an important role in innovation. However, R & D was the third important criterion affecting the level of innovation for our participants. The low R & D investment in the hazelnut sector is, therefore, the biggest obstacle to the conversion of hazelnut into value-added products. Financial support for R & D activities is a crucial driving force. The success of financially supported R & D activities depends on the availability of qualified work force because it is the creative people who can innovate. If R & D staff does not have entrepreneurial spirit, then economic and social value cannot be created, and R & D activities cannot be transformed into innovation. Therefore, employees of today should know what characteristics creative people possess and acquire them through education and effort. For successful innovation, managers' and employees' resistance to change should first be eliminated. Innovation begins with ideas, and therefore, employees should be provided with an environment that promotes creativity. Since innovation is a process involving uncertainty and risk, senior managers should have the ability to take risks and assess challenging opportunities. Although R & D supports innovation, innovation is not just an R &D activity. Successful innovation requires collaboration and communication among different stakeholders. Innovation is a team work. Problems in superior-subordinate communication prevent teamwork and adversely affect innovation. Marketing function is the last criterion that affects the innovation performance of the hazelnut companies. The key to success in marketing is to be customer-oriented, which is based on a strong understanding of market research. R & D and innovation are essential pillars for the transformation of hazelnut into high value added products. Therefore, hazelnut companies should be financially supported so that they can focus on R & D.

The limitation of this study is that the sample was restricted to a single geographic area and consisted only of hazelnut companies in Ünye due to cost and time constraints. It is, therefore, recommended that future studies draw samples from hazelnut companies of different sizes in different regions of Turkey to identify different regional factors affecting innovation.

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This study was carried out by creating a new survey with results obtained from the study titled "Determination of Factors Affecting Innovation in Hazelnut Enterprises by AHP Method: An Application in Ünye District" presented at II. Business & Organization Research Conference held from 04-06 September 2019,suggestion during the presentation, literature research. The study titled "Determination of Factors Affecting Innovation in Hazelnut Enterprises by AHP Method: An Application in Ünye District" is aimed to determine how the enterprises that export hazelnuts in national and international markets in the Ünye District of Ordu define the concept of innovation, what developments they can consider as innovation in their enterprises, what are the criteria that positively and negatively affect innovation levels and the importance of these criteria. In the book section entitled" Evaluation of Innovation Performance with AHP and topsis Integrated Approach: an Application in Hazelnut Sector", micro factors affecting innovation were classified as 5 main criteria and the enterprises exporting hazelnuts in the national and international markets of Ünye district of Ordu were ranked according to their innovation performance using the TOPSIS method.

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KEY TERMS AND DEFINITIONS

Creativity: Creativity is a thought system that helps create ideas.

Diffusion: It is the way innovations are distributed to various consumers, sectors, regions, markets, countries, and businesses from the first application, via market or non-market channels.

Innovation: Innovation is the implementation of new ideas and methods.

Innovation Activities: Innovation activities are all technological, scientific, financial, organizational, and commercial steps that lead or are expected to lead to the implementation of innovations.

Innovation Process: The innovation process needs inputs such as R&D, specialized human resources, or technical equipment, and produces some outputs, such as new or significantly improved products.

Research and Development (R&D): R&D is the systematic work that is carried out systematically to increase knowledge and the use of this information to create new applications.

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Chapter 17
The Differences in Leadership Styles Among Generations

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ABSTRACT

Studies show that there are differences among generations in terms of characteristics and work attitudes and values, and these differences in their work values and attitudes as well as their characteristics affect their leadership styles at the workplaces. However, little research has been produced from the perspective of leaders. This research's purpose of the project is to set forth whether the leaders in different generations are adapting different leadership styles according to the generations or not in order to be successful during their leadership. The study was conducted in automotive industry in Turkey. Two mixed focus group discussions were conducted with leaders representing each generational cohort groups. The study's results support that there are more differences than the similarities among the generations, which is in compliance with many studies conducted by the researchers. Also, the leaders tend to adapt different leadership styles according to the generations of their subordinates.

INTRODUCTION

One of the challenges in the workplaces is managing a diverse team consisting of employees from different generations. The workforce is comprised of four generations, namely Silent Generation, Baby Boomers, X Generation and Y Generation. It is getting more important to understand the unique leadership needs of each generation, since a leader needs to get every generation to accomplish the mission.

The leaders are not being selected only according to their ages. At the present time, a leader may come from any generation. In many companies, it is observed that X Generation is leading Baby Boomer or vice versa, or Y Generation is leading X Generation or vice versa. The age does not necessarily equate to seniority. Because each generation may lead the other as the case may be, cross generation differences

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become more important to understand whether the leadership styles are affected by the generational differences. Accordingly, the literature is reviewed to find out a relationship between leadership styles and generational cohorts.

The common ground of the literature regarding generations at work is that there are differences amongst the different generations on basic work characteristics such as work related values, expectations and attitudes (Atabay, Penbek, Zaptçioğlu and Ucel, 2013). A leadership style's effectiveness, productiveness and success are linked by many authors with the work values, ideas, preferences, and expectations that different generations have regarding the leadership (Cennamo and Gardner, 2008; Weston, 2001; Tulgan, 1996). People of different generations with different expectations, preferences and ideas regarding leadership might have different preferences on managing or being managed (Weston, 2001). Joshi et al. (2010) suggest that more research is required for generational phenomena in order to come through the challenges in the organizations. In fact, researches at the literature made different conclusions regarding the generational differences on leadership style and these conclusions are not consistent entirely. Moreover it is detected that in the literature, many research have been done to explore what leadership style is preferred by the employees from different generations and the effect of perceived leadership styles of employees. However, there is a lack of searches in the literature that evaluate the issue from the perspective of leaders.

Accordingly, the primary aim of this study is to understand whether the differences amongst generations have an impact over leadership style and are the leaders taking into account the generations of their subordinates while leading. The main research questions to be answered are:

(i) Are there any differences on leadership style amongst generations?
(ii) Do leaders adapt different leadership styles according to the generations of their subordinates?

For the purposes of answering the research questions above, qualitative research was made by organizing focus groups within a Turkish subsidiary of an international company operating in automobile sector. The study with the method of focus group made it possible by observation of the participants' interaction to get a result on whether people belonging different generations have different leadership style preferences and whether they take attention to the generations while they lead their teams. In this study generational differences are examined in three groups; Generation X, Generation Y and Generation Baby Boom. As a matter of fact, this classification of the generations is the most common in the literature. The leadership styles identified by Goleman (2000b) have been used, because these styles cover all the behaviours mentioned in the remaining literature.

The focus groups provided awareness on whether there are indeed differences in leadership style amongst generations from leaders' perspective and on the need of adapting different leadership styles for different generations. When leaders understand that each generation chooses a different type of management, they will be able to take more attention to the generations of their subordinates and their preferred leadership style. This knowledge would enable the leaders to adapt the appropriate leadership style for the relevant generations.

The study is divided into 3 sections. The first section provides information on leadership, leadership styles and generational cohorts. The following section explains the methodology of the study. Final section concludes the study's outcomes and recommendations by providing a summary of the results.

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THEORETICAL FRAMEWORK

Leadership is an important notion that inspired many theories and definitions. Information on the concept of leadership, leadership styles and generational cohorts are discussed in this section.

The Concept of Leadership

The literature contains various leadership definitions. There is no definition commonly agreed in the literature. Leadership has been defined from several perspectives. The common point of the definition is that the leadership covers the influence effect over a group of people to perform goals.

As mentioned before, there are many definitions of leadership in the literature. Some of them are as follows:

Leaders are agents of change – persons whose acts affect other people more than other people's acts affect them (Bass, 1990).

Schein (1992) defines leadership as the ability to step outside the culture (…) to start evolutionary change processes that are more adaptive.

Leadership is the manner in which the project managers conduct themselves in their role in order to obtain the best performance from the people they are managing (Walker et al., 1996).

Some of the researches describe leadership as a process. Leadership is a process whereby an individual influences a group of individuals to achieve a common goal (Northouse 2007); a process of influencing people to accomplish goals (Huber et al. 2000) and a process (act) of influencing the activities of an organized group in its efforts toward goal setting and goal achievement (Stogdill 1950).

According to Prentice (1961), leadership is the accomplishment of a goal through the direction of human assistants (Prentice 1961).

Leadership is the art of mobilizing others to want to struggle for the shared aspirations (Kouzes and Posner 1995).

It can be observed from the definitions above that the common key elements in the leadership definitions are influence, goal and relationship/interaction.

As long as there is people organized into groups, there is also leaders within those people who organize these people (Chemers 1997). But being in the leadership position does not mean that this person is a leader (DuBois et al. 2015). Leaders have the roles and responsibilities of being a leader (Molinaro 2015). According to Bennis (1989), there are certain characteristics that create a leader, these are; guiding others toward a goal, influencing others to make a difference, or working effectively with and through others.

According to Northouse (2007), leadership and management are different concepts. This idea is supported by Kotterman (2006) as well. The managers develop plans and budgets, whereas leaders give direction and vision (Kotterman 2006).

Leadership Theories

Various theories of leadership is developed in the past century to clarify leadership. Back at 1930s through the 1950s the focus was on characteristics which make a great leader.

Trait theory or great man theory discussed, if the traits of a successful leaders could be determined via studies, people with the same traits characteristics should lead in a succesfull manner as well. But this theory is found uneffective and in 1950s behavioral theory is introduced (Clarke 2014). Later on, as from

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1960s until 1970s, the focus directed to situation theory which is based on the role of circumstances for defining the leadership (Bass 1990). A situational aspect is added to trait theory and behavioral theory through this theory.

In the last decade, transformational leadership became popular in studies, which is introduced by Burns in 1978 and developed by Bass. Through this leadership, it is assumed that the leaders inspire intrinsic motivation in their followers (Northouse 2007). Moreover up to the late 1970s, transactional leadership became the preferred model of leadership theory used in many companies. As a result of the comprehensive studies, the researches came to the outcome that, focus of transactional leaders is on addressing immediately the self-interest of their followers, while transformational leaders motivate and encourage the constant moral of their followers (Clarke 2014).

Leadership Styles

Like the leadership definitions, various definitions of leadership styles can be found in the literature. According to the definition of leadership style made by Huber et al. (2000), the leadership style is the combination of relationship behaviors which are used to influence people to have the goals accomplished.

Each leadership style has its own effectivity and productivity based on the situation (Tulgan 1996). Leaders have to perform different tasks and accordingly they have completely different ways to accomplish those tasks. These differences are a start to define the leaders' style (Gardner 1990).

According to Goleman (2000b), leadership style affects the organizational climate, and six different leadership styles exist depending on emotional intelligence competencies (Goleman 2000b). Each style fits for different conditions and needs of the employees (Goleman 2000b). Below Table 1 summarizes the different six leadership styles identified by Goleman (2000b).

Table 1. The six leadership styles

	Coercive	Visionary	Affiliate	Democratic	Pace-setting	Coaching
The leader's modus operandi	Demands immediate compliance	Mobilizes people towards a vision	Create harmony and builds emotional bonds	Forges consensus through participation	Sets high standards for performance	Develops people for the future
The style in a phrase	"Do as I say"	"Come with me"	"People come first"	"What do you think"	"Do at my pace"	"Try this"
Underlying emotional intelligence competencies	Drive to achieve, initiative, self-control	Self-confidence, empathy, change catalyst	Empathy, building relationships, communication	Collaboration, team leadership, communication	Conscientious, drive to achieve, initiative	Developing others, empathy, self-awareness
When the style works best	In crisis, to kick start a turnaround or with problem employees	When changes require a new vision, or when a clear direction needed	To heal rifts in a team or to motivate people during stressful circumstances	To build buy-in or consensus, or to get input from valuable employees	To get quick results from a highly motivated and competent team	To help an employee improve performances or develop long term strengths

Source: Goleman, 2000b.

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Four amongst six leadership styles are identified as the resonant styles, whereas the remaining two styles are identified as the dissonant styles. The visionary (sometimes called the “authoritative”), the coaching, the affiliative, and the democratic styles are the ones known as the resonant styles and these impact the organizational climate positively. Dissonant styles are the pace-setting and the coercive styles, and these may have a negative impact over the organizational climate when used in an incorrect manner (Goleman 2000a). In his study about leadership styles and organizational climate, Goleman (2000b) explained that:

The business environment is continually changing and a leader must respond in kind. Hour to hour, day to day, week to week, executives must play their leadership styles like a pro — using the right one at just the right time and in the right measure. The payoff is in the results.

Pace-Setting

Accomplishing tasks with high standard of excellence is the primary aim of this style. If high quality results are to be obtained from motivated employees, the most effective way is this style. However if the employees seek feedback and would like to receive development plans for their improvement, this style is the least effective one (Goleman 2000a). In fact, Goleman (2000b) found in his study that pace-setting leadership style had a negative correlation with organizational climate.

Coercive

Employees’ immediate compliance is the primary aim of the coercive style. This style is the most effective in crisis and when facing with problems. On the other hand, this style mostly decrease the performance and blocks the flexibility in the organization (Goleman 2000a).

Visionary

If the aim is to provide long term direction and vision to the employees, the visionary style is the right style. When a new vision is required due to the changes or employee requires clear direction, the most effective style would be this style. However, if the leader works with the more experienced experts than he is, this style is least effective (Goleman 2000a).

Affiliative

This style is effective in order to create harmony within employees and between the leaders and employees. It is most effective when people needs to be motivated under stressful conditions, but least effective when a negative feedback will be given (Goleman 2000a).

Democratic

The primary aim of this style is to build commitment and consensus amongst employees. This style is not effective if the employee has not receive any training for consensus building and democratic decision-

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making. This style is most effective when buy-in consensus will be built for gaining valuable input from the employees (Goleman 2000a).

Coaching

The primary aim of this coaching style is employees' long-term professional development. This style is effective when helping the employees to improve their performances. However if the employees are resistant to changing their ways, this style is least effective (Goleman 2000a).

GENERATIONAL COHORTS

A generation is the group of individuals that share birth years, age, geographic location, and have experienced the same important life events at their life's specific stages. Values and attitudes of each generational cohort group have been formed by the world events happened during respective years that they experienced.

The Baby Boomers grew up with stay-at home mothers, in a time of economic prosperity (Zemke et al. 2000). The civil rights movement, the assassinations of John F. Kennedy and Martin Luther King, the Vietnam War, the first landing on the Moon, the women's liberation movement are the events this generation experienced (Alwin 1998). From technology perspective, Baby Boomers experienced the introduction of the color TV, the photocopier, and touch-tone dialing in developed countries. However, while the world was experiencing the heyday for radio and human rights, Baby Boomers in Turkey were living hard days due to Turkish revolution and transition to multi-party democracy since Turkey is a developing country (Topcuoglu 2007).

Generation X grew up with working mothers (Losyk 1997). Cufaude (2000) explained that this generation came to an empty home every day when they were children since their parents were working. They have been shaped by the events of the fall of the Berlin Wall; and the spread of AIDS (Losyk 1997). On the other hand, while their peers in Western societies were benefiting from the advantages of technological developments such as the internet, Generation X in Turkey were having trouble of transition to liberal economy, economic crisis and ethnic terrorism (Topcuoglu 2007).

Generation Y is the one who experienced the development of technology closely. Generation Y grew up in a world of cell phones and the Internet. In the world that they experienced, everyone is connected to each other through internet, and information is a click away (Oreg 2003). Generation Y in Turkey matched with their peers in the Western countries, since all were born to the age of technology. With the improvement in transportation and information flow globally due to technological advancements, the gap between generations in Turkey and Western countries went down for Generation Y (Topcuoglu 2007).

Also; common conclusion of the researches is that expectations, work values, work characteristics and goals of the generational cohorts differ considerably (Cennamo and Gardner 2008). The values and mindsets are formed by experiencing historical events at approximately the same age, which creates collective memories and similar approaches to institutions and authority (Baker 2015). From this logic, the differences in the experiences had by the generational cohorts enable the understanding of the key differences in their attitudes and core values.

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Thus, preferred leadership style is also different for generations. Leadership styles are formed by differences in beliefs, attitudes, and values (Zemke et al. 2000). From this aspect, it appears that generational differences could create different preferences for leadership style.

The characteristics that individuals expect from their leaders also differ according to each generation cohort (Salahuddin 2010). Generational characteristics have an important role for the preferences of the employees to be led and managed (Cennamo and Gardner 2008). Jeffries and Hunte (2004) supports the same conclusion and found that the specific characteristics of generational groups give leaders a starting point for better understanding their subordinates and their leadership preferences. Differences existing between the generation cohorts with respect to leadership cover the work values, employees' retention, the perception of being a good leader, and issues related to motivation (Arsenault 2004).

For example for Baby Boomer and Generation X, it was found in a study comparing these two generations, that Generation X differs from the Baby Boomers since Generation X prefers challenging tasks accomplished within a workday versus several workdays; surfing and using the internet instead of using the telephone; having flexible work hours instead of having regularly scheduled hours (Rodriquez, Green, and Ree 2003). Unavoidably, the difference of working method would lead a leader from Generation X to act in line his/her preferences but these will be not welcoming by his/her Baby Boomer subordinates. On the other hand, it is found that Generation Y employees want open and positive managers that would empower them (Broadbridge et al. 2007). In addition, Twenge and Campbell (2008) found that this generation expects genuineness from a leader. Moreover, Generation Y has been found to want leaders who challenge the status quo (Arsenault, 2004).

METHODOLOGY

Objectives of The Study and Hypothesis

The literature argued for the existence of differences in core values, characteristics and perception of business ethics amongst the generation and these result in differences in leadership styles among the generations (Meriac, Woehr, Banister, 2010; Zemke, Raines, Filipczak, 2000). With this study, this argument will be further explored in the context of a Turkish subsidiary of an international company operating in automobile sector. Literature investigates leadership styles of generations mostly in terms of generations' views and expectations from the leaders (Sessa, Kabacoff, Deal, Brown 2007). However, little research has been made from the perspective of leaders and their preferred leadership behaviors towards their subordinates belonging different generations. In this study, the aim was to focus the view of leaders leading different generations in the workplace, who need to ensure the harmony in their team.

With respect to this study's research questions, research hypotheses were formulated as following:

H_1: There are differences in leadership style amongst generations.
H_2: Leaders adapt different leadership styles according to the generations of their subordinates.

Research Design and Methodology

In order to answer the research questions, qualitative research methods are used. Qualitative research method is adapted for the purposes of achieving detailed understanding of the subject (Mariampolski,

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2001). Two focus groups have been conducted with the participation of the leaders within a Turkish subsidiary of an international company active in automobile sector.

This study is explorative since it is formed to explore the participant's underlying values, concepts, and norms (Ritchie and Lewis, 2003). It is aimed to understand through these focus groups, the preferred leadership style of different generational cohorts and on how they adapt their leadership style to be as effective as possible for their subordinates belonging different generations. This explorative study includes broad questions other than the research question, which provide the participants courage to express their preferences (Ritchie and Lewis, 2003). Due to the explorative nature of this study, the research questions are researched in a qualitative manner by acquiring data from focus groups. Qualitative methods enable participants to explain their thoughts freely (Mariampolski, 2001).

In this study, the leadership styles identified by Goleman (2000b) were used, because these styles cover all the behaviours mentioned in the remaining literature. The focus group meetings took approximately one hour. The focus groups have been led by one researcher who acted as a mediator. Discussions in the focus groups were transcribed on laptop and recorded. The researcher led the participants talk and share ideas and experiences without any restrictions and all preformed questions were asked in an independently flowing dialogue format. In line with recommendations for focus group research in the literature, a conversational approach is adapted to ease the discussion (Krueger, 1997). The focus group meetings started by receiving generational background information such as age, working experience, number of employees in their team, and ended by presenting gratitude.

Focus Group

Focus group which is a qualitative research method was used for this study. This method is used to explore new ideas (Hannum, 2004). A focus group is a discussion group enable a few group of people discuss a certain topic (Marelli, 2008). In focus groups, it is possible to report the factual data and interpret the opinions (Chioncel,Van der Veen, Wildemeersch, Jarvis, 2003). In focus groups, group interaction can be actively encouraged (Barbour and Kitzinger 2001). In the focus group discussions, the participants are actively interaction with each other and can share their values, thoughts within the group (Hannum, 2004, Barbour and Kitzinger, 2001). Accordingly, with the help of this method, the opinions and preferred behaviours of the leaders working in the Turkish subsidiary of an international company active in automobile sector are understood. Since there were discussions going on, participants brought new unexpected ideas and opinions which they would not have mentioned if a survey or one to one interview would have been done.

The aim is not to reach generalizations, but to reveal opinions. Therefore, there is no need for percentage, frequency or statistical tests and tables when giving results. Moreover, the results should not be quantified. It is important how the differences of individual thoughts are given rather than numerical data (Çokluk et al. 2011).

In this study, the focus group is a good method to understand the preferences of different generations for leadership style. It made it possible by observation of the participants' interaction to get a result on whether people from different generations have different preferences for leadership styles and whether they take attention to the generations while they lead their teams.

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Sample and Data Collection

The current study's sample consisted of in total sixteen employees who are in the position of a leader at a Turkish subsidiary of an international company active in automobile sector. Thirty leaders employed in that company have been invited via e-mail to join the focus group and sixteen of them accepted. In these invitations via e-mail information is provided regarding the subject of the discussion and a cover letter explaining the purpose of the survey. Participation to the study was voluntary. Participants were confident that their responses would remain confidential and anonymous. Demographic characteristics of the sample: İt consist of 16 participants 5 of which are woman and 11 of which are men. 5 of the participants are between 56-74 years old, 6 of them are between 40-55 years old and 5 of them are between20-39 years old. All of the participants have at least under graduated degree.

For the purposes of this study, a leader is considered as the person who is in the position requiring independent judgment and has supervisory authority over a specific department. Accordingly, the leaders are department heads under this study.

Focus groups can be homogeneous and heterogeneous, but heterogeneous focus groups should be used when collecting participants for focus groups for the purposes of comparing opposite opinions (Zeist, 2011). Accordingly, since the aim for this study was to compare different preferences in leadership style of the generations, heterogeneous focus groups have been formed.

The study focused on members of Generation Baby Boomer, Generation X and Generation Y who are currently employed in the same organization and have a leadership position. Two mixed focus group with different generations have been used. In both groups, leaders from different generations as well as same generations were present in order to compare differences or similarities for leadership preferences among the different generations.

The first mixed group consists of eight leaders; three from Babyboomer Generation, two from Generation X and two from Generation Y. The second mixed group also consists of eight leaders; two from Babyboomer Generation, three from Generation X and two from Generation Y. This data can be found in Table 2 below:

Table 2. Sample Figures

	Number of Generation Y participants	Number of Generation X participants	Number of Baby Boomer participants
Mix Group 1	2	3	3
Mix Group 2	3	3	2
Total	5	6	5

The generational distribution of the sample is provided under the Table 3 below:

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Table 3. Generational Distribution Of The Sample

Generational Cohort	Number of participants	Percentage of sample
Baby Boomers (1946-1964)	5	%31,2
Generation X (1965-1980)	6	%37,6
Generation Y (1981-2000)	5	%31,2
Total	16	%100

MEASURING INSTRUMENT

Thirteen questions were prepared beforehand to keep the discussion going and to receive information regarding preferences for leadership by the leaders and their leadership styles adapted according to the generations of their subordinates. The questions are provided in Appendix 1.

First question is demographic question asking the ages of the participants to understand which generation they belong to. Second question aims to understand the experience of the leader. Third, fourth and fifth questions have the purpose of understanding whether the leaders do take attention their subordinates' generation. The remaining eight questions assess participants' preferred leadership style. The last eight questions were used before by Zeist (2011) in her Master thesis. Zeist (2011) used this questionnaire to explore generational differences, leadership styles and team climate. The first five questions are self-developed for and tailored to the specific needs of this study.

CODING

The best way to analyze the data for the focus group is to determine codes/keywords under certain headings (Creswell 1998). According to Miles and Huberman (1994), keywords are efficient data labeling and data retrieval tools empowering and speeding up analysis. Accordingly, a preliminary list of keywords are prepared beforehand in this study and the respondents by the participants of the focus groups were coded and categorized to one or more of the leadership styles. Each type of leadership style has been given with certain keywords, which are based on Goleman (2000a and 2000b).

Table 4. Keywords for Leadership Style

Leadership style	Keywords
Pace-setting leader	Decisive, task-oriented, formal, number Oriented, long-term oriented, high performance
Democratic leader	Solution for work related problem, involve, consider the views, trust, team, people oriented, participative, collaboration, consensus
Coercive leader	Solve problem in crisis, ask what to do, control
Visionary leader	Vision, direction, empathy, mobilizes towards a goal, set achievable goals, plan the future, flexible, clear instructions
Affiliative leader	Communication, positive feedback, trust, harmony, motivation, relationship
Coaching leader	Development, commitment, improve performance, constant feedback

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The keywords used by each generation sorted out in order to identify their preferred leadership. The keywords including the leadership style they represent can be found in Table 4 above.

The keywords given for a leadership style were categorized to view which generation has given the least and the most keywords for that particular leadership style. With help of the keywords, an analysis and conclusions were made.

DATA ANALYSES AND RESULTS

During the focus groups, the comments of the participant were noted, and voice recorder was used to collect the data. Participants were asked the questions prepared before to share their opinion and preferences for leadership style. To analyze the data obtained by focus groups, keywords were used. Goleman's (2000a and 2000b) leadership styles framework was used and the keywords were clustered under six leadership styles.

During the analyses, in order to see how many keywords were used by each generation, the keywords given for each leadership style were categorized. Most keywords used by specific generation for a particular leadership style shows the preferred leadership style by that generation. Analyzing the data with the keywords made it easy to come to conclusions on the preferred leadership style of different generations.

In total one hundred and twenty keywords on leadership styles were derived from the focus groups. These statements were categorized into six leadership style categories, consisting of pacesetter, democratic, coercive, visionary, affiliative and coaching leadership styles.

The results and the summary for the preferred leadership style from the most to the least can be found in Table 5 below. As can be seen in Table 5, the visionary leadership style is most valued by Generation Y, whereas Generation X shows the highest percentages for the coaching leadership style, and Generation Babyboomer mostly prefers democratic leadership style.

According to the Table 5, leaders from Generation Babyboomer find the democratic leadership style more attractive than the other styles, where leaders from Generation Y and X valued different leadership styles the most. Except the visionary and coaching styles, every leadership style was valued nearly the same extent by Generation X and Generation Y. Contrary to Generation X, Generation Y valued the visionary leadership style the most. Generation X valued the coaching leadership style the most.

Only one keyword is detected related to coercive leadership style which is used by one leader belonging to the Generation Y. The pacesetting leadership is also one of the less preferred leadership styles among all the generations. This leadership style is the second last one among the six leadership styles. Generation Y is the one which is the closest to use the pacesetting leadership. The leader from Generation Y, who used the keyword for pacesetting in the focus group discussions, mentioned that she is aware that none of the generations' expectation is a pacesetting leadership style but it may be necessary in some specific cases to adapt pacesetting leadership style and be task oriented. She added that being a pacesetter may sound terrifying but may be useful in certain cases as all leadership styles have their own advantages if they are used properly at the right time.

There are no significant difference between the generations regarding the affiliative leadership style. The approaches of all generations were close to each other when it somes to affiliative leadership style. Accordingly similarities in leadership styles among the generations are also observed in this leadership style.

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Table 5. Results, Preferences Of Generations For Leadership Style

Generation	Leadership style	Keywords	% within leadership style
X	Pacesetter	1	2.7
	Democratic	8	22
	Coercive	0	0
	Visionary	7	19.5
	Affiliative	7	19.5
	Coaching	13	36.3
Y	Pacesetter	5	9.8
	Democratic	12	23.5
	Coercive	1	1.9
	Visionary	20	39.2
	Affiliative	9	17.6
	Coaching	4	8
Baby Boomer	Pacesetter	1	3
	Democratic	12	36.4
	Coercive	0	0
	Visionary	7	21.2
	Affiliative	10	30.3
	Coaching	3	9.1

According to these results H_1 supported.

Table 6 presents the ranking of the three generations' preferences for leadership styles. Coercive leadership is the least preferred one by all generations. However, there are some deviations between the preferences of different generations in terms of the most preferred leadership style. The results which were gathered in this study are presented in the following table.

Moreover it is detected that 62.5% of the leaders do know the exact ages and the generations of their subordinates. The relevant data collected from participants during focus groups are as follows:

Generation X is the one that do value the ages during leading the teams whereas the Generation Y has less awareness of the ages of their subordinates. Since Generation Y is the youngest generation, this can be an argument as the reason of this result. According to these results H_2 has been partially supported.

LIMITATIONS AND RECOMMENDATIONS

In order to have more certain result, the characteristc of each person should be also taken into account. People irrespective from which generation they belong to may have the most and the least preferred leadership styles, since not every member of a generation thinks or acts exactly same. Therefore, it is also important to take into account that the characteristics of the three generations are sensitive for stereo-

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typing. For a more certain result, future researches may create a larger sample with more focus groups, preferably in different organizations. Samples from different organizations may enable the researchers to generalize the results.

In this study only heterogeanous focus groups are used. It might be interesting to have also homogeneous groups in addition to the heterogeanous focus groups. It can make it possible to detect whether the participants gave different answers when the participants of the group differs. Moreover in this study, generations were not equally represented in the mix groups, therefore equally representation of the generations in the focus group can be recommended for a clearer result.

Table 6. Results, Deviation of Generations Within Leadership Style

Leadership Style	Keywords#	Generation	Keywords#	% within Generations
Pacesetter Leadership 5.7%	7	X	1	14.2
		Y	5	71.6
		Baby Boomer	1	14.2
Democratic Leadership 26.7%	32	X	8	25
		Y	12	37.5
		Baby Boomer	12	37.5
Coercive leadership 0.8%	1	X	0	0
		Y	1	100
		Baby Boomer	0	0
Visionary Leadership 28.4%	34	X	7	20.5
		Y	20	59
		Baby Boomer	7	20.5
Affiliative Leadership 21.7%	26	X	7	27
		Y	9	35
		Baby Boomer	10	38
Coaching Leadership 16.7%	20	X	13	65
		Y	4	20
		Baby Boomer	3	15

Table 7. Knowledge On the Exact Age of The Subordinates

Generation	Do you know the exact age of your subordinates?	
	Yes	**No**
X	5	1
Y	2	3
Baby Boomer	3	2
Total	**10**	**6**

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In this study, other aspects of diversity, such as gender and job definition have not been taken into account. It can be tested whether the preferences of leaders from different generations are affected by other diverse dimensions.

CONCLUSION

The aim of this study was to understand whether there are any differences in leadership style among generations and if so, whether leaders take into account the difference in generations while leading. With the use of focus groups, information for analyses and explore the reserach questions has been gathered. The study included focus group discussions with leaders representing three generations, respectively Baby Boomers, Generation X and Generation Y. The results of the study showed that there are both some similarities and differences in regards to leadership styles of these generations. The results support the argument that the leadership style varies generation to generation. Accordingly, the results show consistency with previous literature showing that there are differences among the generations. Based on the results of the focus groups, it became clear that there are less similarities and more differences between different generations' leadership preferences. According to the information gathered during focus groups, the leadership styles are in common for the leaders belonging to same generation, but each leader is aware of and experienced already the generational differences, and try to reach employees with different leadership style. Majority of the leaders participated in the focus groups mentioned the importance of understanding the differences in the generations to be a successful leader. According to the results, there are differences in leadership style amongst generations and leaders adapt different leadership styles according to the generations of their subordinates. Therefore, both two hypothesises are supported with this study.

Moreover, the results support that the leaders do not use only one leadership style. They tend to use different styles according to the situations, cases, characteristics and ages of their subordinates as well. Nevertheless, the results show that there is a common tendency for a certain leadership style in the leaders within the same generational cohorts. The leaders within the same generation made similar explanations and used similar keywords during the focus group discussions. The synergie between the leaders belonging the same generation was very clear and attracted attention in the focus group meetings. This finding is consistent with the literature stating that there are shared behaviors by the generational cohorts.

In the study, some deviations between the preferences of leaders from three generations are detected. This result shows that this generation values the participative approach and collaboration and supports the argument of Salahhuddin (2010) stating that Baby Boomer's work ethic is formed by democratic. This is in consistent with the literature stating that Baby Boomers believe in the participative style of leadership (Salahhuddin, 2010). Moreover this aligns also with the conclusions made by Arsenault (2004) and Zemke et al. (2000) that Baby Boomers prefers a collegial and consensual style. This can be explained by the fact that people from the Babyboomer generation are the oldest and the most experienced employees within the organization. The democratic leadership style gives them the opportunity to use their knowledge and experience, and to share their suggestions, ideas and opinions (House, 1971). As fight for freedom is more important to Generation Y than other generations (Martin, 2005), it was expected that Generation Y will have a higher percentage concerning democratic leadership.

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The results of Kraus (2017) showed that the visionary and coaching styles are the most preferred leadership styles for both Generation X and Generation Y with just minor differences. Our result is similar but not exactly same with the the conclusion made by Kraus (2017).

All generations are the least attracted to the coercive leadership style, which is line with the results of the study by Kraus (2017) stating that both generations value the coercive leadership style the least. Therefore altough differences are clear, there are also similarities between different generation on leadership style.

The main conclusion from this study is that although there are some similarities in the results, the preferred leadership styles differ according to the generation of the leaders. This is not surprising, since there are differences among the generations in thoughts, behaviors, attitudes, ideas, values (Joshi, Dencker, Martocchio, 2010), work values (Cennamo and Gardner, 2008) and preferences for leadership (Weston, 2001). Lastly, the results show that the leaders mostly take attention to their subordinates' ages and generations.

Leaders could use this study's result to improve their awareness about the generation they are belonged to and their success in leading different generations. This study would be helpful to the researches in the fields of generations and leadership styles.

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KEY TERMS AND DEFINITIONS

Affiliative Leadership: A leadership style whose firstly aim is to create harmony within employees and between the leaders and employees.

Coaching Leadership: A leadership style whose firstly aim is employees' long-term professional development.

Coercive Leadership: A leadership style whose firstly aim is employees' immediate compliance.

Democratic Leadership: A leadership style whose firstly aim is to build commitment and consensus amongst employees.

Generation: A group of individuals that share birth years, age, geographic location, and have experienced the same important life events at their life's specific stages.

Leader: Person who covers the influence effect over a group of people to perform goals.

Pace-Setting Leadership: A leadership style whose firstly aim is to accomplish tasks with high standard of excellence.

Visionary Leadership: A leadership style whose firstly aim is to provide long term direction and vision to the employees.

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APPENDIX

1. How old are you?
2. Since when are you working in this organization?
3. How many subordinates you have in your team?
4. Do you know their exact ages?
5. Which attitude of your subordinates belonging different generations take your attention?
6. What are important characteristics of a leader?
7. What kind of leadership do you prefer?
8. What behavior or qualities should a leader poses to ensure a good climate or culture?
9. What behavior or qualities should a leader poses to ensure high or good performance?
10. What behavior or qualities should a leader poses to ensure high satisfaction?
11. What behavior or qualities should a leader poses to ensure high engagement?
12. What behavior or qualities should a leader poses to ensure a good work-life balance?
13. What behavior or qualities should a leader poses to ensure trust?

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Chapter 18
Supplier Evaluation With BWM and Fuzzy CODAS Methods

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ABSTRACT

The selection of supplier is a crucial process. The main objective of supplier selection problem is to determine the most suitable suppliers with respect to the company's goals. The selection of supplier is, therefore, an important process for the firm to obtain goals of business. MCDM methods are useful to address this problem as supplier selection problem contains many criteria. An integrated MCDM model comprising BWM and fuzzy CODAS is proposed to address a supplier selection problem for a Turkish furniture workshop in this study. This study aims to fill the research gap in the literature. This research gap is that the number of studies using the BWM and CODAS method together is limited.

INTRODUCTION

Evaluating the performance of suppliers and identifying suppliers having the best performance constitutes one of the most critical problems encountered in supply chain management. In addition, suppliers' performance can affect the entire supply chain performance. For example, if the raw material supplier fails to deliver the raw material to the production plant on time or delivers incomplete quantities, production disruption will occur first, then disruptions in distribution will be affected and other members of the chain will be affected gradually.

One of the most significant success factors in production companies in supply chain management depends on the proper functioning of supply activities. Under the increasingly competitive conditions that come with globalization, in order to ensure business continuity and competitive advantage, production plants should use their resources with high efficiency and manufacture products with high quality and at the lowest cost.

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The selection of suitable upstream suppliers is a significant achievement aspect, which will significantly reduce buying costs, enhance the satisfaction of downstream customer and rise competitive ability (Liao and Kao, 2010). The growing and quick changing demands of customers force firms to focus on their core competencies and allow suppliers to do more of the business than ever before. This will increase companies' dependence on suppliers, so companies need to collaborate with their suppliers. In this relationship, there is a need to assess the performance of the suppliers as the performance of suppliers may affect the performance of company directly or indirectly. Therefore, companies need to evaluate the performance of their suppliers periodically.

The selection of supplier is a crucial process that as a result of assessments of their performance manufacturing companies identify the best ones among suppliers offering high-value services and materials. The main objective of supplier selection is to determine the most suitable suppliers with respect to the company's goals. The selection of supplier is, therefore, an important process for the firm to obtain goals of business. More attributes or criteria are needed to take into account in the supplier selection problem. Thus, MCDM (Multi Criteria Decision Making) methods are useful to address this problem.

In choosing suppliers, considered criteria usually contain uncertain and ambiguous data. In order to handle uncertain data, in the literature many approaches have been proposed. One of them is FST (fuzzy set theory). This theory have been integrated with different MCDM methods to address supplier selection problem many times in the literature (Chai et al., 2013; Ghorabaee et al., 2017a). An integrated MCDM model comprising BWM (Best-Worst Method) and fuzzy CODAS (Combinative Distance-based Assessment) is proposed to address a supplier selection problem for a Turkish furniture workshop in this study. The reasons why BWM is preferred in this study can be listed as follows. BWM requires fewer benchmarks compared to the AHP (Analytical Hierarchy Process) method. However, compared to the AHP method, it makes more consistent criteria comparison and uses only integers differently from the AHP method, making BWM easier to use (Rezaei, 2015). The reasons why fuzzy CODAS is preferred in this study can be listed as follows. The CODAS method utilizes two different distances (Euclidean and Taxicab) in order to evaluate the alternatives on multiple criteria (Ghorabaee et al., 2016). This can make the CODAS method to obtain much more robust results than other MCDM methods. In this study, fuzzy CODAS method will be utilised to handle the uncertainties in the problem.

This study aims to fill a research gap in the literature. This research gap is that the number of studies using the BWM and CODAS method is limited (Maghsoodi et al., 2020). However, both methods have advantages over other MCDM methods. Some of these advantages are mentioned above. For this reason, the BWM and fuzzy CODAS methods are used together in the study. These MCDM methods are utilized to select the best supplier for a furniture workshop. The main purpose of this study is to obtain more consistent criteria weights with fewer data compared to AHP by using BWM and to address the uncertainty by using fuzzy CODAS in the supplier selection problem.

BACKGROUND

The supplier selection problem is divided into many classes with the differentiation of criteria used over time. In recent years, three classes of supplier problems are encountered in the literature. These three classes are as follows; green, traditional and sustainable supplier selection. With environmental factors gaining importance in recent years, green and sustainable supplier selection problems have been widely encountered in the literature. The process of determining the criteria in the supplier selection problem

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is based on approximately 50 years. In 1966, Dickson identified 23 criteria (Dickson, 1966) and then Weber et al. (1991) examined 74 articles with respect to these criteria (Weber et al., 1991). Different criteria have been included in the supplier selection problem with the development of technology and the increase in environmental awareness. For example, environmental criteria and sustainability criteria have been considered in the supplier selection problem, with the increase in environmental awareness. With the increasing criteria in the supplier selection problem, the number of uncertainties encountered in solving the problem has also increased. Many methods have been suggested in the literature to address these uncertainties. FST (for more information see Zadeh, 1965; Bellman and Zadeh, 1970; Zadeh, 1975; Zimmerman, 1991; Zadeh, 1999) is one of the most popular and most widely used of these. Due to the multi-criteria structure of the supplier selection problem, FST is generally used in combination with MCDM methods. MCDM methods are widely used in the addressing of supplier selection problem. Some current studies on the use of MCDM methods in supplier selection are given in Table 1.

The BWM has been used to solve different MCDM problems, such as measuring projects' efficiency (Salimi and Rezaei, 2016), evaluating supply chains' social sustainability (Ahmadi et al., 2017), scientific outputs' quality assessment (Salimi, 2017), location selection (Stević et al., 2018), assessing R&D performance of companies (Salimi and Rezaei, 2018), facility location selection (Kheybari et al., 2019), the performance evaluation of hospital (Liao et al., 2019), assessing the user activity-oriented service requirement (Chen et al., 2020) and robot selection (Ali and Rashid, 2020). Additionally, this method has been used to address supplier selection problems in the literature (Rezaei et al., 2016; Gupta and Barua, 2017; Lo et al., 2018; Tian et al., 2018; Wu et al., 2019; Liu et al., 2019; Ecer and Pamucar, 2020; Xiong et al., 2020).

The CODAS method utilises Taxicab and Euclidean distances so as to evaluate the alternatives on multiple criteria (Ghorabaee et al., 2016). Unlike the CODAS method, the Fuzzy CODAS method uses the Hamming distance approach instead of the Taxicab distance. The fuzzy CODAS method has been used to solve different MCDM problems, such as market segment assessment (Ghorabaee et al., 2017b), location selection for wave energy facility (Bolturk and Kahraman, 2018) and personnel selection problem (Yalçın and Yapıcı Pehlivan, 2019). Besides, Bolturk (2018) developed Pythagorean fuzzy CODAS to solve a supplier selection problem. Although both MCDM methods have been used in many studies, the number of studies where these MCDM methods are used together is few (Maghsoodi et al., 2020).

MAIN FOCUS OF CHAPTER

The supplier selection problem is one of the important factors affecting the performance of the supply chain. Failure to choose the right supplier will result in various delays, reduced product quality, and increased costs across the entire chain. In addition to these, late delivery of the product and / or decrease in product quality will cause a decrease in customer satisfaction. Therefore, choosing the right and appropriate supplier positively affects both the performance of the company and the supply chain performance. The main focus of this chapter is to evaluate suppliers for a Turkish furniture workshop and to determine the most appropriate supplier. In this evaluation process, the main aim of this study is to obtain more consistent criteria weights with less data compared to AHP by using BWM and to address the uncertainties in the problem with the fuzzy CODAS method. Thus, a strong integrated MCDM model has been proposed by taking advantage of its individual advantages in both methods.

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Table 1. Current studies

Authors	MCDM Methods	Main Criteria
Wang et al. (2018)	TOPSIS, AHP	Responsiveness, Costs, Agility, Reliability and Asset Management Efficiency
Jain et al. (2018)	Fuzzy TOPSIS, AHP	Quality of Relationship, Warranty, Environmental Performance, On Time Delivery, Brand Name, Price/Cost, Manufacturing Capability and Product Quality
Banaeian et al. (2018)	Fuzzy TOPSIS, GRA VIKOR	Environmental Management Systems, Price, Quality and Service Level
Jiang et al. (2018)	Grey DEMATEL-based ANP	Quality, Cost, Pollution Control, Ecological Design, Environmental Management System, Technology, Management Commitment and Delivery Time
Stojić et al. (2018)	Rough WASPAS, Rough AHP	Price of the Material, the Methods of Payments, Reliability, Warranty Period, Volume Discounts, Reputation, Delivery Time, Certification of the Products and Quality of the Material
Kumar et al. (2018)	Fuzzy TOPSIS	Reputation, Performance, Quality of Product, Delivery Capabilities and Cost
Mohammed et al. (2019)	Fuzzy TOPSIS, Fuzzy AHP	Social, Green and Conventional
Matić et al. (2019)	Rough COPRAS, FUCOM	Environmental, Social and Economic
Fei et al. (2019)	DS-VIKOR	Risk Factor, Service Performance, Product Quality, Difficulty to Establish Cooperation and Price/Cost
Wang et al. (2019)	Fuzzy ANP, VIKOR	Asset Management Efficiency, Costs, Ability, Responsiveness and Reliability
Kaya and Yet (2019)	Bayesian Networks on DEMATEL	Reputation, Cooperation, Flexibility, Quality System Certifications, Delivery Performance, Cost and Product Quality
Akcan and Güldeş (2019)	AHP, TOPSIS, ELECTRE, SAW, GRA	Quality, Cost, Logistics, Flexibility and Reliability
Gupta et al. (2019)	Fuzzy AHP, MABAC, WASPAS, TOPSIS	Staff Environmental Training, Resource Consumption, Pollution Control, Green Image, Service Level, Eco Design, Quality, Cost/Price and Environmental Management System
Stević et al. (2020)	MARCOS	Economic Criterion, Social Criterion and Environmental Criterion
Jain et al. (2020)	Fuzzy AHP, TOPSIS	Economic Criteria, Social Criteria and Environmental Criteria
Rezaei et al. (2020)	AHP, Fuzzy AHP	Relation with Lean Manufacturing, Measurability and Real Application in Industry
Rouyendegh et al. (2020)	Intuitionistic Fuzzy TOPSIS	Environmental Management and Control, Green Application, Cooperation, Green Supplier Image, Green Manufacturing System, Technology, Sustainability, Cost, Service & Delivery and Quality
Wang et al. (2020)	Fuzzy AHP, PROMETHEE II	Assets, Cost, Flexibility, Responsiveness and Reliability
Ecer (2020)	Interval Type-2 Fuzzy AHP	Green Technology, Green Management, Green Manufacturing and Green Cost
Kumari and Mishra (2020)	Intuitionistic Fuzzy COPRAS	Use of Green Technology, Quality Management, Use of Green Materials, Pollution, Ecological Design, Supply Consumption, Commitment of Managers to Green Supply Chain Management and Management System

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METHODOLOGY

In this study, BWM and fuzzy CODAS methods are used together to select the best supplier. While the BWM is used to achieve criteria weights, the fuzzy CODAS method is used in ranking suppliers and determining the best supplier.

BWM Method

BWM (developed by Rezaei, 2015) is used to obtain criteria weights. The steps of this method are explained as follows (Rezaei, 2015).

Step 1: Criteria for evaluation process are determined.
Step 2: The worst and the best criteria are identified.
Step 3: The best criterion is compared with other criteria to compute the preference of the best criterion over other criteria. When calculating the preferences, a number between 1 and 9 is used. Equation 1 indicates this vector.

$$S_B = (S_{B1}, S_{B2}, \ldots, S_{Bn}) \tag{1}$$

In equation 1, S_{Bj} denotes the preference of the best criterion B over criterion j and S_{BB} is 1.

Step 4: Other criteria are compared with the worst criterion to compute the preference of other criteria over the worst criterion. When calculating the preferences, a number between 1 and 9 is used. Equation 2 indicates this vector.

$$S_W = (S_{1W}, S_{2W}, \ldots, S_{nW})^T \tag{2}$$

In equation 2, S_{jW} indicates the preference of the criterion j over the worst criterion and S_{WW} is 1.

Step 5: The optimal weights of criteria $(w_1^*, w_2^*, \ldots, w_n^*)$ and an indicator of comparisons' consistency ($\xi L^{)}$ are obtained by using equation 3 (Rezaei, 2016). The ξL ^{n}earing to 0 means that a high level of consistency is obtained (Rezaei, 2016).

$$\min \xi L$$

$$|wB - SB_{jw} j_{|} \leq \xi L$$

$$|wj - Sj_{ww} w_{|} \leq \xi L$$

$$\sum_{j=1}^{n} w_j = 1 \tag{3}$$

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$w_j \geq 0$

After obtaining criteria weights (w_j), Fuzzy CODAS method is used to evaluate and rank suppliers.

Fuzzy CODAS Method

Fuzzy CODAS method is utilized to evaluate the performance of suppliers and rank them. The steps of fuzzy CODAS method are explained as follows (Ghorabaee et al., 2017b).

Step 1: Decision-maker assign linguistic scores, which are indicated in Table 2, to alternatives in order to construct fuzzy decision matrix ($\tilde{T}$).

$$\tilde{T} = \left[\tilde{t}_{ij}\right]_{m \times n} \tag{4}$$

Table 2. Fuzzy and linguistic scores

Linguistic Scores	Fuzzy Scores
Very High (VEH)	(8, 9, 10, 10)
High (HI)	(7, 8, 8, 9)
Medium High (MEH)	(5, 6, 7, 8)
Medium (MD)	(4, 5, 5, 6)
Medium Low (MEL)	(2, 3, 4, 5)
Low (LW)	(1, 2, 2, 3)
Very Low (VLW)	(0, 0, 1, 2)

Source: Adapted from Ghorabaee et al (2017b)

In equation 4, $\tilde{t}_{ij}\left(\tilde{t}_{ij} = \left(t_{ij}^{m1}, t_{ij}^{m2}, t_{ij}^{m3}, t_{ij}^{m4}\right)\right)$ is a trapezoidal fuzzy number and it indicates the fuzzy performance of *i*th alternative on *j*th criterion.

Step 2: Fuzzy normalized matrix ($\tilde{T}' = \left[\tilde{t}_{ij}'\right]_{m \times n}$) is constructed by using equation 5 (for beneficial criteria) and 6 (for non-beneficial criteria).

$$\tilde{t}_{ij}' = \tilde{t}_{ij} / \max D(\tilde{t}_{ij}) \tag{5}$$

$$\tilde{t}_{ij}' = 1 - \left(\tilde{t}_{ij} / \max D(\tilde{t}_{ij})\right) \tag{6}$$

In equation 5 and 6, $D(\tilde{t}_{ij})$ denotes the crisp value of $\tilde{t}_{ij}\left(\tilde{t}_{ij} = \left(t_{ij}^{m1}, t_{ij}^{m2}, t_{ij}^{m3}, t_{ij}^{m4}\right)\right)$. It can be calculated by using equation 7 (Wang et al., 2006).

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$$D(\tilde{t}_{ij}) = \frac{1}{3}\left(t_{ij}^{m1} + t_{ij}^{m2} + t_{ij}^{m3} + t_{ij}^{m4} - \frac{t_{ij}^{m3}t_{ij}^{m4} - t_{ij}^{m1}t_{ij}^{m2}}{\left(t_{ij}^{m3} + t_{ij}^{m4}\right) - \left(t_{ij}^{m1} + t_{ij}^{m2}\right)} \right) \tag{7}$$

Step 3: Fuzzy weighted normalized decision matrix ($\tilde{K}$) is computed as.

$$\tilde{K} = \left[\tilde{k}_{ij} \right]_{m \times n} \tag{8}$$

where

$$\tilde{k}_{ij} = w_j \times \tilde{t}_{ij}^{'} \tag{9}$$

Step 4: Fuzzy negative-ideal solution ($\tilde{e}$) is obtained as following equation.

$$\tilde{E} = \left[\tilde{e}_j \right]_{1 \times n} \tag{10}$$

$$\tilde{e}_j = \min(\tilde{k}_{ij}) \tag{11}$$

where $\min(\tilde{k}_{ij}) = \left\{ \tilde{k}_{fj} \,||\, D(\tilde{k}_{fj}) = \min(D(\tilde{k}_{ij})), f \in \{1, 2, \ldots, m\} \right\}$.

Step 5: The fuzzy weighted Euclidean (ED_i) and Hamming (HD_i) distances can be computed as:

$$ED_i = \sum_{j=1}^{n} d_E(\tilde{k}_{ij}, \tilde{e}_j) \tag{12}$$

$$HD_i = \sum_{j=1}^{n} d_H(\tilde{k}_{ij}, \tilde{e}_j) \tag{13}$$

In equations 12 and 13, $d_E(\tilde{k}_{ij}, \tilde{e}_j)$ and $d_H(\tilde{k}_{ij}, \tilde{e}_j)$ are used to measure the distances between $\tilde{k}_{ij}\left(\tilde{k}_{ij} = \left(k_{ij}^{m1}, k_{ij}^{m2}, k_{ij}^{m3}, k_{ij}^{m4}\right)\right)$ and $\tilde{e}_j\left(\tilde{e}_j = \left(e_j^{m1}, e_j^{m2}, e_j^{m3}, e_j^{m4}\right)\right)$, which are two trapezoidal fuzzy numbers, can be computed by using equation 14 and 15 respectively (Li, 2007).

$$d_E(\tilde{k}_{ij}, \tilde{e}_j) = \sqrt{\frac{\left(k_{ij}^{m1} - e_j^{m1}\right)^2 + 2\times\left(k_{ij}^{m2} - e_j^{m2}\right)^2 + 2\times\left(k_{ij}^{m3} - e_j^{m3}\right)^2 + \left(k_{ij}^{m4} - e_j^{m4}\right)^2}{6}} \tag{14}$$

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$$d_H(\tilde{k}_{ij}, \tilde{e}_j) = \frac{\left|k_{ij}^{m1} - e_j^{m1}\right| + 2 \times \left|k_{ij}^{m2} - e_j^{m2}\right| + 2 \times \left|k_{ij}^{m3} - e_j^{m3}\right| + \left|k_{ij}^{m4} - e_j^{m4}\right|}{6} \quad (15)$$

Step 6: Relative assessment matrix (G) is computed as follows:

$$G = \left[g_{iu}\right]_{m \times m} \quad (16)$$

$$g_{iu} = \left(ED_i - ED_u\right) + \left(\alpha\left(ED_i - ED_u\right) \times \left(HD_i - HD_u\right)\right) \quad (17)$$

where α denotes a threshold function that is explained as:

$$\alpha(x) = \begin{cases} 1, \text{ if } & |x| \geq \psi \\ 0, \text{ if } & |x| < \psi \end{cases} \quad (18)$$

In equation 18, Ψ is a parameter that is defined by decision-maker. In this study, this value equals to 0.02.

Step 7: The assessment score (H_i) for each alternative is computed as follows:

$$H_i = \sum_{u=1}^{m} g_{iu} \quad (19)$$

The alternative having the highest score is the most appropriate alternative.

APPLICATION

The proposed model is applied to a Turkish furniture workshop. By entering into the scope of small business, this furniture workshop produces and sells seats, sofas, and tables to both local customers (in the same city) and to customers in different cities. This workshop usually purchases raw materials from three suppliers; however, plans to reduce the number of suppliers and to work with the best supplier due to the cost of working with three suppliers. Data was collected from three managers working in the workshop to assist the workshop in assessing suppliers' performance and identifying the best supplier. Managers have determined six criteria for raw material supplier selection. These are production capacity (PC), cost (C), quality (Q), delivery (D), flexibility (F), and payment terms (PT). Managers evaluated these six criteria together and determined the best and worst of these criteria. C criterion was chosen as the best criterion and PC criterion was chosen as the worst criterion. Managers compared the best and the worst criteria with other criteria to determine S_B and S_W. These vectors are indicated in Table 3.

Data showed in Table 3 are placed in equation 3 and this equation is solved by using Lingo 15.0 to obtain criteria weights. These weights are indicated in Table 4.

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Table 3. and Vectors

S_B Vector						
Criteria **Criteria**	**PC**	**C**	**Q**	**D**	**F**	**PT**
C	6	1	2	3	5	5
S_w Vector						
Criteria **Criteria**	**PC**	**C**	**Q**	**D**	**F**	**PT**
PC	1	6	4	5	2	2

Table 4. Criteria Weights

Criteria **Weights**	**PC**	**C**	**Q**	**D**	**F**	**PT**
w_j	0.0484	0.3779	0.2326	0.1550	0.0930	0.0930
ξL=0,0872						

According to Table 4, the order of criteria is as follows: C, Q, D, F, PT and PC. Additionally, the indicator of comparisons' consistency (ξL) nearly equals to 0 and it means that this matrix is highly consistent. The criteria weights obtained in BWM were transferred into fuzzy CODAS method. The suppliers (Supplier 1 (SPL1), Supplier 2 (SPL2), Supplier 3 (SPL3)) with which the workshop works have been identified as alternatives. These suppliers were evaluated by managers. They assigned a linguistic score to suppliers with respect to their performances. Table 5 indicates the linguistic performance scores of suppliers.

Table 5. The Linguistic Performance Scores of Suppliers

Criteria **Suppliers**	**PC**	**C**	**Q**	**D**	**F**	**PT**
SPL1	MD	LW	LW	MD	MEL	MEH
SPL2	MEH	MEL	MEH	MEH	MD	MEL
SPL3	MEH	MEL	MD	MD	LW	MD

These linguistic scores were converted into trapezoidal fuzzy performance scores by using Table 2 so as to construct the fuzzy decision matrix. Table 6 presents the fuzzy decision matrix.

Equation 5 and 6 are applied to the fuzzy decision matrix to normalize this matrix. The fuzzy normalized matrix is shown in Table 7.

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Table 6. The Fuzzy Decision Matrix

Criteria Suppliers	PC	C	Q
SPL1	(4, 5, 5, 6)	(1, 2, 2, 3)	(1, 2, 2, 3)
SPL2	(5, 6, 7, 8)	(2, 3, 4, 5)	(5, 6, 7, 8)
SPL3	(5, 6, 7, 8)	(2, 3, 4, 5)	(4, 5, 5, 6)
Criteria Suppliers	**D**	**F**	**PT**
SPL1	(4, 5, 5, 6)	(2, 3, 4, 5)	(5, 6, 7, 8)
SPL2	(5, 6, 7, 8)	(4, 5, 5, 6)	(2, 3, 4, 5)
SPL3	(4, 5, 5, 6)	(1, 2, 2, 3)	(4, 5, 5, 6)

Table 7. The Fuzzy Normalized Matrix

Criteria Suppliers	PC	C	Q
SPL1	(0.615, 0.769, 0.769, 0.923)	(0.143, 0.429, 0.429, 0.714)	(0.154, 0.308, 0.308, 0.462)
SPL2	(0.769, 0.923, 1.077, 1.231)	(-0.429, -0.143, 0.143, 0.429)	(0.769, 0.923, 1.077, 1.231)
SPL3	(0.769, 0.923, 1.077, 1.231)	(-0.429, -0.143, 0.143, 0.429)	(0.615, 0.769, 0.769, 0.923)
Criteria Suppliers	**D**	**F**	**PT**
SPL1	(0.615, 0.769, 0.769, 0.923)	(0.400, 0.600, 0.800, 1.000)	(0.769, 0.923, 1.077, 1.231)
SPL2	(0.769, 0.923, 1.077, 1.231)	(0.800, 1.000, 1.000, 1.200)	(0.308, 0.462, 0.615, 0.769)
SPL3	(0.615, 0.769, 0.769, 0.923)	(0.200, 0.400, 0.400, 0.600)	(0.615, 0.769, 0.769, 0.923)

Criteria weights (obtained in BWM) are multiplied with fuzzy normalized values by using equation 9 to obtain the fuzzy weighted normalized decision matrix. Additionally, fuzzy negative-ideal solution is achieved by using equation 11. The fuzzy weighted normalized decision matrix and fuzzy negative-ideal solutions are indicated in Table 8.

By using equations 12 and 13, fuzzy weighted Euclidean (ED_i) and Hamming (HD_i) distances are computed. These distances are presented in Table 9.

Relative assessment matrix is computed by using equations 16-18. Then, the assessment score (H) for each supplier is computed by using equation 19. Relative assessment matrix and the assessment score (H_i) are indicated in Table 10.

As can be seen from Table 10, the ranking of suppliers is as follows: SPL2, SPL1 and SPL3. To test the accuracy of the results of the fuzzy CODAS method, fuzzy COPRAS and fuzzy ARAS methods have been applied to the fuzzy decision matrix. The rankings of suppliers with respect to fuzzy CODAS, fuzzy COPRAS, and fuzzy ARAS are indicated in Table 11.

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Table 8. The Fuzzy Weighted Normalized Decision Matrix

Criteria / Suppliers	PC	C	Q
SPL1	(0.030, 0.037, 0.037, 0.045)	(0.054, 0.162, 0.162, 0.270)	(0.036, 0.072, 0.072, 0.107)
SPL2	(0.037, 0.045, 0.052, 0.060)	(-0.162, -0.054, 0.054, 0.162)	(0.179, 0.215, 0.251, 0.286)
SPL3	(0.037, 0.045, 0.052, 0.060)	(-0.162, -0.054, 0.054, 0.162)	(0.143, 0.179, 0.179, 0.215)
$\tilde{e}_j$	(0.030, 0.037, 0.037, 0.045)	(-0.162, -0.054, 0.054, 0.162)	(0.036, 0.072, 0.072, 0.107)
Criteria / Suppliers	**D**	**F**	**PT**
SPL1	(0.095, 0.119, 0.119, 0.143)	(0.037, 0.056, 0.074, 0.093)	(0.072, 0.086, 0.100, 0.115)
SPL2	(0.119, 0.143, 0.167, 0.191)	(0.074, 0.093, 0.093, 0.112)	(0.029, 0.043, 0.057, 0.072)
SPL3	(0.095, 0.119, 0.119, 0.143)	(0.019, 0.037, 0.037, 0.056)	(0.057, 0.072, 0.072, 0.086)
$\tilde{e}_j$	(0.095, 0.119, 0.119, 0.143)	(0.019, 0.037, 0.037, 0.056)	(0.029, 0.043, 0.057, 0.072)

Table 9. Fuzzy Weighted Euclidean and Hamming Distances

Distances / Suppliers	ED_i	HD_i
SPL1	0.243	0.233
SPL2	0.267	0.264
SPL3	0.142	0.140

Table 10. Relative Assessment Matrix and the Assessment Scores for Suppliers

Suppliers / Suppliers	SPL1	SPL2	SPL3	H_i
SPL1	0	-0.055	0.194	0.139
SPL2	0.055	0	0.249	0.304
SPL3	-0.194	-0.249	0	-0.443

Table 11. The Rankings of Suppliers w.r.t. Fuzzy Methods

Results / Suppliers	Fuzzy CODAS	Fuzzy COPRAS	Fuzzy ARAS
SPL1	2	2	2
SPL2	1	1	1
SPL3	3	3	3

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As can be seen from Table 11, there has been no change in the ranking of the suppliers. The supplier with the highest performance is designated as SPL2 coded Supplier 2. Therefore, it can be said that the proposed method achieved accurate results. In addition, by showing the results to the managers in the workshop, the advice was given to the workshop to work with SPL2 coded Supplier 2.

FUTURE RESEARCH DIRECTIONS

Future studies may integrate fuzzy BWM and fuzzy CODAS method to solve a supplier selection problem or a different MCDM problem, such as warehouse location selection, facility selection and personnel selection. Future studies can also integrate the BWM method with a different MCDM method such as fuzzy MABAC, fuzzy MAIRCA, and fuzzy EDAS to solve a green or sustainable supplier selection problem.

CONCLUSION

The selection of supplier is a crucial process that as a result of assessments of their performance manufacturing companies identify the best ones among suppliers offering high-value services and materials. The main objective of the selection of suppliers is to find the most suitable suppliers regarding the company's goals. The selection of suppliers is thus a critical process for the company to achieve business objectives. More attributes or criteria are needed to consider in the supplier selection problem. Thus, MCDM methods are useful to address this problem. Criteria also include vague and ambiguous data when selecting the suppliers. A variety of approaches have been proposed in the literature to reduce ambiguity. One such is FST. In this study, an integrated MCDM model comprising BWM and fuzzy CODAS was proposed to address a supplier selection problem for a Turkish furniture workshop. The BWM was used to obtain criteria weights. According to the results of BWM, the order of criteria is as follows: C, Q, D, F, PT and PC. Fuzzy CODAS method was used to rank suppliers. According to the results of fuzzy CODAS, the order of suppliers is as follows: SPL2, SPL1 and SPL3. To test the accuracy of the results of the fuzzy CODAS method, fuzzy COPRAS and fuzzy ARAS methods have been applied to the fuzzy decision matrix. The rankings of suppliers with respect to fuzzy CODAS, fuzzy COPRAS and fuzzy ARAS are same. Hence, it can be said that the proposed method achieved accurate results. This study aims to fill the research gap in the literature. This research gap is that the number of studies using the BWM and CODAS method is limited. However, both methods have advantages over other MCDM methods. Therefore, the BWM and fuzzy CODAS methods were used together in the study.

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KEY TERMS AND DEFINITIONS

BWM: It is a method that is used to obtain criteria weights such as the AHP method but requires less data than the AHP method.

Codas: It is an MCDM method that uses Euclidean and Taxicab distance approaches.

Fuzzy Codas: It is a fuzzy MCDM method that uses Euclidean and Hamming distance approaches.

MCDM: The name is given to problems where more than one alternative is evaluated according to more than one criterion and the methods used in the solution of these problems. Supplier Selection: It is the name given to the process of determining the best supplier in a system with more than one supplier.

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Chapter 19
An Action Research to Identify Problems Experienced in the ERP System Installation Process in SMEs:
Sample of an SMEs Operating in Turkey

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ABSTRACT

In today's conditions, where information plays a leading role in all administrative and operational processes of the business, it is very important to collect, store, and present information to the user for the effectiveness and efficiency of all business processes. One of the tools that is important in information management and frequently preferred by businesses is the enterprise resource planning (ERP) system. This study aimed to identify the problems faced by enterprises and the root causes underlying these problems in the ERP system transition process. The problems experienced in system transition were identified by taking part in the system installation process of a medium-sized enterprise that decided to implement an ERP system, for 18 months. As a result of the study, it was determined that the enterprise had problems mostly in the design and data transfer stages of the system. The main causes of these problems were determined as the difficulties encountered in restructuring the business processes and the resistance of the employees to change.

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INTRODUCTION

The importance of Enterprise Resource Planning (ERP) systems is increasing with the growing use of industrial digitalization and smart factory systems. Gathering the data obtained from operational processes on a common platform and providing support to users in decision processes will increase the chance of success with ERP. However, initially the enterprise needs to establish and maintain a system that is suitable for its field and organizational structure.

In the digital age, information systems and technology are among the most fundamental strategies for the business to achieve its goals. However, technology is not just an application that can be purchased and implemented (Candra, 2012: 143). Information Systems (IS) are social systems that deal with human and technology interaction (Matende and Ogao, 2013: 519). Enterprise Resource Planning (ERP), one of these systems, consists of a series of applications that automate routine operations such as financial management, inventory management, planning, order fulfillment, service and cost control and many more, while providing benefits to improve efficiency, quality, productivity and profitability (Candra, 2012: 143). ERP is an information system designed to provide data to support strategy development, operational management, data analysis and decision-making functions in organizations (Matende and Ogao, 2013: 519).

At the heart of the ERP system is a central database that collects real-time information from business functions and transfers and feeds data to a range of applications (Davenport, 1998: 124). The main purpose is to ensure that business operations are carried out in an integrated database. The output of one function is the input of another function and the system is based on the principle of process quality excellence. For this reason, it is necessary to configure business processes correctly and to integrate the system into processes.

If ERP systems work in harmony with existing business processes in line with technical and organizational needs, it has the potential to provide significant competitive advantages to the business (Al-Mashari, Al-Mudimigh and Zairi, 2003: 352). However, the importance of integration is not fully understood by the owners or managers, or not explained by the system providers due to their sales targets. The sales negotiations usually focus on the advantages that the system will provide, while the requirements of the system and the negative situations that may be encountered are ignored. Problems arise when the decision to purchase the system is made and the installation process begins, which can turn into fatigue and boredom in business ERP officers, resistance in other related employees, and pressure and regret on the management side. Setting up the system, which is a long and difficult process, and determining the problems that may be encountered in practice beforehand and transferring them to managers and employees and developing business-based solutions for these problems are very important for the effective use of the system.

In this context, the basic questions of the study are:

- At what stages are small and medium enterprises experiencing problems during the ERP System installation process?
- What are the main causes of these problems?
- What should be done to prevent these problems?

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The first part of the study covers the literature review related to the ERP system, and in the second part, the application is mentioned. In the last part, the findings, evaluation and suggestions obtained within the scope of research questions are presented.

WHAT IS ENTERPRISE RESOURCE PLANNING (ERP)?

Enterprise Resource Planning (ERP) systems are an information system that integrates processes with a common database and shared reporting tools (Dredden and Bergdolt, 2007: 48). The purpose of the ERP system is to create a common information pool that the functions can apply within the framework of the needs by adding the accounting and after-sales service operations to the supply chain functions in the enterprises (Çetinoğu, Kurnaz & Şen, 2011: 141).

The functionality of ERP applications, which was born with the need for resource planning, management and accountability, mainly in different production environments, has made progress in both width and depth in recent years (Laughlin, 1999: 32). Because an information system that supports all functions is needed for enterprises to succeed. These information systems improve the adaptation ability between functions in businesses (Gökbayrak, 2018: 7).

In the system, functions that were formerly independent such as finance, human resources, production, storage are integrated in a software program divided into modules. Modular structure and module combinations, which are among the most important features of the system, differentiate the software from each other. A basic ERP system consists of accounting, human resources, production and logistics, sales / purchasing / distribution and inventory management modules (Yıldız and Akaydın, 2012: 6). Modular structuring increases the flexibility of the system and offers enterprises step-by-step transition.

Businesses grow as business volumes increase and become uncontrollable and unmanageable with the work carried out on the basis of functions. This can lead to a decrease in product and service quality, inability to meet orders, excess inventory, delays in delivery, increase in lost times and waste, and many other problems. Accordingly, the enterprise faces the need to establish a corporate management system and to run this system from a common database. ERP systems are an important tool that management can use to respond to increasing business needs more effectively and efficiently (Spathis and Constantinides, 2003: 677). The system provides the opportunity for decision makers to access information in a timely manner, regardless of location (Özen & Sezen, 2018: 664).

In order to understand the benefits of the system, it will be useful to examine the main reasons that direct businesses establish an ERP system (Koch et al., 1999: 4; Fitzgerald, 1992: 293):

- **Integrating financial information:** To ensure that financial records held by different business units in the enterprise and sometimes differ from each other can be queried on a single system.
- **Integrating customer order information:** Ensuring that orders are tracked more easily by taking orders, coordinating production, inventory and shipping processes through a single system.
- **Standardizing and speeding up production processes:** Standardizing the production management system to ensure control over a single integrated platform. This reduces errors, saves time and labor, thus increases productivity.
- **Inventory reduction:** ERP helps the production process flow go more smoothly and improves internal order fulfillment. It contributes to reducing the amount of stock of materials and finished products, while enabling a more effective delivery planning opportunity.

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- **Standardizing human resources information:** To ensure effective management of human resources records, especially in businesses with multiple business units.
- **Providing flexibility:** With ERKP, businesses can respond to changes in customer demands faster, which makes the business more flexible. Ability to provide common use of business units located in different regions; the use of the desired modules in accordance with the needs and the ability to use them in the desired languages reflect the flexibility of the system.

The implementation of ERP appears to be a way to institutionalize, especially for small and medium-sized enterprises. Defining the current business processes, process inputs and outputs of the business will create the possibility of managerial traceability, measurement and control. ERP system will be an important opportunity for businesses that are aware of the importance of traceability but could not implement it. With the ERP system, the rate of decision-making in procurement and delivery processes will increase while error rates will decrease. While efficient management of warehouses is ensured, it will be possible to measure waste and losses. In other words, ERP provides holistic benefits to the business as the only software system in which management can follow all functions at the same time.

ENTERPRISE RESOURCE PLANNING (ERP) INSTALLATION PROCESS

The installation process of the ERP System is the process that starts with defining the need for the system and lasts until the system can be carried out within the enterprise without the need for a system consultant. From time to time, ERP officers and all system users in the enterprise may need expert support due to disruptions or changes or improvements to the process.

However, it can be said that the system installation has been completed at the stage where the company can maintain the system with its own resources during the usual business processes.

The stages of the installation of the ERP system include the comprehensive review of the business processes in the organization, the selection of the most suitable software solution that matches the needs of the business, the configuration of the selected systems, the staff training, the customization of the selected software solutions, including the development of the necessary interfaces (Ahmad and Cuenca, 2013: 105). In some cases, businesses determine and use modules based on their needs, rather than using the system as a whole. In this context, deciding which modules to use and configuring the system is another important step. Sun, Ni and Lam (2015: 42) classified the ERP system installation steps as follows:

- Preparation phase of the enterprise to the ERP system.
- Selection of the ERP system provider (ERP package) to be used.
- System setup.
- ERP final preparations (final checks).
- ERP application (real-time use).

The implementation of an ERP system is fundamentally different from the development and use of traditional systems. For example, the first step in adapting the software to suit organizational processes requires users to define, analyze and identify organizational needs. On the other hand, since ERP has a basic built-in structure, the business should learn to use this structure to some extent. Adaptation of the software and organizational processes is limited by both the organizational features of the organization

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and the built-in features of the software, and an iterative process that requires revision for both parties (Volkoff, 1999: 236). In some cases, enterprises have difficulty in ensuring this adaptation and may stop using the system.

PROBLEMS ENCOUNTERED IN THE ERP INSTALLATION PROCESS

There are several obstacles that make it difficult to implement ERP systems (Matende and Ogao, 2013: 520). Information technologies paired with corporate systems require large-scale business transformations and force businesses to change their activities and strategies accordingly (Themistocleous, 2001: 195). Like many computer technology systems, ERP systems, by nature, require simultaneous changes and integration in business processes and information sharing, which makes their use very difficult (Amoako-Gyampah and Salam, 2004: 731). The important factors in ensuring high quality in ERP systems are specified as determining the qualifications of the enterprise and adapting these to the system, and improving the production process (Otieno, Mwangi & Kimani, 2013: 222).

However, even if technical difficulties are of great importance, they are not the main cause of system failure. The biggest problem arises from the inability of enterprises to reconcile the technical difficulties of the corporate system with the needs of the enterprise (Davenport, 1998: 122) and ignoring organizational factors. Karadede and Baykoç (2006) also listed the problems encountered during the installation of the Enterprise Resource Planning (ERP) system as follows:

- Employees' resilience to do their job in a new way, as opposed to the way that they currently do,
- Employees' fear of losing their jobs, and the power they have or their influence within the organizational structure,
- As employees struggled during the installation process, they develop a judgment that the system is poorly designed or difficult to use, and this impression spreads among users,
- Unwillingness to participate in users,
- Loss of motivation and resistance to the new system in users,
- Difficulties due to language differences between information system staff and users,
- The emergence of the situation that the system is more advanced than the user.

One or more of the aforementioned problems are seen in businesses that want to install an ERP system and lead the system to fail. It is very important for both businesses and ERP system providers to develop solutions for anticipating and analyzing these problems, which lead to a significant waste of resources and to give up the benefits that can be obtained.

LITERATURE REVIEW

ERP is one of the important issues studied in many fields in literature. Holland and Light (1999), using qualitative research techniques based on document review, observation and interview, examined the stages of ERP strategy in two businesses from the process of formation to the integration of systems into the organization. They investigated how strategic and tactical decisions affect the outcome in ERP system

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projects, as well as critical success factors that affect implementation success. In the conclusion part of the study, they stated that when starting the ERP process, the companies should plan the transition from their existing systems to this system correctly. Mabert, Soni and Venkataramanan (2001) conducted a qualitative research on the current state and future of ERP systems. Within the scope of the study, they held interviews with ERP system users and consultants. As a result of the study, they stated that the ERP system is a management system that can be used for businesses of all sizes. They pointed out that the system is expensive but has a balanced cost with its benefits; application turns into a benefit in a short time in some businesses, while in some businesses its benefits are understood in the long term. The authors who stated that the most important benefit of the system is in the decision-making mechanism because it increases the quality of information and the speed of access to information, emphasized the importance of ERP as data storage and decision support system.

Spathis and Constantinides (2003) investigated the reasons why businesses in Greece turn to ERP systems and investigated the impact of the system on improving the management process in their survey. As a result of their study, they determined that the enterprises gained advantages in the management system with the ERP application. In particular, flexibility in information production, increasing the quality of the reports, the integration of applications and the large number of maintenance possibilities of databases have been identified as the biggest benefits obtained from ERP systems. Candra (2012) conducted a study to understand the key success factors that affect the success of the ERP application, which he defines as an important competitive tool in the global business world.

In line with his research conducted with 46 senior executives, mostly working in multinational companies and using the ERP system, he concluded that the knowledge and ability of the enterprises are the most important factor affecting the success of the ERP application.

Ahmad and Cuenca (2013) conducted a study based on the thesis that there are a lot of studies in the literature on determining critical factors for the implementation of ERP systems, but the interactions and effects between critical factors are not explored in detail. In the study, first, critical success factors for ERP application are defined (with literature review, questionnaire and expert interviews), then the relationships between these critical success factors and their effects are analyzed. Critical success factors were classified as organizational and operational factors. The authors suggested that organizational factors played a more important role in the implementation of ERP systems than operational factors. They stated that if critical success factors cannot be achieved in the early stages of the ERP application, weak integration will be encountered during the implementation process.

Emphasizing the importance of sustainability for businesses; Chofreh et al. (2016) proposed a master plan consisting of a roadmap, framework and rules for the implementation of a sustainable corporate resource planning system aimed to prevent problems that arise during the establishment and implementation phase of the ERP system. With sustainable corporate resource planning system practices, it is aimed to bring the sustainable business processes into life. This leads to the guarantee of economic development, social equality, justice and environmental protection, with higher quality and lower costs. While the philosophy of the ERP system is profit only, the philosophy of the S-ERP (Sustainable Enterprise Resource Planning) system is profit, people and the planet (Chofreh, Goni and Klemes, 2018: 1326).

Karabaş, Uysal and Karkacier (2017), in their study on 148 manufacturing companies in Ankara, concluded that the companies using ERP increased their productivity, profitability, flexibility and competition aspects.

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Table 1. Some Studies in the Literature on ERP System

Author / Year	Subject	Method	Results
Holland, C. P., & Light, B. / 1999	ERP installation process	Document review, observation and interview in two businesses	Business managers who want to install an ERP system should analyze themselves well.
Themistocleous, M., Irani, Z., & O'Keefe, R. M. / 2001)	Identify and analyze problems related to ERP systems.	Survey	Integration is the most important problem of ERP and partial integration can be achieved in enterprises.
Al-Mashari vd. / 2003	Critical success factors in ERP application process	Literature research	ERP benefits can be achieved if the ERP system is adapted to the business processes.
Spathis, C., & Constantinides, S. / 2003	The effect of ERP systems on improving management processes.	Survey	If ERP systems are used effectively, it is a necessary tool for businesses to survive in difficult competition conditions.
Çetinoğlu, T., Kurnaz, N., & Şen, Y. / 2011	Effect of ERP system applications on managerial decision making processes.	Case study	ERP system provides support for decision making, planning, budgeting, reporting, control and analysis functions.
Candra S. / 2012	Factors affecting the success of ERP application	Survey	The level of knowledge the business has has an important effect on the success of ERP implementation.
Ram, J., Wu, M. L., & Tagg, R. / 2014	Competitive advantage and critical success factors of ERP system.	Survey	Education and system integration positively affect the competitive advantage.
Sun, H., Ni, W., & Lam, R. / 2015	Critical success factors in ERP applications	Case study	Critical success factors and performance evaluation are critical to ERP success.
Karabaş, S., Uysal, Y. L. D., & Karkacıer, O. / 2017	Effect of ERP on business performance.	Survey	There is an increase in productivity, profitability, flexibility and competition levels of companies using ERP.
Avunduk, H., & Güleryüz, Ö. / 2018	Effects of ERP systems on managerial decision making processes.	Semi-structured interview technique	ERP systems affect managerial decision making processes positively.

In the literature review, it has been observed that there are studies carried out with different methods in many different sectors related to the ERP system. By using quantitative and qualitative methods, the importance of the system, the application process, the critical success factors and the reasons for its failure were investigated through studies conducted in different regions and sectors. However, the problems encountered during the ERP installation process have always been examined through questionnaires, interviews or case studies. The most important originality of this study is that the author takes part in the installation process and analyzes the process with all the details. Considering the widespread use of ERP by companies worldwide, its significant advantages in case of successful implementation, and significant losses in case of failure; it seems that it deserves to be investigated from different perspectives.

METHOD

As mentioned in the literature review section, it has been seen that there are many qualitative and quantitative researches related to the ERP system in different fields. However, considering the long and tedious installation process of the system, it was concluded that the evaluation of the system after the installation would not have very realistic results. Therefore, action research, one of the qualitative research methods, was preferred as the research method in this study.

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Action research is process oriented and based on the unity of research and practice. The method is based on understanding the problems that arise in practice and it is aimed for the researcher to take part in the application, to be close to the data, to follow and experience the process more closely (Aslan, 2018: 214, Ilgar and Ilgar, 2013: 202). The most important feature is that the researcher is involved in the process to create wider interaction networks and thus more realistic results can be achieved. Although the starting point and frequent use of the method is within in the education field, it is possible to use it in every field of social sciences (Kemmis, 1993: 3). Realistic and logical identification of the problem and data collection with creative methods are critical for action research (Sekaran and Bougie, 2016: 99).

Within the scope of the study, observation, interview, training and participation in activities were carried out by taking part in all stages of the establishment of the ERP system from the establishment of the medium-sized enterprise to the implementation of the system. The process of setting up the system has been put forward with the effort that took approximately eighteen months. Throughout the process, the work performed, and the problems encountered were recorded. Developed solutions and support of system consultants have been observed. The reactions of the employees and the management and the state reached at the end of the process were recorded in all the details. The findings obtained at the end of the long and difficult recording and observation process were reviewed and evaluated with system practitioners.

RESULTS

The Enterprise Resource Planning (ERP) system is a long, arduous process that requires high participation on a business basis and creates a change and transformation in the business. Of course, as in many processes of change, it is inevitable to encounter disruptions, errors, unexpected situations and resistance by the personnel. In this section, the problems arising during the establishment of the ERP system in an SME scale enterprise were investigated. The problems have been examined in four main stages:

1. Problems arising during the design and implementation process,
2. Problems arising from business processes,
3. Application-related problems,
4. Invisible ERP system costs.

Problems Arising in the Design and Implementation Process

In order to correctly identify the problems that arise in system setup, it is important to understand the stages of the ERP system installation, which takes approximately 18 months. In this context, in accordance with the records and interviews held in the study, the ERP system setup process is presented in Figure 1.

As it can be seen in Figure 1, three different situations are encountered in the process with the decision to establish an ERP system:

- The current activities/processes of the enterprise, which has its equivalent in the ERP system.
- Some of the current and required activities in the enterprise are not defined in the ERP system.
- Some activities/processes defined in the ERP system but currently not implemented in the enterprise.

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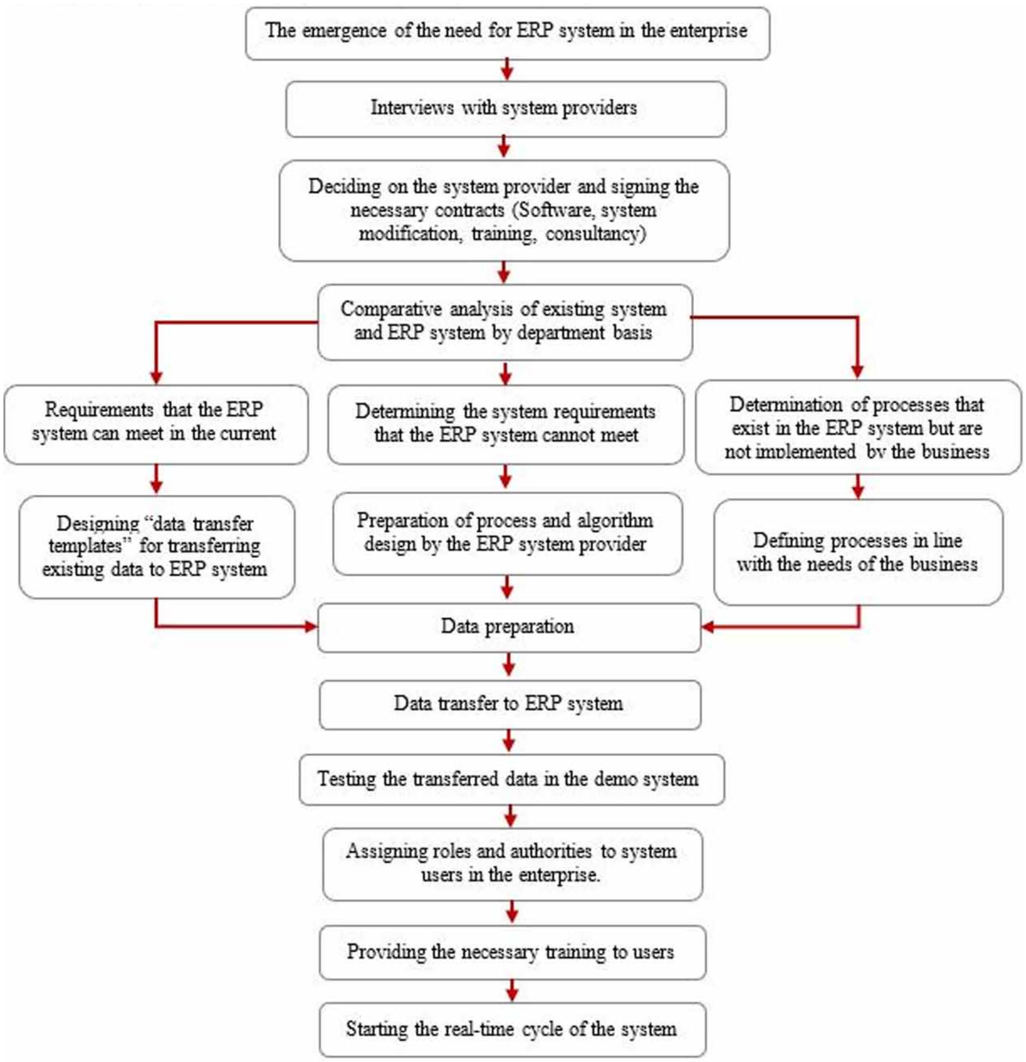
Figure 1. ERP System Installation Process in the Enterprise



These three situations come with new decision-making options and new activities for the business or ERP system provider. Correct evaluation of all three situations is an important requirement for an effective and efficient ERP system.

In this section, the operational stages of an enterprise that decided to install the ERP system and the kinds of problems it encountered in each transaction phase is presented.

Comparative Analysis of Existing System and ERP System at Department Level

The first stage of initiating the system is to compare the current situation with the ERP system requirements. At this stage, business executives hold analysis meetings with ERP system officers and ERP system consultants. At these comparative analysis meetings, the current system of the enterprise and the processes in which the ERP system matches, and does not match are determined. At this stage, while the

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interest and attitude of business officials towards technology and technology requirements are extremely important, it is very important that ERP consultants have sufficient sectoral knowledge and experience besides their technical knowledge. In this way, it is possible to be successful in improving the users' approach to this system, where the business is very foreign, overcoming their prejudices, in developing solutions and a healthy system design.

One of the important problems encountered at this stage; when defining their current systems, business officials do not to act objectively and they define the ideal/desired situation. Because, according to the business officials, ERP systems are to build the future of the business and at this stage, they talk about the imaginary system (desired) rather than the system that actually exists. Similarly, it is an important problem that consultants try to create the perception that everything is perfect by not addressing some (perhaps sectoral) deficiencies related to their systems. This can lead to unforeseen time losses and even conflicts in the later stages. For this reason, it is necessary to transfer the system currently used in the first design phase of the system in its simplest form and to indicate the planned/desired operations. Likewise, it is important that consultants identify and define deficiencies in their systems that cannot meet the requirements of the business at this stage.

While the business may not know the importance of the design phase, system consultants should be aware of the situation in terms of efficient installation and healthy execution of the system. However, consultants may start working without analyzing the business adequately and designing the processes appropriately in order to meet the project work/time plan as well as the sales targets that raise commercial concerns. However, the fact that the system requires a very rapid and radical change brings additional workload to the employees. This being not conveyed to the business officials, may cause delays in system applications and resistance in workers.

Design of Requirements That ERP System Meets in the Current System

After determining the current operations of the business in the system analysis stage, the state of meeting the requirements of the ERP system with these operations can be defined. After identifying the items that overlap in these two systems, detailed meetings are held for each item/operation and the deficiency in the current system can be determined. The actions to be carried out in line with the deficiencies and those responsible for these actions can be determined and the activities can be directed.

The most important problem encountered in this process is that ERP consultants cannot fully grasp the processes of the business and try to design the system with superficial information. The consultants, by considering the basic outputs, assuming that the system requirements are met and activity has been completed, quickly bypasses the relevant process. This raises three new problems in the later stages.

- **Incomplete or Inadequate System Design Due to Non-Routine Activities not Being Defined in the System:** In the analysis meetings held with consultants, the most frequently used question by the consultants is "What is the frequency of this situation?". The consultants prefer to act to solve the problem when encountered in order to make good use of the time if the activity is not carried out very often. However, this situation may cause deficiencies in the later stages. Therefore, regardless of the frequency of the situation, the system should be designed by evaluating all the main and sub processes of the enterprise in detail.
- **Inadequate Access to the Right Information at the Right Time:** In order to access the data entered on ERP screens that are not designed properly, there is a serious time loss between the

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screens. While consultants are acting in a result-oriented manner and emphasize the accessibility of information, the most important thing for the business is to reach the right information in the fastest way possible. A poorly designed ERP system cannot be internalized by users and results in more complicated work.

- **Failure to Detect Errors and Their Solutions:** While the ERP system is designed on the basis of the existing system, most of the time, it is designed that everything will go right and as it should be. There is not much emphasis on errors and possible solutions. In this case, every problem encountered when the system is started to be implemented creates a reaction against the applicability of the system in the employees and officials. They declare that they cannot solve the problems with the ERP system, that they otherwise could in the past. If the system design is done by performing idea development study about possible errors and problems, reaction plans for such risks can be developed and contribution will be made to the effective use of the system.

These sub-problems can cause significant disruptions in the system and significant effects on product and service quality. For this reason, it is critical that system consultants have industry experience and understand the main and sub processes of the business accurately and in detail.

Determination of System Requirements That ERP System Cannot Meet

Commercial enterprises are the customers of ERP system that carry out their activities by producing goods and services that aim for quality and fast production system with minimum cost. Each enterprise has its own methods and processes for doing business.

The ERP systems market is a sector in which significant competition concerns are experienced, involving global or domestic software companies. In order to achieve sustainable success in the sector, besides offering good product and service quality, it is very important for system providers to design the system in the most inclusive/broad style to declare that they can meet the needs of the customers. Operational system requirements / modules are formed on the basis of ERP systems with academic knowledge. However, it is not possible for these systems to meet the needs of every business. At this point, the most important issue is the degree to which the software matches the operational processes of the user enterprise. For this reason, ERP system consultants may want to ignore the deficiencies that arise due to the fact that the activity carried out by the enterprise in its current system does not have an equivalence in the ERP system or new additions to the software to make the incompatible systems applicable.

While these add-ons sometimes do not meet the needs of the business, sometimes they may not work effectively with the software. In this case, the operating authorities should decide on the importance of these processes in terms of operational performance and request to adapt what is really necessary to the ERP system.

Determination of Processes Existing in the ERP System and Not Operated by the Enterprise

As stated in the previous section, system providers offer services with the same software to their customers from different sectors, different sizes and organizations with different organizational structures. System providers update their systems by making add-ons in line with the demands and needs of their customers, and these updates also cause revisions in the systems of all customers. Thus, while the soft-

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ware becomes more comprehensive, complex application screens make the system difficult to use. This application, which prevents the system from being user-friendly and slows down the response time, decreases the performance of the system.

At this stage, business ERP officers and unit managers and ERP system consultants should determine the modules and titles that exist in the ERP system but are no use in the business. The system consultant should convey the benefits that these titles will provide if they are used in the enterprise and offer implementation options. If the business officials decide that the use of modules or titles is applicable, the necessary processes within the business should be designed and documented. If the operating officers and department officers do not require the use of some modules and titles of the system, and these modules and titles do not negatively affect the performance of the entire system, they should be closed by the system experts so screens and applications become more convenient to use.

Collecting and Preparing Data by Designing Data Transfer Templates for ERP System

ISO 9001 Quality Management System, which has the widest use in our country and in the world, requires businesses to document, measure and audit their processes. In fact, this is an important first step towards institutionalization for small and medium-sized businesses. In this way, businesses learn to conduct studies on traceability and data management. However, this data may not be in the sensitivity and detail of the database management system, but in the computer environment or in the form of paper and folders within the capacities of the enterprises. While the existence of this data is of great importance in transition to the ERP system, templates are needed to transfer this data to the database. These templates should be created in detail and filled with all the details. The following items should be taken into consideration when designing the ERP system:

- The ERP system should be seen as an investment for the future of the business and it should be designed in such a way that "every employee to start work can adapt easily".
- All code and name definitions in the business must be created within a certain standard.
- Every information should be defined in detail and clearly so that the system can be maintained independently of individuals.
- While designing the ERP system, it should be taken into consideration that the existing personnel do not have difficulty in transitioning to the new system.
- Designed in such a way that the existing staff can understand and adapt easily, the new system is also important to ensure the reliability of the entered data.

Data Transfer to ERP System

Establishing the two systems in accordance with each other and collecting the correct data are the basic steps of the healthy progress of the system to be established. A proper, reliable and user-friendly system design has an important place in preventing chronic errors that may arise later. Likewise, entering the collected data into the system is a subject that requires precision.

The most important point in the design and implementation processes of the ERP system is errors that cannot be noticed for a long time due to design or data transfer mistakes. The fact that the system is new may also cause errors to be detected late. As time goes by, it is easier to spot errors in an ERP

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system with data entries for months or years, but it is very difficult to correct errors. As the data entry increases, the connections between the tables in the database increase and this leads to the formation of nodes in the system. This situation can be solved by the ERP service provider through remote intervention to the software however, this is likely to cause loss of data.

While designing the system, all possibilities and sensitive points should be determined, and solutions should be developed. The great attention should be paid in the data transfer and the errors that will become chronic should be eliminated at the source.

Testing the Data Transferred to the ERP System in the Demo System

This stage is the pilot testing of the system. It is desired to make sure that the system is correctly configured by trying the data defined in accordance with the prepared structure in the demo system. In such a way, before the actual system is used, it is evaluated whether the designed system meets the desired conditions.

At this stage, tests should be carried out by trying out all the possibilities and forcing the demo system. Each different scenario should be tried step by step. The problems that arise should be evaluated and comprehensive solution suggestions should be developed. In addition, after the actual system usage has started, the demo server should be kept online and used for control purposes after the changes and updates are received.

Determination of ERP System Users and Roles / Authorities

In ERP systems, all data produced in the enterprise is located in a single database, which poses a risk for information security. Only relevant departments or responsible staff should be able to view / change this information. Departments, such as production, sales, purchasing, finance, quality control, should not be able to access the information of other departments; as well as, those responsible should not be able to access others' data. At this stage, related restrictions or authorizations can be made in the system using user - role - authority definitions. However, first, modules and screens need to be fully understood. Occurrence of unpredictable errors are most likely, if authorizations are made before each segment and their functions are fully understood. For example; some information in stock receipts such as supplier firm, product name, unit, quantity may be needed by an engineer working in production, while price information may not be requested to be seen by an employee other than the purchasing unit. In order to prevent the occurrence of similar situations, it is necessary to be careful and precise while assigning the authorization of the information to each segment.

At the stage of user - role - authorization definitions in the system, it should be well known which segment has which functions. It is possible to reach different information with methods such as right-click menus and short-cut buttons in the segment. During the authorization phase, employees should not be allowed to access any information more than their job requires.

After the setup of the system has been completed in general terms and the authorizations have been assigned, the system becomes ready to be used. This may cause both consultants and business officials to hurry to use the system at this stage. Since the reverting of the authorization decisions, made in a rush, by the management may cause more important damages, correct determinations should be made step by step and by examining the individual segments at this stage.

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Providing and Supporting the Necessary Trainings to System Users

In the ERP system, together with the ERP officers assigned at the beginning of the project, people who will enter and query data in the departments are determined. Training plan should be prepared for each personnel to be included in the ERP system according to the user - role – authorizations. After the trainings are completed within the scope of the training plan, the processes carried out should be checked at regular intervals and negativities should be determined and on-the-job trainings should be continued. Trainings should be continued until errors caused by data entry are completely eliminated.

Starting the Real Time Cycle of the Installed System

Training must be completed before real-time implementation of the system. Thus, the wrong and incomplete entry of the data will be prevented from leading to problematic records in the real system in the future. Accumulation of problematic records slows the system and an increase in the prevalence of these records showing up in inquiries causes distress in users, as well as complaints and resistance to the system. Segments need to be designed with the aim of ensuring that transactions can be completed as quickly and easily as possible in real-time use of the system.

Problems Arising from Business Processes

Small and Medium Enterprises (SMEs) are of great importance for the countries' economies. Development of SMEs in the center of the economy with their contribution to employment, their fast and agile structures is a necessity for the development of countries. One of the important tools that SMEs can use to transition to the corporate structure is the ERP system. However, in addition to the financial requirements of the system, the fact that it brings additional bureaucratic procedures in the enterprise and creates additional workload and time losses for personnel who are not accustomed to keeping records results in the abandonment or partial use of many projects.

In SMEs, decision making and solution development processes are mostly carried out with short meetings or verbal consent of the management. This accelerates the business and creates a significant competitive advantage, even if it is not suitable for the corporate structure. Since the ERP system brings standardization in the processes, it requires all units to follow specific steps in their work. Units capable of doing business with a much faster response time before the ERP system must perform certain registry entries after the ERP system implementation. This situation is initially seen as a significant waste of time by the employees and thus causes them to gain resistance against the system. In order to prevent this resistance, the advantages of the system should be explained to the employees and a determination should be shown to maintain the system.

Thanks to the standardized processes and standard data collected in the database, the problems and solutions experienced in the processes turn into corporate memory in the database. Creating corporate memory without any loss of information is an important resource for decision making and problem solving activities that will take place in the future, and will contribute to the development and sustainability of the business.

This situation may not be understood both by business owners, managers and decision makers, and employees. While the employees state that their work is getting more difficult and their workloads are

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increasing due to leaving their comfort zones, management starts to think if they have made a mistake by switching to the ERP system. At this point, what needs to be done by ERP officers and business owners:

- ERP system officers should provide employees with ERP system awareness training. Although these trainings are sometimes implemented in a training format, sometimes they should be conducted as informal on-the-job chats. The long-term benefits of the system and their contribution to the work they perform should be explained. At this stage, it should be explained that ERP is not a smart system or automation system, it is a record keeping software in which data is entered regularly and in a standard form. The importance of the data they enter should be addressed in order for the system to be executed in a healthy way. It should be emphasized that data entry is an important and necessary business process as much as production, billing or shipping is.
- In line with the review of the operation of the system, new personnel should be recruited to the blocked points. Assigning a new task which they are not accustomed to will result in an increase in the psychological pressure and resistance of the employee who works in a sensitive job or with an intense performance. Personnel recruitment is very important in terms of reducing the pressure and stress on existing personnel. Furthermore, the integration of new staff into the system is much easier.

Application Based Problems

ERP system software is designed based on academic resources and is structured to meet the general needs of businesses and offered to businesses. Academic studies describe the ideal situation; however, practices do not always reflect these situations. Commercial companies are developing their operational processes in order to produce the product that will meet the expectations of the customer, with the lowest cost and the fastest way. Each enterprise carries out its own business development studies; this poses significant difficulties in making the ERP system suitable for the enterprise. During the purchasing process, in order to complete the sale, the service providers promise full integration by making particular changes. However, this does not happen in practice or causes high costs in case of attempting.

ERP system is based on the execution of the activities within the framework of planning, implementation, control and approval cycle. However, especially in SME-scale enterprises, planning is not effective, and operations are carried out in line with orders. This situation prevents full time and full compliance in data entries. ERP systems, which enable the recording of the activities carried out within the enterprise, require data entry in areas where there are no character limitations due to application limitations. This causes problems in the data analysis to be carried out in the future. At this point, the ERP system, which aims to standardize processes and data, contradicts itself.

In this context, the fact that the enterprises that will use the ERP system do not have the necessary information in the purchasing process causes them to fail to predict the problems that they may encounter in the future. Enterprises should be asked to have detailed discussions with more than one supplier company during the purchasing process and to suggest reference companies from which they can learn their experience. It would be beneficial to have interviews with users from similar sectors who are using the system and learning the problems they experience. Signing the contract with the service provider, in line with the information gained, is important for the effective execution of the system.

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Invisible ERP System Costs

Businesses are structures that carry out their activities for profit and contribute to society in terms of employment, national income and social development. Investment decisions of businesses are evaluated within the framework of the return time of the investment and financial output. The return and cost of an investment decision to buy a new workbench can be concretely expressed. However, an investment decision such as establishing a new system; its duration, cost and return cannot be clearly calculated and, in some cases, cannot be concretized. Besides the net cost of the system, it is very difficult to predict possible additional costs, adaptation period and return.

ERP is usually a system installation that includes new and more standard operations on a system that is currently running. In this case, users can exhibit behaviors that protect the present system that they are accustomed to, thus easy to use. At this point, the short- and long-term advantages of the system should be explained to the employees. However, in some cases, excessive resistance to the system or leaves may be observed. This situation may be reflected to the business as a loss of skilled employees.

The ERP system is seen as an important investment for businesses. However, the main cost item is not the ERP system software cost, but the new process costs such as infrastructure needs (network infrastructure, server, cooling system, data entry units - computer or mobile device, label printer etc.), new personnel employment, error costs and time losses. Changing in many processes that have become ossified in line with the system causes additional unforeseen costs. However, despite all these additional cost items, the ERP system is an important requirement for an enterprise that has reached a certain growth and development phase to move forward faster.

FUTURE RESEARCH DIRECTIONS

Within the scope of the study, the ERP setup process of a SME enterprise and the problems encountered were presented. It was observed that the findings obtained from the interviews with different companies are also experienced in those enterprises. A questionnaire is planned to be created within the framework of the problems identified in future studies. The validity of the results obtained by applying the survey to more companies and analyzing the results should be investigated.

CONCLUSION

The ERP system is a researched subject in the literature with different methods and different perspectives. The ERP system requires research and development due to its wide usage area in the world and its structure applicable to every sector and every business size. Despite its high costs and low level of success in its use, the ERP system is an important step towards institutionalization for businesses, considering its benefits in terms of sustainable business management.

The ERP system journey begins with the emergence of the need for an ERP system in the enterprise and negotiations with the service provider suppliers. The success of this stage is closely related to the success of the system in the later stages. Having an agreement with a service provider with industry expertise, expert advisors and training staff within the framework of a detailed business plan is important to establish a successful system. At this stage, it is effective to request sectoral references from candidate

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suppliers and to understand the problems encountered in practice by interviewing users, to identify the right supplier and to ensure the success of the system.

Following the selection of the service provider, the system should be designed in accordance with the operating activities. As the ERP system is designed to meet the needs of many businesses working in different fields, it is actually a loose-fitting dress for businesses. The analysis of the existing processes and the design phase of the new system is a tailoring process to make this loose fitting dress a good fit for a specific business. Since these revisions will be much more difficult after the system has been put into practice, all the necessary preliminary preparations should be implemented in the design phase. At this stage, all main and sub processes should be taken into consideration and non-routine activities should also be evaluated.

The ERP system should be seen as an investment for the future of the business and it should be designed in such a way that every new employee can adapt easily. All code and name definitions should be made within a certain standard and necessary explanations should be included. One of the important issues is to make user - role - authorization definitions in the system. Since the definitions of authority, the importance of which can sometimes be ignored, may cause important problems, user - role - authority definitions should be made by analyzing which screen has which functions and which information can be accessed with which buttons.

Businesses should be aware of the importance of training during the system setup phase. After the trainings are completed within the scope of the training plan, the processes carried out should be checked at regular intervals and negativities should be determined and on-the-job trainings should be provided. Trainings should be continued until the errors caused by data entry are completely eliminated.

Unforeseen costs should be taken into consideration during the installation of the system. Infrastructure requirements must be determined in detail with the supplier company.

Resistance to change is one of the most important problems experienced at the point of transition to an ERP or any new system. This resistance, which can occur at any stage of the process, can sometimes reach managers or even the owner of the business. Replacing their existing systems, which they are accustomed to and easy to implement, with a new system that will bring additional workload and pressure to them, brings resistance together. For this reason, in order to be successful, the long-term advantages and ease of use of the system should be explained to the employees to ensure the effective participation of the employees.

This study was conducted by using action research method in an SME scale enterprise. The reliability of the research was ensured by recording all the details of the attitudes of the employees and management and the state reached at the end of the process within the framework of observation, an examination of records, participation in meetings, interviews with experts and consultants within an 18-month working period. The most important limitation of the study is that the research was carried out within the scope of a single enterprise. In order to generalize the results, it is important to conduct interviews with businesses from different sectors and to compare the problems encountered during the ERP system setup process. In fact, in the next step, improving the findings so as to explore the perspectives of system providers (ERP consultants) will provide significant benefits.

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KEY TERMS AND DEFINITIONS

Action Research: This type of research is carried out to understand the problems that arise in practice and involves the researcher in the process. Thus, the process can be followed more closely and the problems can be detailed.

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Enterprise Resource Management (ERP): It is an information system designed to support strategy development, operational management, data analysis and decision-making functions in businesses. The system provides controlling routine operations such as sales, purchasing, inventory management, production planning and control, service, and financial management under one roof.

Operational Management: It is the process of combining existing facility, material, equipment, and human resources in a business in a manner to produce the targeted amount of product, at the specified quality, at the desired time and at the lowest cost.

SME: Businesses that employ less than 250 employees annually and whose annual sales revenue or financial balance is determined on a country basis. They are classified as micro enterprise, small enterprise, and medium enterprise.

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Chapter 20
Economic Opportunities in One Belt One Road (OBOR) Project and Turkey's Position

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ABSTRACT

After a short time from the discovery of silk by China, it had become a status symbol in the world, and it reached up to the Roman Empire. This created trade routes and they were called the "Silk Road." The goods that came to the Mediterranean through this historical trade route were distributed to the world through Mediterranean ports. However, invention of compass by China paved the way for geographical discoveries and new trade routes were found as a result of these discoveries. These developments reduced importance of the Silk Road. Approx. 500 years later, China became a manufacturing center as a result of its trade with the West. This situation reminded China of the "Historic Silk Road," and they announced the project under the name of One Belt One Road to the world in 2013, which is essentially a modern version of the "Historic Silk Road." Economic Opportunities In Obor Project will be analysed in this study.

INTRODUCTION

The change experienced by the world with globalization has accelerated world trade and the desire of countries to reach economies of scale has resulted in economic integration and even integration processes as in the EU example. Like all these processes, there has been a transition from transportation to logistics at the point of shipment of manufactured goods, and a transition from single-mode transportation to

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multi-mode transportation in the field of transportation. The development of the above-mentioned types of transport has been with the containerization process that emerged with the standardization of transport containers towards the end of the 20th century. Containers have harmonized transport between different modes of transport. All these processes have spawned the concept of international transport corridors in transport infrastructure. The TRACECA Project, known as the "Iron Silk Road", which will connect the EU with Asia, more than sixty countries within China's OBOR Project, can be cited as an example of some of the international transportation corridors.

Turkey is at the intersection cluster of two projects in the corridor-based China's OBOR Project and the EU's TRACECA Project, especially for trade and transportation activities between Europe and Asia. Geographically, Asia, Turkey is in a crossroads position between Europe and Africa has become the center of the country who want to improve and to meet their transportation needs in a sense. This study contains Turkey relations with international transport corridors, Turkey's transport projects developed associated with the corridors and especially developed by China "A Generation A Way" Project (OBOR) project across an opportunity includes logistics potential, Turkey's economic benefits which can also be created the opportunity to become beneficiary of this transportation corridors. Also in this Chapter, the "Silk Road" used in history is examined and the process up to the OBOR Project, which China has created with the inspiration of this historical way, and the process after the announcement of OBOR, China's Belt and Road Initiative, its goals, routes, project execution. It will be examined for the necessary financial resources and what opportunities it offers for Turkey. In addition, it is thought to be beneficial for other academic studies; OBOR Project by rail transit through Turkey's potential revenue to be earned, commercial revenue growth again OBOR take the consequences for the economies of Corridor Project with possible minimum share and so on. calculations are also included.

PROCESS FROM HISTORICAL SILK ROAD TO MODERN SILK ROAD

The Silk Road Concept

In Britannica, the Silk Road is defined as "the ancient trade route connecting China to the west, where goods and ideas are moved between two great civilizations of Rome and China (Britannica, 2019: Silk Road). The concept of "Silk Road" is actually a word with a hundred years of history used by German Geologist and geographer Ferdinand von Richthofen in his work in which he describes China and the west of China. But there's no doubt that even if the road is based on the silk from which it gets its name, it has gained another dimension with the Aurignac traces on Loess Cover found by Teilhard de Chardin geologist and paleontologist who discovered the Beijing Human Skull. Aurignac is the general name of the industrial phase from the upper paleolithic period and dates back to the west of France and up to 33.000 BC. In the new Stone Age, the ceramic produced unique to that age was delivered to China with the road going through the (Uhlig, 1986: 13-18). Looking at the earlier periods, although it could be said that the road which could not be named until Richthofen was primarily a ceramics road depending on the commodity of ceramics carried on it, ceramics could not get in the way of silk with the fact that ceramics reached China and easily it could be produced in China and it could be processed in other civilizations in time. Because silk had become a symbol of wealth, luxury and nobleness for that period, and it was produced in the Chinese monopoly for a long time. It is also accepted as a natural resource with limited production status such as gold and silver. The trade of the silk, which was attributed so

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much importance for that period, created a transport corridor, and although corridor's name was given later, it received approval as "Silk Road".

Silk as a Commercial Commodity and its Economic Value

Although the discovery of silk yarn and its artistic processing stemmed from the basic need of man to dress, it has become one of the class symbols in China, then in the entire ancient world between East Asia and Rome. In ancient China, that first only the royal family, later the rich class could own silk made it a status symbol in social life in time (Uhlig, 1986: 20-33). The fact that silk is a symbol of wealth in the world has made it a capital that is valued as long as it is held in hand for those who trade. Therefore, it has been interpreted as one of the first forms of the capitalist system. Because between East and West, silk, the only equivalent of gold, emerges as the first currency, the first convertible value. Besides, fashion meant silk for that period; the richness of the patterns, the need for a special production technique, the difficulty to be imitated made it different and difficult to reach. Similar to the desire in today's youth and third world countries to have electronic devices and cars, the desire to possess silk in its numerous forms became widespread in those times. The increase in the demand due to the desire to have status, desires and ambitions caused an economy to occur, while shopping was done first based on exchange, gold could be purchased with silk and therefore values that could be measured in gold could be purchased with silk and the switch to convertibility started (Uhlig, 1986:24-33). The first economic value of convertibility can be calculated with the thirteen thousand rolls of silk exchanged between Chinese Emperor Yangti and Gokturk Khan Şimin in return for three thousand horses, which shows that one horse costs 4.5 rolls of silk (Onay, 2019:7). The fact that the silk is so important for that period also reveals the reason why the Silk Road has emerged.

Historic Silk Road Corridors

For centuries, the historic Silk Road has remained the most important road connecting Europe and Asia. Silk Road consisting of many different routes and spreading to a wide geography has not only been the source of prosperity and commercial relations but also has made history as a corridor of cultural interaction, exchange of knowledge and experience between different communities. Land routes, unlike sea routes, have forced communities to interact with other communities and different cultures. As a result of commercial interaction, even the smallest villages have been exposed not only to the products of advanced civilizations, but also to exchange of ideas, knowledge, experience and faith (Fedorenko, 2013: 3).

Until recently, it was thought that there was only one road between China and western civilization, this road being one which crosses the Gansu Region and the north of the agricultural basins, from Pamir Mountains to Afghanistan and then to Iran, Syria and Anatolia. The most important reason for the inability to clarify the Silk Road routes is that the names of the places are named differently in both eastern and western historical records. For example, while the Chinese named the old Uyghur city in the Tufan Valley Hoço as Kao Ch'ang, the Uyghur people never used this name.

When archaeological excavations were examined, while the first findings were known to be based on the silk garment found in the grave of one of the relatives of Greek Commander Alkibiades in the Kerameikos graveyard in Athens, this changed shape with the silk found in South Germany in 6 B.C. in a Celtic King's tomb. If these findings are followed by the oldest caravan road from China to the northwest, the road leading to Urumchi is reached from the northern border of Gansu and from the Tufan Valley

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which carries great importance in the South route. On the other hand, the border of the South roads is narrower and the exit point is Changan, which is the Khan's imperial city and commercial center at the same time. From here, it headed northwest, reaching the Gansu corridor via Lanchov and then to Dun Huang. The roads diverged here, the South Road, progressing through Yangyuan pass along Lake Lop reached Kashgar over Loulan and from there reaching Pamir connected with the North road in a plateau in present day Kyrgyzstan. On the other hand, the North road connected to Karaşar at the South skirts of Tengri Mountains going through Yumen Kuan, Yarkhoto and Hoço. From here, it reaches Pamir via Şorşuk, Kuça, Aksu, Tumşuk and Kashgar by heading to the south west (Uhlig, 1986:65-79).

The connected road, reaches Belh in present day Afghanistan from Baktra along the side of the Pamir Mountain and then to Tahran over Sahrud near the South East shore of the Caspian Sea. From here, it reaches Attaleia, present day Antalya over Hamadan (a city in Iran), Medain and Palmyra (a city n Syria) and the goods reaching here were sent to ports of Rome and to Alexandria (Uhlig, 1986:65-79).

Figure 1. Silk road routes in the middle ages
Source: (Fedorenko, 2013:2)

The Modern Silk Road Idea

The historic Silk Road has been an area which countries in the region want to dominate because of both the security advantages and economic advantages in terms of the economic opportunities it creates. The Silk Road has continued to increase the opportunities it has created as the only transport corridor until

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the geographical explorations. China, an important international trade center with the silk it has found and subsequently developing Silk Road corridor, lost its dominance with the shift of the trade corridor to Atlantic Ocean due to geographical explorations, which were realized thanks to the compass it discovered again in a sense. However, with the increasing production due to the changing world conjuncture and capitalism, the desire of producing companies to reach scale economy, the ability to make optimization calculations and apply comfortably in manufacturing with industrial engineering has paved the way for the minimization of input and production costs which in turn has caused labor costs to become important in production. Just at this point, China, with its crowded population and cheap labor, became a center of attraction again with its accelerated international trade and evolving transportation infrastructure, which has become widespread and accelerated by initiatives made by the World Trade Organization after World War II. China, an important actor in the region, has continued its growth rapidly by first by making subcontracted production with cheap workforce, and in the meantime has increased its capital accumulation considerably. After the accumulation of capital, it has produced world ranking companies that are able to produce technology outside of subcontracted production such as Huawei and Alibaba. China has recalled the Silk Road, a historic legacy for itself in the face of increased energy needs, security concerns and transport and logistics costs that have become important in competition with industry giant countries. This is due to the economic setup all around the world that enhances companies to operate beyond their boundaries of origin country (Doğru, 2019).

An old Chinese Proverb which has reached today says: "History does not talk about the old, it creates the new." It would not be wrong to say that this proverb inspired China's New Silk Road Project. Because the "Modern (New) Silk Road" initiative, which is discussed by both China and other world states and will then ultimately be called the "Belt and Road Project", will be the main element of this section.

The Chinese Dream

Before China introduced the "One Belt to The Road" Project to the world, in the closing session of the12th National People's Congress when he was elected president of the People's Republic of China in the 12th century, Xi Jinping has explained the "Chinese Dream" as follows: "In order to realize the Chinese Dream we must follow the Chinese Road, we must glorify the Chinese Spirit, unite all forces of China. The People of China are peaceful. We will raise the flag of peace, solidarity and win-win partnership, we will proceed unsurprisingly on the path of peaceful development, we will follow the win-win strategy that benefits mutually from opening out. We will dedicate ourselves to developing friendly partnerships with all other countries around the world, fulfilling our international duties and responsibilities, and continuing to advance the purpose of great peace and development."

Between March and June 2013, he visited Russia, Africa, Latin America and the U.S. and during his visit to the U.S. in a clear statement to President Obama he said: "China will work hard to realize its great dream of renewal and strive to advance its purpose. The Chinese Dream means a rich and powerful country, happy, contented people. Efforts for peace, development, cooperation and win-win results were linked to the American Dream and the beautiful dreams of the people in the rest of the world" (Xiaosi, 2017: 15-16: Kassymov).

The Chinese Dream has caused many comments that have resonated around the world after these statements. According to former U.S. Secretary of State Henry Kissinger; The American Dream is based on Americans constantly working for better living conditions, thinking that tomorrow will be better. It is very important that the People of China, who have suffered 100-150 years of poverty, put forward the

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Chinese Dream. While interpreting that although the two dreams have different sources, the end result is a more peaceful, rich and collaborative world, former Deputy of the Information Department of the Council of China has stated;

"The Chinese Dream aims to evolve and enrich in harmony with the rest of the world. Each country can choose its own dream based on its own historical and cultural background, but all good dreams will affect the enrichment of the countries and the well-being of the people". Also former Chinese Culture Minister Wang Meng has added a new dimension by saying; The "Chinese Dream", which first accepted the Great World Unity, is based on the belief that all the people in the world are brothers and that the world will be a better place. Until now, the Chinese have always remembered the Great World Unity Dream" (Xiaosi, 2017:117-127: Kassymov). Of course, this dream can be realized by the contributions of countries which rely on innovation. Because, the investments made on both social and technological innovation sustain countries to gain competitive advantage over other countries (Doğru, 2020).

As you can see, there are intersection clusters of the American Dream and the Chinese Dream. While they both contain the promise of rich countries, rich communities and wealthy individuals, the question arises as to whether the American Dream tries to enter and shape the densely populated regions of the world it has not achieved to enter with capitalism through the Chinese Dream. But regardless of everything, with the Chinese Dream, the world has begun to take a new shape. Because the Chinese Dream aims to contribute to the development of the world with countries involved in the process, not globalization on the axis of globalization. The "Belt and Road Project" that will be explained below is also an extension of this dream and when examined closely, although it presents some solutions for meeting the increasing energy need of China for energy, its aim is not taking the resources almost without no charge by dominating administrations like in the example of imperialist countries exploiting Africa with the industrial revolution, but buying with the prevailing prices in the world by realizing relevant projects. Because China is concerned with the price due to the fact that it is in competition with the world in addition to how many tons of oil it can bring into the country; therefore, price is a determining factor in the recent periods.

China's "Belt and Road" (Modern Silk Road) Initiative

After the declaration of the Chinese Dream, during Chinese President Xi Jinping's visit to Central Asia in September 2013 that corresponds to the six months after his inauguration has announced the Silk Road Economic Belt initiative under the name "One Belt One Road". In a speech made at the Nazarbayev University in Kazakhstan, President Xi has proposed China and Central Asia to act together to create Silk Road economic belt to boost cooperation in the region he has determined the framework of the initiative as such (Xinhua News Agency):

1. Policy communication, coordination,
2. Infrastructure connection; The creation of a road link from the Pacific to the Baltic Sea and a transport network connecting East Asia, West Asia and South Asia,
3. Easing trade, unhindered trade
4. Monetary circulation, financial integration
5. Connecting people

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Routes and Scope of China's "Belt and Road (Modern Silk Road) Project"

Concept 1 in the Belt and Road Project, is stated as follows when it was formally adopted in November 2013 at the Third General Assembly Meeting of the 18th Central Committee (CPC) of the Communist Party of China; this concept is based on the idea of strengthening economic integration and globalization processes through the development of the infrastructure of land and sea transportation combining existing projects. Then, in March 2015, the 2nd Concept was explained with the Chinese Foreign Minister stating that the country's main focus in 2015 was multifaceted, adding that the project would accelerate the revival of the Eurasian continent as a whole. The second concept in the field of the "Belt and Road" initiative has been accepted as announced with the publication of the Silk Road Economic Belt and 21st Century Maritime Silk Road map by State News Agency Xinhua (See Figure 2).

Figure 2. Belt and road project: "Economic belt and 21st century maritime silk road map"
Source: Xinhua News Agency

The map, published by Xinhua News Agency, shows that the Modern Silk Road Economic Belt Project Route will pass through Central Asia, Iran, Iraq, Syria and Turkey, starting from Xi in central China. On the other hand, the Maritime Silk Road crosses the Indian Ocean starting from the South Chinese Sea, connects the Land Silk Road in Venice by crossing the Red Sea and the Mediterranean after stopping at Kenya (Habova, 2015:64). The most important international meeting on China's "Modern (New) Silk Road" called "One Belt One Road ", International Cooperation Forum was done between May 14-15 2016 in Beijin; more than 100 state and international organizations have declared support for the project at the forum attended by 29 state and government leaders. China has signed an agreement with over

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fourty participants. Xiang Junyong, a researcher at Renmin University in China has drawn a general framework by saying; "The main structure of the Modern Silk Road has been roughly shaped as routes, trade zones, international economic corridors, better roads between cities and better ports". In addition, in the countries involved in the project, 56 cooperation zones were created for Chinese businesses and approximately one billion USD in tax revenue has been earned. As a result, 180,000 local jobs were provided (A modern Silk Road in the making, Xinhua News Agency, 2017).

Although the Belt and Road Initiative initially set out to establish a tighter connection between the countries on the old Silk Road, it later became a major project aimed at improving regional cooperation. While the Silk Road Economic Belt forms the land network, the sea route forms the 21st Century Maritime Silk Road. The initiative, which initially began with the introduction of 64 economies, has brought together more than 100 economies today. Table 1 shows a list of economies with cooperation agreement with China (China's new silk route PwC,2016:5):

Table 1. Economies Included in Belt and Road Initiative

REGION	ECONOMY
East Asia	"China, Mongolia"
South East Asia	"Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, East Timor, Vietnam"
South Asia	"Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka"
Central Asia	"Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan"
Middle East and North Africa	"Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Palestine, B.A.E, Yemen"
Europe and Central Asia	"Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Latvia, Lithuania, Former Yugoslav Republic of Macedonia, Moldova, Montenegro, Poland, Romania, Russia Federation, Serbia, Slovakia, Slovenia, Turkey, Ukraine, Italy"
21st Century Maritime Silk Road	"Ethiopia, Kenya, Morocco, New Zealand, Panama, Korea, South Africa"
1- Economies are grouped on the basis of the Classification of the World Bank Group by region.	

Source: China's new silk route PwC

Specific Goals of "Belt and Road" Project

While the "Belt and Road Initiative" which emerged in order to facilitate trade and investment aims to develop the countries involved in this project, supports China becoming a regional leader with participation on a country-by-country basis because of the win-win strategy at its core. This has also paved the way for greater benefits for China. Because as a natural result of the project, China will ensure its own energy, food and resource security. Although specific targets for the "Belt and Road Initiative" have previously been mentioned in speeches made by the authorities, China's "13th Five -Year Plan" has been officially stated in its other parts

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- The process of increasing trade and investment in the Belt and Road Initiative: "By focusing on political communication, infrastructure links, easing trade, flow of capital and change from person to person, bilateral and multilateral cooperation mechanisms will be developed".
- The process of creating free trade zones along the Silk Road: "Efforts will be increased to accelerate the free trade zone strategy, and there will be active participation in negotiations with countries and regions along the Belt and Road Initiative routes in relation to the construction of Free Trade Zones by gradually creating a network of high-standard free trade areas."
- The process of financing infrastructure, the development of financial cooperation in the region: " To strengthen cooperation with international organizations including international financial institutions and institutions, to actively work to promote the development of the Asian Infrastructure Investment Bank and The New Development Bank, to use the Silk Road Fund effectively, and a platform of financial cooperation that provides open, pluralist and mutual benefit will be established."
- The process of accessing to natural resources: "International cooperation on energy, resources, production chains, internal processing and transformation will be strengthened."
- The process of strengthening transportation infrastructure in BRI corridors:
- To build international logistics routes that combine highways, railways, waterways and airlines and strengthen infrastructure development along the main routes and in the main ports, to develop multi-mode transportation development, to develop Xinjianb, considered the core region for the 21st Century Maritime Silk Road and Silk Road Economic Belt" (China's Belt and Road Initiative in the Global Trade, Investment and Finance Landscape, OECD Business And Finance Outlook, 2018:10).

Funding Resources of "Belt and Road Project"

Since the Belt and Road Initiative (BRI) was announced in 2013, more than 126 countries and 29 international organizations in Asia, the Middle East, Europe, Africa and South America have signed cooperation agreements with China to join. As the total trade volume between China and participating countries exceeds USD 6 trillion and needs an additional USD 26 trillion to sustain the economy's growth by 2030, financing is of great importance to ensure the ongoing success of the initiative. An infrastructure investment of around $8 billion is needed for BRI, according to U.S. estimates (https://www.chinadaily.com.cn/a/201904/26/WS5cc2a6f6a3104842260b8966.html).

"Asian Infrastructure Investment Bank (AIIB) was established in Beijing on October 24, 2014, an agreement signed by 21 countries, as this financing was not possible to be funded by the "United States and the World Bank".

China, the bank's largest shareholder, is 26% share, while the 2nd largest shareholder India's share is 7.5%. Turkey is the 11th largest shareholder with a capital commitment of USD 2,609,000,000 in the bank which has 57 members today. (Zentürk, n.d.).

Established as a regional development bank, the AIIB aims to provide funding support mainly on infrastructure, energy, logistics, telecommunications, urban and rural development and environment within sustainable development. With these initiatives, China appears to have begun to create its own sources of financing, in a sense, in addition to global powers and their corporate financing providers. It

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seems possible that the AIIB should be considered as an initiative that would pave the way for China to develop the BRI Project. These days when it is being discussed that significant changes will be made to the new economic order established after World War II, China; By ensuring that US allies such as "South Korea, Japan, Britain and Germany" join the AIIB, wants to take part in money transfer by installing CIPS (China International Payment System) against SWIFT. However, after China's attempt to establish the AIIB, the United States opposed the restructuring and urged other countries interested in the bank not to join. There have been no call-up countries in the developed countries, except for "Japan and Canada"(Yavilioğlu, 2016:10-12).

Projects Financed and/or Executed Within the Scope of the "Belt and Road Project"

Although the 2013 announcement of the "Belt and Road Project" has been named China's Marshall Plan in various sources, China has refuted this thesis in a sense with its declarations that this project is a "Win-Win" project within the framework of mutual volunteering. With the introduction of the project's financing resources and the introduction of applications, this time it has been described as China's "Debt Diplomacy".

Sri Lanka, for example, has signed agreements worth USD 15 billion over 12 years for various investments, including railways, airports and ports, as part of the Belt-Road Project, which is 15 times the total aid made to the country between 1956 and 2016. As of 2015, Sri Lanka has an external debt of USD 8 billion to China, and as of the end of 2018, Sri Lanka's revenue of USD 14.8 billion is going to foreign debts of USD 12.3 billion. Due to borrowing, Sri Lanka transferred 70 percent of the Colombo port business to China for 99 years, in return of USD 1.1 billion of its debt to China, and also approved the allocation of 15 hectares of land around the port to the company for the creation of a natural gas plant, refineries and logistics zone (Oguz, 2019).

The debts taken by Pakistan in the scope of China Pakistan Economic Corridor (CPEK) as one of the important parts of the "One Belt One Road Project" have been interpreted as China having started to create a debt diplomacy or "debt trap". As of 2017, Pakistan's debt to China totaled USD 19 billion, equal to a fifth of its public debt. Analysts note that in such cases, China is pursuing its strategy of taking control of the country's strategic elements such as ports and roads in exchange for unpaid debts. (Yıldızoğlu, n.d.) Pakistan's transfer of Gwadar Port to China for 43 years in order to establish an "economic zone" where tax exemptions are also provided supports this view.

The comment by Asif Yasin Malik, a retired Lieutenant General of the Pakistani army that "Keeping Gwadar Port under control for 43 years for China would be a very satisfactory development for China and that China can intervene in the event that ships from the Strait of Malakka in the Indian Ocean are blocked from Africa, Europe and other countries" reveals China's strategic intention sparked by this trade initiative.

In 2018, interestingly, Pakistani Prime Minister Imran Khan declared that Pakistan may need to go to the IMF to overcome the balance of payments crisis, but the priority will be in the search for funds from friendly countries. Pakistani Finance Minister Asad Umar announced earlier that he needed at least USD 8 billion by the end of the year to pay off his foreign debts and announced that negotiations would begin with the IMF for urgent financial aid (Koyuncu, 2018).

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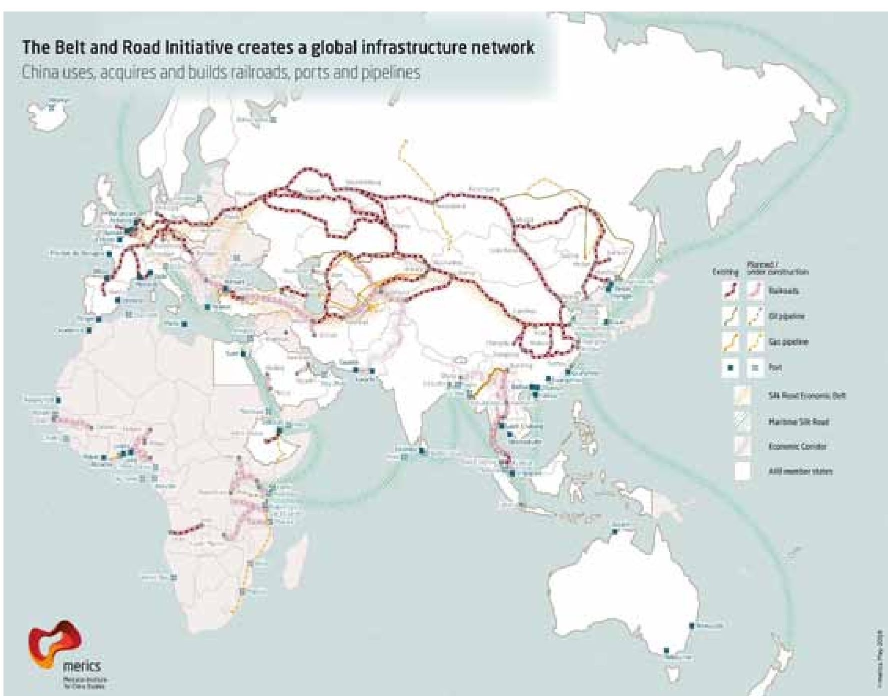
Although Pakistan's announcement of going to the IMF could be interpreted as a implicit and indirect win-win agreement between China and America, China's focus on overcoming these problems with Chinese Multinational Corporations, which will be heard frequently in the coming years, is being evaluated. Otherwise, due to China's debt to itself, China's overlooking secondary borrowing agreements between the countries it is in relations with and IMF and similar institutions could lead to the extinction of the Belt and Road Project.

Malaysia has cancelled $20 billion of rail and $2.3 billion gas projects with China in the face of all these incidents. On the other hand, due to the fact that some of the partners of the initiative stating complaints about the high cost of projects started in 2013, and some western countries stating that they have doubts about China using the Belt an Road Project in order to increase its influence on foreign countries and pull them into a non-sustainable debt swamp; China has issued some kind of guarantee commitment by declaring that will produce a framework for sustainable debt in April 2019 to address doubts to "avoid and solve debt risk" (Sade, 2019: Euronews).

Usually because the majority of its commercial volume is with western countries, for Turkey, which always has a policy of developing business and relations with the west, with a single pole, for the first time, the new order has created the opportunity to develop two-pole, eastern and Eurasian-based trade strategies outside the west. Therefore, the "Win-Win" Strategy of the "Belt and Road Project" creates a situation in Turkey's favor, contrary to the negative examples described above. Because Turkey has a long history and experience in Build Operate Transfer, financing-based project execution. Moreover, Turkey is not like the above-mentioned small economies that base their development to BRI in a sense.

Figure 3. Project Financed and/or Executed within the Scope of Belt and Road Project
Source: The Mercator Institute for China Studies (MERICS)



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Turkey, with its geographical location, is both the door of the Silk Road opening to the world from the East to the West and the door of the Traceca Project also called "Iron Rail Road" developed from Europe to Asia and almost the intersection of these two projects.

The issue that should be discussed here is that whether Turkey will stay only as a transit corridor or become a logistics center with its current situation. Since Turkey and the "Belt and Road Project" will be discussed under a separate heading, here lastly the map of projects financed and/or implemented by China in stakeholder countries within the scope of the entire Project is provided in Figure 3, country-based estimated costs are shown in Table 3.

When the tables are examined and strategic analyses are excluded, it can be concluded that the project is an important project in terms of liquefying World Trade and accelerating regional development. Although this project has been criticized for the borrowing of countries or China exploiting countries in different ways the countries in the table don't have the technological infrastructure and know-how to solely to do it on their own, even if they solve its financing. It is also undeniable that China fills a gap in this sense.

Table 3. Estimated BRI Infrastructure Projects Costs by countries

COUNTRY	COST (Million USD)
Afghanistan	12,252.14
Azerbaijan	2,262.44
Bangladesh	6,880.27
Cambodia	2,039.68
China	63,706.51
Georgia	5,146.44
Greece	0
India	3,400.00
Iran	10,621.36
Kazakhstan	21,305.71
Kenya	23,597.86
Kyrgyzstan	5,391.43
Laos	6,528.57
Malaysia	12,997.86
Mongolia	35,515.57
Myanmar	26,397.86
Pakistan	49,301.82
Russia	18,065.90
Tajikistan	3,480.29
Turkmenistan	15,155.30
Turkey	1,946.71
TOTAL	368,168.23
Source: World Bank, 2019. "Policy Research Working Paper 880"	

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Risks and Opportunities of the Belt and Road Project

The land corridor of the Belt and Road Project, called the "Belt", connects China to Central and South Asia and then to Europe; The sea corridor so-called "Road" connects China to South East Asia, the Gulf States, East and North Africa and Europe. In the project, 6 land economic corridors have been identified:

1. China-Mongolia-Russia Economic Corridor,
2. New Eurasian Land Bridge,
3. China-Central Asia-West Asia Economic Corridor,
4. China-Indo-China Peninsula Economic Corridor,
5. China-Pakistan Economic Corridor,
6. Bangladesh-China-India-Myanmar Economic Corridor.

Based on the World Bank's analysis of the risks and opportunities of transport corridors within the "Belt and Road Project", a review of how BRI can contribute to the economies of the countries within the project and what risks are, will provide a perspective on ensuring the sustainability of the project, which is scheduled to be completed in 2049 when the People's Republic of China will celebrate its 100th Anniversary (World Bank, 2019: 4-7):

Four main findings emerge from the analysis:

Infrastructure and policy gaps in belt and road corridor economies hinder trade and foreign investment. Although it is thought that project-based infrastructure investments can help close these gaps, the high cost of some investments can further increase the risks of raising public debt. The following is the data that is examined and analyzed in this article:

- Border delays in economically underperforming countries can be 40 times higher than in countries with good economic performance. Reducing travel time one day will increase BRI trade by 5.2 percent.
- BRI transportation projects cost between USD 144 billion and USD 304 billion in 70 corridor economies (excluding China). An estimated BRI investment, including projects in all sectors including energy, is worth USD 575 billion. These investments are realized in the context of rapidly increasing public debt. This leads to problems in some economies due to the increasing debt burden.

BRI transportation projects can reduce trade costs, expand trade, increase foreign investment and reduce poverty. But for some countries, new infrastructure costs could outweigh earnings due to the increased debt burden seen as a chronic problem. The criteria analyzed to achieve this result are as follows:

- If fully implemented, BRI transportation infrastructure will be able to reduce trade costs by reducing travel times of economies along transportation corridors by up to 12%. With the effect of this, travel times are estimated to fall by an average of 3% in the rest of the world, which means that non-generational countries will benefit from access to advanced railways and ports in corridor economies.

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- BRI transport projects are forecast to increase trade in aisle economies between 2.8% and 9.7%, and world trade between 1.7% and 6.2%. While not all countries in the world will feel these positive commercial effects, the total impact will be positive as environmental countries will experience a decrease in trade costs due to BRI's network impact. Sectors that require time-sensitive sensitive inputs (such as fresh fruits and vegetables) or other time-sensitive inputs (such as electronics, chemicals, and others integrated into global value chains) will benefit the most. In addition, the increase in trade is expected to increase DFI inflows by 7.6 percent for low-income aisle economies.
- Increased trade is expected to increase global real income by 0.7% to 2.9%, which does not include the cost of infrastructure investment. However, the biggest gains are expected for corridor economies, which are expected to be between 1.2% and 3.4% of real income increases, which will further increase real income increases along with increases in the FDI.

Legal arrangements should be made in countries in Belt and Road Economies and measures should be taken against the risks that may occur.

- Increasing the participation of the private sector can help maintain BRI in the long term. Such initiatives have so far been mainly driven by China's state banks and state enterprises. To increase private sector participation in BRI, participating countries need to improve the investment environment and reduce the risks faced by potential investors. Special reforms and regulatory laws must be improved and investments must be protected legally through their implementation.
- While policies for complementary policies, strengthening social security, improving worker education and increasing workforce mobility can help share gains from BRI projects, however, some risks are likely to occur. For the economies of Belt and Road corridor, about 12 million workers from the agricultural sector will be displaced, and workers could also migrate to take advantage of the opportunities that arise in urban centers or other places where economic activities are concentrated.

BRI offers common risks to major infrastructure projects. These risks suggest that the initiative's limited transparency and openness can worsen with the weak economic foundations and governance of participating countries.

- Large infrastructure investments involving debt financing pose a risk to debt sustainability. China should also have a debt restructuring arrangement that provides a better coordination between different actors (government agencies, lenders, private sector firms and state-owned businesses) and a collaborative approach with other creditors.

Apart from those mentioned in the above analysis, the "Belt and Road Initiative" has the potential to contribute to the long-term development of corridor economies by focusing on transport links and integration. However, achieving targeted potential will depend on the creation of policies that can reduce risks and support complementary reforms in corridor countries, and also to establish regulatory institutions.

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"One Belt One Road Project" and Turkey

After Chinese President Xi Jinping announced the Silk Road Economic Belt Initiative during a visit to Central Asia in September 2013, the Silk Road Economic Belt Initiative was dubbed "One Belt One Road.", in March 2015, under the authority of the State Council, "National Development and Reform Commission of the People's Republic of China, Ministry of Foreign Affairs - Ministry of Commerce", described what can be described as the Constitution of "OBOR" and what the project covers with its historical development with the headlines "I. The Grounds for Age, II. Principles, III. Framework, IV. Cooperation Priorities, V. Cooperation Mechanisms, VI. Expansion Status in China, VII. China's Activities, VIII. Embracing a Brighter Future Together" published under the name of "Visions and Activities on Promoting Joint Construction of Silk Road Economy Belt and 21st Century Maritime Silk Road". This text, which may be considered the Constitution of OBOR, is presented in Appendix – 6.

The project was echoed around the world after the announcement by China, and the countries of the region declared that they were involved in this project with the initiatives they named accordingly. Russia; "Eurasian Economic Union", Kazakhstan; "Bright Road Initiative", Turkey;" The Middle Corridor Initiative supported OBOR with the declarations of will, which they named.

The signing of the "Intergovernmental" Agreement between the "Chinese Railway Ministry" and the "Turkish Ministry of Transport, Maritime affairs and Communications" and the start of negotiations for cooperation with Chinese businesses and banks within the "East-West High Speed Railway" project with Turkish authorities marked a new era in Turkish-Chinese relations due to China's opening the way for foreign direct investment in Turkey.

Speaking at the opening of Marmaray in 2013, Turkish Prime Minister Recep Tayyip Erdogan noted that the opening of this work connecting Beijing to London means an extension of the Silk Road, noting that it is almost not far from the idea of "New Silk Road". In 2014, "Foreign extension and cooperation, building the Silk Road Economic Belt together", "4. In interviews with China-Eurasia Fair, Zhu Guangyao, Undersecretary of Economy in Ankara, it was declared that China is ready to establish the "Silk Road Economic Belt" with Turkey (http://tr.china-embassy.org/tur/ztgx/t1201739.htm). After these positive statements, at the G-20 Summit in Antalya in November 2015 " inter-delegation talks were held chaired by "President of the Republic of Turkey Recep Tayyip Erdogan" and "Chinese President Xi Jinping" and 7 agreements were signed between the two countries as a result of the negotiations (https://www.aa.com.tr/tr/ekonomi/turkiye-ile-cin-7-anlasma-imzaladi/473607). These are "Memorandum of Understanding between Government of the Turkish Republic and the Government of the People's Republic of China regarding the Harmonization of the Silk Road Economic Belt and 21st Century Maritime Silk Road and the Mid-Aisle Initiative"

1. Memorandum of Understanding on Strengthening Cooperation in E-Commerce between the Ministry of Transport, Maritime Affairs and Communications of the Republic of Turkey and the Development and Reform Commission of the People's Republic of China
2. "Railroad Cooperation Agreement prepared in the scope of Edirne-Kars High Speed Train Project"
3. "Plant Health Requirements Protocol for Exporting Turkish Cherries to China Between the Ministry of Food Agriculture and Livestock of the Republic of Turkey and the People's Republic of China
4. "Protocol on Veterinary and Health Conditions for Dairy Products to Be Exported from Turkey to China between Ministry of Food Agriculture and Livestock of the Republic of Turkey and the People's Republic of China.

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5. Framework Cooperation Agreement between China Export and Credit Insurance Corporation (Sinosure) with The Prime Minister's Investment Support and Promotion Agency in Turkey.
6. Deal regarding the transfer of Kumport Port shares was signed between China Merchants with Fiba Holding, China Ocean Shipping Company (COSCO) and China Investment Corporation (CIC)

Lastly, "Memorandum of Understanding Regarding the Harmonization of Silk Road Economic Belt and 21st Century Maritime Silk Road and Middle Corridor Initiative" signed between "the Government of the Republic of Turkey and the Government of the People's Republic of China" in Antalya was presented to the Turkish Parliament on 24/02/2016, was adopted by law no. 6792 on 15/02/2017 and put into effect after being Published in the Official Gazette dated 07/03/2017 (https://www.resmigazete.gov.tr/eskiler/2017/03/20170308-28.pdf).

Opportunities Offered by OBOR Project to Turkey

After the acceptance of the "Memorandum of Understanding Regarding the Harmonization of Silk Road Economic Belt and 21st Century Maritime Silk Road and Middle Corridor Initiative" signed between "the Government of the Republic of Turkey and the Government of the People's Republic of China in the Turkish Parliament, it carries importance to explore issues such as how much share it can take from east-west, west-east transportation and what can be its contribution to our country's economy in general apart from areas such as the improvement of the transportation infrastructure that OBOR offers to Turkey, etc.in order to understand the contributions of the OBOR Project.

In the report of EU Parliament, The General Directorate of Domestic Policies, The Policy Office on Structural and Compliance Policies, titled Transportation and Tourism; TRAN Committee Research: New Silk Road Route, June 2018, opportunities and challenges for EU transport, total west and eastern trade flows for Maritime transportation between the Far East and EU in 2016 are estimated to be just over 16 million TEU (Twenty-foot Equivalent Units). According to estimates presented in the study, total two-way freight traffic is estimated to be around 40 million TEU by 2040. For air transport, the total two-way cargo traffic between Europe and the Far East was 3.3 million tons in 2016. This is estimated to increase to 5 million tons by 2040.

In addition, this research also assessed the extent to which cargo currently transported by maritime and air modes between Europe and the Far East will be improved by project BRI, to what extent will there be shifts to the railway in the future. The results of the analysis show that by 2040, approximately 2.5 million TEU from Maritime freight to rail and 0.5 million TEU from air transport could be transferred to the railway. This is estimated to be equivalent to 50 to 60 additional trains per day or 2 to 3 trains per hour. With this data, railway services can be expected to target higher value and time-sensitive products than existing Maritime freight. Based on the conclusion that 3 million TEU annually will shift to the railway from other modes of transport by 2040, and within the constraints of Turkey's completion of the necessary infrastructure investments in the face of this demand, we can calculate the income that our country is likely to receive from these transit crossings as follows:

If we take an average of 20 tons of carrying capacity of 1 TEU container in appendix 8; The amount of cargo to be transported by rail through Turkey in other words through the Middle Corridor can be calculated as:

(A) 3.000.000 TEU x 20 ton = 60.000.000 tons.

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From the TCDD Administration Transit Unit Remuneration Table presented in Appendix 9, for a distance of between 1901 and 2000 km, it will be possible to conclude that it charges 20 tons of transport at 65.65 Euros.

From here, it is possible to conclude that 1 ton of transit for distance from 1901 to 2000 km costs approximately (B) 3.28 Euros.

Therefore, within the framework of the above criteria, the profit Turkey can obtain only from transit transportation within the "OBOR Central Corridor"

From (A) x (B) can be calculated as; 60.000.000 x 3,28 = 196.950.000 Euros.

Based on the World Bank's analysis of the risks and opportunities of transportation corridors within the "Belt and Road Project", BRI transport projects are forecast to increase trade in aisle economies by between 2.8% and 9.7%, and world trade between 1.7% and 6.2% (World Bank, 2019: 4-7). In the January-December period of 2019, Turkeys' exports increased by 2.04% to USD 180.5 billion (https://ticaret.gov.tr/haberler/2019-yili-aralik-ayi-dis-ticaret-ticaret-esnaf-ve-kooperatif-verileri). Based on the result of the OBOR Project, which increased the trade of corridor economies between 2.8% and 9.7%, our foreign trade could increase by a minimum of 2.8% on the "Central Corridor", and if the integration of the OBOR Project for today is fully achieved, it is probable that our foreign trade is to increase approximately:

180.500.000.000 USD x %2, 8 = 5.054.000.000 USD

This increase will be possible with constructive policies that must be made within the OBOR Project and the policymakers will develop within the topics evaluated in the "OBOR Project Risks and Opportunities" section examined in the previous section. Again, it is necessary not to ignore the employment-enhancing characteristics of these possible effects of the OBOR Project on our economy. The collection of four transport modes as a result of the geographical location of our country provides advantages to our country in terms of logistics activities. OBOR's transportation infrastructure is a priority project, which in this sense makes Turkey a strategic point in the project. EU-origin TRACECA "Railway Project" also supports Turkey's position. However, not all of these projects have a specific constitution other than infrastructure investments. In this context, Turkey has a successful policy under the name of "Multilateral Transportation Policy", but it must complete infrastructure investments such as port capacities, railway infrastructure, etc. in order to centralize itself on an international scale. Foreign direct investment opportunities, which can be seen as another opportunity for Turkey, which is among the trade flow between the EU and Asia, will be evaluated in the next section.

Foreign Direct Investment (FDI) Opportunities and Turkey with China's OBOR Project

While it is clear that it will be an advantage to attract foreign investors to make or lower the current account deficit, which is a chronic problem for Turkey, with the OBOR Turkey will benefit from foreign direct investments (FDI) from China. It is clear that the FDI, which is currently largely dependent on investment from Europe, will contribute to Turkey's economic growth as well as the potential to reduce Turkey's dependence on the EU and increase its capital accumulation in Turkey (Inan, 2017:45).

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According to Rostow, one of the development theorists, the accumulation of capital needed for production and production is important during the development phase of an economy. In order for these elements to take action, large investments such as transport infrastructure and production facilities must be made first. In the future, technological investments will be needed to reach the economic scale. At this point, if the capital accumulation of countries is insufficient, capital imports will be needed, which can be carried out with foreign direct investment (Yıldıran,2013:50). With capital growth, economic growth is also achieved. If technological and administrative expertise can also be withdrawn with imported capital, it will positively affect all stages of economic development. Technological advances through FDI will play an important role in the integration of FDI - attracting countries into international markets. In particular, even if developing countries imitates these technologies with technology transfers, they will be able to adapt to the structure of these technologies to achieve significant improvements in reducing their dependence on the outside and contributing to the economy of their own countries (Koç Aytekin, 2006: 43-44).

Direct Investments of People Resident Abroad in Turkey are the Netherlands, Russia, Germany, Qatar, Azerbaijan, USA, which are concentrated in reference to Table 3.a, which is created with CBT data. The reason the data has been examined since 2013 is because the OBOR Project was announced by China in 2013. Again, when table 3.a is examined, China's direct investments in Turkey in 2017 and 2018 are three times the size of 2013, 2014, 2015 total and continue with increasing momentum. With this data, Turkey's investments within the OBOR-"Middle Corridor" initiative can reach the conclusion that "Middle Corridor", which was revived after the acquisition of the year 2017 and beyond, has a positive effect on relations with China. If we also consider the Hunutlu Thermal Power Plant investment whose foundation was lain in 2019 and has a cost of USD 1,7 billion, which was not evaluated in Table 3. since its official TCMB data was not published until 2018 but whose details are given in this section, it could be said that with the OBOR Project, foreign investments in Chinese origin continue with increasing momentum (Turan, 2020: 38)

Table 3. Direct Investments in Turkey by People Based Abroad (Million USD), (Netherlands, Russia, Germany, Qatar, Azerbaijan, USA, China)

YEAR / COUNTRY	2013	2014	2015	2016	2017	2018
Holland	26.328	30.389	27.311	25.081	40.620	33.494
Russia	6.643	9.563	7.060	10.409	12.687	16.022
Germany	17.377	18.179	14.529	13.611	17.666	10.929
Qatar	323	778	715	4.941	5.663	6.433
Azerbaijan	2.922	4.330	6.452	5.715	9.349	5.901
U.S.A.	6.408	9.092	5.094	4.595	7.081	4.333
China	69	82	624	474	1.562	1.126

Source: Created by the author from the Central Bank of the Republic of Turkey statistics general directorate of payments balance.

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The important FDIs that China has made in Turkey in recent years are as follows:

- "In 2016, China's smartphone and telecommunications equipment manufacturer ZTE announced that it had bought about 48% stake of system integrator Netaş for $101 million" (İş Bank, China Bulletin: https://ekonomi.isbank.com.tr).
- In 2016, "BRSA has been allowed to establish a deposit bank in Turkey with a capital of USD 300 million by Bank of China, the fourth largest bank in the world and China, which has been operating through representation in Turkey since 2011. In 2015, Industrial and Commercial Bank of China (ICBC) also acquired Tekstilbank and started to operate in the Turkish market. In 2016, China's total direct investments in Turkey totaled USD 300 million" (İş Bank, China Bulletin: https://ekonomi.isbank.com.tr).
- China also has contracting activities in infrastructure investments in Turkey. In this context, the high-speed train project between Istanbul and Ankara within the second stage is the first high-speed train project carried out by China abroad. While an agreement is also reached for the Edirne-Kars railway project, the project is ultimately aimed at faster and less costly access from China to Europe. In addition, China is involved in Turkey's implementation of its strategies in the energy sector. Salt Lake natural gas storage facility is among the projects carried out in China's energy sector in Turkey in order to ensure supply sustainability in the face of natural gas outages" (İş Bank, China Bulletin: https://ekonomi.isbank.com.tr).
- "Smart Growth International (SGI), Chinese-Turkish partnership, has signed an investment agreement with the China Development and Investment Authority (SDIC) for wind power plant investment at USD 225 million. The agreement covers the power plants that have been running since 2012 and the Aydin-Söke RES, which is still projected in the Aydin and Manisa region" (İş Bank, China Bulletin: https://ekonomi.isbank.com.tr).
- "Hunutlu Thermal Power Plant, China's largest direct investment in Turkey, will be realized with a total of USD 1.7 billion funding obtained from Shanghai Electric Power Company. The project is an important project that combines the Belt and Road Initiative proposed by China with Turkey's vision of the "Middle Corridor" (Xinhua / Zheng Siyuan). Thermal Power Plant Construction officially began on Sunday, 22.09.2019 with the groundbreaking ceremony in Hunutlu Town of Yumurtalık district of Adana. The plant also has a port specially designed for coal transport. The project, which is expected to have a capacity of 1,320 megawatts, is expected to generate 9 billion kilowatt hours of electricity each year after it is fully operational, which accounts for an estimated 3 percent of all electricity sources in Turkey. The project is scheduled to begin at the end of 2021" (China Belt and Road Official Website, Belt and Road Portal, 2019 https://eng.yidaiyilu.gov.cn/qwyw/rdxw/104246.htm#p=7).
- "In 2015, the Cosco Pacific Consortium acquired a 65% Stake in Kumport Port operated by Fiba Group at a cost of USD 940 million. The purchase process is the largest foreign direct investment ever to come to Turkey from China. Cosco, one of China's largest state-owned enterprises, is also a minority partner in the Port of Piraeus in Greece." (https://www.dunya.com/sirketler/kumport-limani-cosco-pacific039e-satildi-haberi-292370).
- "On July 24, 2018, with the approval of the Competition Board, China's Alibaba officially acquired Trendyol, a Turkish online shopping site with 16 million users and more than 90 million monthly visitors. The purchase price is $728 million for majority shares." (https://www.dunya.com/kose-yazisi/alibaba-trendyola-728-milyon-dolar-odedi/424231).

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- "Zhongtian Technology acquired 100% stake of Demirer Cable for $67 million in 2018."
- "Finally, Sale negotiation for the 51% Share of Third Bridge and Link Roads of Istanbul has been announced by China Merchants Joint Venture with amount of USD 688.5 million (http://www.anhui-expressway.net/en/upload/2019-12/157715241220844800.pdf).

China's growth move, which began with cheap labor ship in the first stage, has been driven by outsourced production, without China's know-how, causing the Chinese products perceived as imitation and to be known as poor quality. In 2009, China tried to take refuge in the quality of the brands which belonged to world brands it produced by giving ads to global channels such as CNN with the slogan "Made in China Made with the World", and quickly attracted ads. Nowadays, China has increased its technological capacity and has revealed the slogan "Made in China 2025" which symbolizes that it will become a technological power in the world at the 100th Anniversary of the Chinese Revolution by 2049. It would not be wrong to say that the goal is to transform China from a labor-intensive center to a high-tech center based on innovation.

China's initiative was prepared by the "Ministry of Industry and Information Technologies" and announced by the "State Council of China" in May 2015, and the target can be expressed as being able to make China a world technology power by desisting it from being the manufacturing center of the world. A three-stage action plan is aimed for this transformation by 2049, but it is also possible to accept the "Made in China 2025" initiative as a Chinese version of the "Industry 4.0" vision announced by Germany (https://digitalage.com.tr/cin-made-in-china-2025le-imalat-merkezinden-teknolojik-guce-donusu-hedefliyor/).

China's focus on a technology-intensive target is also an opportunity for foreign direct investments in the OBOR Project countries. Because in addition to China-based marketing at the point of marketing of diversity in Chinese production capacity, it follows pre-opener strategies with acquisitions such as "Volvo, IBM" and technology exports such as Huawei in Turkey. This, as previously announced, includes the potential for internalization of technology for developing countries, so it is an issue that should be considered.

TURKEY AND INTERNATIONAL TRANSPORTATION CORRIDORS RELATIONSHIP

Turkey, as of its geographical location; as a natural crossroads at the intersection of Asia, Europe and Africa continents, is located in the center of the European-Asian International Transport networks connecting Asia, the Caucasus and the Black Sea and even the Pacific countries. International transport corridors concerning Turkey are as follows: (https://www.kgm.gov.tr/Sayfalar/KGM/SiteTr/Projeler/UluslararasiProjeler/uluslararasiYolGuzargahi.aspx):

A) UN International Transport Corridors
   - "TEM: UNECE Trans Europe North-South Highway Project",
   - "TER: UNECE Trans European Railway Project",
   - "TAR: UNESCAP Trans Asian Railway Network",
   - "AGR: E - Highway Project",
   - "EATL: Eurasian Road Connections",

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B) EU International Transport Corridors
- "Pan - European Transport Corridors",
- "Traceca (Europe - Caucasus - Asia) Transport Corridor",
- "TEN-T: Trans European Transport Comprehensive Road Network",

C) Other International Transport Corridors
- "Black Sea Economic Cooperation Organization Corridor",
- "Organization for Economic Cooperation",
- "OBOR, "Central Corridor".

In this section, Turkey's initiative for the OBOR Project, the "Middle Corridor", will be examined.

OBOR, China-Central Asia - West Asia Economic Corridor (Central Corridor)

Beijing prefers to use the Trans-Siberian Railway "Northern Corridor - NC" to send about 10 million containers a year to Europe. Turkey's initiative, the "Middle Corridor", "2.000 km shorter, more favorable climate conditions and reduces travel time by sea by 1/3 (15 days) from the Northern Corridor. The Middle Corridor offers great opportunities for cargo traffic in Asia but is used effectively, it will create significant economic opportunities for Central Asian countries to benefit from trade, which is estimated to be USD 600 billion annually between China and Europe" In addition, the establishment of logistics centers and free trade zones in Turkmenistan, Kazakhstan and Azerbaijan ports will facilitate the development and deepening of Trans - Caspian cooperation.

"The Middle Corridor" was previously known as the Trans-Caspian International Transportation Route. In 2014, the corridor was proposed by seven logistics companies from Kazakhstan (Kazakhstan Railways and Aktau Sea Port), Azerbaijan (Azerbaijan Railways, Baku Sea Port and Azerbaijan Caspian Maritime) and Georgia (Georgia Railway and Batumi Sea Port). In the first phase, participants aimed to develop multi-mode transportation routes between their countries, especially from Kazakhstan to the ports of Georgia. (https://www.railfreight.com/tag/middle-corridor/?gdpr=accept).

However, the "Middle Corridor" has come to life with the Baku - Tbilisi - Kars Railway line, which Turkey developed and implemented under the Silk Road initiative called the "Middle Corridor" and formed the main mast of the Central Corridor. Its main purpose is to follow the route of the block container train services "starting from Xi'an and Turkmenistan-Uzbekistan-Kyrgyzstan or Kazakhstan", passing by railway and road via the Caspian Sea (crossing the Caspian transit corridor), from Azerbaijan, Georgia routes to Turkey; Kars, Erzurum, Erzincan, Sivas, Kayseri, Kirikkale, Ankara, Eskisehir, Kocaeli, Istanbul (Marmaray) and Kapikule (Edirne)" via Europe (https://www.insideover.com/politics/a-significant-step-in-sino-turkish-relations.html).

It is difficult to say that Turkey's "Middle Corridor" initiative has a roadmap for the integration of BRI and despite the agreements between China and Turkey, In the absence of concrete proposals for Turkey's Silk Road cooperation projects, China is likely to follow the wait and see policy in order to avoid political uncertainties related to any initiative concerning Turkey (https://www.mei.edu/publications/chinas-belt-and-road-initiative-and-turkeys-middle-corridor-question-compatibility#_ftn9).

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Projects Created with Initiative of Turkey within Middle Corridor in OBOR Project

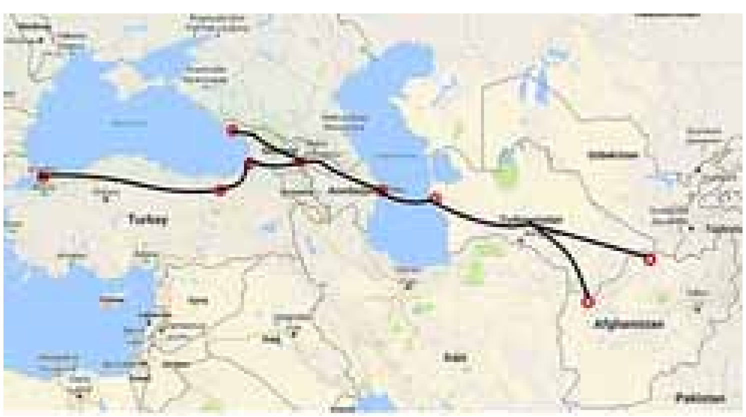
Although there is no designated roadmap between Turkey and China in the alignment of the plans of BRI and the "Middle Corridor", as mentioned earlier, Turkey follows a unique path by creating its own policies under the name of "Multilateral Transportation Policy". However, Turkey in a sense supports the "Middle Corridor" initiative by increasing mutual dependence. Turkey's projects within the "Multilateral Transportation Policy" will be examined in sub-topics.

Lapus - Lazuli Corridor

In November 2017, Turkey signed the "Agreement on the Transit Transport Corridor of Turkey-Georgia-Azerbaijan-Turkmenistan-Afghanistan (Lapis Lazuli) during the "Regional Economic Cooperation Conference for Afghanistan" (RECCA) held in Ashgabat. This agreement in which China had very low-key role covers same routes with the transport routes that United States had built to support its military operations in Afghanistan. China's border with Afghanistan in the west of Eastern Xinjiang Province and the fact that it is uncomfortable with the terrorist crackdown affecting the region makes the Lapis Lazuli Corridor for China important not only for trade, but also for security. Therefore, it would not be wrong to say that most infrastructure investments in this region will be covered by China. The corridor begins with The City of Aqina in the North Faryab region, adjacent to Afghanistan's border with Turkmenistan, and Torghundi in West Herat. The fact that both Akina and Torghundi have a railway link to Turkmenistan means connection to Turkmenbashi Caspian Sea Port. After crossing the Caspian, the route continues to Baku, the capital of Azerbaijan, and then connects to the Ports of Poti and Batumi, Georgia, as well as Tbilisi, the capital of Georgia; In addition, the corridor is connected to the Central Corridor from Kars in Turkey and İstanbul to Europe through the Baku - Tbilisi - Kars Project.

Turkey's move has provided the link between the Central Corridor of OBOR and the North-South Transportation Corridor, connecting India and Iran to Europe (via Turkey). Also again, this recently created corridor, surrounding networks and the North Corridor; Extends to Russia and the large rail network.

Figure 4. Lapus - Lazuli Corridor
Source:(https://www.silkroadbriefing.com/news/2018/06/19/turkeys-pivotal-role-chinas-belt-road-initiative-europe-central-asia-middle-east/).



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Trans-Caspian International Transport Association

On 07.08.2013 "Trans - Caspian International Transport Line for Development of Coordination Committee Notice" agreement between Georgia - Azerbaijan - Kazakhstan" was signed for the purpose of organizing transport alternatives at the Caspian Sea crossing. (http://www.mfa.gov.tr/turkiye_nin-cok-tarafli-ulastirma-politikasi.tr.mfa). This Agreement, which China was later a party to, increased the importance of Turkey's Central Corridor initiative. In February 2017, the "Trans-Caspian International Transport Route Association" was established for the effective and efficient use of the "Trans-Caspian Transport Line" and was briefly named "TITR".

TITR has taken priority objectives to make some logistical improvements in the field of logistics to increase competitiveness, to increase efficiency in the field of transportation, to regulate railway tariffs in the field of freight transportation, to make harmonization. As of February 16, 2018, "TCDD Transportation Inc" was elected as an independent member of the union and achieved a new political success in the "Middle Corridor" initiative on "Turkey's Multilateral Transportation Policies". Thus, if a Chinese-starting cargo follows the "Kazakhstan-Azerbaijan-Georgia-Turkey" route, the transport time will be reduced from forty-five days to fifteen days and save 1/3 time in the "Central Corridor" integrated with the Trans-Caspian Line and BTK Railway.

Baku - Tbilisi - Kars (BTK) Railway

The Baku - Tbilisi - Kars (BTK) railway line is a railway project that is the backbone of the Central Corridor, which is directly connected to Turkey's Kars, Georgia, Tbilisi and Baku in Azerbaijan. The total estimated cost of the project is USD 600 million. The foundations of the project began on May 25, 2005 by the Presidents of Azerbaijan, Georgia and Turkey to sign a declaration on the Baku - Tbilisi - Kars railway connection. The reason the agreement was signed between the three countries was because the EU and the United States by-passed Armenia, so the project rejected options for development, financial aid and financing. (https://www.railway-technology.com/projects/baku-tbilisi-kars/). On top of this, Georgia used a 25-year 200 million USD loan from Azerbaijan at an annual interest rate of 200 million USD to build its own line of BTK connection. Turkey and Azerbaijan have financed their own routes. The total length of the Kars - Akhalkalaki railway line is 105 kilometers. The construction of the Kars and Akhalkalaki railway line, which is 76 km long over Turkey, was financed by Turkey and the construction and reconstruction of the 26 km long Kars - Akhalkalaki railway line over Georgia and the rehabilitation/reconstruction of Akhalkalaki - Marabda's existing 153 km long railway line with USD 200 million USD (loan) by the Republic of Azerbaijan (https://www.oilfund.az/en/projects/6). A special area has been built to transform axle width of trains from 1.520 mm to 1.435 mm at Akhalkalaki station to harmonize the width of Turkish railways and Georgian railway.

BTK rail line will carry one million passengers and 6.5 million tons of cargo in the initial phase, and by 2030 it is estimated that about 17 million tons of cargo and approximately three million passengers will be transported by 2030. As seen in Figure 3.b, Europe is united through China – Kazakhstan - The Caspian Sea - Azerbaijan and Turkey. The line will be the shortest rail bridge between Asia and Europe with the joint will and completion of all investments.

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Figure 5. BTK Railroad
Source: *Giorgi Balakhadze, https://commons.wikimedia.org/w/index.php?curid=52167737.*

Agreement on Legal Status of the Caspian Sea (Aktau Statement; Caspian Constitution)

While the Caspian Sea is considered "sea" under UN Marine Law, Turkmenistan, Iran and Russia have accepted the Caspian Sea as a "lake" and have led to the international arena describing the Caspian Sea as a "sea of debate". Because of the countries that have the coast of the Caspian Sea while "Iran has a coastline of 724 km, Russia 695 km, Kazakhstan 2320 km, Turkmenistan 1200 km, and Azerbaijan 955 km" Iran and Russia, which have the shortest coastline, want to use the Caspian Sea equally, and coastal countries' refusal to do so was the real source of the problem (Kemaloğlu:2018).

Russia has defended the sea's public use, except for the individual territorial waters of states bordering the Caspian Sea so as not to lose its border with Iran, which borders the Caspian Sea, and to avoid the destruction of free sea circulation. However, Russia and Iran, which are the sides of the dispute for security reasons such as the proximity of countries such as Kazakhstan and Azerbaijan to the United States, have signed the "Legal Status Agreement of the Caspian Sea" in Aktau on 12.08.2018 among states on the Coast of the Caspian Sea. The agreement was formally announced on September 25th, when it passed through the Russian Federation Council and approved by President Putin.

Under the agreement, "States on the coast of the Caspian Sea will be able to use the surface part of the sea in a common way, while the bottom and mineral reserves will be shared between coastal states, understood on the basis of international law. The laying of maritime, fishing, scientific research and the main pipelines will be carried out according to the rules that the parties will agree on. If comprehensive sea projects are implemented, jobs and actions will be taken into account the ecology factor" and foreign countries will not be able to show military presence in the Caspian Sea.

The determination of the legal status of the Caspian and therefore the fact that states on the coast of the Caspian Sea can use the surface part of the sea in a common way constituted another route outside the "Indian Ocean" route for loads to be transported from Europe. New status of the Caspian Sea for cargo transported from Europe to India and Iran has also created an opportunity for Europe.

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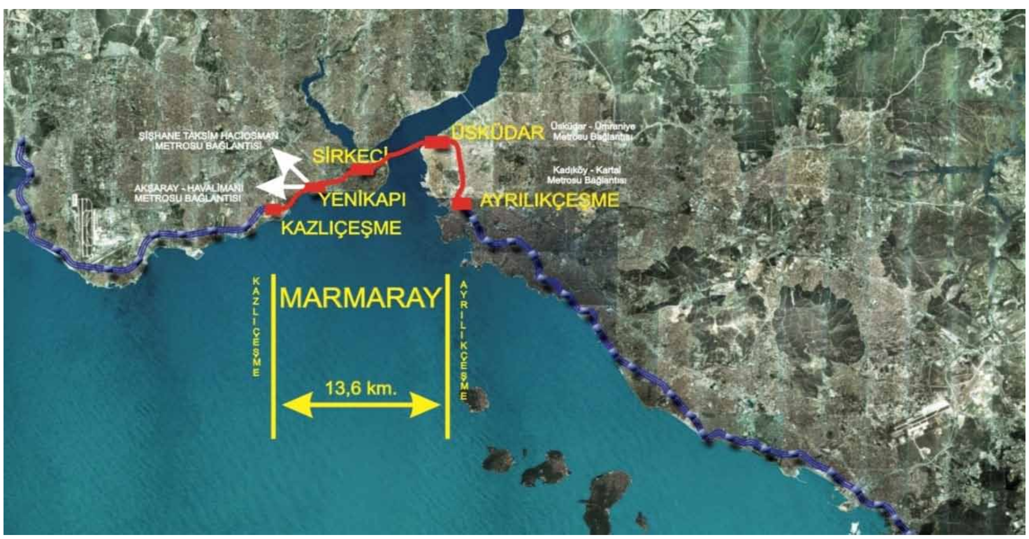
As a result, the OBOR - Middle Corridor, which is under the "Multilateral Transport Policies" for Turkey, resolved possible political and security issues over the Caspian Sea crossing and connected to a legal status, which paved the way for the policies being carried out. In addition, the obstacles to the construction of the "Trans-Caspian Natural Gas Pipeline" between Turkmenistan and Turkey, which are waiting for reasons arising from disputes in the Caspian Sea, have also been removed.

Marmaray Project

Marmaray Project is one of the rare projects that subway and freight trains can operate within the same line, built with 1.4 km long "Sinking Tunnel" under the Bosphorus connecting Asia and Europe and 11 km long "Drilling Tunnels" opened on both sides. Within the scope of the project, 440 "Pulled-Pulling" Railway vehicles were also supplied. 3. Marmaray with bridge, OBOR is evaluated on "Central Corridor". Turkey will be the most advantageous country in OBOR with the project, which also provides uninterrupted rail connectivity from Asia to Europe (from Beijing to London).

Figure 6. Marmaray
Source: *(http://www.marmaray.gov.tr/content/hayal_gercek_oldu.pdf).*



Viking Train Project

"Viking Train", is the first combined transportation project for Turkey on a route that combines seaports "Klaipeda, Odessa and Ilicevski between the Baltic Sea and the Black Sea" with railways. Through the TRACECA corridor, Europe is intended to connect to the Middle East and Asia in the shortest way. The fact that the "Viking Train" can provide "Mediterranean, Europe, Middle East and Central Asia" via Turkey has provided with another transport corridor connection. "Memorandum of Understanding on the Development of Intermodal Transport and Viking Train" between TCDD and Ukrainian Railways was signed in Ankara on September 25, 2013 (TCDD Railway Industry Report, 2014).

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Figure 7. Viking Train Project Route
Source: Center for Transport Strategies.

Other Projects

Other projects developed under the OBOR Project "Middle Corridor" and within the framework of Turkey's multilateral transportation policies;

- "Kervansaray Project for inter-customs cooperation within the Central Corridor, which is intended to connect Turkey to China via Central Asia",
- "Yavuz Sultan Selim Bridge opened on August 26, 2016",
- "Eurasia Tube Pass" opened on December 20, 2016",
- "Istanbul Airport opened on October 29, 2018",
  are among the completed projects, "Çanakkale Boğazı Köprüsü",
- "3-Storey Tube Gateway Project",
- Construction of Filyos (Zonguldak), Çandarlı (Izmir) and Mersin Ports"
- "Edirne - Kars High Speed Rail Connections Railway Projects to connect Asia and Europe"

Are projects in the construction phase and/or in the project stage.

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FUTURE RESEARCH SUGGESTIONS

This research limited to the "Turkey's" potential economic opportunities and position within Obor Project and also relationship between transportation corridors have been studied. Therefore, suggestions on what kind of researches can be studied in the future are presented below.

Nowadays, when the world trade wars are intense, the announcement of the American blue dot project against the Chinas' OBOR project requires new researches. So, one of research suggestion can be considered as "The main points where America's Blue Dot Project and China's Obor Project intersect and contradict."

Increment of debates of changement in axis theories of international relations paves the way for new researches. Second research suggestion can be considered as "The Effect of China's OBOR Project to International Axis Theories and Commercial Results".

CONCLUSION

Since the economic indicators in this study are projected values without Global Pandemic, it would be more accurate to look at the OBOR Project and its economic opportunities along with pandemic.

These days during which Covid-19 Pandemics' economic impacts around the world are being discussed, the IMF announced that it expects the cost of the Covid-19 virus to be approximately USD 3 trillion in 2020, while the IMF's global growth forecast for 2020 just three months ago was 3.3 percent. In January 2020, estimates by the IMF predicted that the US economy would grow by 2 percent, the EU by 1.3 percent and China 6 percent, while World Trade is expected to grow by 2.9 percent in 2020, as of April 15, the point we have reached is that all of the forecasts made in January have become impossible to be realized and the announcement that this will be the worst year after the 1929 Depression.

Again, according to the IMF, for the first time since the Great Depression, both developed and developing countries will enter recession. However, developed countries will shrink by 6.1 percent and developing countries by 1 percent (China and India remain surplus with 1.2 percent and 1.9 percent, keeping the average of developing countries above average). The US economy is expected to shrink by 5.9 percent and the EU is expected to shrink by 7.5 percent. The 2020 growth forecast for Turkey was announced by the government at the beginning of the year at 5 percent, but this forecast was somewhat optimistic by international organizations and the average growth forecast for the 2020 Turkish economy was declared in the band 3 - 3.5 percent. The IMF said it expected 5 percent contraction for Turkey and 5 percent growth for 2021 according to the forecasts it has revised with the Covid 19 Pandemic.

As can be seen, China's 1.2% growth forecast for the U.S. in the face of expected contraction due to pandemic makes China's OBOR Project more important. Because in the face of pandemics, the EU and US economies have failed to provide the necessary supply against demand of emergency health supplies. China, on the other hand, has met the health supplies needed to avoid disrupting the world supply chain despite its own difficult situation. Even if the inadequacy of the EU and the USA against the demand for emergency health supplies is thought to be based on "Ricardo's Theory of Comparative Advantages", it would not be wrong to announce from today that there will be changes in the world economic system after the pandemic. At this point, OBOR project which promises an uninterrupted supply chain will be accelerated by China considering the axis change in the global world after the pandemic. Because pandemics have alienated countries and people from the idea of globalization and allowed them to return

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to national consciousness. This will be an indication that the OBOR Project, which is based on both the win-win strategy and includes the interests of more than 70 countries, will develop without hesitation. An indication of this is the Chinese Development Bank's announcement of plans to support BRI companies affected by coronavirus in recent days.

Turkey's initiative for the OBOR Project, "Middle Corridor", has officially come to life with the completion of BTK, Marmaray, Yavuz Sultan Selim Bridge Projects and the signing of the Caspian Transition Status agreement by the relevant countries. "Middle Corridor" has placed Turkey in the center with shorter, more favorable climatic conditions than the OBOR North Corridor and opportunities that shorten travel time by 1/3 (15 days) compared to sea. The Central Corridor offers great opportunities for cargo traffic in Asia but is used effectively, it is clear that Central Asian countries and Turkey will create significant economic opportunities for them to benefit from trade, which is estimated to be USD 600 billion annually between China and Europe. Undoubtedly, this will follow a course based on the harmony of globalization with the OBOR Project.

According to George Modelski, "globalization is the history of the growing connection between the world's great civilizations", while Castells says that one of the most important differences in economic spheres of globalization as it stands today is the transition of industrial production from the old holistic production structures to a divided and divided structure across the world. Held and McGrewon the other hand define globalization as; "a process that generates intercontinental or inter-regional flows and networks, representing transformation in the organization of social relations". When the OBOR Project is analyzed within all these western current views:

- It is the fastest transport corridor between West and Eastern Civilization,
- Industrial production, which has moved away from the old holistic production approach, has gained a widespread structure as China became a manufacturing center.
- OBOR Project will create and introduce intercontinental or interregional flows and networks in terms of containing many corridors.

As it turns out, the strongly anticipated results of the OBOR Project coincide with the theories of globalization theorists. In this case, the OBOR Project will be discussed a lot in the next 10 years, with the participation of more than 70 countries around the world, and will continue its development rapidly. Turkey will also show its central feature in the "Central Corridor" created within the OBOR Project with its own initiatives.

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KEY TERMS AND DEFINITIONS

Logistic: It refers to all the processes of a product from the first manufacturer to the end consumer, such as transportation, storage, customs clearance, packaging, distribution. In another definition, logistics; To provide the right product at the right place, at the right time, in the right amount, in the right way, in the right quality, at a competitive price.

Middle Corridor: Turkey's initiative called as "Middle Project" which is a transportation corridor intersect with China's OBOR Project.

One Belt One Road (OBOR): It is today's most ambitious infrastructure initiative that aims to change the axis of global trade. China, Turkey Relations: Diplomatic relations between the East Asian countries of China and Turkey, is based on the 1971.The cooperation between Ankara and Beijing has gained momentum since the 1980s, when both countries began to open up to the outside and rose economically and politically. Relations, which were raised to the level of "Strategic Cooperation" in 2010, developed with the contribution of mutual high-level visits.

Transportation Corridors: It is a geographical line that connects two points within the scope of freight and passenger transport using one or more transport modes. National for those who connect the dots within the same country; Those connecting points within different countries are called international transport corridors. Priority transport corridors with high capacity and quality, with a variety of transport modes are called main (core) transport corridors. Corridors that connect the main transportation corridors to each other and reach different endpoints are called intermediate or branch corridors. The fact that there is only one highway between two points does not make this a transportation corridor. There must be a variety of different transport modes for different types of freight.

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Chapter 21
Effects of the Exchange Rate on the Export Share of Sales in Borsa Istanbul Firms

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ABSTRACT

For many years, the current account deficit problem is on the agenda of policymakers and academics in Turkey. With the exchange rate shock experienced in 2018, the importance of the current account deficit has become clearer. The relationship between exchange rates and trade flow is one of the issues frequently discussed in the literature. In this study, to contribute to the subject from a different perspective, the 12-year data of 230 companies traded on Borsa Istanbul from 2008 to 2019 were used and the share of these companies' exports in their total sales was analyzed. According to the research findings, there is a strong, statistically significant, and positive relationship between real Euro/USD exchange rate and export shares of Turkish firms. There is also a positive relationship between the real Euro rate and export share of automotive firms in Borsa İstanbul.

INTRODUCTION

Turkey is a developing country with a current account deficit. Sustainable growth of the Turkish economy can only be achieved by minimizing the current account deficit. So, increasing the export volume of companies in comparison with total import is needed. In this study, the relationship between exchange rates and export share of companies in Borsa İstanbul is analyzed.

There are several studies on the effects of currency exchange rates has been done in the literature. Most of these studies are focused on exchange rate volatility and macro-level analyses rather than using company level statistical data. The common finding of a significant part of the studies on this subject is that the volatility in the exchange rates limits the export volume of countries (Sugiharti, Esquivias

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and Setyorani, 2020; Chi and Cheng, 2016; Auboin and Ruta, 2013). The other studies are focused effects of the exchange rate on the trading flow in terms of quantity or value. These studies have found that lower valuation of local exchange rate support export performance. (Lee and Lee, 2017; Sonaglio, Campos and Braga, 2016).

This study aims to determine the relationship between exchange rates and export share of total sales of firms listed in Borsa İstanbul. The findings of this research can be used by monetary and fiscal policymakers, academics and also the investors in Borsa İstanbul. This research contributes to the literature with (1) the usage of most updated data including 2018 exchange rate shock, (2) the independent variable selection of Euro / USD exchange rate which has not used in similar studies, and (3) the company-specific data and the sector-specific analysis.

In this study rather than focusing on country-level data, the panel data of 2485 firm-year observations of companies in Borsa Istanbul have been used over 2008 and 2019. In the study, correlation analysis, unit root test, and robust least square methods have been implemented. For the dependent variable, to efficiently determine the decisions of companies, the export share in total sales of the companies has been used. Because the European Union is the largest trading partner of Turkey, European Union's economic growth rate and the real exchange rate of Europe are selected as independent variables. In the export of Turkey, Euro is the dominant currency however in the import side USD becomes dominant. So, to reflect the effects of different currency usage in import and export, the real Euro / USD exchange rate has been added in the model as an independent variable. The real effective exchange rate of TRY, GDP growth of Turkey and the difference between growth rates of Turkey and Europe are other independent variables.

The remainder of the section is structured as follows. In the background part, the studies in the literature are summarized. The main topics covered in this part are the effects of exchange rate volatility and exchange rate change and misalignments. In the data and methodology part, the data and empirical methodology and the findings of the research are explained. The section is finalized with future research directions and the conclusion.

Background

The Bretton Woods system which requires convertibility of one ounce of gold with 35 US dollars and fixed exchange rate of other currencies to the US dollar has been terminated in 1971(Van, 1978). After the Bretton Woods system, most of the countries have selected floating rate regimes and this causes volatility and misalignment of value between currencies.

Exchange rates affect companies in three main ways. The first one is related to revenues. The companies which have export activities benefit from low local currency rates because this makes their export income higher than their local costs. The second one is related to financing. Especially in developing countries, most of the companies that are looking for long term financing prefer FX-based borrowing. Due to changes in factors such as inflation, local currency's interest rates are very higher in the long term. The last one is related to the FX-based costs of exporters. Because of the integration of the world economy, most of the exporters are also the importers. For example, Turkey is an energy importer and a significant amount of Turkish import is in US Dollars currency. On the other hand, the biggest market for Turkish companies is European countries. Euro is used in the export to the EU. So, the Euro/USD rate is very important for Turkish companies.

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Exchange rates are not only determinants of competitiveness of the companies in international trade but also indicators showing the macroeconomic conditions. The unemployment rate, availability of the natural resources, inflation rate, economic crisis, change in economic growth rate and other macroeconomic factors affect the exchange rate. Regarding the relation between the exchange rate and export performance of countries, there are two main groups of academic studies. The first group is concentrated on exchange rate volatility and possible effects on trade flows. The second group of studies is concerned with the relation between exchange rate misalignment and trade flows. After the Bretton Woods system, starting from the 1970s since the 1990s, exchange rates volatility and its outcomes were popular among the academics who study trade policy. With the 2000s, the misalignments of the currencies began to gain importance (Auboin and Ruta, 2013).

Exchange Rate Volatility

Large investments need time and a high amount of capital. When a company plans to construct a new plant, most of the time, the necessary duration for the completion of the project requires several years. Exchange rate volatility makes almost impossible to plan the feasibility of such kind of long-term projects. Kiyota and Urata (2004) investigated the relationship between exchange rate volatility and foreign direct investment (FDI) flow to Japan. Their findings show that large fluctuations in real exchange rates reduce FDI flow. On the other hand, the depreciation of local currency rates attracts foreign investors. Crowley and Lee (2003) find different results in their study which covers 18 OECD member countries. According to their research between 1980 and 1998, they found no clear evidence about the relationship between volatility in the exchange rate and foreign direct investment. They show that the relationship differs across countries; and countries which have a relatively stable currency rate are affected less than other countries in terms of FDI flow. From the economic theory side, there is an adverse relationship between exchange rate fluctuations and international trade because of the difficulties of planning in a highly volatile market (Bahmani-Oskooee and Gelan, 2018). Other studies related to exchange rate volatility are summarized below.

Kasman and Kasman (2005) analyzed the impacts of exchange rate uncertainty on the export of Turkey by using exchange rate volatility data from 1982 to 2001. Their findings indicate that exchange rate volatility is a long-term positive effect on Turkish export activities.

Asteriou, Masatci, and Pilbeam (2016) investigated the relationship between exchange rates and trade volumes of MINT countries which includes Turkey, Mexico, Indonesia, and Nigeria. According to the findings of this research, exchange rate volatility affects export and import volumes in Mexico and Indonesia in the short-term and in Turkey in the long-term.

In their study, Chi and Cheng (2016) examined the effects of bilateral exchange rates, fluctuation in exchange rates and economic growth on Australia's export flow with their main trading partners. Their study covers the duration between 2000 and 2013 and the countries including China, Japan, the Republic of Korea, Taiwan, India, Indonesia, and Malaysia. Their findings show that Australian export volume mainly depends on its trading partners' economic growth. In addition, they also found that exchange volatility has long term effects on maritime export volumes of Australia.

Bahmani and Gelan (2018) examined the relationship between volatility in exchange rates and international trade performance using data from 12 African countries between 1971 and 2015. Their findings show that in the short-term volatility in exchange rates affects trade performances of 8 out of 12 countries in their study. In the long run, volatility in exchange rates affects only five countries.

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Saraçoğlu, Açıkgöz, and Çatalbaş (2018) investigated the effect of the exchange rate volatility on trade in goods between Germany and Turkey. In the study, they used a quarterly data set between 2002 and 2015 and analyzed the effects of the volatility of the exchange rate in different sectors. No significant impact of exchange rate volatility has been identified in the miscellaneous goods sector, which makes approximately 20% of imports from Germany. In the machinery and transportation sector, which constitutes 33% of Turkey's export to Germany, the exchange rate and exchange rate uncertainties are found to be effective. As the lira depreciated, it was seen that the sector's export has the potential to increase. However, as the uncertainties in the exchange rate increase, export is becoming risky.

Özkul and Öztürk (2019) analyzed the relationship between volatility of exchange rate, real exchange rate and sectoral foreign trade between 1997 and 2018. According to the research findings, causal relationships have been found between exchange rate volatility and foreign trade in the agriculture and mining sector; and between the real exchange rate and foreign trade in the agriculture and manufacturing industry sector.

Sugiharti, Esquivias, and Setyorani (2020) investigated the relationship between exchange rate volatility and Indonesia's export volumes to main trading partners. They used the export volumes of the top eleven products and their data covers the duration between 2006 and 2018. By using GARCH-type models they found that exchange rate volatility has a negative correlation with Indonesian export activities. They also determined that the index of industrial production also have a significant effect on some export volumes.

Exchange Rate Change and Misalignments

Several studies including Grobar (1993) and Sekkat and Varoudakis (2000) have shown that the overvaluation of the exchange rate reduces the country's ability to export manufacture goods. Rodrik (2008) in his study, including developing countries, has shown that the undervaluation of the local currency increases the developing countries' export volumes and helps the economic growth of these countries by large current account surplus. Other studies related to exchange rate change and misalignments are summarized below.

Li, Ma, and Xu (2005) used Chinese Customs Office's firm-level data from 2000 to 2007, and they examined how exporters in China reacted to the movements of the local currency rate. According to their findings, the elasticity of the price of products is so low and the over-valuation of the local currency could not be effectively reflected on the price of the products. On the other hand, the volume of exported products is seriously decreased during the over-valuation of the local currency exchange rate.

In their study, Dekle, Eaton, and Kortum (2007) used 40 different countries trade, real wages, and welfare data and analyzed required changes in GDP to adjust trade balances. In their study, the main focus is a trade deficit of the United States which is at the level of 6% of the country's GDP in 2004. They found that to minimize this trade deficit United States' GDP needs to be decreased by 7% relative to the change in World GDP.

Xu, Mao, and Tong (2016) analyzed the effects of change in exchange rates on the export performance of Chinese firms. They use the data which covers the years between 2000 and 2007. China is the largest share in total production and export of manufacture goods. China succeeded to increase its export volume of manufacture goods from \$0.25 trillion in 2000 to \$1.2 trillion in 2007 while the Chinese currency's real exchange rate appreciated by 39% in the same period.

Sekkat (2016) analyzed the relation between the misalignment of the local currency's valuation and verification of export products in 55 low- and middle-income countries. The data covers the 25 years

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duration between 1985 and 2009. Sekkat's findings show that there is no meaningful relation between exchange rate misalignment and export diversification however undervaluation of the local currency increases the export share of the manufacturer's products.

Kolcu and Yamak (2017) analyzed the impact of changes in the exchange rate on prices of foreign trade. They used quarterly data on import and export prices between 1998 and 2016. This shows that there is an inverse relationship between the exchange rate and both import and export prices. It was determined that the increases in exchange rates caused a decrease in import and export prices. In addition, positive exchange rate changes have an impact on export prices in the short term, while negative exchange rate changes do not.

Fitzgerald & Haller (2018) studied the relationship between change in tariff and exchange rate and export volumes. Their research includes the manufacturing, mining and utility companies in Ireland. The data of 4729 companies were used between 1996-2009. They found that the export entry is three times more sensitive to tariffs than exchange rates and export revenue is six times more sensitive to tariffs than the exchange rate.

Şahin and Durmuş (2019) analyzed the relation between export, import and real effective exchange rates in Turkey between 2003 and 2018. According to their findings, there is a one-way causality relationship from real effective exchange rate to imports and there is a one-way causality from exports to the real effective exchange rate.

Özçelik ve Uslu (2020), studied the relation between export, import and real exchange rates in Turkey between 2003 and 2016. According to the results of their study import has a weak relation with the real exchange rate and strong relation with export. On the other hand, the relation between export and the real effective exchange rate is weak.

Interest and Exchange Rate Policies

In his study, Thirlwall (1979) explained the reason behind different growth rates between countries. The economic growth rate depends on the growth of total factor productivity. However, the growth of total factor productivity can be sustainable only with the demand. In an open economy, the balance of payments is a significant constraint that determines healthy demand. In the study, Thirlwall has shown that countries that increase their export volumes can achieve higher growth rates in the long run.

In their study, Lee and Lee (2017) analyzed the exchange rate policy of China by using trade statistics with the United States between 1990 and 2013. Their findings show that appreciation of Chinese local currency affects export prices of Chinese exporters. They suggest that the rapid increase of local currency rate will result in a dramatic decline in the export so an imbalance of trade with the United States needs to be reduced by the continuous appreciation of the local currency at a slow pace.

MAIN FOCUS OF THE CHAPTER

Turkey, as a developing country, needs to increase its export volume to minimize the trade deficit and to support the growth rate of the economy. Between 2008 and 2018, the average trade balance of Turkey was around -$70 billion (-4% of the GDP). On the other hand, Turkey's workforce increased from 21 million in 2000 to 33 million in 2019. With the help of the young demographic structure and the increase in the workforce participation rate, this increase will continue in the coming years. Because of these factors,

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sustainable growth in Turkey depends on increasing export volume of the companies. The exchange rate is one of the most significant determinants for the competitiveness of companies in international trade.

At the beginning of 2018 USD/TRY exchange rate was 3.73. In February of 2018, the USD/TRY exchange rate started to increase significantly. On August 21, 2018, the USD/TRY exchange rate reached 6.55 by a 75% increase in just six months. This is the largest exchange rate shock since 2001. With the help of the increase in the foreign exchange rate, the export volume of Turkey increased from 164 billion USD in 2017 to 177 billion USD in 2018 and 180 billion USD in 2019. On the other hand, import volume has been decreased from 238 billion USD in 2017 to 210 billion USD in 2019 (Turkish Statistical Institute (TUIK), 2020).

In this study, it is aimed to make several contributions to the literature. Firstly, the exchange rate exposure of the companies at the micro-level is one of the less-studied areas in the literature (Dominguez and Tesar, 2006). Most studies have focused on trade volumes at the country level, but this study used the individual companies' ratios of exports to sales. For this reason, this study aims to show evidence to policymakers with an analysis made from another dimension. Secondly, in terms of investors, it is a major concern about how the change in exchange rates will affect firm values. It is known that most of the companies are affected negatively because of their FX-based debts and the decrease of local purchasing power during currency rate depreciation. However, some companies can benefit from the same situation with a higher competitive advantage in foreign markets because of the lower local costs of their inputs in the home market. This study demonstrates how the export volume of the companies is affected during the exchange rate movements. So, it can contribute to investors' decisions while they are developing foresight in various macroeconomic conditions. Finally, this study used the most updated data from 2008 to 2019, which covers the 2008 global financial crisis and the 2018 Turkey FX rate shock. In addition, data on companies operating in important sectors such as consumer durables, automotive and textiles were analyzed separately.

DATA AND METHODOLOGY

Data

Most large firms in Turkey are traded on the Istanbul stock exchange. In 2019 total export of Turkey was $180 billion and 30% of export has been done by Borsa İstanbul companies. Automotive, textile, basic metals, durable goods, and food products industries have the largest shares in Turkish export activities and most of the companies in these industries are also represented in Borsa İstanbul. So, the companies which are listed in Borsa İstanbul effectively represent the Turkish export structure. Firms in Borsa İstanbul should enclose export and local sales values in their financial statements. So, all of the Borsa İstanbul companies having export activities have been analyzed in the study.

From 2008 to 2019, 12 years of data of 230 companies which are trading in Borsa Istanbul included in the study which constitutes panel data of 2485 firm-year observations. GDP growth and inflation index data compiled from World Bank, exchange rates are obtained from Central Bank of the Republic of Turkey and financial tables of companies are compiled from the isyatirim.com website.

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Methodology

In the literature, there are two main dependent variables selected to measure the relation between exchange rate and trade flows. The first one is the country's change in total exports which is used by many academic studies including Mayer and Steingress (2019); Xu, Mao, and Tong (2016); Li, Ma, and Xu (2015); Arkolakis and Rodríguez-Clare (2012); Dekle, Eaton, and Kortum (2007); and others. The other commonly used dependent variable is exchange rate volatility (Sugiharti, Esquivias and Setyorani, 2020; Bahmani-Oskooee and Gelan, 2018; Qian and Varangis, 1994). These studies analyzed the effects of exchange rates at a macro level rather than a firm-level. In this study, the main focus is determining the effects of exchange rate changes on trade flows by using micro-level data including individual companies' performances. So, to analyses, different sectors and companies listed in Borsa İstanbul, the share of export has been selected as a dependent variable. Theoretically, the increase in the value of the foreign exchange rates causes loss of export revenue in terms of amounts in local currencies. So, the increase in foreign exchange rates may cause companies to prefer to export rather than domestic sales. On the other hand, the overvaluation of the foreign exchange rates weakens the purchasing power of the households. These two dynamics have the effect of reducing the current account deficit.

Campa and Goldberg, L. S. (1997) examined the development of the shares of import and export in different sectors over the years and; they try to find the effects of trade policy changes and external exposure to the exchange rate. Their data covers four countries, including the United Kingdom, the United States, Canada, and Japan over 1975-1995. They found that external factors are significantly affecting the import and export volumes and shares in different sectors. They used total import and export volumes in different sectors. In this study, company-based panel data is used to measure the reaction of individual companies against exchange rate changes separately. The dependent variable of this study is the export share of individual companies in their total production volumes. In this way, it was possible to monitor the development of a high amount of 270 participants in the cross-section between 2008 and 2019.

This study aims to find the effects of changes in FX rates on trade decisions of companies so three types of exchange rates are determined as independent variables. The first and most important independent variable is the real EURO / USD rate. European Union is the largest trading partner of Turkey. The share of Euro-based transactions in export is higher than 50% of Turkey's total export. However, Euro-based imports only constitute 38% of the total import. So, from the view of the current balance, Turkey is positively affected by an increase of the Euro rate however negatively affected by the increase of United States dollars. The second independent variable is the real Euro / Turkish Lira exchange rate which is adjusted with the consumer price index of Germany and Turkey. These first two independent variables are concerned with Turkey's largest market. The third independent variable is the real exchange rate of Turkish Lira which affects all trade flow of Turkey.

The trade flows are affected not only from exchange rates but also from the GDP growth of countries. Because of the high level of correlation between GDP growth rates of different countries, it is not possible to efficiently measure them in the same equation. So, in different models (1) Turkey's GDP growth rate minus EU growth rate; (2) EU's GDP growth rate and (3) Turkey's GDP growth rates are included separately as control variables.

The hypothesis of the study: Will the increase in the value of the foreign currency cause companies to turn to exports?

The definitions of variables:

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SXPORT : The export share of companies in their total sales
REUR_RUSD : Real Euro / USD exchange rate
REUR : Real Euro / TRY exchange rate
CREER : The change in the real exchange rate of TRY
TR_EU_GDP : GDP growth rate of Turkey minus GDP growth rate of European Union
TR_GDP : GDP growth rate of Turkey
EU_GDP : GDP growth rate of European Union

To test the hypothesis, three groups of models are formed. In the first group, as shown in the below equations (1), (2) and (3), the control variable is the GDP growth of Turkey minus GDP growth of the European Union. In the first model, the independent variables are REUR_RUSD and CREER. The Euro / USD ratio plays a significant role in the income and expenses of the exporting companies since the dollar is mainly used in imports and the euro is used in exports. On the other hand, an increase in CREER increase the costs of Turkish exporting firms.

$$\text{SXPORT} = \alpha_{it} + \beta_1 REUR\_RUSD_{it} + \beta_2 CREER_{it} + \beta_3 TR\_EU\_GDP_{it} + \epsilon_{it} \tag{1}$$

$$\text{SXPORT} = \alpha_{it} + \beta_1 \text{CREER}_{it} + \beta_2 TR\_EU\_GDP_{it} + \epsilon_{it} \tag{2}$$

$$\text{SXPORT} = \alpha_{it} + \beta_1 \text{CREUR}_{it} + \beta_2 TR\_EU\_GDP_{it} + \epsilon_{it} \tag{3}$$

The same independent variables are used in the second and third groups of models. In the second group of models as shown in the below equations (4), (5) and (6) the control variable is TR_GDP. Growth in the economy also increases the purchasing power of households so, companies can focus on local sales instead of exporting. On the other hand, the rapid growth of the economy has an impact on increasing imports and the current account deficit.

$$\text{SXPORT} = \alpha_{it} + \beta_1 REUR\_RUSD_{it} + \beta_2 CREER_{it} + \beta_3 TR\_GDP_{it} + \epsilon_{it} \tag{4}$$

$$\text{SXPORT} = \alpha_{it} + \beta_1 REER_{it} + \beta_2 TR\_GDP_{it} + \epsilon_{it} \tag{5}$$

$$\text{SXPORT} = \alpha_{it} + \beta_1 REUR_{it} + \beta_2 TR\_GDP_{it} + \epsilon_{it} \tag{6}$$

In the final group of models, as shown below, EU_GDP is selected as the control variable. The growth in the European economy, regardless of the change in exchange rates, is an important factor which is supporting the export performance of Turkish firms.

$$\text{SXPORT} = \alpha_{it} + \beta_1 REUR\_RUSD_{it} + \beta_2 CREER_{it} + \beta_3 EU\_GDP_{it} + \epsilon_{it} \tag{7}$$

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$$\text{SXPORT} = \alpha_{it} + \beta_1 REER_{it} + \beta_2 EU\_GDP_{it} + \epsilon_{it} \tag{8}$$

$$\text{SXPORT} = \alpha_{it} + \beta_1 REUR_{it} + \beta_2 EU\_GDP_{it} + \epsilon_{it} \tag{9}$$

To check the robustness of equations, firstly correlation analysis and unit root tests (Levin, Lin, and Chu, 2002) are implemented. After implementing the Random effects model, Durbin Watson stats are to be found lower than limit values. Since there is a correlation between dependent variable and error term in the same direction, the robust least-squares model is used which is robust to autocorrelation and correlation between units and suitable for the cases where T is lower than N (Elitaş, Doğan, and Kevser, 2017).

Findings

Descriptive statistics are shared in table 1. The average share of export in total sales of Borsa İstanbul companies is 24%. For some of the years, the data of share of export is not available, because some companies went public during the study period.

Table 1. Descriptive Statistics

	SXPORT	REER	REUR	REUR/USD	TR_GDP	EU_GDP	TR-EU_GDP
Mean	0.238	102.019	2.080	1.247	4.554	1.022	3.532
Median	0.150	102.746	2.007	1.273	4.790	1.791	3.428
Maximum	1.000	121.967	2.719	1.466	11.114	2.598	9.322
Minimum	0.000	75.219	1.748	1.079	-4.704	-4.315	-0.600
Std. Dev.	0.255	14.093	0.304	0.134	4.111	1.833	3.212
Skewness	1.077	-0.651	1.237	0.017	-0.561	-1.960	0.323
Kurtosis	3.186	2.468	3.160	1.518	2.955	6.129	1.881
Jarque-Bera	484	227	705	252	145	2885	192
Probability	0	0	0	0	0	0	0
Observations	2485	2753	2753	2753	2753	2753	2753

The correlation matrix of the variables can be found in Table 2. There is a high correlation in exchange rates and growth rates among themselves. However, the correlation between growth rates and exchange rates are lower.

Before regression analysis, the unit root test by Levin, Lin, and Chu (LLC) (2002) is implemented and results are given in Table 3. As shown in Table 3, the LLC test rejects the null hypothesis of stationary of series at a 1% level except for REER. So instead of REER, CREER is used in the models.

Panel data analysis of the study has been done in four different parts. After the overall examination of panel data, the largest three industries including automotive, textile and durable goods are given separately.

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Table 2. Correlation Matrix

	SXPORT	REER	REUR	REUR_RUSD	TR_GDP	EU_GDP	TR_EU_GDP
SXPORT	1.00						
REER	0.01	1.00					
REUR	0.00	-0.94**	1.00				
REUR_RUSD	0.04*	0.76**	-0.57**	1.00			
TR_GDP	-0.03	0.19**	-0.34**	0.00	1.00		
EU_GDP	-0.04	-0.35**	0.21**	-0.54**	0.63**	1.00	
TR_EU_GDP	-0.02	0.43**	-0.55**	0.30	0.90**	0.23**	1.00

Statistically significant at *5% level and **1% level.

Table 3. Results of LLC Unit Root Tests

Variables	Stats	Prob.
SXPORT	-195.07	0.000
EU_GDP	-72.80	0.000
REER	44.42	1.000
CREER	-13.41	0.000
REUR	-59.09	0.000
REUR_RUSD	-12.81	0.000
TR_EU_GDP	-18.03	0.000
TR_GDP	-61.11	0.000
W_GDP	-324.46	0.000
EU_GDP	-72.80	0.000

Overall Analysis of Panel Data

The company's sales in abroad is summarized by year and industry in Table 4. Airline and service industry is having the highest volume but the companies in this industry including THY, Pegasus and TAV Airports which have operations in some other countries. So, these companies extracted from the study. Like the airlines and service industry, the major companies in the soft drinks and beverage industry including Anadolu Efes and Coca-Cola are extracted because of their operations in overseas. The companies that have overseas operations, but main operations are located in Turkey are not extracted.

In Figure 1, the real exchange rate (REER) of Turkish lira; real Euro / USD rate and export share of Borsa İstanbul Firms are shown. Starting from 2013 there is a sharp downward trend in REER and the opposite is true for export share of Borsa İstanbul firms. There is also a reverse relation between the real Euro / USD exchange rate and export share of Borsa İstanbul firms.

The results of the robust least square analysis of panel data are shown in Table 5. According to results export share of companies in Borsa İstanbul increases significantly with the increase in the Real Euro / USD exchange rate at the 1% significance level. This supports the hypothesis that Turkish companies benefit from the increasing Euro exchange rate. According to the results of the study, there is no statisti-

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cally significant relationship between the dependent variable (SXPORT) and the real Euro exchange rate and change in the real effective exchange rate of TRY. In the literature, similar studies found an adverse relation between the value of local currency and export performance (Lee and Lee, 2017; Sekkat, 2016; Sonaglio, Campos and Braga, 2016; Li, Ma, and Xu, 2005). There are weak relations with GDP growth variables, and they are at a 5% significance level. Xu (1996) investigated the causality between GDP growth and export; and found that in 17 economies in a sample of 32 economies, the export support GDP growth rate. In this study different perspective is used. Regardless of the exchange rate development, the economic growth in the country and the trade partner countries affect the export decisions of the companies.

Table 4. The Overseas Sales of Borsa İstanbul Companies (In Billions $)

Industries	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Airlines and Service.	3.7	4.1	4.8	6.3	7.6	9.2	10.3	9.8	9.1	10.3	12.5	13.0
Automotive	7.7	5.1	6.2	7.4	7.0	7.5	7.0	7.5	8.7	9.8	10.5	10.4
Durable Goods	6.5	5.5	6.1	7.1	7.7	7.2	7.6	6.8	6.8	6.7	7.5	7.5
Oil	5.1	2.4	3.6	6.0	6.5	5.3	4.5	3.6	2.7	3.8	3.7	4.7
Soft Drinks / Beverages	1.6	1.5	1.7	1.9	2.2	2.6	4.0	3.3	3.0	3.3	3.9	4.2
Construction- Contracting	4.2	2.7	1.9	2.0	2.5	3.0	2.6	2.0	1.9	1.8	2.5	2.6
Steel	2.6	1.6	1.4	2.7	2.5	1.9	4.2	1.5	1.6	2.0	2.9	2.5
Glass	1.3	0.9	1.1	1.1	1.1	1.2	1.4	1.2	1.6	2.0	2.3	2.1
Textile	1.0	0.8	1.1	1.2	1.1	1.4	1.3	1.0	0.9	1.0	1.0	0.9
Food	0.6	0.5	0.4	0.7	0.7	0.7	0.7	0.6	0.7	0.8	1.0	1.0
Cement	0.8	0.8	0.7	0.7	0.5	0.6	0.5	0.4	0.4	0.4	0.5	0.7
Construction Materials	0.6	0.3	0.5	0.6	0.6	0.6	0.6	0.5	0.5	0.7	0.7	0.6
Contact	1.0	0.8	0.8	0.8	0.6	0.7	0.6	0.4	0.3	0.3	0.3	0.3
Agricultural Chemicals	0.1	0.2	0.4	0.6	0.5	0.4	0.5	0.4	0.2	0.3	0.4	0.3
Electricity	0.2	0.4	0.3	0.2	0.2	0.3	0.3	0.2	0.3	0.5	0.6	0.4
Paper Products	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Defense	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Retail - Trading	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Chemical Product	0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cable	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Communication Devices	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Media	0.3	0.2	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
Mining	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Ceramic	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Furniture	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Farming	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Leather Clothing	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Others	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	38.5	29.0	32.3	40.8	42.7	44.2	47.8	40.7	40.1	45.0	51.8	52.3

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Figure 1. The Relation between Real Effective Exchange Rate, Real Euro / USD Rate and Export Share of Borsa Istanbul Firms

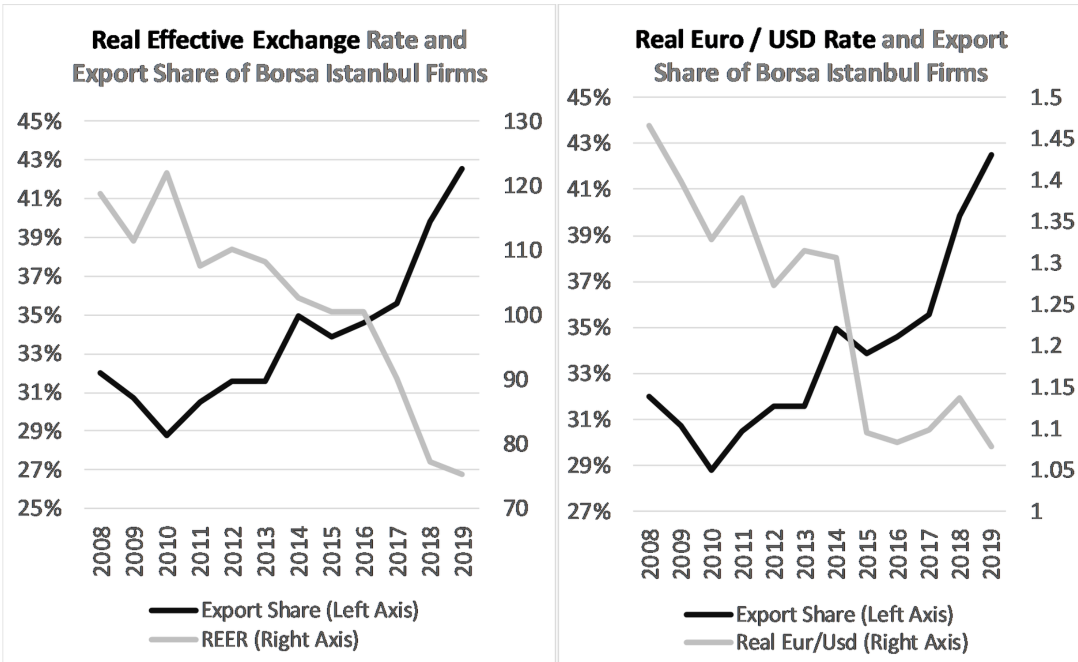

Table 5. The Results of Panel Data Analyses in Overall Borsa Istanbul Firms

Dependent Variable: SXPORT	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
REUR_RUSD	0.137**			0.114**			0.102*		
	(0.039)			(0.038)			(0.045)		
REUR			-0.017			-0.014			0.005
			(0.019)			(0.017)			(0.016)
CREER	-0.017	0.020		-0.015	0.019		-0.018	0.005	
	(0.079)	(0.079)		(0.079)	(0.079)		(0.079)	(0.079)	
TR_EU_GDP	-0.003*	-0.002	-0.003						
	(0.002)	(0.002)	(0.002)						
TR_GDP				-0.002	-0.002	-0.003*			
				(0.001)	(0.001)	(0.001)			
EU_GDP							-0.002	-0.006*	-0.006*
							(0.003)	(0.003)	(0.003)
Obervations	2485	2485	2485	2485	2485	2485	2485	2485	2485

Statistically significant at *5% level and **1% level. Standard deviations are shown in parenthesis.

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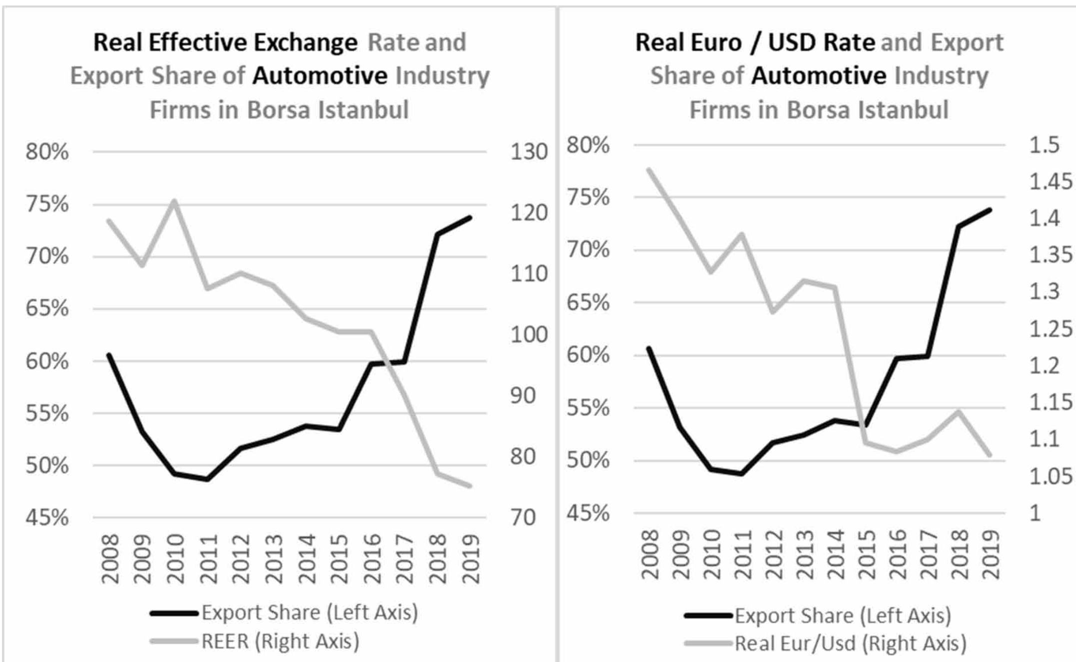
Automotive Industry

Figure 2 illustrates the relation between exchange rates and export share of companies in the Automotive industry. Similar to Figure 1, adverse correlations can be observed.

Figure 2. The Relation between Real Effective Exchange Rate, Real Euro / USD Rate and Export Share of Automotive Firms in Borsa Istanbul



Panel data analysis of automotive firms with the robust least square method is summarized in Table 6. Unlike the analysis that includes all companies in Table 5, these models do not show a statistically significant relationship between the export shares of automotive companies and the Real Euro/USD exchange rate. However, when the relationship with the real Euro rate is analyzed there is a strong correlation in the same direction found at a 5% significance level. No statistically significant relationship was found regarding other variables.

Consumer Durables Industry

Seven companies are operating in the consumer durables industry are listed in Borsa İstanbul. Similar to overall statistics in Borsa İstanbul and automotive industry there is a negative relationship between the export share of the consumer durables firms and real exchange rate as shown in Figure 3.

Table 7 shows the robust least square panel data analysis in durable goods firms. There is no statistically significant relationship can be found in these analyses.

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Table 6. The Results of Panel Data Analyses in Automotive Firms in Borsa Istanbul

Dependent Variable: SXPORT	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
REUR_RUSD	-0.213			-0.261			-0.279		
	(0.145)			(0.141)			(0.169)		
REUR			0.132			0.145*			0.144*
			(0.071)			(0.064)			(0.062)
CREER	-0.189	-0.254		-0.187	-0.277		-0.197	-0.281	
	(0.297)	(0.296)		(0.297)	(0.299)		(0.301)	(0.299)	
TR_EU_GDP	-0.007	-0.009	-0.003						
	(0.006)	(0.006)	(0.007)						
TR_GDP				-0.004	-0.004	-0.001			
				(0.004)	(0.005)	(0.005)			
EU_GDP							-0.003	0.007	0.003
							(0.012)	(0.010)	(0.010)
Obervations	211	211	211	211	211	211	211	211	211

Statistically significant at *5% level and **1% level. Standard deviations are shown in parenthesis.

Figure 3. The Relation between Real Effective Exchange Rate, Real Euro / USD Rate and Export Share of Consumer Durables Firms in Borsa Istanbul

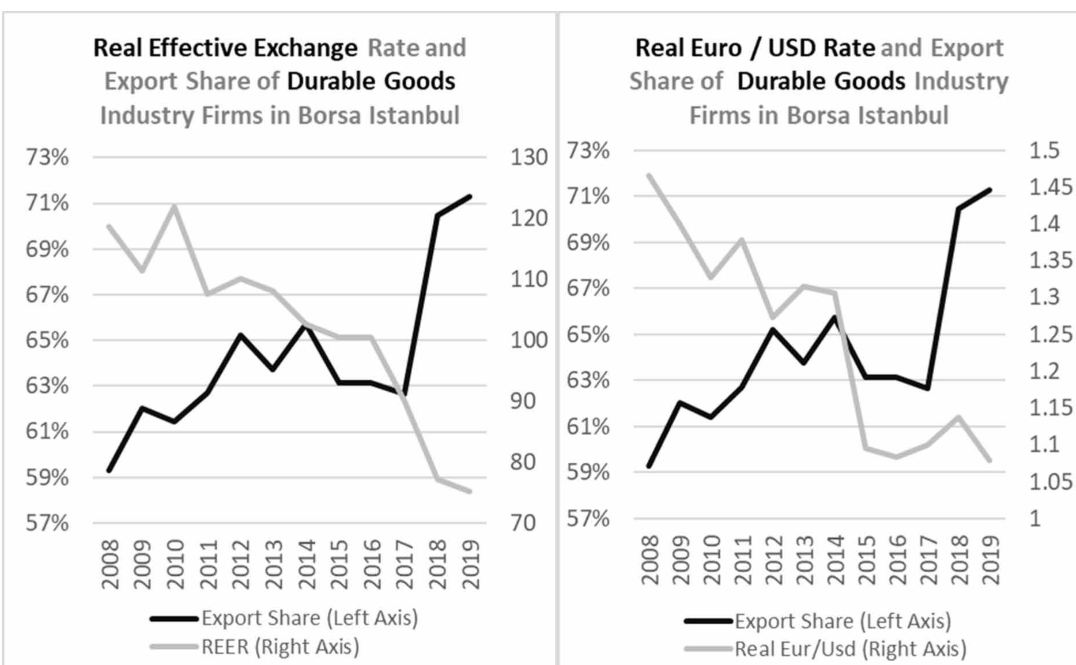

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Table 7. The Results of Panel Data Analyses in Durable Goods Firms in Borsa Istanbul

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
REUR_RUSD	0.168			0.154			0.109		
	(0.256)			(0.249)			(0.300)		
REUR			-0.055			-0.054			-0.028
			(0.127)			(0.113)			(0.110)
CREER	0.075	0.135		0.078	0.139		0.083	0.118	
	(0.535)	(0.534)		(0.537)	(0.535)		(0.542)	(0.533)	
TR_EU_GDP	-0.002	0.000	-0.003						
	(0.011)	(0.011)	(0.012)						
TR_GDP				-0.002	-0.002	-0.004			
				(0.008)	(0.008)	(0.009)			
EU_GDP							-0.007	-0.011	-0.011
							(0.022)	(0.019)	(0.019)
Obervations	77	77	77	77	77	77	77	77	77

Statistically significant at *5% level and **1% level. Standard deviations are shown in parenthesis.

Textile Industry

When the companies in the textile industry are examined, a different result is obtained compared to other sectors and the general sample. As shown in Figure 4, there is a positive relationship between the export share of companies in the textile industry and the real exchange rates. Contrary to expectations, the textile industry's exports, benefit from strong TRY and strong USD and negatively affected by strong Euro.

The regression results of the companies in the textile industry are given in Table 8. No statistically significant results were found in the robust least squares regression analysis in this part.

FUTURE RESEARCH DIRECTIONS

Only companies in Borsa Istanbul are included in this study. For future research topics, the relationship between the exchange rate and the share of exports in other developing countries, including Eastern European countries, can be analyzed and international studies can be conducted on this subject. More detailed company-specific analysis of the effects of exchange rates can also be evaluated.

CONCLUSION

This section investigated the effects of currency rate changes on the export share of the companies which are listed in Borsa İstanbul over 2008 to 2019. The results of the study show that there is a strong, statistically significant and positive relationship between real Euro / USD exchange rate and export shares of Turkish firms. The export share of Turkish companies is not affected by the real Euro exchange rate. The effects of GDP growth rates in Turkey and the European Union are statistically significant but weak. The

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Figure 4. The Relation between Real Effective Exchange Rate, Real Euro / USD Rate and Export Share of Textile Firms in Borsa Istanbul

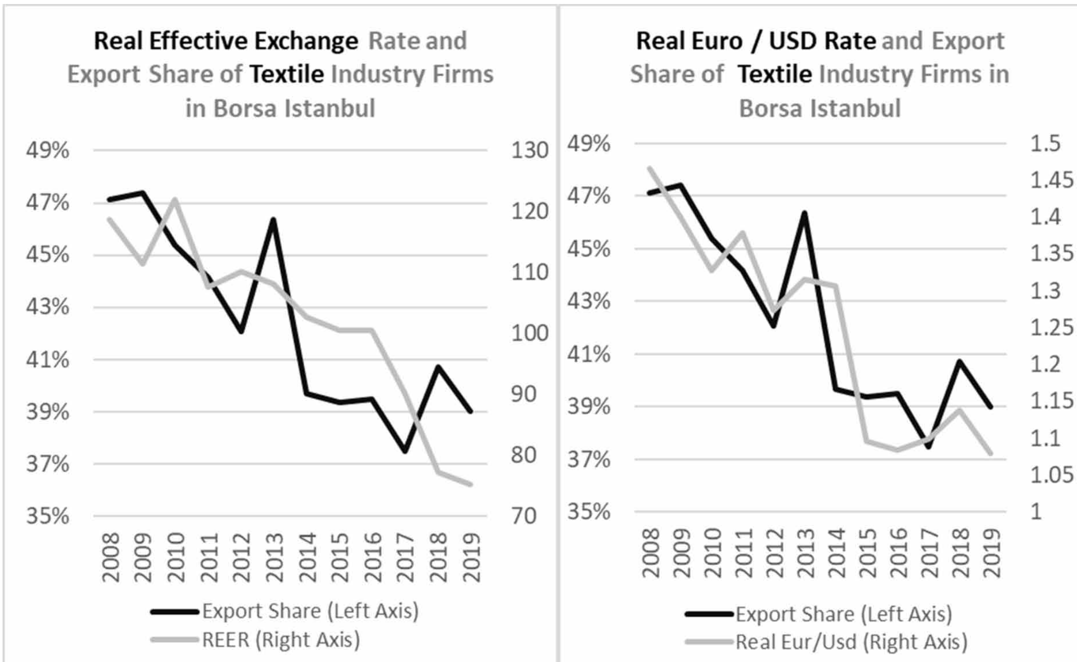

Table 8. The Results of Panel Data Analyses in Textile Firms in Borsa Istanbul

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
REUR_RUSD	0.092			0.067			0.052		
	(0.154)			(0.146)			(0.173)		
REUR			-0.069			-0.052			-0.032
			(0.074)			(0.066)			(0.063)
CREER	0.053	0.074		0.053	0.072		0.050	0.062	
	(0.309)	(0.304)		(0.308)	(0.304)		(0.308)	(0.304)	
TR_EU_GDP	-0.003	-0.002	-0.006						
	(0.006)	(0.006)	(0.007)						
TR_GDP				-0.002	-0.002	-0.004			
				(0.005)	(0.005)	(0.005)			
EU_GDP							-0.002	-0.004	-0.003
							(0.013)	(0.011)	(0.011)
Obervations	228	228	228	228	228	228	228	228	228

Statistically significant at *5% level and **1% level. Standard deviations are shown in parenthesis.

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effects of exchange rate change in specific sectors have also been analyzed. For the automotive industry, a statistically significant and positive relationship has been found between the real Euro rate and export share of Borsa İstanbul companies. For other sectors there is no statistically significant result has been obtained. When the graphs which show export share and real exchange rates over 2008 and 2019 have been checked, the reverse relationship draws attention with one exception. In the textile sector, the real exchange rates and export share of firms decrease together but the results are not statistically significant.

This study has made three main contributions to the academic literature. The first contribution is rather than using exchange volatility or macro-scale data, individual companies' data has been used. The second contribution is the recent exchange rate shock in 2018 Turkey has been included in the study. The third contribution is as an independent variable Euro / USD exchange rate has been chosen. In this way, not only the relationship of the country's own currency with other currencies; but also, the exchange rate between major foreign currencies has been included in the study.

The results have shown that the real effective exchange rate of TRY has a limited effect on export-related choices of companies in Borsa İstanbul. Therefore, public authorities have a limited influence on export performance by interfering with currency exchange rates. According to results of the study, the investors in Borsa İstanbul companies may pay higher attention to changes in Euro / USD rates rather than the real effective exchange rate of TRY.

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