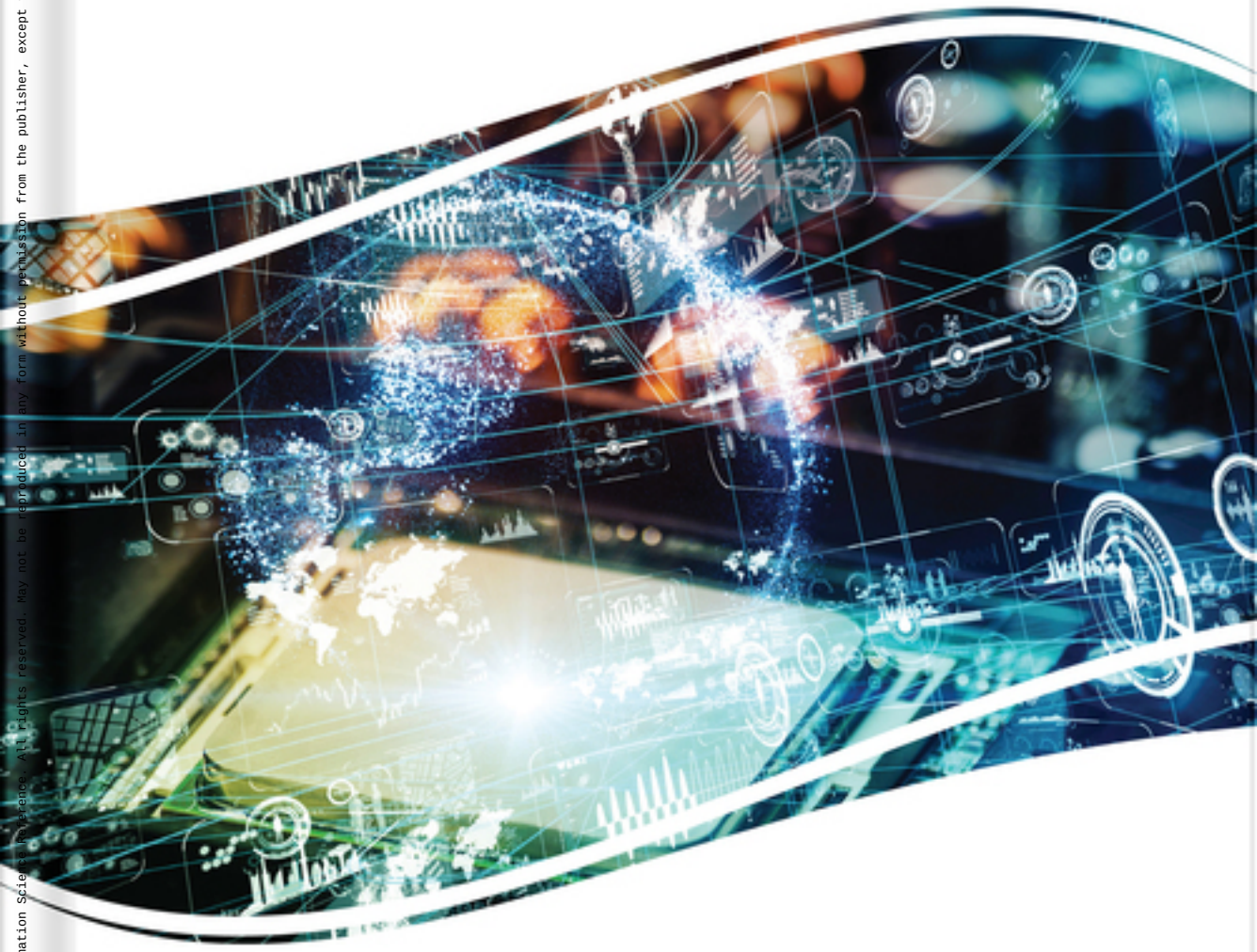
Premier Reference Source

Novel Theories and Applications of Global Information Resource Management



Zuopeng (Justin) Zhang

IGI Global
DISSEMINATOR OF KNOWLEDGE

Novel Theories and Applications of Global Information Resource Management

Zuopeng (Justin) Zhang
University of North Florida, USA

A volume in the Advances in Library and Information Science (ALIS) Book Series

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

Library of Congress Cataloging-in-Publication Data

Names: Zhang, Zuopeng (Justin), 1973- editor.
Title: Novel theories and applications of global information resource management / Zuopeng (Justin) Zhang, editor.
Description: Hershey, PA : Information Science Reference, [2019] | Includes bibliographical references and index. | Summary: “”This book examines developing practices for businesses to effectively manage their assets on a global scale. It also examines the implementation of technological innovation into business techniques as well as the methods of controlling information in a contemporary society”--Provided by publisher”-- Provided by publisher.
Identifiers: LCCN 2019034159 (print) | LCCN 2019034160 (ebook) | ISBN 9781799817864 (hardcover) | ISBN 9781799817871 (paperback) | ISBN 9781799817888 (ebook)
Subjects: LCSH: Information technology--Management. | Industrial management--Technological innovations. | Customer relations--Technological innovations. | Consumer satisfaction.
Classification: LCC HD30.2 N6734 2019 (print) | LCC HD30.2 (ebook) | DDC 658.4/038--dc23
LC record available at https://lccn.loc.gov/2019034159
LC ebook record available at https://lccn.loc.gov/2019034160

This book is published in the IGI Global book series Advances in Library and Information Science (ALIS) (ISSN: 2326-4136; eISSN: 2326-4144)

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

All work contributed to this book is new, previously-unpublished material.
The views expressed in this book are those of the authors, but not necessarily of the publisher.

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

Advances in Library and Information Science (ALIS) Book Series

ISSN:2326-4136
EISSN:2326-4144

MISSION

The **Advances in Library and Information Science (ALIS) Book Series** is comprised of high quality, research-oriented publications on the continuing developments and trends affecting the public, school, and academic fields, as well as specialized libraries and librarians globally. These discussions on professional and organizational considerations in library and information resource development and management assist in showcasing the latest methodologies and tools in the field.

The **ALIS Book Series** aims to expand the body of library science literature by covering a wide range of topics affecting the profession and field at large. The series also seeks to provide readers with an essential resource for uncovering the latest research in library and information science management, development, and technologies.

COVERAGE

- Journal Collections
- Outreach, Promotion, and Advocacy
- Databases
- Technologies Affecting Library Services
- Alternatives to Dewey Decimal System
- Image Management
- Service Learning in Libraries
- Free Online Resources
- User Surveys and Focus Groups
- Blogging in Libraries

The Advances in Library and Information Science (ALIS) Book Series (ISSN 2326-4136) is published by IGI Global, 701 E. Chocolate Avenue, Hershey, PA 17033-1240, USA, www.igi-global.com. This series is composed of titles available for purchase individually; each title is edited to be contextually exclusive from any other title within the series. For pricing and ordering information please visit http://www.igi-global.com/book-series/advances-library-information-science/73002. Postmaster: Send all address changes to above address.

Titles in this Series

For a list of additional titles in this series, please visit:
https://www.igi-global.com/book-series/advances-library-information-science/73002

Cooperation and Collaboration Initiatives for Libraries and Related Institutions
Collence Takaingenhamo Chisita (University of South Africa, South Africa)
Information Science Reference • copyright 2020 • 394pp • H/C (ISBN: 9781799800439) • US $195.00 (our price)

Critical Approaches to Information Retrieval Research
Muhammad Sarfraz (Kuwait University, Kuwait)
Information Science Reference • copyright 2020 • 355pp • H/C (ISBN: 9781799810216) • US $195.00 (our price)

Handbook of Research on Digital Devices for Inclusivity and Engagement in Libraries
Adeyinka Tella (University of Ilorin, Nigeria)
Information Science Reference • copyright 2020 • 491pp • H/C (ISBN: 9781522590347) • US $265.00 (our price)

Research Data Access and Management in Modern Libraries
Raj Kumar Bhardwaj (University of Delhi, India) and Paul Banks (The Royal Society of Medicine, UK)
Information Science Reference • copyright 2019 • 418pp • H/C (ISBN: 9781522584377) • US $195.00 (our price)

Handbook of Research on Transdisciplinary Knowledge Generation
Victor X. Wang (Liberty University, USA)
Information Science Reference • copyright 2019 • 475pp • H/C (ISBN: 9781522595311) • US $285.00 (our price)

Social Media for Communication and Instruction in Academic Libraries
Jennifer Joe (University of Toledo, USA) and Elisabeth Knight (Western Kentucky University, USA)

For an entire list of titles in this series, please visit:
https://www.igi-global.com/book-series/advances-library-information-science/73002

701 East Chocolate Avenue, Hershey, PA 17033, USA
Tel: 717-533-8845 x100 • Fax: 717-533-8661
E-Mail: cust@igi-global.com • www.igi-global.com

Table of Contents

Detailed Table of Contents

contextual consistency. This study reconciles prior debates by anchoring on the load theory of selective attention to propose that user response to contextually consistent adverts is dependent on their intra-page and inter-page positional display. In collaboration with a European mobile application company, adverts were randomly displayed in its location-based mobile social networking application. The follow-up think-aloud protocol analysis, conducted to collect qualitative feedback from users, validates the theoretical assumptions. The findings reveal that high click-through could be obtained when contextually consistent adverts are displayed at the top positions or the front page of the mobile application. These findings address an enduringly debated issue of how to leverage on new technology, such as mobile device, to display commercial information most effectively.

Managing software quality is a major challenge for software development firms. This has led many firms to adopt software process improvement programs such as the capability maturity model integration to improve the software development process. However, these models are often too cumbersome and costly, especially for small software firms in developing countries, to implement. This chapter proposes a simplified software process improvement model that prioritises key practices for software development, given the constraints that face small firms. Using data collected in four developing countries in the English-speaking Caribbean from 112 developer/user dyads on their software practices, the results show that software process coupled with supporting technology (e.g., project management tools) significantly impact the quality of the software product. Smaller projects (represented by size of the project team) are also associated with high quality software products than larger projects. Implications for SPI programs in small firms and future research is discussed.

A major challenge for multinational companies is how to motivate employees with different individual cultural characteristics and national cultures to share knowledge.

The purpose of this study is to investigate the effects of individual and national cultures on knowledge sharing. Individual cultural characteristics are incorporated into the model as antecedents of knowledge-sharing motivations (organizational rewards, image, and reciprocal benefits). National cultural differences are examined by conducting studies with subjects in the U.S. and China. The results show that power distance is significantly related to reciprocal benefits in the U.S. but not in China. Individualism/collectivism is related to organizational rewards and image in the U.S. but not in China, while individualism/collectivism is significantly related to reciprocal benefits in China but not in the U.S. Uncertainty avoidance is significantly related to reciprocal benefits in the U.S. but not in China. This study provides knowledge-sharing practices and management implications for multinational companies.

Recently, mobile banking has gained significant importance, and the growth of the field is accelerating. Due to a rapid increase in smart phone users, banks have shifted the competitive landscape from physical banking branches to internet banking and mobile banking services. However, many customers remain reluctant to use this banking channel. It is crucial for banks to meet customers' need and understand which factors play an important role in encouraging or discouraging them from using mobile banking. Culture can also play an important role on these factors. This study compares the mobile banking perceptions between the consumers in the U.S. and in Thailand and reveal various factors that influence mobile banking adoption for these two nationalities. The findings suggest factors that banks should consider when implementing mobile banking services, thus allowing them to design the services that meet the needs of their customers.

Trust is a central element in online transactions in B2C e-marketplaces where a buyer needs to evaluate intermediary trust as well as seller trust to make a purchase decision. The authors develop and test a consumer trust model to predict first-time

buyer's trust in an intermediary in Korean online marketplaces. Data were collected via a questionnaire survey using 218 respondents. Results from an empirical analysis indicate that while all the three factors of trustworthiness were found to be a predictor of overall initial trust in the intermediary, 'integrity' turned out to have the strongest association with overall trust. The findings suggest that trustworthiness beliefs and trust are conceptually distinct from each other and that the former is a predictor of the latter. The chapter offers implications for both academics and practitioners of online marketplaces.

Health systems are currently facing a series of challenges dealing with continuous technology advances and social demands, which require changes at managerial and policy level that fully incorporate social responsibilities within healthcare organizations' strategy. Thus, communicating corporate social responsibility (CSR) takes an important role in today's health contexts worldwide. This work aims to investigate CSR communication in healthcare through the use of both traditional and interactive technologies by adopting a mixed qualitative-quantitative research approach. To this extent, a comparative research was conducted in two different countries with different health systems and contexts, namely Malta and India. Findings show that healthcare organisations of both countries are increasing their awareness towards their social responsibilities and the different ways of communicating their CSR activities. A mixed strategy—including both digital (interactive technologies) and traditional tools—was identified as the most effective way of communicating CSR in a healthcare context.

Has the Internet impacted the core values of consumers, particularly in developing nations? Unlike one-way mass media vehicles such as television, the internet's two-

way, interactive nature allows individuals to communicate in a high-involvement, border-free world via social media, blogs, online forums, and the like. This will result in the trading of values and ideas, and especially in the erosion of traditional value systems in developing nations. This chapter highlights the changes in values in India between 2004 and 2014, with a marked increase in Western individualistic values such as power and achievement, eroding traditional collective values such as universalism among Indian youth during this period. Since consumers buy products that reflect their values, these findings have profound implications for business management and marketing. Further, the general notion that the core values of a society are slow to change is refuted.

With the advent of globalization and fast changing environment, companies are using information and communication systems in the supply chain. Supply chain management information system (SCMIS) has gained a lot of importance because of its ability to reduce costs and increase responsiveness in the supply chain. Review of literature has revealed that the success in implementation of SCMIS and successfully attaining the return expected from the system implemented is a challenge. With such high failure rates scenario, it becomes imperative to identify the risk and the failure factors that may arise during implementation and the ways to tackle these risks. In this chapter, an attempt has been made to establish the challenges, their severity, and improvisation for the successful implementation of SCMIS in the Indian automobile industry. The findings can help the practitioners and managers better understand the challenges, focus the resources, their attention, set up the priorities, and thus improve the chances of successful implementation of SCMIS.

Development of cities brings in overall economic growth of the country. As a result, cities are taking new shape with modern facilities to ensure development. In this perspective, Government of India (GOI) has announced to create 100 Smart Cities across different locations in India. In these Smart Cities, modern infrastructure would be created with introduction of modern 5G network systems. This network system is expected to bring in considerable improvements in the Smart Cities if the

security and privacy issues involved in this system can be addressed. This chapter has taken an attempt to identify the critical success factors (CSFs) instrumental to improve this network system within the acceptable level of security and privacy vulnerabilities in Smart Cities of India. To identify the CSFs, different standard methods including questionnaire-oriented survey, brainstorming have been adopted. Interpretive structural modelling (ISM) methodology has been used to find out inter-relationships among the CSFs along with identification of driving forces.

Chapter 11

Dynamic modularity is one of the fundamental characteristics of the human brain. Cooperative divide and conquer strategy is a basic problem solving approach. This chapter proposes a new subnet training method for modular neural networks with the inspiration of the principle of "an expert with other capabilities." The key point of this method is that a subnet learns the neighbor data sets while fulfilling its main task: learning the objective data set. Additionally, a relative distance measure is proposed to replace the absolute distance measure used in the classical method and its advantage is theoretically discussed. Both methodology and empirical study are presented. Two types of experiments respectively related with the approximation problem and the prediction problem in nonlinear dynamic systems are designed to verify the effectiveness of the proposed method. Compared with the classical learning method, the average testing error is dramatically decreased and more stable. The superiority of the relative distance measure is also corroborated. Finally, a mind-gut frame is proposed.

Chapter 12

Designing various energy-saving routing protocols for real-time internet of things (IoT) applications in modern secure wireless sensor networks (MS-WSN) is a tough task. Many hierarchical protocols for WSNs were not well scalable to large-scale IoT

applications. Low energy adaptive two-level-CH clustering hierarchy (LEATCH) is an optimized technique reduces the energy-utilization of few cluster heads, but the LEATCH is not suitable for scalable and dynamic routing. For dynamic routing in MS-WSN, energy efficiency and event clustering adaptive routing protocol (EEECARP) with event-based dynamic clustering and relay communication by selecting intermediates nodes as relay-nodes is necessary. However, EEECARP cannot consider the hop-count, different magnitude ecological conditions, and energy wastage in cluster formation while collisions occur. So, the authors propose the modified EEECARP to address these issues for better dynamic event clustering adaptive routing to improve the lifetime of MS-WSNs. The experimental outcomes show that proposed protocol achieves better results than EEECARP and LEATCH.

Preface

The technology landscape in the world has been continuously advancing at an unprecedented pace over the last decade, resulting in many novel theories and applications of global information resource management. The new technology landscape manifested by the emerging technology and applications has brought new opportunities for companies from different industries to enhance their competitive edge in global markets. The increasingly fierce global competition has demanded companies to closely monitor the development of new technologies, evaluate their potential values, and use them for their advantages. To meet the growing demand for research from these perspectives, this book presents some latest studies on the innovative approaches of managing information resources in the contemporary global society.

ORGANIZATION OF THE BOOK

This book presents 12 chapters submitted by contributors from twelve different countries including Brazil, China, France, India, Jamaica, Malta, New Zealand, Singapore, South Korea, Thailand, United Kingdom, and United States of America, documenting the latest development of new technologies and their applications in global information management in different countries. The book covers a broad range of topics on global information management, such as risk management, IT project management, mobile computing, software development, knowledge sharing, online trust, health-care systems, supply chain management systems, privacy and security issues in network systems, neural networks, and Internet of Things. Specifically, the book is organized as follows.

Chapter 1 reviews relevant literature in the last 20 years with respect to the risks in global and local IT projects and conducts a systematic comparison.

Chapter 2 studies how to effectively display commercial information on mobile devices based on its collaboration with a European mobile application company.

Chapter 3 proposes a simplified software process improvement model for small businesses in developing countries.

Chapter 4 investigates the effects of national cultures on individuals' knowledge sharing with subjects in the U.S. and China.

Chapter 5 conducts a comparative study of mobile banking adoption by customers in the U.S. and Thailand.

Chapter 6 develops and tests a consumer trust model to predict a first-time buyer's trust in a Korean business-to-customer online marketplace.

Chapter 7 conducts comparative research on the different health systems in two different countries: Malta and India.

Chapter 8 examines the impact of the Internet on the core values of consumers in India.

Chapter 9 highlights the challenges, their severity, and improvisation for the successful implementation of supply chain management information systems in the Indian automobile industry.

Chapter 10 identifies the critical success factors to improve the network system to reduce the security and privacy vulnerabilities in smart cities of India.

Chapter 11 proposes a new subnet training method for modular neural networks.

Chapter 12 develops a modified method to address the issues for Internet-of-Things applications.

CONTRIBUTIONS OF THE BOOK

The last two decades have witnessed the abundance of research on IT project risk management. While local IT projects concern more on clients and scope, those on a global scale care more about the psychic distance, coordination, and control. The first chapter entitled "Are Risks in IT Global and Local Projects the Same? Systematic Literature Review of the Last 20 Years" identifies and differentiates the risk between global and local IT projects through exploratory research carried out using a systematic literature review. This chapter helps readers understand the different concerns between local and global IT projects as well as the main differences between the risk categories for each project type.

There has been an ongoing debate about how to place advertisements so as to attract users' attention to generate more click-throughs on mobile devices. The chapter entitled "Mobile Advert's Contextual Consistency: The Effect of Its Positional Display" provides findings based on the collaboration with a European mobile application company, to help businesses understand how to effectively leverage the emerging technologies to effectively display commercial information. In particular, the chapter shows that when contextual advertisements are consistently placed at the

top position or on the front page of a mobile application, it is more likely to achieve high click-throughs among users.

To better manage software quality, many companies have adopted different software process improvement programs to improve the process of software development. However, most of the existing models are often expensive and difficult to implement, particularly for small software firms in developing countries. The chapter entitled "A Software Process Improvement Model for Small Firms in Developing Countries" presents a simplified software process improvement model that ranks the primary considerations in the process of software development, subject to the constraints for small businesses. Specifically, the paper collected and analyzed the data collected from 112 developer/user dyads regarding their best practices of software development in four Caribbean developing countries, and demonstrates the factors, processes, and technologies that significantly impact the quality of the software product.

Motivating employees to share knowledge remains a challenge in organizations, particularly for employees with different individual and national cultural characteristics in multinational companies. Based on the analysis of subjects in both the U.S. and China, the chapter entitled "National Culture on Knowledge Sharing in the U.S. and China" investigates how individual and national cultures impact knowledge sharing by considering individual cultural characteristics as antecedents of knowledge-sharing motivations and studying the national cultural differences. The chapter makes several significant findings for multinational companies to develop best practices to facilitate knowledge sharing. For instance, the chapter identifies that power distance and uncertainty avoidance are significantly related to reciprocal benefits in the U.S. but not in China. In addition, individualism (collectivism) relates to organizational rewards and images only in the U.S., but reciprocal benefits only in China.

Recent years have seen the accelerated pace of the development in mobile banking due to the increasing number of smartphone users. In response to this trend, banks have started to strengthen their mobile banking services as a new focus on competitive advantages. Due to a variety of reasons, many customers are still reluctant to use mobile banking services. Therefore, there is an urgent need for banks to understand the influential factors that inhibit them from using mobile banking. Against this backdrop, the chapter entitled "A Comparative Study of Mobile Banking Adoption: An Analysis of Banking Customers in the U.S. and Thailand" explores consumers' perceptions of mobile banking in both the U.S. and Thailand and identifies important factors affecting mobile banking adoption by people in these two countries. The factors identified by this chapter provides practical guidance for global companies to better design mobile services to satisfy customers' needs when developing and deploying mobile banking services.

In an online marketplace, trust is a fundamental element to facilitate the transactions between buyers and sellers who often have never met before. The chapter entitled

"Predicting Consumer Trust in an Intermediary in B2C Online Marketplaces: Insights From the Korean Experience" presents a consumer trust model to assess the trust of first-time buyers in a Korean online marketplace. Analyzing data collected from 208 respondents, the chapter investigates some specific organizational factors of trustworthiness that help predict the overall trust in an online intermediary. For instance, it was found that integrity has the most significant association with the overall trust in an intermediary. An online marketplace typically has its unique level of trustworthiness beliefs, which serve as the predictor of its overall trust.

The continuously advanced technologies and social demands have challenged healthcare organizations to update their management policies and strategies to increase their awareness of corporate social responsibility (CSR). Using a mixed qualitative-quantitative research approach, the chapter entitled "Communicating Corporate Social Responsibility in Healthcare Through Digital and Traditional Tools: A Two-Country Analysis" explores the CSR communication in a healthcare setting regarding the use of both traditional and interactive technologies in both Malta and India. This chapter finds that healthcare organizations in both countries have been enhancing their CSR awareness and suggests different strategies based on both digital and traditional tools to effectively communicate CSR initiatives in healthcare organizations.

The ubiquity of the Internet has made it easier to transfer values and beliefs between western and eastern cultures. The recent development in Web 2.0 technologies such as social media, blogs, wikis, and online forums have enabled individuals from different cultural backgrounds to communicate and exchange the beliefs from their value systems. Studying the impact of western individualistic culture, the chapter entitled "The Impact of The Internet on Change in Consumer Values in India: Internet and Values" summarizes the changes in values in India between 2004 and 2014 due to the influence of the Internet. The traditional collective values such as Universalism among the youths in India have been increasingly replaced by western individualistic values such as power and achievement. The findings from this chapter provide valuable implications for businesses as customers' preferences are typically aligned with their values.

The increasingly globalized business environment requires companies to constantly seek innovative solutions to manage their information and communication systems in supply chains. Supply Chain Management Information System (SCMIS) plays an important role in the whole process of supply chain management by reducing the costs and enhancing the responsiveness of supply chains. Prior research shows that it is a major challenge to successfully implement SCMIS and achieve expected returns as many implementations suffer from a high failure rate. Therefore, more research is needed to identify the risk factors that may lead to failures in implementing SCMIS and the ways to mitigate such risks. The chapter entitled

"Fading Challenges in Implementation of Supply Chain Management Information System in Indian Automobile Industry" studies the implementation of a SCMIS in the Indian automobile industry with respect to the challenges and success factors. The chapter makes valuable suggestions to help managers develop appropriate practices to overcome the challenges and better utilize the resources during the process of SCMIS implementation.

The advancement of technologies provides opportunities for cities to modernize their facilities to sustain their developments. In India, the government has launched initiatives to create 100 smart cities in different regions where 5G network systems will be introduced to deploy the underlying network infrastructure. However, such development opportunities also bring new concerns about the privacy and security issues involved in the network systems. Considering the needs of the smart cities in India, the chapter entitled "Critical Success Factors to Create 5G Networks in Smart Cities of India: From Security and Privacy Perspectives" proposes a framework to identify the critical success to improve the security and privacy levels in the network systems. The chapter applies different standardized methods to detect the relationship among the critical success factors so as to mitigate privacy and security vulnerabilities.

Dynamic modularity, one of the fundamental characteristics of the human brain, serves as the fundamental principle of the cooperative divide-and-conquer approach used in problem-solving. From the perspective of "an expert with other capabilities", the chapter entitled "A Novel Cooperative Divide-and-Conquer Neural Networks Algorithm" develops a new subnet training method for modular neural networks. The method proposed is based on the assumption that a subnet learns the data sets from its neighbor while completing its main task. The chapter also suggests replacing the classical absolute distance measure with a relative distance measure. Conducting both methodological and empirical studies, the chapter designs two types of experiments to solve both approximation and prediction problems in nonlinear dynamic systems.

For real-time Internet-of-Things (IoT) applications in Modern-Secure-Wireless Sensor Networks (MS-WSN), it is challenging to design energy saving routing protocols. Existing hierarchical protocols for WSN lack scalability in large-scale global IoT applications. For instance, Low Energy Adaptive Two-level-CH Clustering Hierarchy (LEATCH) reduces the energy-consumption but is not suitable for scalable and dynamic routing. Energy Efficiency and Event Clustering Adaptive Routing Protocol (EEECARP) relays information with intermediates nodes but cannot address issues such as magnitude ecological conditions and energy waste. The chapter entitled "An Experimental Analysis of Modified EEECARP an Optimized Cluster-Based Adaptive Routing Protocol for Modern-Secure-Wireless Sensor Networks" develops the modified EEECARP to address the above issues to improve the lifetime of MS-

WSNs with better dynamic event clustering adaptive routing. The chapter conducts experiments to demonstrate the better performance of the proposed protocol than that for EEECARP and LEATCH.

Zuopeng (Justin) Zhang
University of North Florida, USA

Acknowledgment

On behalf of all the contributors of this book, I am delighted to share this sampling of the latest research on novel theories and applications of global information resource management with our readers and hope that this book will serve our readers as an avenue to gain a perspective on the recent challenges and development of global information recourse management research. Especially, I would like to thank the Director of Intellectual Property and Contracts, Ms. Jan Travers, and Assistant Development Editor, Ms. Maria Rohde, for their encouragement and guidance throughout this endeavor. I am also deeply grateful to all the contributors who diligently worked with us. Without their time and efforts, this book would never have come to be.

Zuopeng (Justin) Zhang
University of North Florida, USA

Chapter 1
Are Risks in IT Global and Local Projects the Same?
Systematic Literature Review of the Last 20 Years

Rosaria de F. S. M. Russo
https://orcid.org/0000-0002-3579-4168
Universidade Nove de Julho, Brazil

Franciane F. Silveira
https://orcid.org/0000-0002-8015-8144
Federal University of ABC, Brazil

ABSTRACT

The aim of this chapter is to identifier the differentiation of risk between global and local projects through exploratory research carried out using a systematic literature review. One thousand seven hundred twenty-five risks were identified in 46 articles published in the last 20 years and classified within 22 categories. The major concern regarded in local project management was the client (external risk) and scope (internal risk) and, in global project management, the psychic distance (external) and coordination and control (internal). The main difference between the risk categories for each project type refers to the psychic distance category, which was identified almost exclusively in global projects, thus making the external risks more relevant than those in local projects. On the other hand, it allows some risks, such as supplier and stakeholder, to be underestimated. The results indicate that project managers should focus on different risks depending on the type of IT project: global or local.

DOI: 10.4018/978-1-7998-1786-4.ch001

INTRODUCTION

The complexity of IT projects has increased as technologies evolve, end users demand greater ease of use and flexibility and their development is carried out globally. There are many differences between the attributes in local and global IT projects. While local projects involve a single or a limited number of organizations, global projects have multiple organizations and departments involved, each with their different interests and cultures. While legislation is known and well understood in local projects, in global projects the comprehension is difficult and needs interpretation (Lientz & Rea, 2003). Regardless of being local or global, projects are impacted by numerous uncertainty and risk events during execution, producing a high level of failure among organizations (Sauser, Reilly, & Shenhar, 2009). The Risk Management [RM] is the knowledge area within project management [PM] that regularly handles risk. Risk Management provides a dynamic way of decision making, prioritizing and classifying risks (Pasha, Qaiser & Pasha, 2018), therefore it is considered a key process to achieve high performance in IT projects (Kutsch, Denyer, Hall & Lee-Kelley, 2013; Odzaly; Greer & Stewart, 2018).

Many studies focus on the risks management in local IT projects regarding information systems Shokouhyar, Panahifar, Karimisefat, & Nezafatbakhsh, 2018), software (Jiang & Klein, 2000), Enterprise Resource Planning [ERP] (Sumner, 2000) and Outsourcing (Bunker, Hardy, Babar & Stevens, 2015). Other articles focus on the risks of global IT projects related to ERP (Aloini, Dulmin, & Mininno, 2012), outsourcing (Kliem, 2004) and software (Perrson, Mathiassen, Boeg, Madsen, Steinson, 2009; Verner, Brereton, Kitchenham, Turner & Niazi, 2013). However, few studies look into the difference between the risks in both of them. The exception was the study by Ghafoor, Shah, and Rashid (2017) which analyzed risks in adopting agile methodologies in both, global and local, software projects; Nakatsu and Iacovou (2009), who, nevertheless, focus on the main risk factors in outsourcing projects; and Shehzad, Awan, Lalu, and Aslam (2017) who identified patterns of failure in software projects, which is risk to future ones.

Therefore, this chapter has the aim of identifying the differentiation of risk between global and local projects, which will be highlighted through a Systematic Literature Review [SLR] method, based in Petticrew and Roberts (2008), published between 2000 and 2019. The methodological procedures are described in the appendix. This is an evidence-based approach (Tranfield, Denyes & Smart, 2003). Identify risks and risk categories involved in IT projects, as well as their specificities related to the type of projects (global or local) can help organizations review their management strategies and practices, as well as facilitating successful scaling and, in the case of global projects, improving relations between geographically distributed organizations (Shameem, Kumst, Kumst, Chandra, & Kan, 2018).

BACKGROUND

IT projects are classified into system and infrastructure development projects. In the former, delivery is a computational system. In the latest, on the other hand, deliveries are related to servers, communications, and other several possibilities, thus having specific risks for each type (Sommerville, 2015). In this chapter, systems will be the focus. It is common to use offshore teams in this type of project (Kliem, 2004), constituting what is known as a global project, which uses distributed teams (Ebert, 2011). Specifically, software projects have been called distributed software development.

Global projects are those that involve individuals, teams, groups and organizations from multiple locations (Lientz & Rea, 2003), cultures and business units and functions (Anantatmula & Thomas, 2010). There are unique challenges in this new context, such as language and communication barriers, cultural differences, distributed teams, and different government regulations from one country to another. The trend of involving different countries in such projects is due to the use of each country's competitive advantages, which can be explained specifically by two factors: the marketing factor, in which there is the need for access to markets and use of distribution channels, responding to local needs and increasing client intimacy, and the technology factor, related to the recruitment of qualified personnel, access to foreign talents, the existence of lower wages and differentiated technologies (Chiesa, 1995).

Specifically, global IT development projects promise improvements in the time to market, round-the-clock development, client proximity and access to cheaper skilled labor (Carmel, 1999; Holmstrom, Conchúir, Ågerfalk & Fitzgerald, 2006) and thus to gain and maintain competitive advantage (Kommeren & Paiviainen, 2007). However, in addition to bringing benefits to the projects, this new reality introduces new challenges to their management due to the distance aspects known as geographical distance, temporal distance (time zone difference), and socio-cultural distance. These characteristics are usually termed as ''global distance'' (Noll, Beecham, & Richardson, 2010). All these challenges must be dealt with through RM. They are another aspect that becomes predominant within the overall project scope and, if ignored, can increase the likelihood of project failure (Jalali & Wohlin, 2010). It can be seen as a combination of the probability of occurrence and alternate impacts, including perceived importance for the stakeholders (Treasury, 2004). Thus, it involves uncertainty and it is an opportunity, if positive, or a threat, if negative (Project Management Institute - PMI, 2017) and *specific unknown risks cannot be managed proactively, which suggests that project teams should create a contingency plan* (PMI, 2009). Although RM is a continuous process, Russo, Sbragia and Yu (2017) state that it occurs mainly in the initial phase of the project,

emphasizing the importance of identification of the early signs of environmental change during the project.

IT risks are related to systems development, support infrastructure, peopleware and information security (Sommerville, 2015). Many risk factors come from outside the project, the company and its environment, so the project manager should promote favorable effective communication and collaboration between all stakeholders, a particularly important condition for the early detection of risk and its management (Thamhain, 2013). The user is one of the most important stakeholders because they are the primary source of requirements for the system (Schmidt, Lyytinen, Keil, & Cule, 2001). Risks events can serve as input information for knowledge management in projects (Alhawari, Karadsheh, Talet, & Mansour, 2012) to organizational learning. Prikladnicki and Yamaguti (2004) affirm that RM must not only be adapted to the configuration of global software development projects, as it also becomes more important in this context than in the context of local projects.

DIFFERENCE BETWEEN GLOBAL AND LOCAL RISKS

Which Literature Shows Risks?

Table 1 features 46 selected papers, 17 about global projects, 26 articles related to local projects and 3 articles covering the two types of projects. Among the selected references, 2 articles evaluated ERP projects, 4 articles evaluated Information System projects, 6 evaluated Outsourcing and the majority referred to Software development. The vast majority applied qualitative procedures to deal with research about risks, which shows deep analyzes, and the quantitative ones mainly tried to identify the most relevant risks to the context.

The researched papers bring us different points of view regarding the risks, as clients (Nakatsu & Iacovou, 2009), managers (Dwivedi et al., 2015), project managers (Smite, 2006), service providers (Ahmed, Capretz, Sandhu, & Raza, 2014), experts and practitioners (Shrivastava & Rathod, 2015); team members (Hwang, Hsiao, & Chern, 2016). Few articles explore more than one point of view: senior executives and project managers (Liu, Zhang, Keil, & Chen, 2010), client and vendor (Bunker et al., 2015) and managers and software developers (Neves, da Silva, Salomon, da Silva, & Sotomonte 2014).

From this overview it is noted that distributed software development projects have become the most published topic in recent literature on IT project risks. Another recurring theme in recent years is agile project management that focuses on teamwork, the importance of individuals and their interactions throughout the life cycle, early product delivery, customer collaboration, and changing response

Table 1. References selected in the Systematic Literature Review

Id	Reference	Project Type	It Project	Research Type
1	Ahmed et al., 2014	Global	Outsourcing	Mixed
2	Aloini et al., 2012	Global	ERP	Qualitative
3	Aslam et al., 2017	Global	Software	Mixed
4	Aslam, Ijaz et al., 2017	Global	Software	Qualitative
5	Aundhe & Mathew, 2009	Global	Outsourcing	Qualitative
6	Baccarini et al., 2004	Local	Software	Quantitative
7	Brookfield et al., 2014	Local	Software	Quantitative
8	Bunker et al., 2015	Local	Outsourcing	Qualitative
9	Dwivedi et al., 2015	Local	Information Systems	Qualitative
10	Ebert et al., 2008	Global	Software	Qualitative
11	Elzamly et al., 2016	Local	Software	Quantitative
12	Ghafoor et al., 2017	Both	Software	SRL
13	Gheni et al., 2016	Global	Software	Mixed
14	Ghobadi & Mathiasse, 2017	Local	Software	Mixed
15	Han, 2014	Local	Software	Quantitative
16	Hijazi et al, 2014	Local	Software	Qualitative
17	Hwang et al., 2016	Local	Information Systems	Qualitative
18	Jiang & Klein. 2000	Local	Software	Quantitative
19	Kliem, 2004	Global	Outsourcing	N/A
20	Lee & Baby, 2013	Global	Software	Qualitative
21	Liu & Wang, 2014	Local	Outsourcing	Quantitative
22	Liu et al., 2010	Local	Software	Qualitative
23	López & Salmeron, 2012	Local	Software	Qualitative
24	Lu et al., 2013	Local	Software	Qualitative
25	Nakatsu & Iacovou, 2009	Both	Outsourcing	Qualitative
26	Neves et al., 2014	Local	Software	Qualitative
27	Nicolás et al., 2018	Global	Software	RSL - Quantitative
28	Nurdiani et al., 2011	Global	Software	RSL - Quantitative
29	Pasha et al., 2018	Local	Software	Qualitative
30	Perrson et al., 2009	Global	Software	Qualitative
31	Rodriguez et al., 2016	Local	Software	Qualitative
32	Samantra et al., 2016	Local	Software	Quantitative
33	Sarigiannidis & Chatzoglou, 2014	Local	Software	Quantitative
34	Schmidt et al., 2001	Global	Software	Quantitative
35	Shameem et al., 2017	Global	Software	Mixed
36	Sharma et al., 2011	Local	Software	Mixed

continued on following page

Table 1. Continued

Id	Reference	Project Type	It Project	Research Type
37	Shehzad et al, 2017	Both	Software	RSL
38	Shokouhyar et al, 2018	Local	Information Systems	Quantitative
39	Shrivastava & Rathod, 2015	Global	Software	Qualitative
40	Smite, 2006	Global	Software	Quantitative
41	Sonchan & Ramingwong, 2014	Local	Software	Qualitative
42	Sumner, 2000	Local	ERP	Qualitative
43	Verner et al, 2014	Global	Software	RSL
44	Vrhovec et al., 2015	Local	Software	Qualitative
45	Wallace & Keil, 2004	Local	Software	Quantitative
46	Ziemba & Kolasa, 2015	Local	Information Systems	Qualitative

Source: Authors

requirements (Aslam et al., 2017; Ghafoor et al., 2017; Shameem et al., 2018; Nicolás, de Gea, Nicolás, Fernández-Alemán, Toval, 2018).

Which Differences Are There Between Risk Categories?

To discuss this differences, in the next topics it will be explained each risk category by type of project. The complete risk category table by author is extensive, so the reader can access it at the link http://gg.gg/erlus.

External Risks

Table 2 summarizes the external risk items identified from 46 references, classifying them according to different categories, project type, and references. Moreover, it is noteworthy that most external risks were cited in articles about global projects.

The global and local projects showed a relative concern with the **client** category of risks, which include user also. Client commitment with project is the most common risk (Shameem et al., 2017). In local projects, the main types of risks found were related to the failures in managing client expectations and lack of commitment, support, and participation of users, as Jiang and Klein (2000) discussed in detail. In addition to the fact that these same risks have been found in global projects, risks related to the difficulty in managing conflicts of major clients, changes in the structure (like mergers and acquisitions), CEO/top management change, and processes specific to bigger clients have also been noted.

The **psychic distance** is the difference between the home country and the foreign country. The greater difference between the countries, the greater the level of uncertainty involved in the business (Carlson, 1975). Even in local projects, some

Table 2. External risks by categories and by reference

Risk Category	Local			Global			Total	
	Quantity	%	Id Authors	Quantity	%	Id Authors	Quantity	%
Client	95	8%	7, 8, 9, 11, 12, 14, 15, 16, 17, 18, 21, 22, 23, 25, 26, 29, 31, 33, 36, 37, 41, 42, 44, 45, 46	32	5%	2, 3, 5, 12, 25, 27, 34, 35, 39	127	7%
Psychic Distance	7	1%	8, 9, 14	117	19%	3, 4, 10, 12, 13, 19, 20, 25, 27, 28, 30, 35, 37, 39, 40, 43	124	7%
Economic	12	1%	6, 11, 15, 22, 29	14	2%	1, 5, 10, 19, 28, 37	26	2%
Supplier	22	2%	6, 8, 9, 11, 15, 22, 45	24	4%	1, 2, 3, 10, 25, 27, 34, 35, 37, 39, 43	46	3%
Environment	5	0%	8, 38	3	0%	20, 37	8	0%
Political	1	0%	9	8	1%	1, 5, 19, 25, 37, 43	9	1%
Regulatory	5	0%	8, 11, 15, 33, 41	12	2%	1, 5, 10, 19, 20, 28, 37, 43	17	1%
Stakeholder	16	1%	6, 8, 22, 29, 36, 37, 44	14	2%	3, 20, 27, 28, 30, 34, 37, 39, 43	30	2%
Technological	6	1%	7, 8, 9	0	0%		6	0%
Total	**169**	**15%**		**224**	**37%**		**393**	**23%**
General Total	**1118**	**100%**		**607**	**100%**		**1725**	**100%**

Source: Authors

Note: The authors of each reference are detailed in Table 1

authors (Bunker et al, 2015, Dwivedi et al., 2015; Ghobadi & Mathiasse, 2017) highlighted the risks when the project involves different organizations in a team. Nurdiani, Jabangwe, Smite and Damian (2011) extensively explored this kind of risk in global projects in three dimensions: temporal, as time-zone differences; geographical, which limits face-to-face meetings; and socio-cultural, which includes language, values and work process. These risks can result in a decrease in communication frequency, access, and richness. Difficulty in creating mutual trust and cohesion between team members due to physical distance was also reported. It was expected that this risk category would be significantly different between global and local projects, as Table 2 shows. This category is very significant and represents 32% of the external risks of global projects.

Few risks were related to the **economic** category, which shows low concern from local and global projects with this kind of risk. These risks are related to currency fluctuation, macroeconomic instability (such as inflation), high exchange rate and competitors' actions, which were the main factors reported. Apart from these risks, Ahmed et al. (2014) cited new competitors that may affect both the organization and offshore outsourcing projects. The major importance given by researchers of global

projects can be explained by the novelty of the context that this type of project will be faced with, and the likely consequent lack of knowledge of the new market and competitors (Pasha et al., 2018).

The risks covered by the **supplier** category are related to the performance and behavior of suppliers, which can hardly be anticipated or controlled. Despite the slight difference in the number of risks in global and local projects, it can be considered significant. Articles from both projects mention risks relating to non-compliance with deliveries agreed upon, lack of cooperation and integration between suppliers or between them and the client, infrastructure incompatible with the requirements, opportunistic or unethical behaviors and hidden costs. Bunker et al. (2015) highlight the hazard of reputational damage caused because of this category of risks.

Risk events related to the **environment** category are linked to the requirements or restrictions imposed by nature. Only eight risks were mentioned and they were related to the lack of disaster recovery practices, both for the project and the business, as Bunker et al. (2015) mentioned. This indicates that there is little concern about risks related to the environment for both project types.

Another type little cited is **political** risks for which global projects are more concerned. Political risks are about hostile societies (such as terrorism, insurrection, riots, revolutions and civil wars) and interstate (such as economic sanctions and wars) than risks related to a government, expropriation, confiscation, restrictions, and taxation. The risks cited in researched articles were: the tension between countries, war, disorder, terrorism, corruption, protectionist laws, and political instability of the destination countries, as Ahmed et al., (2014) mentioned.

The **regulatory** risk category is reported mainly in articles about global projects. Issues related to lack of knowledge or understanding of the law, differentiation of agreements, protection of patents and intellectual property, including concerns about private property.

The **stakeholder** category includes generic risks to any external stakeholder of the project and those that could not be classified into the supplier or client/user categories. Internal organization stakeholders (sponsor, representatives of other departments) were classified in the organizational environment category. The risks cited in global and local projects related to excessive external dependence, lack of commitment and trust, and failure to identify all stakeholders. In local projects, the concern was focused on conflicts between users and developers and withholding of information.

Obsolescence and emergence of new technologies risks may arise due both to the opportunity to find a more suitable technology and to the increased cost to find new **technological** options. Bunker et al. (2015) classified them in strategy risks, which included ROI and reputational damage risks, while Brookfield, Fischbacher-Smith, Mohd-Rahim, and Boussabaine (2014) considered the appropriateness of

choice of technology and its impacts as cost. It is surprising that only articles about local projects cited this kind of risk. The cited authors considered more relevant the risk to deal with technology internally than the change in the technology itself.

Regarding the **social** category that encompasses risks include actions that affect the communities around them, labor issues, human rights violations within the workforce, and corruption. This allows us to infer that project management is still far from addressing more structural and deeper issues of the external environment.

Internal Risks

The internal risks are presented in Table 3 and it has been observed that internal risks were mentioned more in articles about local projects than to global projects.

Among the internal risks of the organization, the **organizational environment** category stands out. This category was cited by 26 authors, who focused on local projects, such as Lu et al. (2013), who identified that this subtype is more influential to experts from a medium-scale technology enterprise and a software development company. The risks cited are very similar in both projects. This category can be subdivided into 2 subtypes: issues related to **culture and organizational processes** and those related to **internal stakeholder**. As for the first subtype, the following were cited: the distinction of business tradition among organizations, the lack of project value for the business, change conditions and organizational structure. As for the stakeholder, the instability of the organizational environment arising from the change of sponsors and the opposition to the IT department were both cited. The same subdivision can be applied to risks in local projects. Regarding the organizational processes and culture, the following were cited: the changing environment, including its priorities and instability, lack of experience of the organization with the project type, lack of organizational structure to support the project, projects generated for political reasons, lack of maturity. Concerning stakeholder, certain conflicts between departments were cited, such as lack of support and commitment of sponsors. The lack of executive (sponsor) involvement and support were unanimous among authors.

While the supplier category contains risks that do not depend on the performing organization, the **acquisition** category contains risks that can be managed by the project team. Bunker et al. (2015) identified 27 risks in local projects, which involve contracts, as risks arising from the choice of agreement, choice of consultants and outsourcing, a false sense of risks being mitigated or transferred. The risks related to global projects present more details on these risks, as pointed Verner et al. (2014), including the most suitable type of agreement, the inclusion of specific clauses, such as one relating to intellectual property and confidential information, including the lack of learning and control. Therefore, a greater concern has been noted on risks in global projects regarding the acquisition process and the performance of suppliers.

Table 3. Internal risks by category

Risk Category	Local			Global			Total	
	Quantity	%	Id Authors	Quantity	%	Id Authors	Quantity	%
Organizational Environment	115	10%	6, 7, 8, 9, 11, 12, 14, 15, 17, 21, 22, 23, 24, 25, 26, 29, 31, 32, 33, 36, 37, 41, 42, 44, 45, 46	33	5%	1, 2, 3, 12, 19, 20, 25, 34, 37, 39, 40, 43	148	9%
Acquisition	34	3%	6, 8, 11, 22, 29, 33, 37	26	4%	5, 10, 25, 37, 43	60	3%
Complexity	45	4%	7, 9, 14, 17, 18, 21, 22, 23, 24, 25, 31, 32, 33, 41, 42, 45, 46	10	2%	2, 3, 13, 19, 34, 35, 43	55	3%
Communication	23	2%	7, 8, 11, 12, 14, 16, 17, 21, 22, 23, 29, 33, 37, 41, 45, 46	28	5%	2, 3, 12, 19, 35, 37, 39, 43	51	3%
Coordination and Control	139	12%	6, 7, 8, 9, 11, 12, 14, 15, 16, 17, 18, 21, 22, 23, 24, 25, 26, 29, 31, 32, 33, 36, 37, 38, 41, 42, 44, 45, 46	65	11%	2, 3, 4, 10, 12, 19, 20, 27, 30, 34, 35, 37, 39, 40, 43	204	12%
Cost	18	2%	8, 16, 25, 32, 36, 37, 41, 45	11	2%	2, 19, 25, 27, 34, 35, 37, 39	29	2%
Scope	154	14%	6, 7, 8, 9, 11, 12, 15, 16, 17, 18, 21, 22, 23, 24, 25, 26, 29, 31, 32, 33, 36, 37, 41, 42, 45, 46	28	5%	2, 3, 12, 19, 27, 28, 34, 35, 37, 39, 43	182	11%
Human Resource Management	111	10%	6, 7, 8, 9, 11, 12, 14, 15, 16, 17, 18, 22, 23, 24, 25, 26, 29, 32, 33, 36, 37, 38, 41, 42, 45, 46	54	9%	2, 4, 10, 13, 19, 20, 27, 28, 30, 34, 35, 37, 39, 40, 43	165	10%
Personal	78	7%	6, 7, 8, 9, 11, 12, 14, 17, 21, 22, 23, 24, 29, 31, 32, 33, 36, 37, 41, 42, 45, 46	42	7%	3, 10, 12, 19, 27, 28, 30, 34, 35, 37, 39, 40, 43	120	7%
Product Process	115	10%	7, 8, 9, 11, 12, 15, 16, 21, 22, 23, 29, 31, 32, 36, 37, 41, 46	35	6%	3, 4, 12, 19, 27, 34, 35, 39, 43	150	9%
Quality	44	4%	7, 8, 9, 12, 23, 29, 32, 33, 36, 37, 41	6	1%	3, 37, 39, 43	50	3%
Technology	51	5%	6, 7, 8, 9, 11, 14, 15, 17, 18, 21, 22, 23, 24, 29, 36, 37, 38, 41, 42, 45, 46	40	7%	2, 3, 12, 13, 19, 20, 25, 27, 28, 30, 34, 35, 39, 40, 43	91	5%
Time	22	2%	7, 8, 15, 16, 22, 23, 26, 32, 36, 37, 41, 45, 46	5	1%	30, 34, 37, 43	27	2%
Total	**949**	**85%**		**383**	**63%**		**1332**	**77%**
General Total	**1118**	**100%**		**607**	**100%**		**1725**	**100%**

Source: Authors

Note: Id authors correspond to Table 1

It is important to remark the concern conveyed by Nakatsu and Iacovou (2009) on this category only in global projects when they analyzed the two kinds of projects.

Only a few risks were cited in the **complexity** category for global projects, however, this category was relatively well cited in the local projects category. While the risks in global projects were more focused on the complexity that results from the interaction with several organizations that impacted project control and communication, local projects focused instead on project size, large number of departments or units involved, on the great number of technological interfaces with other systems, on the number of features to be developed and on the technological level required. One could say that these risks relate more to complicated projects than to complex projects because complexity arises from the interplay of variables. However, some authors (Liu & Wang, 2014; Wallace, Kell, & Rai, 2004) suggested reducing or managing the complexity because it may amplify a risk's impact.

The **communication** category presented more risks caused by misunderstandings due to the absence and/or poor communication between project teams. As expected, the risks reported related more to global projects. This is since communication in dispersed teams always generates a challenge to global projects. However, the low percentage in local projects was surprising. In these projects, the poor and inefficient communication with project stakeholders stood out, while in global projects, the lack of synchronous communication and lack of properly designed communication planning were the ones with the most detail. Therefore, preventing communication from being minimized between geographically dispersed teams is one of the main challenges of the project, especially when it comes to distributed projects (Aslam et al., 2017; Perrson et al., 2009; Smite, 2006).

The authors have highlighted both in local and in global projects the **coordination and control** category. The leader's role is also emphasized in this category. The vast majority of risks listed in this category refer to problems in or lack of project managing methodologies, lack of maturity in Project Management, lack of application of management, including RM, and lack of planning, coordination, and control. In global projects, strategic thinking and planning were mentioned, as well as problems caused by asymmetry in processes, policies, and standards. Besides, some authors mentioned creating, capturing and sharing knowledge (Lee & Baby, 2013; Perrson et al., 2009).

Only eight authors cited the **cost** category generally linked to local projects. Such risks focus on measurement, inadequate budget and cost management. In turn, the risks of global projects are more detailed, such as the risks for the early definition of costs without a detailed definition of the project, assessment of costs of passing from transition to operation, failure to use appropriate tools to calculate the cost,

and lack of reserves. It can be said that they relate to the accuracy of project cost estimates. This category and the time category had the lowest percentage among all internal risk categories.

The **scope** category was the second most mentioned and is mainly linked to poorly designed requirements or omissions, including business requirements, failure to meet expected results, mismanaged change requests, lack of freezing changes, erroneous development of features, gold plating (including unsolicited features). Although there is a great difference in the number of risks cited between the two project types, the risks cited for global projects are also classified as specifically formulated for local projects. Nicolás et al. (2018) focus on requirements issues on global projects and Neves et al. (2014) concluded that unclear or misinterpreted scope and objectives are the main risk factor for local projects in incubated technology-based firms.

The **staff management** category is mainly related to problems with the distribution of roles and responsibilities among team members. This was the third most mentioned category. It refers to problems in the distribution of resources, to the lack of qualified personnel, lack of training, turnover, improper distribution of roles and responsibilities, conflict management, negative attitudes by the development team, and different levels of knowledge among team members. Jiang and Klein (2000) detailed many kinds of lack of expertise of team members and lack of clarity in role definitions. The distinction in global project risks is the difficulties in coordination of multisite development (Verner et. al., 2014) and delegation (Klein, 2004). Few studies focus on virtual teams (Gheni, Yusmadi, Marzanah, & Norhayati, 2016) and distributed teams (Nurdiani et al., 2011; Smite, 2006).

Risks relating to personal characteristics of the project team, project manager and members, were grouped in the **staff** category. It was not as listed as the staff management category. It was well balanced between the authors and between global and local project types. The most frequently reported risks of that category were: lack of expertise, experience, skill, and competence; behavioral attitudes such as lack of commitment, trust, and collaboration; diversity of styles. Focusing on local projects, Baccarini, Salm and Love (2004) identified this risk category as the most present based on interviews with 18 IT managers.

The category **product process** covers all risks related to the specific project product development. The risks referred to errors in the development strategy and product configuration, flaws in software development processes (architecture, analysis, design, coding, and integration). Some authors (Hijazi, Alqrainy, Muaidi, & KhdourIdentifyin, 2014; Elzamly, Hussin, Saleh, 2016) analyzed in detail the risks of each phase of the life cycle of a software project, which can explain the high number of risks in this category.

The risks of the **quality** category refer mainly to the low quality of tests conducted, as well as their lack of planning. It is perceived that there was little concern for

quality in local projects and even less in global projects. The high number of risks generated by Bunker et al. (2015) in this category refers to the risks that may arise regarding the Service Level Agreement [SLA].

The risks related to **technology** in both types of projects referred mainly to the tools, infrastructure and technologies required to develop the product of the project and transition it into operations. The differentiated risks of global projects were related to the infrastructure of communication and security, cited by Kliem (2004), Nakatsu and Iacovou, (2009), Verner et al. (2014), Shrivastava and Rathod (2015), and Smite (2006).

The most prominent risks in the **time** category concerned the estimates of unrealistic deadlines. Moreover, it is noticed that the local projects are more concerned about this kind of risks. Herbsleb and Mockus (2003) concluded that global projects take, on average, more than twice the time required for a local project of equal content.

Are These Differences Significant?

In Table 4, it is presented the quantity and percentage of risks by category and type of project. The chi-square statistical test was significant ($p < 0.0001$) (Siege & Castelan, 2006), accepting that there are differences in the treatment of risks between global and local projects.

SOLUTIONS AND RECOMMENDATIONS

By differentiating global projects from local, it is possible to highlight the deeper concern about external risks in global projects when compared to local projects, which give significance statistical to this difference. Such risks are hardly controlled directly by the organization; nevertheless, they should be identified and monitored by the company. As Russo et al. (2017) state, at least managers and the team must be aware of changes in the environment to proactively manage the situation.

Naturally, psychic distance has a strong presence in global projects, as it encompasses the differences between the home country and the foreign country. Of the seven specific risk events of global projects identified by Nakatsu and Iacovou (2009), five also fall into this category: the language barrier in communication, cultural differences between nations, restrictions due to different time zones, lack of familiarity with the agreements and laws of the destination country, as well as its political instability. Therefore, it can be mentioned that many risks related to the supplier, client, and stakeholder in global projects were included in the psychic distance, for instance, the language barrier will not only impact the team elements but also suppliers, clients, users, interpretation of the law, etc.

Table 4. External risks by category

Risk Category	Local		Global		Total		Level of Significance
	Quantity	%	Quantity	%	Quantity	%	
External Risks	**169**	**15%**	**224**	**37%**	**393**	**23%**	
Client	95	8%	32	5%	127	7%	0.02*
Psychic Distance	7	1%	117	19%	124	7%	0.00***
Economic	12	1%	14	2%	26	2%	0.05*
Supplier	22	2%	24	4%	46	3%	0.02*
Environment	5	0%	3	0%	8	0%	0.89
Political	1	0%	8	1%	9	1%	0.00**
Regulatory	5	0%	12	2%	17	1%	0.00**
Stakeholder	16	1%	14	2%	30	2%	0.19
Technological	6	1%	0	0%	6	0%	
Internal Risks	**949**	**85%**	**383**	**63%**	**1332**	**77%**	**0.00**
Organizational Environment	115	10%	33	5%	148	9%	0.00**
Acquisition	34	3%	26	4%	60	3%	0.19
Complexity	45	4%	10	2%	55	3%	0.01**
Communication	23	2%	28	5%	51	3%	0.00
Coordination And Control	139	12%	65	11%	204	12%	0.32
Cost	18	2%	11	2%	29	2%	0.76
Scope	154	14%	28	5%	182	11%	0.00***
Staff Management	111	10%	54	9%	165	10%	0.51
Staff	78	7%	42	7%	120	7%	0.97
Product Process	115	10%	35	6%	150	9%	0.00**
Quality	44	4%	6	1%	50	3%	0.00**
Technology	51	5%	40	7%	91	5%	0.08
Time	22	2%	5	1%	27	2%	0.07
Total	**1118**	**100%**	**607**	**100%**	**1725**	**100%**	0.00**

Source: Authors
Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.0001$

The more presence of economic, political and regulatory categories in global projects also demonstrates concern about the instability of governments and regulations that underpin the competitive advantages of such projects. As highlighted by Chiesa (2000), obtaining economies of scale and protection of technological rights are relevant criteria for achieving the purposes of global projects.

Also noteworthy is the lack of concern with external risks in the social and environment categories for both types of projects. Note, however, that global projects also add complexity to internal management processes, such as processes related to communication, which have their frequency and efficiency diminished, to technology, which is not always compatible with the technology of the foreign units, to the time for project development, which can be two and a half times longer than the time of a local project (Herbsleb & Mokus, 2003), among other internal aspects. This concern was in fact verified in this research since the internal risks of the global projects also stood out with a strong occurrence in the researched literature. Thus, the effort to manage such internal risks in global projects must be redoubled in practice by project managers.

The lack of risks in the technological category in global projects and the small number in local projects show that the obsolescence and emergence of new technologies do not concern many practitioners. It is surprising that only articles about local projects cited this kind of risk. The cited authors considered more the risk to deal with technology internally than the change in technology outside.

Concerning internal risks, it was observed that the authors mentioned the coordination and control, the scope, the staff management, and organizational environment categories the most. Regarding global projects, four major risks are noteworthy: coordination and control, staff management, staff and technology. As well as the supplier external category, the acquisition was presented with more details in global projects, mainly because of the need for including specific clauses such as intellectual property. Another consideration is that communication in global projects should be the focus of most attention, through technology and control being used in ensuring proper flow of information, with the restrictions and peculiarities of this type of project. Allen (2007) and Chiesa (1995) argue that communication becomes more difficult and reduced among teams dispersed worldwide. It is known that problems in communication between teams will cause rework, misunderstandings and will even increase project development time. Virtual and distributed teams used in the global project require technology to overcome the distance and support communications (Lee-Kelley & Sankey, 2008; Gheni et al., 2016, Nurdiani et al., 2011), which brings a high level of risks to the project.

It must be clear that a risk list can help identify the occurrence of risks, but as the uncertainties are located precisely in the lack of knowledge, merely listing several factors does not ensure their identification. The team can use such a list to get an insight into some aspects that differentiate the project to be careful about them, as well as obtain more information and perceive early signs of change in the environment, as Russo et al. (2017) suggested. These authors recommend that the entire team, not just the project manager, stay alert for signs of changing environment,

especially early in the project, with discussion to reduce ambiguity and make sense of early signs. Stakeholder management, although little cited by the authors, is a process that can support the issues encountered.

FUTURE RESEARCH DIRECTIONS

Agile methods are increasingly being used in globally distributed teams, this generates an avenue of research possibilities, that some authors have begun to look at (Aslam, Ijaz, Lali, & Mehmood, 2017; Ghobadi & Mathiasse, 2017; Shameem et al., 2018). For example, the inclusion of multidisciplinarity in teams makes dialogue even more subject to misunderstanding when done remotely; the daily meetings with different time zones and other method features may bring other differences in risk handling. In addition, in many organizations risks are handled for each sprint, which can hide non-technical risks.

CONCLUSION

In response to the purpose of this study, which aimed to identify differences in risk categories between global and local IT projects, based on a survey of the relevant theory, the findings will be presented in four points:

1. Categories with more emphasis on global projects: the percentage of risks in global projects in the **external category** shows that, given its greater focus, the **psychic distance** plays a rather important role in these projects. The second most important was **client**, because the difficulty in managing conflicts of major clients, changes in the clients structure and gain their commitment. The **supplier** category, evidently because language and cultural differences, increase management difficulty. It is also noteworthy that the **political, economic** and **regulatory** risk categories were more cited in global projects because such projects must deal with political systems and the specific laws of each country involved. The most conspicuous categories related to internal risks were **coordination and control, staff management, staff, and technology. Communication**, as expected, is focus by various authors. Although there are no percentage-related remarks in other categories, some of them show differences in the type of risk involved within the category. The focus of the complexity category differs by being involved in global projects of various organizations, often large corporations; which also led to minor differences in deepening the risks of the client, stakeholder, coordination and control categories. Besides

these, it is noted that important aspects of the management of external risks such as stakeholders had little relative occurrence in the global projects. Such a lack of concern is probably due to the concern with the risks related to the category of psychic distance.

2. Categories with **greater emphasis on local projects: internal** risks were prevalent. The idea is that these projects also include a greater concern with primordial aspects of management, such as the risks related to the **scope**, **organizational environment**, **complexity**, **product process**, **quality** and **time**.
3. Similarities between the categories of the two types of project: **environmental** and **social** risks have few citations by authors and show the stage of IT Management regarding sustainability issues. **Technological** risks deserve little concern, probably because of the proximity to the technology market of these projects or overconfidence in their criteria to choose the right technology. About external risks, the **stakeholder** category, and to the internal risks, **coordination and control, cost**, **staff management**, **staff**, and **time** have similar levels of citation percentage. They are basic areas in PM and show that managers must observe these risks in the same way, regardless of the kind of project.

Thus, the main theoretical contribution of this chapter was the identification of differences in risk categories between global and local IT projects. Additionally, the following contributions stand out: i) the identification and consolidation of a list of risk categories classified as internal and external risks; ii) the identification of the relevance of these categories in terms of risk occurrences based on the researched literature (1725 risks); iii) the classification of the relevance of the categories according to the type of project (global and local).

The practical contribution indicates that the project managers should focus on different risks depending on the type of IT project, global or local. This study relates to the indication of risk categories that must be stressed in managing global and local projects. The categories presented in the description of the respective risk events can be an initial list of risks becoming the basis for identifying risks in such projects, to get more information or raise awareness of early signs of change in the environment. Moreover, according to the scenario of risks and project needs, the IT project manager can evaluate the skills required for the team, leading it and managing stakeholders to mitigate the most likely risks and those with a higher impact on the objectives of their project. Also, based on the conclusions above, it is possible to observe the importance of interpersonal competence, communication, cultural and political awareness of global project managers, due to the psychic distance generated mainly related to the personal and cultural aspects, showing that deficiencies in that area may compromise project success.

The risk categories defined by this work summarize the perceptions and experiences of various academics, experts and managers, which has updated the theory of RM in IT projects. This article integrates this theory with the organizational internationalization theory, thus identifying important features for global projects, differentiating them from local ones. Its contribution becomes more relevant as, given the literature on internationalization, the specific category of psychic distance could be identified in global projects, as well as its influence on other categories. It should also be remarked that a gap was identified in the RM of both global and local projects, about the environmental and social aspects. These categories (external) are essential to meet the increasing demand of society for socially responsible companies. Problems in these areas may not only impact the image and reputation of the project but also of the entire organization. The heightened focus on external risks to the detriment of internal risks, equally important for the management of global projects was another gap identified by the study, allowing to suggest to practitioners a need for closer attention to the internal aspects of management of global projects.

ACKNOWLEDGMENT

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

REFERENCES

Ahmed, F., Capretz, L. F., Sandhu, M. A., & Raza, A. (2014). Analysis of risks faced by information technology offshore outsourcing service providers. *IET Software*, *8*(6), 279–284. doi:10.1049/iet-sen.2013.0204

Alhawari, S., Karadsheh, L., Talet, A. N., & Mansour, E. (2012). Knowledge-based risk management framework for information technology project. *International Journal of Information Management*, *32*(1), 50–65. doi:10.1016/j.ijinfomgt.2011.07.002

Allen, T. J. (2007). Architecture and communication among product development engineers. *California Management Review*, *49*(2), 23–41. doi:10.2307/41166381

Aloini, D., Dulmin, R., & Mininno, V. (2012). Risk assessment in ERP projects. *Information Systems*, *37*(3), 183–199. doi:10.1016/j.is.2011.10.001

Anantatmula, V., & Thomas, M. (2010). Managing global projects: A structured approach for better performance. *Project Management Journal*, *41*(2), 60–72. doi:10.1002/pmj.20168

Aslam, A., Ahmad, N., Saba, T., Almazyad, A. S., Rehman, A., Anjum, A., & Khan, A. (2017). Decision support system for risk assessment and management strategies in distributed software development. *IEEE Access: Practical Innovations, Open Solutions*, *5*, 20349–20373. doi:10.1109/ACCESS.2017.2757605

Aslam, W., Ijaz, F., Lali, M. I. U., & Mehmood, W. (2017). Risk Aware and Quality Enriched Effort Estimation for Mobile Applications in Distributed Agile Software Development. *Journal of Information Science and Engineering*, *33*(6), 1481–1500. doi:10.6688/JISE.2017.33.6.6

Aundhe, M. D., & Mathew, S. K. (2009). Risks in offshore IT outsourcing: A service provider perspective. *European Management Journal*, *27*(6), 418–428. doi:10.1016/j.emj.2009.01.004

Baccarini, D., Salm, G., & Love, P. E. D. (2004). Management of risks in information technology projects. *Industrial Management & Data Systems*, *104*(4), 286–295. doi:10.1108/02635570410530702

Brookfield, D., Fischbacher-Smith, D., Mohd-Rahim, F., & Boussabaine, H. (2014). Conceptualising and responding to risk in IT projects. *Risk Management*, *16*(3), 195–230. doi:10.1057/rm.2014.10

Bunker, D., Hardy, C., Babar, A., & Stevens, K. (2015). *Exploring practitioner perspectives of sourcing risks: Towards the development of an integrated risk and control framework*. In *Australasian Conference on Information Systems*, Adelaide, South Australia.

Carlson, S. (1975). *How foreign is foreign trade: a problem in international business research*. Uppsala: Uppsala University Press.

Carmel, E. (1999). *Global software teams: collaborating across borders and time zones*. Prentice Hall PTR.

Chiesa, V. (1995). Globalizing R & D around centers of excellence. *Long Range Planning*, *28*(6), 19–28. doi:10.1016/0024-6301(95)00048-N

Chiesa, V. (2000). Global R&D project management and organization: A taxonomy. *Journal of Product Innovation Management*, *17*(5), 341–359. doi:10.1111/1540-5885.1750341

Committee of Sponsoring Organizations of the Treadway Commission (COSO). (2007). *Gerenciamento de risco corporativo – estrutura integrada*. Recovered on January 26, 2011 from http://www.coso.org/documents/COSO_ERM_ExecutiveSummary_Portuguese.pdf

Dwivedi, Y. K., Wastell, D., Laumer, S., Henriksen, H. Z., Myers, M. D., Bunker, D., & Srivastava, S. C. (2015). Research on information systems failures and successes: Status update and future directions. *Information Systems Frontiers*, *17*(1), 143–157. doi:10.100710796-014-9500-y

Ebert, C. (2011). *Global software and IT: A guide to distributed development, projects, and outsourcing*. Wiley-IEEE Computer Society Press; doi:10.1002/9781118135105

Ebert, C., Murthy, B. K., & Jha, N. N. (2008). Managing risks in global software engineering: principles and practices. *Global Software Engineering, 2008. ICGSE 2008. IEEE International Conference on. IEEE, 2008*, 131-140. 10.1109/ICGSE.2008.12

Elzamly, A., Hussin, B., & Salleh, N. (2016). Top Fifty Software Risk Factors and the Best Thirty Risk Management Techniques in Software Development Lifecycle for Successful Software Projects. *International Journal of Hybrid Information Technology*, *9*(6), 11–32. doi:10.14257/ijhit.2016.9.6.02

Ghafoor, F., Shah, I. A., & Rashid, N. (2017). Issues in adopting agile methodologies in global and local software development: A systematic literature review protocol with preliminary results. *International Journal of Computers and Applications*, *160*(7), 37–41. doi:10.5120/ijca2017913092

Gheni, A. Y., Yusmadi, Y. J., Marzanah, A. J., & Norhayati, M. A. (2016). Factors affecting global virtual teams' performance in software projects. *Journal of Theoretical and Applied Information Technology*, *92*(1), 90–97.

Ghobadi, S., & Mathiassen, L. (2017). Risks to effective knowledge sharing in agile software teams: A model for assessing and mitigating risks. *Information Systems Journal*, *27*(6), 699–731. doi:10.1111/isj.12117

Han, W. M. (2014). Validating differential relationships between risk categories and project performance as perceived by managers. *Empirical Software Engineering*, *19*(6), 1956–1966. doi:10.100710664-013-9270-z

Herbsleb, J. D., & Mockus, A. (2003). An empirical study of speed and communication in globally distributed software development. *Software Engineering. IEEE Transactions on Software Engineering*, *29*(6), 481–494. doi:10.1109/TSE.2003.1205177

Higuera, R., & Haimes, Y. (1996). *Software risk management*. Pittsburgh, PA: Carnegie Mellon, Software Engineering Institute.

Hijazi, H., Alqrainy, S., & Muaidi, H., & KhdourIdentifyin, T. (2014). Causality relation between software projects Risk Factors. *International Journal of Software Engineering and Its Applications*, *8*(2), 51–58.

Holmström, H., Conchúir, Ó. E., Ågerfalk, P. J., & Fitzgerald, B. (2006). *Global software development challenges: A case study on temporal, geographical and socio-cultural distance*. In International Conference on Global Software Engineering (ICGSE2006), Costão do Santinho, Florianópolis, Brazil. 10.1109/ICGSE.2006.261210

Hwang, C., Hsiao, B. H. G., & Chern, C. C. (2016). Multiphase assessment of project risk interdependencies: Evidence from a university ISD Project in Taiwan. *Project Management Journal*, *47*(1), 59–75. doi:10.1002/pmj.21563

Jalali, S., & Wohlin, C. (2010, August). Agile practices in global software engineering-A systematic map. In *2010 5th IEEE International Conference on Global Software Engineering* (pp. 45-54). IEEE. 10.1109/ICGSE.2010.14

Jiang, J. J., & Klein, G. (2000). Software development risks to project effectiveness. *Journal of Systems and Software*, *52*(1), 3–10. doi:10.1016/S0164-1212(99)00128-4

Kliem, R. (2004). Managing the risks of offshore IT development projects. *Information Systems Management*, *21*(3), 22–27. doi:10.1201/1078/44432.21.3.20040601/82473.4

Kommeren, R., & Paiviainen, P. (2007). Philips experiences in global distributed software development. *Empirical Software Engineering*, *12*(6), 647–660. doi:10.100710664-007-9047-3

Kutsch, E., Denyer, D., Hall, M., & Lee-Kelley, E. (2013). Does risk matter? Disengagement from risk management practices in information systems projects. *European Journal of Information Systems*, *22*(6), 637–649. doi:10.1057/ejis.2012.6

Lee, O. K., & Baby, D. V. (2013). Managing dynamic risks in global it projects: Agile risk-management using the principles of service-oriented architecture. *International Journal of Information Technology & Decision Making*, *12*(6), 1121–1150. doi:10.1142/S0219622013400117

Lee-Kelley, L., & Sankey, T. (2008). Global virtual teams for value creation and project success: A case study. *International Journal of Project Management*, *26*(1), 51–62. doi:10.1016/j.ijproman.2007.08.010

Lientz, B. P., & Rea, K. P. (2003). *International project management*. San Diego, CA: Academic Press.

Liu, S., & Wang, L. (2014). Understanding the impact of risks on performance in internal and outsourced information technology projects: The role of strategic importance. *International Journal of Project Management*, *32*(8), 1494–1510. doi:10.1016/j.ijproman.2014.01.012

Liu, S., Zhang, J., Keil, M., & Chen, T. (2010). Comparing senior executive and project manager perceptions of IT project risk: A Chinese Delphi study. *Information Systems Journal*, *20*(4), 319–355. doi:10.1111/j.1365-2575.2009.00333.x

López, C., & Salmeron, J. L. (2012). Risks response strategies for supporting practitioners decision-making in software projects. *Procedia Technology*, *5*, 437–444. doi:10.1016/j.protcy.2012.09.048

Lu, S. T., Yu, S. H., Chang, D. S., & Su, S. C. (2013). Using the Fuzzy Linguistic Preference relation approach for assessing the importance of risk factors in a software development project. *Mathematical Problems in Engineering*. doi:10.1155/2013/376375

Nakatsu, R. T., & Iacovou, C. L. (2009). A comparative study of important risk factors involved in offshore and domestic outsourcing of software development projects: A two-panel Delphi study. *Information & Management*, *46*(1), 57–68. doi:10.1016/j.im.2008.11.005

Neves, S. M., da Silva, C. E. S., Salomon, V. A. P., da Silva, A. F., & Sotomonte, B. E. P. (2014). Risk management in software projects through Knowledge Management techniques: Cases in Brazilian Incubated Technology-Based Firms. *International Journal of Project Management*, *32*(1), 125–138. doi:10.1016/j.ijproman.2013.02.007

Nicolás, J., De Gea, J. M. C., Nicolás, B., Fernández-Alemán, J. L., & Toval, A. (2018). On the risks and safeguards for requirements engineering in global software development: Systematic literature review and quantitative assessment. *IEEE Access: Practical Innovations, Open Solutions*, *6*, 59628–59656. doi:10.1109/ACCESS.2018.2874096

Noll, J., Beecham, S., & Richardson, I. (2010). Global software development and collaboration: Barriers and solutions. *ACM Inroads*, *1*(3), 66–78. doi:10.1145/1835428.1835445

Nurdiani, I., Jabangwe, R., Smite, D., & Damian, D. (2011, August). Risk identification and risk mitigation instruments for global software development: Systematic review and survey results. In *Global Software Engineering Workshop (ICGSEW), 2011 Sixth IEEE International Conference on* (pp. 36-41). IEEE. 10.1109/ICGSE-W.2011.16

Odzaly, E. E., Greer, D., & Stewart, D. (2018). Agile risk management using software agents. *Journal of Ambient Intelligence and Humanized Computing*, *9*(3), 823–841. doi:10.100712652-017-0488-2

Office of Government Commerce (OGC). (2005). *Managing successful projects with Prince2* (4th ed.). London: The Stationery Office.

Pasha, M., Qaiser, G., & Pasha, U. (2018). A critical analysis of software risk management techniques in large scale systems. *IEEE Access: Practical Innovations, Open Solutions*, *6*, 12412–12424. doi:10.1109/ACCESS.2018.2805862

Persson, J. S., Mathiassen, L., Boeg, J., Madsen, T. S., & Steinson, F. (2009). Managing risks in distributed software projects: An integrative framework. *IEEE Transactions on Engineering Management*, *56*(3), 508–532. doi:10.1109/TEM.2009.2013827

Petticrew, M., & Roberts, H. (2008). *Systematic reviews in the social sciences: A practical guide*. John Wiley & Sons.

Prikladnicki, R., & Yamaguti, M. (2004). Risk management in global software development: a position paper. In *Third International Workshop on Global Software Development (GSD 2004) - 26th IEEE - International Conference on Software Engineering*, (pp. 18 – 20). Stevenage, UK: IEEE. 10.1049/ic:20040306

Project Management Institute (PMI). (2009). *Practice Standard for Project Risk Management*. Newton Square: PMI.

Project Management Institute (PMI). (2017). *PMBOK Guide – A guide to the Project Management Body of Knowledge* (6th ed). Newton Square: PMI.

Rodríguez, A., Ortega, F., & Concepción, R. (2016). A method for the evaluation of risk in IT projects. *Expert Systems with Applications*, *45*, 273–285. doi:10.1016/j.eswa.2015.09.056

Russo, R. D. F. S. M., Sbragia, R., & Abraham, S. O. Y. (2017). Unknown Unknowns in Innovative Projects: Early Signs Sensemaking. *BAR - Brazilian Administration Review*, *14*(3), 1–24. doi:10.1590/1807-7692bar2017170060

Samantra, C., Datta, S., Mahapatra, S. S., & Debata, B. R. (2016). Interpretive structural modelling of critical risk factors in software engineering project. *Benchmarking: An International Journal*, *23*(1), 2–24. doi:10.1108/BIJ-07-2013-0071

Sarigiannidis, L., & Chatzoglou, P. D. (2014). Quality vs risk: An investigation of their relationship in software development projects. *International Journal of Project Management*, *32*(6), 1073–1082. doi:10.1016/j.ijproman.2013.11.001

Sauser, B. J., Reilly, R. R., & Shenhar, A. J. (2009). Why projects fail? How contingency theory can provide new insights – A comparative analysis of NASA's Mars Climate Orbiter loss. *International Journal of Project Management*, *27*(7), 665–679. doi:10.1016/j.ijproman.2009.01.004

Schmidt, R., Lyytinen, K., Keil, M., & Cule, P. (2001). Identifying software project risks: An international Delphi study. *Journal of Management Information Systems*, *17*(4), 5–36. doi:10.1080/07421222.2001.11045662

Shameem, M., Kumar, R. R., Kumar, C., Chandra, B., & Khan, A. A. (2018). Prioritizing challenges of agile process in distributed software development environment using analytic hierarchy process. *Journal of Software: Evolution and Process*, *30*(11), e1979. doi:10.1002mr.1979

Sharma, A., Sengupta, S., & Gupta, A. (2011). Exploring risk dimensions in the Indian software industry. *Project Management Journal*, *42*(5), 78–91. doi:10.1002/pmj.20258

Shehzad, B., Awan, K. M., Lali, M. I. U., & Aslam, W. (2017). Identification of Patterns in Failure of Software Projects. *Journal of Information Science and Engineering*, *33*(6), 1465–1479. doi:10.6688/JISE.2017.33.6.5

Shokouhyar, S., Panahifar, F., Karimisefat, A., & Nezafatbakhsh, M. (2018). An information system risk assessment model: A case study in online banking system. *International Journal of Electronic Security and Digital Forensics*, *10*(1), 39–60. doi:10.1504/IJESDF.2018.089205

Shrivastava, S. V., & Rathod, U. (2015). Categorization of risk factors for distributed agile projects. *Information and Software Technology*, *58*, 373–387. doi:10.1016/j.infsof.2014.07.007

Siegel, S., & Castellan, N. J. Jr. (1988). *Nonparametric Statistics for the Behavioral Sciences*. New York: McGraw-HiU Book Company.

Šmite, D. (2006). Global software development projects in one of the biggest companies in Latvia: Is geographical distribution a problem? *Software Process Improvement and Practice*, *11*(1), 61–76. doi:10.1002pip.252

Sommerville, I. (2015). *Software Engineering*. Pearson Education.

Sonchan, P., & Ramingwong, S. (2014, May). Top twenty risks in software projects: A content analysis and Delphi study. In *Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), 2014 11th International Conference on* (pp. 1-6). IEEE. 10.1109/ECTICon.2014.6839820

Sumner, M. (2000). Risk factors in enterprise-wide/ERP projects. *Journal of Information Technology*, *15*(4), 317–327. doi:10.1177/026839620001500407

Thamhain, H. (2013). Managing risks in complex projects. *Project Management Journal*, *44*(2), 20–35. doi:10.1002/pmj.21325

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence informed management knowledge by means of systematic review. *British Journal of Management*, *14*(3), 207–222. doi:10.1111/1467-8551.00375

Treasury, H. M. S. (2004). *The Orange Book: management of risk–principles and concepts*. London: HM Treasury.

Verner, J. M., Brereton, O. P., Kitchenham, B. A., Turner, M., & Niazi, M. (2014). Risks and risk mitigation in global software development: A tertiary study. *Information and Software Technology*, *56*(1), 54–78. doi:10.1016/j.infsof.2013.06.005

Vrhovec, S. L., Hovelja, T., Vavpotič, D., & Krisper, M. (2015). Diagnosing organizational risks in software projects: Stakeholder resistance. *International Journal of Project Management*, *33*(6), 1262–1273. doi:10.1016/j.ijproman.2015.03.007

Wallace, L., Keil, M., & Rai, A. (2004). How software project risk affects project performance: An investigation of the dimensions of risk and an exploratory model. *Decision Sciences*, *35*(2), 289–321. doi:10.1111/j.00117315.2004.02059.x

ADDITIONAL READING

Cagliano, A. C., Grimaldi, S., & Rafele, C. (2015). Choosing project risk management techniques. A theoretical framework. *Journal of Risk Research*, *18*(2), 232–248. do i:10.1080/13669877.2014.896398

Grimaldi, S., Rafele, C., & Cagliano, A. C. (2012). A framework to select techniques supporting project risk management. In N. Banaitiene (Ed.), *Risk Management: current issues and challenges* (pp. 67–96). Croatia: Intech; doi:10.5772/50991

Moeini, M., & Rivard, S. (2019). Responding—or not—to information technology project risks: An integrative model. *Management Information Systems Quarterly*, *43*(2), 475–500. doi:10.25300/MISQ/2019/14505

Pimchangthong, D., & Boonjing, V. (2017). Effects of risk management practices on IT project success. *Management and Production Engineering Review, 8*(1), 30-37. doi:10.1515/mper-2017-0004

Rodríguez, A., Ortega, F., & Concepción, R. (2017). An intuitionistic method for the selection of a risk management approach to information technology projects. *Information Sciences*, *375*, 202–218. doi:10.1016/j.ins.2016.09.053

Shishodia, A., Dixit, V., & Verma, P. (2018). Project risk analysis based on project characteristics. Benchmarking. *International Journal (Toronto, Ont.)*, *25*(3), 893–918. doi:10.1108/BIJ-06-2017-0151

Shrivastava, S. V., & Rathod, U. (2017). A risk management framework for distributed agile projects. *Information and Software Technology*, *85*, 1–15. doi:10.1016/j.infsof.2016.12.005

Teller, J., Kock, A., & Gemünden, H. G. (2014). Risk management in project portfolios is more than managing project risks: A contingency perspective on risk management. *Project Management Journal*, *45*(4), 67–80. doi:10.1002/pmj.21431

KEY TERMS AND DEFINITIONS

External Risk Factor: It arises from outside the organization, can only be mitigated, but cannot be managed. They can be classified as client, psychic distance, political, regulatory, economic, social, technology, environment, stakeholder, and suppliers.

Global Project: It involves individuals, teams, groups, business units and organizations from multiple locations with different cultures, languages or other characteristics.

Internal Risk Factor: It is related to the internal operations of the organization refer to providing capacity and competence. They can vary greatly depending on the product (complexity, product process, technology), the project (acquisition, communication, coordination and control, cost, scope, staff management, quality and time), and the organization as environmental.

Local Project: It involves a single or a limited number of organizations in a near location geographically.

Psychic Distance: The sum of the factors that affect the flow of information between countries whose companies perform certain trading activities, in terms of development, educational content and level, language, culture, economy, political system, market structure, among others.

Risk: It is a situation that can influence the project goals and outcomes, depending upon the probability of occurrence and impact of loss. This impact cannot be completely eliminated, but if well managed it can be reduced.

Risk Management: Process of identifying, analyzing, defining strategies to deal with the more concerning risks, which can be threats or opportunities to project objectives. In the process, it is included the control of the risks throughout the life cycle of the project.

APPENDIX

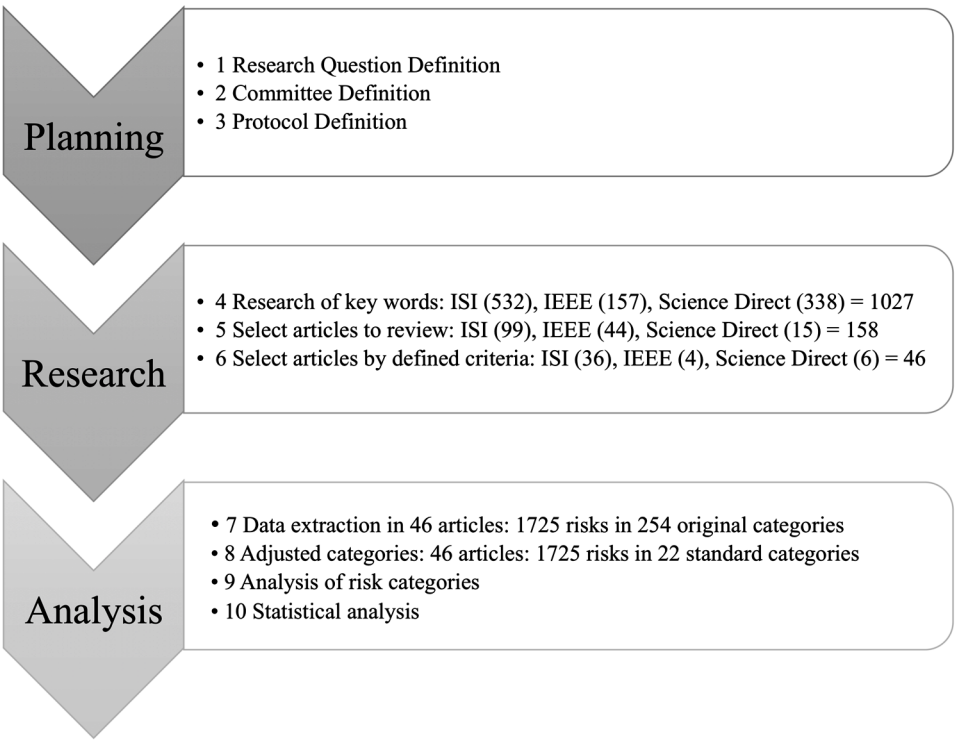
Research Procedures

As a research strategy, it was used a Systematic Literature Review. The inclusion criteria were (1) studies from the IT sector; (2) those that addressed global or local projects; (3) those that had empirical research; (4) those that listed the risks of these projects; and (5) those written in English.

To explore the literature, the first nine steps defined by Petticrew and Roberts (2008) was used and a step for performing a statistical evaluation of the results. These steps are detailed in Figure 1. Conflicts were discussed in committee meetings for consensus. The protocol (step 3) was defined toward research and analysis, which was followed in the subsequent steps.

For the research (step 4), three tools to access information were used: *Institute for Scientific Information* [ISI], Science Direct and *Institute of Electrical and Electronics Engineers* [IEEE]. It was searched for the words, risk, project, global

Figure 1. SLR flow in 10 steps
Source: Authors



project, international project, information technology, information systems, ERP and software; whenever possible, the research scope was defined within the areas Business and Computer Science. With this method, the authors were able to research various types of sources, including conference proceedings and industry. In this step, it was selected 1027 articles.

In the following step (5), the abstracts were assessed and the five inclusion criteria were applied, resulting in 158 complete articles to be analyzed. Reading these articles in the following step (6) led to the exclusion of 112 of them, which either were duplicated in the bases, or dealt with the same projects, or presented only risk categories, or were theoretical or did not meet the inclusion criteria completely. The authors made a quality assessment of the internal validity of each article and some were excluded when the resulting list of risks was not objecting of analysis.

In the following step (7), the lists of risk items and their respective risk categories, when it was possible, were extracted. The authors classified projects as global or local projects and by the type of IT. It was also identified the source of the information in the articles, regarding the risk list as empirical research, when the list of risks was originated in the research of the article, or as literature, when the list was generated based on literature searches. To identify relevant outcomes, it was extracted the objectives, keywords, methodological procedures applied, outcomes and contributions. Then, the authors conducted another quality assessment of the internal validity of each article to identify the impact factor and number of citations as well. The result was a database with 1725 risks, another with their 254 original categories and the classification of 46 articles.

Aiming at consolidating the **original categories**, the authors reclassified them in the subsequent step (8). First, the database with original categories was compared with **standard categories** based on the initial risk factor lists of RM standards established in the Protocol (*Committee of Sponsoring Organizations of the Treadway Commission* [COSO] (2007); Higuera & Haimes, 1996; *Office of Government Commerce* [OGC], 2005; PMI, 2017; Treasury, 2004). Some of these standards refer to these lists as risk categories, a term that is also used in this study. Those categories, however, have shown to be insufficient for proper classification and thus adjustments have been made, resulting in 22 categories, called **an adjusted category** which was explained in key terms and definitions.

After that, the authors evaluated the classification of each risk under the adjusted categories. At times, it was needed to reread the original article to get a deeper understanding of each risk to classify it in the correct category. In some cases, it was necessary to transfer the risk to another category, as when the original category was referring to a specific phase of the life cycle of the project. Then, a comparative

framework was generated based on adjusted categories. Although the client, supplier, and staff were considered stakeholder, the authors decided to split them into various categories, given a large number of risk items related to each one of them.

The analysis (step 9) was made using differences and similarities between risk categories (internal and external) and the categories of local and global projects. The literature was accessed to validate the findings. Step 10 (statistically evaluate the results) was not indicated by Petticrew and Roberts (2008) as advisable but was included to validate the hypothesis of a difference in the treatment of risks among the authors of articles related to global and local projects. For the verification of independence between the two groups of articles, the chi-square statistical test was applied, and the significance level (or error rate) was set at 5% in the statistical analysis (Siegel & Castellan, 1988). As the chi-square test requires the number of zeroed cells to be at a minimum, the technological category was excluded due to the low number of risks identified in each of them, accounting for 18 degrees of freedom.

Chapter 2
Mobile Advert's Contextual Consistency:
The Effect of Its Positional Display

Yi Liu
Rennes School of Business, France

Chuan-Hoo Tan
National University of Singapore, Singapore

Juliana Sutanto
Lancaster University, UK

ABSTRACT

How adverts can be better displayed to attract more click-throughs has been enduringly debated, and mixed findings have been reported regarding the effectiveness of contextual consistency. This study reconciles prior debates by anchoring on the load theory of selective attention to propose that user response to contextually consistent adverts is dependent on their intra-page and inter-page positional display. In collaboration with a European mobile application company, adverts were randomly displayed in its location-based mobile social networking application. The follow-up think-aloud protocol analysis, conducted to collect qualitative feedback from users, validates the theoretical assumptions. The findings reveal that high click-through could be obtained when contextually consistent adverts are displayed at the top positions or the front page of the mobile application. These findings address an enduringly debated issue of how to leverage on new technology, such as mobile device, to display commercial information most effectively.

DOI: 10.4018/978-1-7998-1786-4.ch002

INTRODUCTION

Mobile Internet technology has been rapidly adopted in the last decade and it is estimated that around 2 billion users are using smartphones globally (Dong, 2009; Su et al., 2018). The global mobile application revenue has reached US$88 billion in 2016 and it has been forecasted to reach US$189 billion in 2020 (Dogtiev, 2019a). Due to the importance of mobile Internet market, advertisers have been focusing on running advertisement campaigns in mobile applications, and it is reported that global mobile advertising spending reached US$107 billion in 2017 (Dogtiev, 2019b). Advertisers would like to have their displayed adverts to receive high number of click-throughs. However, the effectiveness of advert displays in mobile applications has been questioned. For example, Google faces the difficulty to monetize mobile advert clicks for most of the places globally (Marvin, 2014), and it is reported that most of the mobile users do not click on those adverts (Belicove, 2013). Thus, how mobile adverts should be displayed in mobile applications to attract higher click-throughs needs to be examined.

Although the display of adverts has been examined in traditional forms of media, only a few studies have focused on mobile context (Vasisht et al., 2004). Due to its smaller screen size characteristics, only limited information or adverts can be displayed on the screen, which forces mobile users to engage in extensive scrolling to navigate within and across mobile pages (Jones et al., 1999). Although adverts are visual distractions from the primary task of using the backdrop media (McCoy et al., 2007), the distraction effects could differ based on the theme of advert content (Edwards et al., 2002; Moore et al., 2005). When the content of an advert shares the same theme as the backdrop content, such as an advert of a mobile gaming application appears on the same page of an article on online gaming, the advert could be recognized as contextually consistent. Existing studies found that contextually consistent adverts are perceived as informative (see e.g., Edwards et al., 2002), and affect users' overall perceptions of a web page positively (Newman et al., 2004). However, other studies claimed that such contextual consistency does not necessarily lead to higher click-throughs for adverts (Lee & Faber, 2007; Mandler, 1982; Moore et al., 2005). These mixed findings suggest that the effectiveness of contextually consistent adverts needs further examination.

This article aims to empirically examine whether and how contextually consistent adverts can be effective in terms of users' click-throughs. Previous studies considered users' cognitive loads, which are affected by the position where an advert is displayed in the mobile application, and suggested that contextually consistent adverts could receive high click-throughs when they are exposed to mobile users earlier, but the effect diminishes (Liu et al., 2016). The objective of this study is to enrich the previous findings by examining this positive effect in different positions. Specifically,

the positional display of an advert can be considered in two ways: intra-page and inter-page positional displays. By collaborating with a mobile application company, empirical investigations using the company's location-based mobile social networking application was conducted. Field data were collected, in which users' click-through records were obtained, and think-aloud protocol analysis was performed, in which users were recruited to validate the theoretical assumption. This study contributes to the existing literature by examining the advert display, and taking into account the contextual consistency and the position in which the mobile advert is displayed in the application.

LITERATURE REVIEW

Studies on online advert display have largely focused on non-mobile context, such as desktop version of websites. Various factors have been examined, such as website complexity (Nadkarni & Gupta, 2007), formats (e.g., graphics and animations) (Hong et al., 2004), personalization (Halkias & Kokkinaki, 2017), and privacy considerations (Tsai et al., 2011). Regarding the positional display of adverts, existing studies have claimed the primacy effect as an important design principle for advert display (Hoque & Lohse, 1999). For instance, adverts displayed at the left side (Ryu et al., 2007) and the top positions of a web page (Agarwal et al., 2011; Ghose & Yang, 2009) could receive more click-throughs from users. A general deduction from these studies is that users are inclined to respond favorably to adverts if they are displayed at the top rather than the bottom of a page when it is tall and narrow, and on the left rather than on the right side of pages that are short and wide.

Existing studies have also compared intra-page advert displays where adverts are displayed across pages with the explicit consideration of the contextual consistency between adverts and the backdrop media content. An advert which is consistent with backdrop page content is perceived to be informative (Edwards et al., 2002), and positively affects the perception of the web page where it is displayed (Newman et al., 2004). Contextual consistency increases the recognition of adverts by users seeking information in online magazines (Zanjani et al., 2011), leading to high advert click-through (Cho, 2003). But, other studies have claimed that context consistency does not necessarily draw users' attention to adverts, because it could not raise visual and semantic contrasts that distract users away from the page content (Lee & Faber, 2007; Mandler, 1982; Moore et al., 2005). It has been also found that only contextual consistency between visual adverts and visual backdrop content leads to better persuasion (Bishop et al., 2017).

Recent studies started to investigate advert display in the mobile context. It has been proposed that the effectiveness of mobile adverts is influenced by adverts'

characteristics and different contextual cues, such as environmental, consumer and technological contexts (Grewal et al., 2016). Specifically, it has been found that mobile application usage decreases when users are shown adverts while they are engaging with the application (Ghose & Han, 2014). Users' responses towards mobile adverts are also affected by the types of mobile application, scrolling frequency (Peng et al., 2014). For example, users are more likely to tolerate the adverts in informational application (Logan, 2015), and adverts placed in entertainment applications are more effective (Valvi & West, 2015). Concerning the contextual consistency in the mobile context, a few studies offer us insights. For example, in mobile gaming application, contextually consistent adverts lead to better users' responses toward adverts and advertised products. However, the positive effects were more salient when users played calm–happiness games and were less immersed in the game (Wang & Chou, 2019). Other moderating factors for the effectiveness of contextual consistent adverts were also found, such as nature of game, and brand prominence (Vashisht & Pillai, 2016). Liu et al. (2016) suggested that the effectiveness of contextual consistent adverts is influenced by the early/late exposure of them. Hence, the positional display of mobile adverts potentially moderates the effect of contextual consistency. This study aims to further examine the effectiveness of contextual consistent adverts and investigate their joint effect with the positional display of mobile adverts.

THEORETICAL FOUNDATION AND RESEARCH MODEL

The load theory of selective attention provides us a theoretical foundation to predict the influence of adverts' positional display. It proposes that users make deliberate efforts to maintain selective attention by focusing on the task at hand, and that this conscious effort requires the employment of cognitive functions (working memory) to actively maintain processing priorities (Lavie & Tsal, 1994; Lavie, 1995). Thus, distractions gain no attention from these users with low working memory load. However, high working memory load drains the user's capacity for active control, resulting in increased processing attention being given to distractions (Lavie et al., 2004). For example, Conway et al. (2001) showed that more people with high working memory loads than with low working memory loads notice their names in unattended channels. Prior studies which examined the effects of working memory load manipulated the length of the main content (Lavie et al., 2004), the order of the sequence of digits (de Fockert et al., 2001) and the intervals between targeted stimulus (Jonides et al., 1997).

When users are browsing the content in mobile applications, adverts are distractions from this primary task. Thus, in order to be effective, adverts need to draw users' attention away from that primary focus. Distracted adverts may not get attention

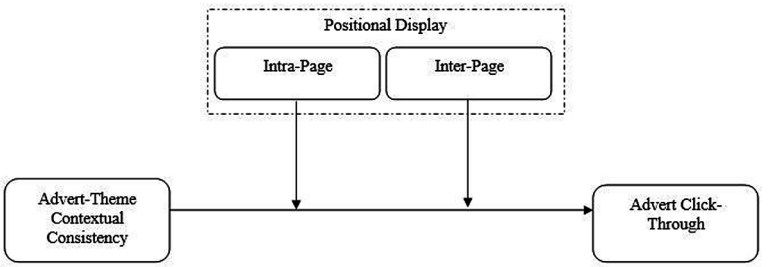
from users involved with low working memory load, since they can selectively channel their attention to the main contents. When applying to mobile application context, these suggest that mobile users could better focus on main content in the application and ignore unrelated distractions, when they are involved with low working memory load compared with high working memory load. However, when mobile users browse progressively through the content of a mobile application by scrolling down from the top to the bottom of a page or navigating from the front to other pages, their working memory load increases. Consequently, an advert's positional display influences users' abilities to ignore this distraction.

Building on the load theory of selective attention, this study considers the joint effects of an advert's contextual consistency and its positional display on its click-through. It proposes that the effectiveness of a contextually consistent advert is contingent on its display position, which could affect users' working memory load. Contextually consistent adverts could receive high number of click-through when it is displayed on the top positions of the pages or the front page of the application, as users are likely to have low working memory loads at those points. Figure 1 depicts the research model.

Intra-Page Positional Display

The primacy effect describes that displaying an advert at the top rather than the bottom of a page can lead to favorable responses from users (Ghose & Yang, 2009; Hoque & Lohse, 1999). Based on the load theory of selective attention, this study argues that this primacy effect is contingent on the contextual consistency of an advert's content. Kane & Engle (2003) found that people with high working memory capacity are better able to ignore inconsistent distractions than are their counterparts who have low working memory capacity and suffer high working memory loads. On the top positions of mobile application pages, users will have low working memory load, and they can actively maintain their processing priorities to ensure

Figure 1. Research model



that distractions do not divert their attention away from the main content (Lavie et al., 2004). Given that they are more likely to consider a textually consistent advert less as a distraction and more as a part of the main page content, a light working memory load will also enable them to more easily ignore the cognitive distraction of one that is contextually inconsistent. Thus, contextually consistent advert has higher chance to be noticed and clicked subsequently.

When adverts are placed at the bottom positions, users need to scroll down through the primary content displayed before reaching them (Jones et al., 1999). Consequently, the main content gradually fills up their working memory, and their working memory load increases as additional information need to be processed. The load theory of selective attention proposes that with a higher working memory load, a mobile user will be less affected by contextually consistent adverts (Lavie et al., 2004). So the consumption of working memory load involved in scrolling down front pages makes it harder for users to identify contextually consistent adverts. Thus, it hypothesizes:

H1: Contextually consistent adverts displayed at top positions are likely to produce higher numbers of click-throughs than contextually inconsistent adverts placed at the same positions.

Inter-Pages Positional Display

The front page of a mobile application is the landing page, where mobile users have low working memory load to maintain their processing priorities. As they navigate beyond the front page to other pages in the mobile application, the cognitive cost of reading the content due to the small smartphone screen size increases, so the consumption of their working memory will be increased further (Ghose et al., 2013). This increase in working memory load drains their active control capabilities, making it less likely for them to detect more contextually consistent adverts from others (Lavie et al., 2004). The assumption can be supported in the previous studies. In the n-back task, which has been used in several prior studies to manipulate working memory load, an increase in the navigation (or interval) length "n" (the length between a stimuli and it being repeated that the participants must recognize at a later stage) increases their working memory load (Jonides et al., 1997). Similar to the n-back task, users' working memory load also increases during the navigation across mobile pages. Related studies examining website navigation and cognitive load, followed the same theoretical perspective, demonstrating the importance of using the working memory concept to theorize online user behavior (e.g., navigating and recalling the website structure/layout across website links). Thus, it hypothesizes:

H2: Contextually consistent adverts displayed at front page, are likely to produce higher numbers of click-throughs than contextually inconsistent adverts placed at the same position.

METHODOLOGY

By collaborating with a mobile application company, field study was conducted on its location-based social networking mobile application between 2007 and 2010. During this period, 1,373 adverts were displayed, in random positions, and they were clicked 201,364 times. The adverts were in the format of banner, and those banners were static, equivalent in size, and displayed at the top or bottom position across pages. The themes of the adverts range from mobile gaming application, lucky draws to social networking applications. The dataset was collected by the collaborator independently. The location-based mobile social networking application is a globally available 'friend-finder' application, which allows users to find others by accessing the phone directory stored in their mobile phones, by self-inputting phone numbers or by searching for nearby application users, so enabling them to find and meet new friends. The front page is the landing page and the directory of the whole application. From the front page, users can navigate to the admin pages to update their profiles, the location-based pages to check nearby users and places, and socializing pages to check the profile of other users and chat with them.

In the dataset, three information about mobile adverts were recorded: intra-page positional display (top or bottom of the content pages), inter-page positional display (front, admin, socializing, or location pages), and advert-theme consistency (if the advert has the same theme as that of the mobile application such as socializing/dating services). The click-through counts were used to measure the effectiveness of mobile adverts, since these adverts were displayed equally often on the mobile application pages. Click-through count data reflects the number of clicks made on an advert, and were obtained for each advert located in each spatial location (intra-page and inter-page) from users in each continent.

DATA ANALYSIS RESULTS

To test the hypotheses, four models were analyzed: main effects only (Model 1); interaction of consistency and intra-page positional display (Model 2); interaction of consistency and inter-page positional display (Model 3); interaction of consistency with both intra-page and inter-page positional display (Model 4). In these models, conditional negative binomial regression was used with fixed effect (grouped by

advert in each specific positional display and user continent), since the dependent variable was a count measure with relatively high dispersion (μ=17.83; σ=140.14; min=1; max=5353). Table 1 gives the analysis results. The results shown in Model 4 indicate that contextual consistent adverts received lower number of click-through (coefficient=-0.164, $p<0.05$). Regarding the positional display, mobile adverts displayed at bottom positions received lower number of click-through (coefficient=-0.105, $p<0.001$) compared with the adverts at top positions, while adverts displayed at front page received higher number of click-through (coefficient=1.027, $p<0.001$). For the interaction effects, contextual consistent adverts at front page (*consistency*front*) yielded higher number of click-through (coefficient=0.254, $p<0.05$), while contextual consistent adverts at bottom positions (*consistency*bottom*) yielded lower number of click-through (coefficient=-0.133, $p<0.05$). Thus, both H1 and H2 are supported.

POST-HOC THINK-ALOUD INVESTIGATION

Since the anchored theoretical lens of load theory of selective attention and the hypotheses are based on the concept of working memory load, a thinking-aloud protocol analysis was conducted to understand and validate our assumptions on how users' working memory loads change while using the application. Participants were asked to use the same mobile application to find new friends, which is the main function of this application, and "think aloud" at the same time. Think aloud is often employed in information management studies, such as website usability (Benbunan-Fich, 2001) and mobile application evaluations (Benbunan-Fich and Benbunan, 2007). It can produce an accurate and valid account of a subject's cognitive process via concurrent verbalizations (Van Someren et al., 1994). In addition, the amount of these thoughts reflects their working memory load. Participants were recruited to represent the demographic profiles (e.g., age, country of origin, etc.) of the location-based mobile social networking application's users. 40 participants, including 22 males and 18 females, attended the think-aloud sessions. Participants' verbal transcripts were categorized based on how long they spent using the mobile application, but no systematic difference was observed. Hence, an aggregate analysis of the verbal transcripts was conducted.

Participants were asked to verbalize their thoughts in each think-aloud session. The sessions followed the protocol analysis procedures suggested in prior studies (Payne 1994; Van Someren et al. 1994). A training session was conducted to accustom the participants to verbalizing their thoughts and actions, after which the main session observed their thoughts while interacting with the mobile application. During the training sessions, which were designed to accustom the participants to

Table 1. Analysis results

	Model 1 (Main Effects)	Model 2 (Interaction of Consistency and Intra-Page Positional Display)	Model 3 (Interaction of Consistency and Inter-Page Positional Display)	Model 4 (Interaction of Consistency With Both Intra-Page and Inter-Page Positional Display)
Advert-Theme Consistency *(Inconsistency as the Base)*				
Consistency	-.136* (.055)	-.067 (.064)	-.236*** (.073)	-.164* (.080)
Intra-Page Positional Display *(Top as the Base)*				
Bottom	-.115*** (.017)	-.105*** (.018)	-.116*** (.017)	-.105*** (.018)
Inter-Page Positional Display *(Admin Page as the Base)*				
Socializing	.505*** (.021)	.505*** (.021)	.493*** (.022)	.493*** (.022)
Location	-.365*** (.038)	-.364*** (.038)	-.382*** (.040)	-.382*** (.040)
Front	1.045*** (.031)	1.047*** (.031)	1.027*** (.033)	1.027*** (.033)
Advert-Theme Consistency* Intra-Page Positional Display				
Consistency*Bottom		-.127* (.064)		-.133* (.064)
Advert-Theme Consistency* Inter-Page Positional Display				
Consistency*Socializing			.151 (.078)	.151 (.078)
Consistency*Location			.232 (.148)	.239 (.148)
Consistency*Front			.242* (.115)	.254* (.115)
Continent (*Base: North America*)				
South America	-.068 (.063)	-.068 (.063)	-.068 (.063)	-.068 (.063)
Africa	.772*** (.049)	.772*** (.049)	.773*** (.049)	.773*** (.049)
Europe	.318*** (.053)	.318*** (.053)	.318*** (.053)	.318*** (.053)
Asia	1.159*** (.046)	1.159*** (.046)	1.159*** (.046)	1.160*** (.046)
Oceania	-.409** (.141)	-.408** (.141)	-.406** (.141)	-.405** (.141)
Number of Observations (Number of groups)	10882 (912)	10882 (912)	10882 (912)	10882 (912)
Hausman test	Fixed effect (p<0.05)	Fixed effect (p<0.05)	Fixed effect (p<0.05)	Fixed effect (p<0.05)
AIC (BIC)	52986.62 (53066.86)	52984.64 (53072.18)	52986.38 (53088.51)	52983.98 (53093.40)

***p<0.001, **p<0.01, *p<0.05

verbalize their thoughts. During the main session, the participants were asked to use the application. They were given instructions and basic information about the application, and asked to use it freely, as they would in normal situations. They were assigned no specific tasks when using the application, in order to examine their natural behaviors in interacting with the application. An immediate retrospective verbalization at the end of each subject's main session was conducted to collect more insights that may not have been verbalized during the session. On average, each subject's think-aloud session lasted approximately one hour.

40 concurrent and retrospective verbalizations were collected. A set of systematic procedures to analyze our think-aloud data based on prior studies was conducted. The verbalizations were transcribed and segmented based on sentences and punctuation. The segments were aggregated into episodes corresponding to the application pages the participants visited. The episodes were analyzed iteratively using an open coding technique (Strauss & Corbin 1998). Each subject's working memory load was ranked based on the number of words verbalized. For instance, if a subject verbalized most in the socializing page, then that page was ranked first for that subject. The results showed that the socializing and location pages produced higher working memory loads than the front page. In most cases, participants verbalized more on these pages.

Based on the results obtained in think-aloud sessions, users consumed more working memory when browsing non-front pages of the mobile application than on its front page, because these pages contain the core and dynamic contents, while front page functions as the directory for the whole application. These qualitative results provide a validating check on our theoretical assumptions concerning the load theory of selective attention.

DISCUSSIONS AND CONCLUSION

This study examines how adverts can be best positioned in the mobile applications and the effectiveness of contextual consistent adverts. It finds that users' responses to contextually consistent advert depend on their working memory load, which is reflected by the positional display in the mobile application. Contextually consistent adverts yielded higher number of click-throughs than contextually inconsistent adverts, when they are placed at the top positions of the pages in the mobile application, or the front page of the application. This study employs field investigation to improve the realism and practical value. However, the application under investigation provides location-based feature, which is common for mobile application, and social networking feature, which is specific for an application. Future research could consider other types of mobile applications.

Theoretical Contributions

This study contributes to academia in several ways. First, this research provides a potential positive understanding of the ongoing debate on the effectiveness of adverts' contextual consistency. Contextually consistent adverts have been found more effective (Cho, 2003; Newman et al., 2004), or less effective (Lee and Faber, 2007; Moore et al., 2005). Hence, other possible factors have been jointly examined with contextual consistency, such as nature of the application (Wang & Chou, 2019), and brand prominence (Vashisht & Pillai, 2016). This research considers users working memory load, which is affected by an advert's display position in the media, and examines the most appropriate placement of consistent adverts to increase user click-throughs. Adverts, as distractions from the media's main content, need to draw attention from users who are processing that target stimuli. Contextually inconsistent adverts that present a semantic contrast to the main content may interrupt users from reading it, but this interruption effect is contingent on user's working memory load, which can increase the interference caused by such distractions. When an advert is displayed at top positions or the front page of the application, users still have enough working memory to separate inconsistent information, so contextually consistent adverts will result in more click-throughs.

Second, this study investigates the positional display of mobile adverts by considering it in two dimensions: intra-page and inter-page. The existing literature on advertising display considers either intra-page (e.g., Ghose and Yang, 2009; Ryu et al., 2007) or inter-page (e.g., Cho, 2003; Moore et al., 2005) advert placement, but never both. By considering the effects of both intra-page and inter-page positional display, the current study presents a more complete empirical understanding of advert display location.

Practical Contributions

This study also offers insights for practitioners. The effectiveness of adverts is an enduring question for marketers, since the adverts always receive low number of click-through (Brenner, 2018). Although the increased proliferation of smartphones in the global consumer market has generated a novel opportunity for marketers to reach an ever-expanding consumer base, the effectiveness of mobile adverts still concerns marketers (Belicove, 2013). A fundamental issue with mobile advertising is smartphones' small screen size compared with desktops, which limits the amount of space available for inserting promotional messages (Park et al., 2008). This space is further reduced when considering that already occupied by the main content itself, and by unsolicited promotional messages, which might not be well received by users, and is likely to make meeting the commercial expectations of gaining

adequate message click-throughs even more difficult (Kim, 2012). This study offers certain solution. By conducting a field study and a follow-up think-aloud protocol analysis, it shows that better positional displays of adverts in mobile applications can contribute to greater advertising effectiveness. It is better to display contextually consistent adverts on the top positions of the mobile application or its front page.

REFERENCES

Agarwal, A., Hosanagar, K., & Smith, M. D. (2011). Location, location, location: An analysis of profitability of position in online advertising markets. *JMR, Journal of Marketing Research*, *48*(6), 1057–1073. doi:10.1509/jmr.08.0468

Belicove, M. E. (2013). *How to fix online mobile advertising*. Retrieved June 27, 2019, from http://www.forbes.com/sites/mikalbelicove/2013/09/04/how-to-fix-online-mobile-advertising

Benbunan-Fich, R. (2001). Using protocol analysis to evaluate the usability of a commercial web site. *Information & Management*, *39*(2), 151–163. doi:10.1016/S0378-7206(01)00085-4

Benbunan-Fich, R., & Benbuna, A. (2007). Understanding user behavior with new mobile applications. *The Journal of Strategic Information Systems*, *16*(4), 393–412. doi:10.1016/j.jsis.2007.08.002

Bishop, M. M., Brocato, E. D., & Vijayalakshmi, A. (2017). The role of medium content and ad format congruity in influencing advertising outcomes. *Journal of Marketing Communications*, *23*(4), 371–384. doi:10.1080/13527266.2015.1033442

Brenner, M. (2018). *Banner Ads Have 99 Problems and A Click Ain't One*. Retrieved June 27, 2019, from https://marketinginsidergroup.com/content-marketing/banners-99-problems/

Cho, C. H. (2003). Factors influencing clicking of banner ads on the WWW. *Cyberpsychology & Behavior*, *6*(2), 201–215. doi:10.1089/109493103321640400 PMID:12804033

Conway, A. R., Cowan, N., & Bunting, M. F. (2001). The cocktail party phenomenon revisited: The importance of working memory capacity. *Psychonomic Bulletin & Review*, *8*(2), 608–611. doi:10.3758/BF03196169 PMID:11495122

Cook, M. P. (2006). Visual representations in science education: The influence of prior knowledge and cognitive load theory on instructional design principles. *Science Education*, *90*(6), 1073–1091. doi:10.1002ce.20164

de Fockert, J. W., Rees, G., Frith, C. D., & Lavie, N. (2001). The role of working memory in visual selective attention. *Science*, *291*(2), 1803–1806. doi:10.1126cience.1056496 PMID:11230699

Dogtiev, A. (2019a). *App Revenues (2017).* Retrieved June 28, 2019, from https://www.businessofapps.com/data/app-revenues/

Dogtiev, A. (2019b). *Mobile App Advertising Rates (2018).* Retrieved June 28, 2019, from https://www.businessofapps.com/ads/research/mobile-app-advertising-cpm-rates/

Dong, H. S. (2009). A cross-national study of mobile internet services: A comparison of U.S. and Korean mobile internet users. *Journal of Global Information Management*, *17*(4), 29–54. doi:10.4018/jgim.2009070902

Edwards, S. M., Li, H., & Lee, J. H. (2002). Forced exposure and psychological reactance: Antecedents and consequences of the perceived intrusiveness of pop-up ads. *Journal of Advertising*, *31*(3), 83–95. doi:10.1080/00913367.2002.10673678

Ghose, A., Goldfarb, A., & Han, S. P. (2013). How is the mobile internet different? Search costs and local activities. *Information Systems Research*, *24*(3), 1–19. doi:10.1287/isre.1120.0453

Ghose, A., & Han, S. P. (2014). Estimating demand for mobile applications in the new economy. *Management Science*, *60*(6), 1470–1488. doi:10.1287/mnsc.2014.1945

Ghose, A., & Yang, S. (2009). An empirical analysis of search engine advertising: Sponsored search in electronic markets. *Management Science*, *55*(10), 1605–1622. doi:10.1287/mnsc.1090.1054

Grewal, D., Bart, Y., Spann, M., & Zubcsek, P. P. (2016). Mobile Advertising: A Framework and Research Agenda. *Journal of Interactive Marketing*, *34*, 3–14. doi:10.1016/j.intmar.2016.03.003

Halkias, G., & Kokkinaki, F. (2017). Schema strength, processing opportunity, and the rewarding nature of incongruity resolution in advertising. *International Journal of Advertising*, *36*(3), 415–438. doi:10.1080/02650487.2016.1169579

Hong, W., Thong, J. Y. L., & Tam, K. Y. (2004). Does animation attract online users' attention? The effects of flash on information search performance and perceptions. *Information Systems Research*, *15*(1), 60–86. doi:10.1287/isre.1040.0017

Hoque, A., & Lohse, G. L. (1999). An information search cost perspective for designing interfaces for electronic commerce. *JMR, Journal of Marketing Research*, *36*(3), 387–394. doi:10.1177/002224379903600307

Jones, M., Marsden, G., Mohd-Nasir, N., Boones, K., & Buchanan, G. (1999). Improving web interaction on small displays. *Computer Networks*, *31*(11-16), 1129–1137. doi:10.1016/S1389-1286(99)00013-4

Jonides, J., Schumacher, E. H., Smith, E. E., Lauber, E. J., Awh, E., Minoshima, S., & Koeppe, R. (1997). Verbal working memory load affects regional brain activation as measured by PET. *Journal of Cognitive Neuroscience*, *9*(4), 462–475. doi:10.1162/jocn.1997.9.4.462 PMID:23968211

Kane, M. J., & Engle, R. W. (2003). Working-memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to Stroop Interface. *Journal of Experimental Psychology. General*, *132*(1), 47–70. doi:10.1037/0096-3445.132.1.47 PMID:12656297

Kim, R. (2012). *What's working in mobile advertising and what might work in the future*. Retrieved June 27, 2019, from http://gigaom.com/2012/11/15/whats-working-in-mobile-advertising-and-what-might-work-in-the-future

Lavie, N. (1995). Perceptual load as a necessary condition for selective attention. *Journal of Experimental Psychology. Human Perception and Performance*, *21*(3), 451–468. doi:10.1037/0096-1523.21.3.451 PMID:7790827

Lavie, N., Hirst, A., de Fockert, J. W., & Viding, E. (2004). Load theory of selective attention and cognitive control. *Journal of Experimental Psychology. General*, *133*(3), 339–354. doi:10.1037/0096-3445.133.3.339 PMID:15355143

Lavie, N., & Tsai, Y. (1994). Perceptual load as a major determinant of the locus of selection in visual attention. *Perception & Psychology*, *65*(2), 202–212. doi:10.3758/BF03194795 PMID:7971119

Lee, M., & Faber, R. J. (2007). Effects of product placement in online-games on brand memory: A Perspective of the limited-capacity model of attention. *Journal of Advertising*, *36*(4), 75–90. doi:10.2753/JOA0091-3367360406

Liu, Y., Tan, C.-H., & Sutanto, J. (2016). Selective Attention to Commercial Information Displays in Globally Available Mobile Application. *Journal of Global Information Management*, *24*(2), 18–38. doi:10.4018/JGIM.2016040102

Logan, K. (2015). How uses and gratifications of smartphone apps affect attitudes toward in-app advertising. *Proceedings of the American Academy of Advertising Conference*, 168.

Mandler, G. (1982). The structure of value: Accounting for taste. In *Affect and Cognition: The 17th Annual Carnegie Symposium* (pp. 203-230). Hillsdale, NJ: Lawrence Erlbaum Associates.

McCoy, S., Everard, A., Polak, P., & Galletta, D. F. (2007). The effects of online advertising. *Communications of the ACM*, *50*(3), 84–88. doi:10.1145/1226736.1226740

Moore, R., Stammerjohan, C. A., & Coulter, R. R. (2005). Banner advertiser-web site context congruity and color effects on attention and attitudes. *Journal of Advertising*, *34*(2), 71–84. doi:10.1080/00913367.2005.10639189

Newman, E. J., Stem, D. E. Jr, & Sprott, D. E. (2004). Banner advertisement and web site congruity effects on consumer web site perceptions. *Industrial Management & Data Systems*, *104*(3), 273–281. doi:10.1108/02635570410525816

Park, T., Shenoy, R., & Salvendy, G. (2008). Effective advertising on mobile phones: A literature review and presentation of results from 53 case studies. *Behaviour & Information Technology*, *27*(5), 355–373. doi:10.1080/01449290600958882

Payne, J. W. (1994). Think aloud: Insights into information processing. *Psychological Science*, *5*(5), 241–247. doi:10.1111/j.1467-9280.1994.tb00620.x

Peng, J., Xiao, W., Peng, L., & Quan, J. (2014). An explorative study of the effectiveness of mobile advertising. *Proceedings of the 2014 Wuhan International Conference on e-Business*, 213–220.

Rouet, J. F., Voros, Z., & Pleh, C. (2012). Incidental learning of links during navigation: The role of visuo-spatial capacity. *Behaviour & Information Technology*, *31*(1), 71–81. doi:10.1080/0144929X.2011.604103

Ryu, G., Lim, E. A. C., Tan, L. T. L., & Han, Y. J. (2007). Preattentive processing of banner advertisements: The role of modality, location and interface. *Electronic Commerce Research and Applications*, *6*(1), 6–18. doi:10.1016/j.elerap.2005.11.001

Shin, D. H., & Choo, H. (2012). Exploring cross-cultural value structures with smartphones. *Journal of Global Information Management*, *20*(2), 67–93. doi:10.4018/jgim.2012040104

Strauss, A. L., & Corbin, J. M. (1998). *Basics of Qualitative Research* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Su, W., Xu, X., Li, Y., Martínez-López, F. J., & Li, L. (2018). Technological Innovation: A Case Study of Mobile Internet Information Technology Applications in Community Management. *Journal of Global Information Management*, *26*(2), 193–203. doi:10.4018/JGIM.2018040109

Tsai, J. Y., Egelman, S., Cranor, L., & Acquisti, A. (2011). The effect of online privacy information on purchasing behavior: An experimental study. *Information Systems Research*, *22*(2), 254–268. doi:10.1287/isre.1090.0260

Valvi, A. C., & West, D. C. (2015). Mobile applications (apps) in advertising: A grounded theory of effective uses and practices. In K. Kubacki (Ed.), *Ideas in marketing: Finding the new and polishing the old* (pp. 349–352). New York, NY: Springer International Publishing. doi:10.1007/978-3-319-10951-0_132

Van Someren, M. W., Barnard, Y. F., & Barnard, J. A. C. (1994). *The think aloud method: A practical guide to modelling cognitive process*. London, UK: Academic Press.

Vashisht, D., & Pillai, S. S. (2016). Are they really persuaded with the brand embedded in the game? Analyzing the effects of nature of game, brand prominence and game-product congruence. *Journal of Research in Interactive Marketing*, *10*(3), 249–264. doi:10.1108/JRIM-04-2015-0026

Vasisht, P., & Guiterrez, J. A. (2004). An investigation of revenue streams of New Zealand online content providers. *Journal of Global Information Management*, *12*(4), 75–88. doi:10.4018/jgim.2004100104

Wang, S. S., & Chou, H.-Y. (2019). Effects of game-product congruity on in-app interstitial advertising and the moderation of media-context factors. *Psychology and Marketing*, *36*(3), 229–246. doi:10.1002/mar.21174

Zanjani, S., Diamond, W., & Chan, K. (2011). Does ad context congruity help surfers and information seekers remember ads in cluttered e-magazines. *Journal of Advertising*, *40*(4), 67–83. doi:10.2753/JOA0091-3367400405

Chapter 3
A Software Process Improvement Model for Small Firms in Developing Countries

Delroy Chevers
The University of the West Indies, Jamaica

Annette Mills
University of Canterbury, New Zealand

Evan Duggan
The University of the West Indies, Jamaica

Stanford Moore
The University of the West Indies, Jamaica

ABSTRACT

Managing software quality is a major challenge for software development firms. This has led many firms to adopt software process improvement programs such as the capability maturity model integration to improve the software development process. However, these models are often too cumbersome and costly, especially for small software firms in developing countries, to implement. This chapter proposes a simplified software process improvement model that prioritises key practices for software development, given the constraints that face small firms. Using data collected in four developing countries in the English-speaking Caribbean from 112 developer/user dyads on their software practices, the results show that software process coupled with supporting technology (e.g., project management tools) significantly impact the quality of the software product. Smaller projects (represented by size of the project team) are also associated with high quality software products than larger projects. Implications for SPI programs in small firms and future research is discussed.

DOI: 10.4018/978-1-7998-1786-4.ch003

INTRODUCTION

The key to the survival of software development firms, both large and small, is to develop and deliver high quality software products (Larrucea, O'Connor, Colomo-Palacios, & Laporte, 2016; Tan, 1996). One approach to achieve this goal is the application of software process improvement (SPI) programs. The benefits of software process improvement (SPI) programs include improvements in software product quality, staff productivity, return on investment, customer satisfaction, and reduced deployment and implementation time (Larrucea et al., 2016; Lee, Shiue, & Chen, 2016; Niazi, Babar, & Verner, 2010; Staples & Niazi, 2008). To achieve these benefits, firms must be able to manage the software development process well and deliver high quality software products. This is a challenge (Larrucea et al., 2016), as evidenced in high project failure rates, time overruns and budget overruns (Standish Group, 2015). Even with improvements in software development processes, for example with the shift to agile development, the failure rate on software projects continues to be high.

The 2015 Chaos report on software projects shows the rate of project success has improved rising from 16% in 1995 to 29% in 2015, and as high as 31% in 2013. However, projects still continue to fail at a high rate, coming in late, over budget or with less than the required features. Indeed, the period from 2011 to 2015 shows some leveling off in success rates with 2011 reporting 29% of projects as successful (and 49% as challenged e.g. coming in late or over budget), compared with 2015 with 29% of projects reported as successful, and 52% as challenged (Standish Group, 2015). Small firms in developing countries with financial, physical and human constraints, are even more challenged as they often do not have the capacity to absorb project failures in comparison to large firms or their counterparts in developed countries (Fiestas, 2011). They also do not have the capacity to implement full-fledged SPI programs such as the CMMI. This divide can severely curtail the competitiveness of small software development firms and impede their ability to secure global contracts so negatively impact the viability of these firms (Niazi et al., 2010). To address these challenges, this study suggests a simplified software process improvement model (SPIM-S) for small firms. The aim is to identify a set of software development practices that are more feasible for small firms to implement and which can help them mature over time and attain the thresholds needed to compete more effectively in a global software market.

It is widely believed the people, technology and process are major determinants of software quality (Gorla & Lin, 2010). These determinants singularly or in combination are possible solutions to address the problem of high rates of project failure. The central belief is that software quality is influenced by the **people** who are involved in the development process and the usage of the system, the **technology** used to

support the development and the software development **process** that is adopted (SEI, 2010). However, some scholars believe that **process** has the greatest impact in determining software quality (Pane & Sarnob, 2015; SEI, 2010). Indeed, the improvements noted in project success (Standish Group, 2015) have been attributed to software development factors including processes, methods, skills, and tools.

The capability maturity model integration for development (CMMI - Dev) is one of the leading SPI model for software process improvement (Pane & Sarnob, 2015; Torrecilla-Salinasa, Sedeñoa, Escalonaa, & Mejíasa, 2016). It has become the de facto standard for assessing and improving processes and is supported by the Software Engineering Institute (SEI, 2010). Having been established with large projects in mind, the CMMI is applied mostly in large firms in developed countries (Iqbal et al., 2016; Niazi et al., 2010). However, it is often criticised for being cumbersome and costly to implement even in large firms (Larrucea et al., 2016; Niazi et al., 2010). The challenge is even greater for small firms, with their limited resources making full-blown maturity models such as the CMMI are often too difficult to implement (Staples and Niazi, 2008). Indeed, for micro-sized and small software firms in developing countries Espinosa-Curiel, Rodriguez-Jacobo and Fernandez-Zepeda (2013) describe CMMI-based SPI programmes as too cumbersome, time consuming, disruptive and too costly to implement. Yet, the practices that these models embody are essential for producing high quality software products and so are important for small software firms which, like their larger counterparts, experience pressure from clients to produce high quality systems (Iqbal et al., 2016; Torrecilla-Salinasa et al., 2016). Furthermore, for software development firms to compete effectively for global contracts it is expected that they demonstrate a certain level of process maturity. Indeed it is expected that firms be assessed at CMMI Level 3 and above in terms of software process maturity to qualify for global contracts (Niazi et al., 2010). Thus it is critical they improve and can show their software development processes are sufficiently capable and mature to compete in a global market. Although SPI models have been proposed for small and medium-sized firms in developing countries few have been empirically tested and validated in practice (Espinosa-Curiel et al., 2013). Indeed, most studies that assess the impact of software improvement practices on software quality have been conducted in developed countries with very few conducted in developing countries (Richardson and von Wangenheim, 2007).

To address the gaps, this study presents and evaluates a simplified software process improvement model proposed for use by small firms (Chevers, Moore, Duggan and Mills, 2008). Drawing on established software process development practices from the CMMI, a set of software practices modelled in a developing country setting, more specifically four countries in the English-speaking Caribbean (ESC) were identified that account for the constraints and goals of small software development firms in developing countries. The aim of this study is to validate an 'a-contextual' set of

best practices for software process improvement for small firms. This study also recognizes that practices related to the software process are not the only resource that determines software quality. As such the impacts of people and technology – related factors along with process, on software quality are also examined. Hence, this study addresses the following research question: *What is the impact of the software process, people and technology in determining the quality of the software product for small firms in developing countries*. It is expected that a simpler and less cumbersome software process model will improve access to best practices for software development and enable small firms to minimise the occurrence of failed and challenged projects and realise the benefits gained by large firms.

LITERATURE REVIEW

Information technology (IT) is recognized as a capability that can lead to competitive advantage and improved performance (Avgerou, 2008; Chi and Sun, 2015; Techatassanasoontorn, Huang, Trauth and Juntiwasarakij, 2011). As such, it is imperative that software development firms (whether large firms in developed countries or small firms in developing countries) produce high-quality software products (Iqbal et al., 2016; Kuhrmann & Fernández, 2015; Larrucea et al., 2016; Vasconcellos et al., 2017). This need by small software development firms to produce high-quality software and to compete effectively in the global market, are underlying reasons why it is important to adopt practices that can help improve the quality of the software product (Gorla and Lin, 2010; Vasconcellos et al., 2017).

It is widely believed that the major determinants of software quality are **people, technology** and **process** (Gorla & Lin, 2010). However, some scholars believe that the quality of the delivered software product relies heavily on the quality of the software development process (Iqbal et al., 2016; Pane & Sarnob, 2015). This has led to the development of software process improvement initiatives (Humphrey, 1989). Process improvement recommends implementing a number of established measures to pave the way towards enhancing software processes which in turn lead to high-quality software being delivered on time, within budget and with the requisite quality features (Iqbal et al., 2016). The underlying tenet of an SPI approach is that an extensive focus on process improvement is needed to establish the predictability necessary to produce and deliver high-quality software. This involves assessing the capability and maturity of a firm's software practices and established implementation plans and improving the process by achieving higher levels of process maturity (Humphrey, 1989). Here, process maturity is defined as the degree to which a process is defined, managed, measured and continually improved (Dooley, Subra and Anderson, 2001).

The CMMI is a process improvement framework that is widely used to measure software process maturity and provide a reference point for planning SPI initiatives (SEI, 2010). It is a *de facto* standard for assessing and improving the software delivery process (Niazi et al., 2010), and is known as the "Father" of all process improvement frameworks. However, it is also criticized for not being able to guarantee success, as well as having too much bureaucracy and being costly to implement (Iqbal et al., 2016; Larrucea et al., 2016). Nonetheless, given its popularity (Pane & Sarnob, 2015; Torrecilla-Salinasa et al., 2016), the CMMI was used in this study as a starting point for identifying software practices that small firms should embrace to improve their software development process.

The CMMI framework has five levels of software maturity (SEI, 2010), namely:

Level 1: *Initial.* Software processes are usually ad hoc and chaotic; few are defined, and success depends on individual effort.

Level 2: *Repeatable.* Basic project management processes are in place which enhances the ability to repeat earlier successes on projects with similar applications.

Level 3: *Defined.* Software processes are documented, standardized, and integrated into a standard software process for the organization; all projects will use an approved, tailored version of the standard software process.

Level 4: *Managed.* Quantitative measures of the software process and product quality are set up and used to manage and control projects.

Level 5: *Optimizing.* The focus is on continuous process improvement enabled by quantitative feedback from the software process and piloting new ideas and technologies.

To progress from one maturity level to the next, firms must demonstrate compliance with the practices at the lower level. So while at Level 1 there are few if any defined software processes, at Level 3 projects will use standard processes for managing, developing and maintaining software, and at Level 5 these practices would be seen as embedded and part of a culture of continuous process improvement.

To improve efficiency, profitability and competitive advantage, it is important that firms improve their software practices and advance along the maturity continuum (SEI, 2010). With sufficient attention to SPI programs, firms can increase the likelihood of producing high quality software, reducing project cycle time, reducing development cost, improving staff productivity and improving customer satisfaction (Lee et al., 2016; Niazi et al., 2010; Staples and Niazi, 2008). Yet studies have found that small firms are not using SPI programs (Chevers and Duggan, 2007; Richardson and von Wangenheim, 2007). This low SPI adoption rate in developing countries is due to the financial, physical and human constraints being experienced by these firms (Avgerou, 2008). Consequently, these small firms are unable to adopt the full-

blown SPI models like the CMMI. With a phased approach, it is hoped that small firms will find the SPIM-S more accessible and be better able to reap the benefits of SPI programs.

In addition to process improvement in software development, the literature also identifies *people* and *technology* as complementary determinants of software quality (Balasubramanian and Raja, 2010; Gorla and Lin, 2010). Altogether, research suggests these three factors (i.e. process, people and technology) impact the quality of the software product (Duggan & Reichgelt, 2006). This study therefore examines the impact of the software process (as encapsulated in the practices identified in the SPIM-S model), together with people and technology on software quality (see Figure 1).

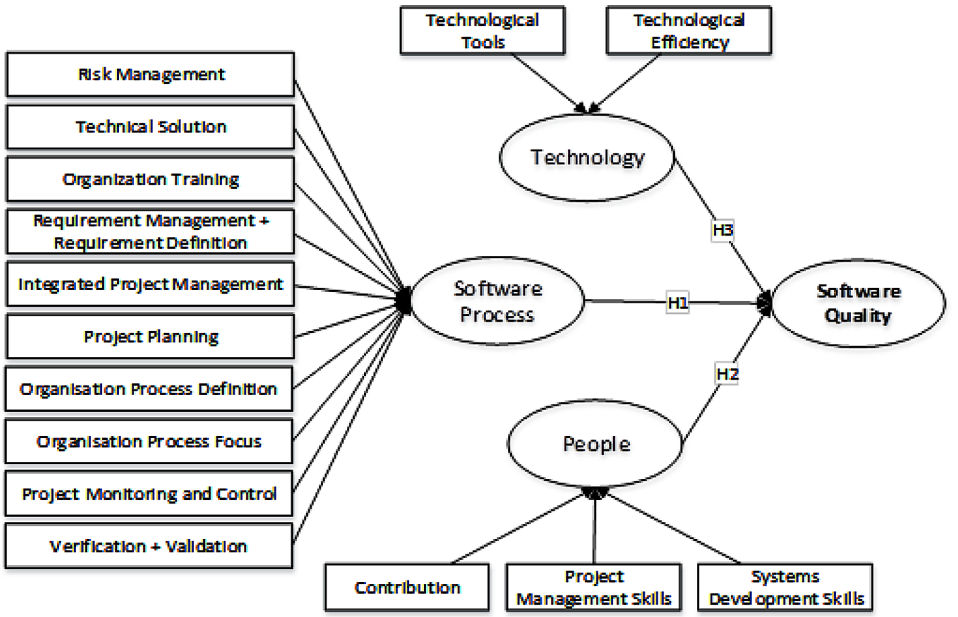
Process Maturity

There are two distinct paradigms of software development approaches (Torrecilla-Salinasa et al., 2016) - structured methods and agile methods. The ultimate goal of each paradigm is to deliver high-quality software products. Within the structured approach, process maturity is seen as the main determinant of software quality (Humphrey, 1989); CMMI-SPI programs fall in this paradigm. Within the agile approach, people are seen as the main determinant of software quality (Cockburn & Highsmith, 2001). Due to the complex nature of software development and the many challenges encountered, there has been an integration of the two paradigms (Dalton, 2016). As a result, CMMI firms have been implementing agile methods in software development and vice versa (Dalton, 2016), so attending to both process and people.

The literature largely confirms that higher CMMI levels are associated with higher software quality and project performance (Chevers et al., 2008; Harter, Slaughter and Krishnan, 2000; Subramanian, Jiang, Klein, Huang and Bramanian, 2007). For example, in a study of 30 software products created by an IT firm, Harter, Krishnan and Slaughter (2007) found that greater embeddedness of SPI practices is related to higher product quality, that is, fewer defects in system and user testing. Likewise, findings from a survey of IEEE Computer Society members suggested higher CMMI levels were related to improved software quality (e.g. software reliability, cost of software operations) and project performance (e.g. meeting budgetary, schedule and user requirements) (Subramanian et al., 2007).

Altogether, these studies acknowledge the importance of specific process improvement practices, and support the notion that sufficient attention to SPI practices, can increase the likelihood of producing high quality software (Niazi and Babar, 2009; Staples and Niazi, 2008). Hence, it is expected that:

Figure 1. The research model



H1: The institutionalization of software process improvement practices will have a positive impact on software quality

People

The agile paradigm emphasizes the importance of people in software development (Cockburn & Highsmith, 2001). Proponents of this view suggest that the competence and contribution of those involved (people) in the development of the software can impact the quality of the delivered software (Torrecilla-Salinasa et al., 2016). In this study, *competence* refers to project management skills, software development methods, software engineering skills and faithful execution of software practices that are brought to bear on the project, while *contribution* describes the level of input by project team members towards the successful execution of the project. It is posited that both the competence and contribution of software developers and project managers can impact the outcome of software projects, and especially in developing countries where there are human resource shortages (Fiestas, 2011).

Duggan and Reichgelt (2006) asserted that if developers are knowledgeable and capable, the possibility exists for the delivered system to be of high quality. They further explained that knowledgeable developers, in the execution of their tasks, are better able to observe sources of inconsistencies, track such occurrences and

negotiate their resolution. In a SPI deployment study, people skills and contribution were found to be the most important (Kaltio and Kinnula, 2000). This suggests that the competencies of the people on a project (i.e. for project managers and system developers) and their contribution to the project are key indicators of the impact of people on software quality. Thus it is expected that:

H2: People skills will have a positive impact on software quality

Technology

Technology is concerned with the extent to which automated facilities are used to support the successful execution of the project. Studies have shown that technological tools (which includes project management software applications and computer aided software engineering tools), when used in software development positively impact the quality of source code, developer's productivity and the quality of documentation (Coupe and Onodu, 1996). For example, computer-aided software engineering (CASE) tools have been found to play a key role in improving IS quality (Coupe & Onodu, 1996; IIT Kharagpur, 2008). CASE tools are described by Coupe and Onodu (1996) as "a fully integrated, automated software development tool, for producing effective information systems that can help organizations fulfill their objectives" (p.173). The benefits include improved software quality, especially in the areas of reliability and functionality quality characteristics (Coupe and Onodu, 1996).

Project management software like Microsoft Project, Smartsheet and Trello are another category of tools that impact software quality. These assist with planning, estimating, scheduling, resource allocation, quality management, cost control and budget management for development projects. Empirical research suggests a positive relationship between established project management practices and the performance of projects (Chou and Yang, 2012). Conversely, it can be suggested that ineffective application of project management practices and procedures can result in the delivery of poor quality products or project failure.

Technologies such as CASE tools and project management software have been shown to enhance the performance of developers and project managers during the development process from requirements management through to deployment (Coupe and Onodu, 1996). In general, the benefits of these tools include improved productivity and efficiency through greater control of resources, improved communication, better documentation, improved code generation and improved tracking of project performance (Wilson, 2007). Hence it is expected that:

H3: The use of technological tools will have a positive impact on software quality

In summary, this study suggests three key factors, that is, the software process in combination with technology and people, as determinants of software quality. These relationships are summarized in Figure 1.

Software Quality

Researchers over the years have not entirely agreed on what is a good measure for software quality. To resolve the issue, in 1991 a group of software and systems engineers under the guidance of the Joint Technical Committee 1 of the International Organization for Standardization and International Electrotechnical Commission, established a set of software product quality standards that are now known as ISO/IEC 25010, and which are widely accepted in the IS community (Gorla and Lin, 2010). They defined quality as "the totality of features and characteristics of a product or service that bears on its ability to satisfy given needs" (ISO 8402: 1986, 3.1), and established a framework for the evaluation of software quality, through identification of key quality characteristics and their metrics.

In this study the ISO/IEC 25010 software product quality standard was chosen based on its popularity (Gorla & Lin, 2010; ISO/IEC, 2014). The ISO/IEC standard comprises six (6) characteristics, namely, functionality, reliability, usability, efficiency, maintainability and portability. However, similar to Gorla and Lin (2010), portability which addresses how easy it is to transfer the software to another environment, was not included in this study, based on the belief that the need to transport software from one platform to another would not be as prevalent for the types of software projects undertaken by small development firms. As such, 'software quality' as defined in this study comprises five (5) dimensions namely, maintainability, reliability, efficiency, functionality and usability.

METHODOLOGY

The key objective of this study was to propose and validate a simplified software process improvement model that maintains the intent of established SPI models such as the CMMI, but is less complex and so more accessible to small firms in developing countries. The first step was to identify key practice areas that small firms should focus on for improving the software development process. Four focus group sessions were held across four developing countries in the English-speaking Caribbean (ESC) countries. Thirty (30) IS professionals working in and with small software development firms participants participated. They were asked to identify, select and rank key software practices based on their knowledge of the goals, norms, software practices, and constraints of small firms in their regions. Starting with the

full set of eighteen CMMI Level 2 and Level 3 practices (See Table 1), persons added, deleted or combined SPI practices they viewed as inseparable, to yield a set of practices which they believed were relevant to small software development firms in the ESC. They then ranked the practices they believed were essential to an SPI framework for small firms; 24 practices (including practice combinations) were identified and ranked. The results were then collated across the regions and the top-ranked practices identified (Chevers et al., 2017).

The 10 top-ranked software practices (Table 1) identified by the focus groups were: risk management, technical solution, organization training, requirements development + requirements management, integrated project management, project planning, organization process definition, organization process focus, project monitoring and control and verification + validation (For brief descriptions of the practices, see Appendix A). The shortlisted practices covered 12 of the 18 CMMI process areas at Levels 2 and 3 (with two practice areas deemed inseparable, i.e. requirements development + requirements management and, verification + validation). The number of practices to be included in the framework was not pre-determined. Rather, the Top-10 list emerged naturally, as those ranked 11 onwards were combinations of practices that were already in the Top-10 (e.g. Requirements Management + Organization Process Definition). This normative set of practices was then incorporated into a simplified software process improvement framework for small firms (SPIM-S) (Chevers et al., 2017).

To validate the SPIM-S framework, a survey using a matched-pair design was conducted in the four countries represented in the focus groups. The impact of the software practices alongside technology and people on software quality was assessed. The participating organizations were small firms, defined as having 50 employees or less, and an annual turnover of up to ten million euros (European Commission, 2005). The unit of analysis was the IS development project. To identify suitable projects and survey respondents, a list of small firms in Barbados, Guyana, Jamaica, and Trinidad & Tobago that develop software for sale or in-house use was identified using phone lists, referrals and other contacts. Contacts were initiated with the firm CEOs/CIOs who referred the research team to recently completed software development projects (i.e. projects implemented within the last two years). The surveys were distributed to the project managers (or senior developers) with responsibility for the project. Each project manager/ developer respondent was asked to complete a set of questions related to software practices, and technology and people elements for that project. The project manager/developer then passed the survey to a key user to respond to items on the quality of the software that had been delivered.

Table 1. CMMI maturity level and associated software process areas

CMMI Maturity Level 2: Software Process Areas	Included in SPIM-S	CMMI Maturity Level 3: Software Process Areas	Included in SPIM-S
Requirements Management	*Y*	*Requirements Development*	*Y*
Project Planning	*Y*	*Risk Management*	*Y*
Project Monitoring & Control	*Y*	*Technical Solution*	*Y*
Supplier Management Agreement		*Organization Training*	*Y*
Measurement and Analysis		*Integrated Project Management*	*Y*
Process & Product Quality Assurance		*Organization Process Definition*	*Y*
Configuration Management		*Organization Process Focus*	*Y*
		Verification	*Y*
		Validation	*Y*
		Product Integration	
		Decision Analysis & Resolution	

Instrument Development

All constructs were operationalized as multi-dimensional with each sub-dimension consisting of 2-4 items each (See Appendix B). Responses were captured using 7-point Likert-type scales anchored as (1) Strongly Disagree and (7) Strongly Agree; those for which a practice was not in place were recorded as 'not applicable', and coded as 0. The software process consisted of 10 sub-dimensions (software practices) and was measured using items from the CMMI 'Maturity Questionnaire' (Zubrow, Hayes, Siegel and Goldenson, 1994). Software quality was assessed in terms of five dimensions, namely maintainability, functionality, usability, efficiency and reliability, and multi-item scales (with 2-3 items each) adapted from (Lewis, 1995).

Construct measures for people and technology elements were newly developed. Based on a review of the literature (Balasubramanian and Raja, 2010), the scales focused on key dimensions of people and technology resources, namely the use of project management and CASE tools for the technology element, and software development and project management skills, and contribution to the project for the people aspect.

The research instrument was then assessed using a pre-test. A convenience sample of 17 IS researchers, research method specialists, and graduate IS students (in Jamaica and Trinidad), provided feedback on the survey form and administration process including duration to complete the survey, and to identify any ambiguous,

compounded or difficult questions. Based on this feedback, the necessary changes were made to the measures and survey administration process.

Data Collection

The survey instrument was distributed to targeted organizations in Jamaica, Barbados, Guyana and Trinidad & Tobago. Respondent dyads consisted of a project manager (or senior developer) and a key user who had participated in a recently deployed software project. The project manager (or developer) represented someone who was knowledgeable about the practices and resources used to plan, organize, schedule, and deploy the respective systems and could evaluate the project from an internal perspective, while the user respondent represented someone who could provide a separate evaluation of the quality of the software project from an external perspective. The research instrument had two (2) parts: Part A listed questions related to the software process, people and technology and were answered by the project manager/developer; while Part B on software quality was completed by a user-respondent of the same system. Responses from project manager/developer and user dyads were then combined to yield one set of measures for each project. While some firms had more than one project that met the study criteria, only one paired project manager/user response was sought from each firm.

The survey was administered online. In total, 360 survey links were sent to small software development organisations. 136 responses were returned of which 24 were incomplete, resulting in a usable response rate of 31% (n=112). Most of the responses came from Jamaica (63%) and Trinidad & Tobago (21%) which was expected as these countries are by far the largest of the four, in terms of population and number of software development firms. Several sectors were represented with responses coming from information technology firms (26%), government agencies (18%), and the education (11%) and communications (10%) sectors. For the selected software project, the average project complexity was just above mid-range at 4.8 (on a scale of 1-7) when compared with other projects in the organisation. Project manager/developer experience ranged from 1 to 30 years (mean=9.1 years, SD=7.3). Most of the project teams were small: 9% had less than 3 members, 32% had 3-5 members, 26% had 6-10 members, and 13% and 20% had 11-15 and >15 members, respectively.

Harman's one-factor test (Podsakoff and Organ, 1986) was used to assess common method bias. The results showed that no single factor accounted for more than 28.7% of the variance observed. Common method bias was therefore not considered an issue for this study.

DATA ANALYSIS

The research model was tested using the Partial Least Squares approach to path modeling (PLS-PM), a structural modeling technique. PLS-PM was chosen because of its ability to handle relatively small sample sizes, and model formative and reflective constructs (Chin, 2010). PLS Graph 3.0 was used to assess the measurement and structural models, and bootstrap re-sampling (500 re-samples) used to determine the significance of the paths within the structural model.

Descriptive statistics for the first-order constructs (i.e. the sub-dimensions of the software process, people, technology, and software quality) are reported in Table 2. The results show the firms evaluated their software quality at just above the mid-point (on a 1-7 scale), with usability being the highest ranked dimension (mean=5.06, SD=1.61) and maintainability the lowest ranked (mean=3.96, SD=1.72). On average, all firms had some software processes in place; however the mean response being around mid-range (mean=4.60, SD=1.55) suggests that the associated practices were not well-established. At the same time, the firms appeared to have reasonable access to people-related skills (e.g. project management and software development skills) with those involved making significant contributions to the project success (mean=5.17, SD=1.35). The results also showed that technology aspects were evaluated on average as below the mid-point (Mean=3.01, SD=2.10) with the higher standard deviation suggesting that tool use was more varied across the firms when compared with the software process and people aspects.

Measurement Model

At the first-order level, all construct sub-dimensions were assessed as reflective, while at the second-order level software quality was modeled as reflective, and software process, people and technology modeled as formative. Analysis of the measurement model for reflective constructs at the first-order level involved an evaluation of the item loadings, and estimations of internal consistency and convergent and discriminant validity. Factor loadings for first-order variables, composite reliabilities and average variance are reported in Table 3.

The results show that for the first-order reflective constructs (Table 3), item loadings were above the recommended cut-off of 0.70 (Chin, 2010), except for five items (i.e. RMRD01, PMC01, PP01, PMSKL02, PMSKL04). PP01, PMSKL02 and PMSKL04 (at 0.6314, 0.6438 and 0.6791 respectively) were just below the threshold of 0.70 and were retained. RMRD01 and PMC01 (at 0.5359 and 0.5425 respectively) were also retained. As these items were informed by established measures for the CMMI (Zubrow et al., 1994), they were retained to preserve content validity. Composite reliability (CR) measures ranged from 0.816 to 0.977, so were well above

Table 2. Descriptive statistics, composite reliability, and average variance extracted

Variable (# of Items)	Description	Mean	SD	Composite Reliability (CR)	Average Variance Extracted (AVE)
Software Process					
RSKM (4)	Risk Management	4.43	1.738	0.949	0.823
TS (3)	Technical Solution	4.81	1.298	0.836	0.630
OT (3)	Organization Training	4.80	1.599	0.886	0.722
RMRD (4)	Requirement Management + Requirement Development	4.89	1.247	0.837	0.570
IPM (3)	Integrated Project Management	4.52	1.687	0.894	0.737
PP (5)	Project Planning	4.88	1.309	0.869	0.573
OPD (3)	Organization Process Definition	4.23	1.968	0.951	0.867
OPF (3)	Organization Process Focus	4.02	1.816	0.921	0.797
PMC (4)	Project Monitoring and Control	4.71	1.338	0.848	0.589
VV (4)	Verification + Validation	4.76	1.514	0.941	0.800
People					
CONTR (3)	Quality of Contribution to Project	5.46	1.237	0.879	0.708
PMSKL (4)	Project Management Skills	4.98	1.252	0.830	0.553
SDSKL (3)	Systems Development Skills	5.07	1.575	0.863	0.677
Technology					
TTOOL (2)	Technological Tools	2.89	2.048	0.816	0.690
TEFFI (2)	Technology Efficiency	3.13	2.150	0.954	0.913
IS Quality					
MAINT (3)	Maintainability	3.96	1.724	0.913	0.778
RELIAB (3)	Reliability	4.61	1.793	0.884	0.718
EFFICI (2)	Efficiency	4.76	1.662	0.925	0.860
FUNCT (3)	Functionality	4.92	1.645	0.913	0.779
USABIL (3)	Usability	5.06	1.607	0.977	0.933

the recommended threshold of 0.70 (Chin, 2010) demonstrating adequate internal consistency. The results also show AVE values ranging from 0.553 to 0.933. These are above the recommended threshold of 0.50, suggesting adequate convergence among the measures for each construct (Chin, 2010).

Discriminant validity indicates the extent to which items load more on their own construct than others in the model. In this study, discriminant validity was assessed at the construct and item levels. For satisfactory discriminant validity at the construct

level, the square-root of the AVE for each construct should exceed the correlations among the constructs (Chin, 2010). Except for organization process definition and organization process focus, the results (Table 4) show that the square root of the AVE for each construct was greater than the correlation of that construct with other constructs in the model, suggesting adequate discriminant validity. For discriminant validity at the item level, the correlation of each item on its own construct was compared with all other constructs (i.e. cross-loadings); when items load more highly on their own construct than on other constructs, discriminant validity is satisfied at the item level (Chin, 2010); Table 5 shows this test was satisfied for all constructs.

Next, the second-order measurement model was evaluated. Latent variable scores were extracted and used to create second-order constructs for software process, people, technology and, software quality. For the second-order model, software process, people and technology were assessed as formative and software quality as reflective.

For software quality, the results (Table 5) showed the factor loadings ranged from 0.849-0.918 so were well above recommended cut-offs of 0.70. Composite reliability and AVE for software quality construct were 0.942 and 0.763 respectively and within the acceptable ranges (Chin, 2010). For discriminant validity the results showed the square root of the AVE for each construct was greater than the correlation of that construct with others in the model, indicating adequate discriminant validity (Chin, 2010).

For formative constructs (i.e. software process, people and technology), item weights and loadings, and collinearity were examined (Hair, Hult, Ringle and Sarstedt, 2016). Item weights indicate the relative importance of an item to the construct while the item loadings indicate its absolute importance to the construct regardless of the contribution of other items. The results (Table 6) showed loadings exceeded 0.50 (except two items) signaling their absolute importance to their respective constructs. Turning to item weights, contribution, project management skills, and technology tool use were also significant ($p \leq 0.10$). For software process improvement practices, the results showed significant weights for organization process focus and, verification and validation at $p \leq 0.10$; organization process definition was weakly significant at $p \leq 0.20$. Since prior work and the focus group results suggest all 10 practices are important for software improvement (SEI, 2010) these were retained to ensure the integrity of the framework. Finally the level of collinearity was assessed using the variance inflation factor (VIF). The results show all items returned a VIF less than 5; as such collinearity was not considered to be an issue.

Structural Model

For the structural model, the results for the main effects showed that the model accounted for 0.276 of the variance observed for software quality. Software process

Table 3. Item loadings, composite reliability and average variance extracted for reflective first order variables

Software Process					
Risk Management:		*Project Monitoring and Control:*		*Verification + Validation:*	
RSKM01	0.863	PMC01	0.543	VV01	0.899
RSKM02	0.930	PMC02	0.772	VV02	0.899
RSKM03	0.933	PMC03	0.842	VV03	0.893
RSKM04	0.902	PMC04	0.870	VV04	0.886
Technical Solution:		*Integrated Project Management:*		*Organization Process Focus:*	
TS01	0.804	IPM01	0.854	OPF01	0.822
TS02	0.793	IPM02	0.811	OPF02	0.919
TS03	0.784	IPM03	0.909	OPF03	0.933
Organization Training:		*Requirement Management + Requirement Development:*		*Project Planning:*	
OT01	0.794	RMRD01	0.536	PP01	0.631
OT02	0.857	RMRD02	0.874	PP02	0.853
OT03	0.894	RMRD03	0.806	PP03	0.722
		RMRD04	0.760	PP04	0.761
Organization Process Definition:				PP05	0.800
OPD01	0.940				
OPD02	0.929				
OPD03	0.924				
Technology					
Technology Tools:		*Technology Efficiency:*			
TTOOL01	0.861	TEFFI01	0.955		
TTOOL02	0.799	TEFFI02	0.956		
People					
Contribution:		*Project Management Skills:*		*Systems Development Skills:*	
CONTR01	0.807	PMSKL01	0.644	SDSKL01	0.804
CONTR02	0.844	PMSKL02	0.841	SDSKL02	0.848
CONTR03	0.872	PMSKL03	0.794	SDSKL03	0.815
		PMSKL04	0.679		
Software Quality					
Maintainability:		Functionality:		Reliability:	
MAINT1	0.899	FUNCT1	0.860	RELIAB1	0.867
MAINT2	0.871	FUNCT2	0.921	RELIAB2	0.816
MAINT3	0.875	FUNCT3	0.866	RELIAB3	0.859
Usability:		Efficiency:			
USABIL1	0.960	EFFICI1	0.935		
USABIL2	0.971	EFFICI2	0.920		
USABIL3	0.967				

Table 4. Inter-construct correlations–first-order model

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. RSKM	**0.907**																			
2. TS	0.447	**0.794**																		
3. OT	0.479	0.411	**0.850**																	
4. RMRD	0.403	0.554	0.383	**0.755**																
5. IPM	0.583	0.496	0.463	0.568	**0.859**															
6. PP	0.461	0.615	0.362	0.691	0.547	**0.757**														
7. OPD	0.179	0.234	0.246	0.287	0.517	0.260	**0.931**													
8. OPF	0.198	0.289	0.329	0.366	0.594	0.319	0.843	**0.893**												
9. PMC	0.580	0.623	0.423	0.633	0.789	0.575	0.469	0.533	**0.768**											
10. VV	0.468	0.606	0.440	0.467	0.559	0.577	0.219	0.391	0.571	**0.894**										
11. CONTR	0.280	0.470	0.443	0.504	0.359	0.388	0.173	0.257	0.347	0.466	**0.841**									
12. PMSKL	0.547	0.535	0.421	0.500	0.560	0.452	0.322	0.374	0.525	0.590	0.458	**0.744**								
13. SDSKL	0.243	0.361	0.308	0.423	0.366	0.390	0.406	0.401	0.261	0.444	0.468	0.537	**0.823**							
14. TTOOL	0.215	0.109	0.251	0.301	0.414	0.255	0.361	0.326	0.273	0.199	0.318	0.337	0.358	**0.830**						
15. TEFFI	0.111	0.095	0.147	0.190	0.274	0.167	0.242	0.201	0.245	0.162	0.271	0.234	0.292	0.762	**0.955**					
16. MAINT	0.285	0.398	0.257	0.392	0.371	0.380	0.087	0.052	0.394	0.370	0.261	0.214	0.304	0.211	0.226	**0.882**				
17. RELIAB	0.231	0.238	0.149	0.177	0.287	0.226	0.109	0.108	0.308	0.324	0.334	0.252	0.355	0.268	0.310	0.680	**0.847**			
18. EFFICI	0.273	0.362	0.238	0.255	0.242	0.356	0.101	0.078	0.272	0.365	0.231	0.118	0.226	0.124	0.148	0.689	0.802	**0.927**		
19. FUNCT	0.178	0.218	0.195	0.162	0.197	0.195	0.029	0.051	0.194	0.244	0.376	0.257	0.289	0.283	0.220	0.558	0.647	0.697	**0.882**	
20. USABIL	0.208	0.301	0.259	0.187	0.208	0.231	0.046	0.041	0.259	0.351	0.286	0.244	0.230	0.260	0.148	0.666	0.749	0.826	0.745	**0.966**

Note: The diagonal elements show the square root of the average variance extracted (AVE).

(β=0.386, $p \leq 0.01$) and technology (β=0.225, $p \leq 0.001$) are significantly and positively related to software quality supporting hypotheses H1 and H3 respectively. However, contrary to expectations, the people element (β=0.050) was not significant regarding software quality; hypothesis H2 was not supported (as shown in Figure 2).

Project Characteristics: Team Size and Project Complexity – A Post-hoc Analysis

To provide insights into alternate explanations for the findings, a post-hoc analysis with two project-characteristics included as control variables was conducted – *project team size* and *project complexity*. *Team size* refers to the number of persons on the project team, and is an indicator of the size of the project. Prior research has shown that the size of the project (i.e. large vs. small) and project complexity are related to project success. For example, research shows smaller projects are more efficient in responding to changes (both business and technological) than larger projects (Lee and Xia, 2005). Agile and iterative development approaches which have been shown to be more successful are also associated with smaller teams (Vijayasarathy and Butler, 2017). It is generally expected that smaller projects are likely to be more successful than larger projects (Standish Group, 2015).

A *complex project* is one that has a number of characteristics (to a degree, or level of severity), that makes it extremely difficult to predict project outcomes, or to control or manage the project (Remington, 2009). Studies suggest that project complexity can negatively impact the success of projects (Luo, He, Xie, Yang, and Wu, 2017) such that less complex projects are likely to be successful than more complex

Table 5. Loading and cross-loadings – first-order model

	RSKM	TS	OT	RMRD	IPM	PP	OPD	PMC	VV	PP	TTOOL	TEFFI	PMSKL	SDSKL	CONTR	MAINT	RELIAB	EFFIC	FUNCT	USABIL
RSKM01	**0.863**	0.357	0.364	0.278	0.459	0.468	0.139	0.105	0.404	0.406	0.238	0.158	0.553	0.255	0.226	0.194	0.224	0.298	0.181	0.207
RSKM02	**0.930**	0.327	0.403	0.328	0.495	0.469	0.075	0.102	0.398	0.405	0.207	0.109	0.481	0.214	0.304	0.273	0.226	0.242	0.125	0.179
RSKM03	**0.933**	0.459	0.468	0.344	0.514	0.489	0.129	0.171	0.437	0.416	0.160	0.049	0.510	0.198	0.202	0.238	0.166	0.208	0.191	0.164
RSKM04	**0.902**	0.461	0.487	0.484	0.625	0.653	0.281	0.308	0.451	0.440	0.183	0.093	0.454	0.218	0.282	0.317	0.222	0.249	0.150	0.204
TS01	0.434	**0.804**	0.227	0.413	0.326	0.463	0.213	0.194	0.490	0.481	0.061	0.080	0.466	0.253	0.397	0.341	0.255	0.394	0.229	0.304
TS02	0.307	**0.793**	0.287	0.422	0.385	0.420	0.048	0.176	0.561	0.487	0.048	0.030	0.403	0.267	0.367	0.272	0.280	0.318	0.208	0.311
TS03	0.324	**0.784**	0.452	0.479	0.465	0.590	0.283	0.310	0.402	0.494	0.144	0.113	0.404	0.334	0.355	0.330	0.046	0.161	0.089	0.113
OT01	0.220	0.331	**0.794**	0.266	0.258	0.218	0.156	0.202	0.329	0.297	0.220	0.114	0.373	0.307	0.403	0.229	0.143	0.261	0.214	0.286
OT02	0.395	0.374	**0.857**	0.301	0.341	0.275	0.095	0.188	0.393	0.309	0.203	0.075	0.330	0.261	0.376	0.161	0.107	0.188	0.150	0.183
OT03	0.545	0.349	**0.894**	0.388	0.528	0.521	0.333	0.405	0.394	0.319	0.221	0.172	0.375	0.237	0.365	0.258	0.132	0.179	0.150	0.210
RMRD01	0.281	0.388	0.361	**0.536**	0.296	0.264	0.241	0.206	0.234	0.461	0.214	0.033	0.404	0.260	0.346	0.151	0.015	0.157	0.133	0.036
RMRD02	0.408	0.501	0.339	**0.874**	0.554	0.550	0.226	0.303	0.454	0.621	0.297	0.203	0.440	0.337	0.486	0.354	0.169	0.231	0.236	0.183
RMRD03	0.227	0.423	0.259	**0.806**	0.450	0.526	0.233	0.340	0.350	0.543	0.235	0.168	0.382	0.357	0.413	0.343	0.219	0.254	0.061	0.172
RMRD04	0.287	0.346	0.208	**0.760**	0.373	0.531	0.175	0.244	0.338	0.440	0.147	0.139	0.282	0.317	0.251	0.305	0.099	0.114	0.039	0.148
IPM01	0.484	0.342	0.415	0.463	**0.854**	0.643	0.476	0.465	0.391	0.466	0.338	0.152	0.484	0.329	0.237	0.347	0.231	0.265	0.133	0.217
IPM02	0.462	0.456	0.334	0.417	**0.811**	0.636	0.277	0.400	0.487	0.410	0.392	0.336	0.481	0.203	0.342	0.278	0.305	0.191	0.217	0.152
IPM03	0.550	0.476	0.437	0.570	**0.909**	0.745	0.555	0.641	0.555	0.525	0.342	0.226	0.482	0.393	0.343	0.330	0.215	0.175	0.163	0.169
PMC01	0.416	0.402	0.351	0.443	0.359	**0.542**	0.080	0.093	0.390	0.387	0.108	0.103	0.305	0.188	0.195	0.244	0.207	0.139	0.056	0.113
PMC02	0.426	0.465	0.299	0.393	0.643	**0.772**	0.403	0.487	0.451	0.303	0.206	0.186	0.417	0.109	0.340	0.349	0.303	0.190	0.159	0.220
PMC03	0.400	0.523	0.360	0.573	0.638	**0.842**	0.358	0.434	0.385	0.524	0.231	0.208	0.381	0.215	0.279	0.291	0.131	0.217	0.173	0.230
PMC04	0.537	0.516	0.310	0.529	0.726	**0.870**	0.519	0.540	0.521	0.531	0.268	0.235	0.489	0.277	0.250	0.323	0.302	0.270	0.185	0.216
OPD01	0.119	0.180	0.186	0.241	0.481	0.425	**0.940**	0.773	0.200	0.226	0.405	0.303	0.296	0.383	0.191	0.090	0.119	0.127	0.016	0.081
OPD02	0.082	0.193	0.166	0.204	0.411	0.356	**0.929**	0.756	0.124	0.201	0.384	0.271	0.308	0.377	0.151	0.051	0.112	0.117	0.037	0.031
OPD03	0.267	0.267	0.310	0.334	0.532	0.504	**0.924**	0.815	0.265	0.285	0.245	0.128	0.296	0.373	0.145	0.094	0.079	0.051	0.030	0.021
OPF01	0.154	0.124	0.218	0.221	0.452	0.370	0.676	**0.822**	0.261	0.234	0.318	0.263	0.293	0.254	0.228	0.021	0.172	0.140	0.106	0.041
OPF02	0.157	0.297	0.296	0.328	0.540	0.502	0.759	**0.919**	0.375	0.243	0.283	0.166	0.350	0.362	0.205	0.073	0.073	0.021	0.018	0.044
OPF03	0.213	0.323	0.350	0.406	0.585	0.534	0.813	**0.933**	0.393	0.363	0.282	0.135	0.353	0.433	0.256	0.041	0.064	0.063	0.028	0.027
VV01	0.406	0.526	0.320	0.395	0.568	0.520	0.272	0.408	**0.899**	0.525	0.248	0.222	0.513	0.422	0.345	0.404	0.359	0.375	0.256	0.333
VV02	0.368	0.497	0.386	0.423	0.484	0.548	0.215	0.377	**0.899**	0.506	0.180	0.126	0.504	0.307	0.432	0.339	0.319	0.341	0.221	0.341
VV03	0.436	0.557	0.422	0.438	0.484	0.482	0.169	0.312	**0.893**	0.556	0.171	0.133	0.550	0.448	0.448	0.339	0.257	0.302	0.207	0.314
VV04	0.464	0.592	0.447	0.415	0.464	0.491	0.126	0.299	**0.886**	0.477	0.110	0.096	0.544	0.409	0.443	0.239	0.222	0.286	0.186	0.266
PP01	0.396	0.332	0.228	0.418	0.411	0.375	0.194	0.237	0.263	**0.631**	0.164	0.024	0.219	0.177	0.158	0.228	0.187	0.200	0.078	0.135
PP02	0.386	0.489	0.377	0.540	0.427	0.492	0.266	0.229	0.481	**0.853**	0.238	0.123	0.409	0.320	0.317	0.358	0.196	0.371	0.134	0.236
PP03	0.271	0.445	0.224	0.403	0.323	0.365	0.165	0.207	0.450	**0.722**	0.099	0.167	0.314	0.249	0.276	0.242	0.154	0.240	0.123	0.188
PP04	0.287	0.560	0.299	0.562	0.391	0.332	0.051	0.194	0.503	**0.761**	0.166	0.098	0.321	0.350	0.386	0.296	0.144	0.260	0.222	0.171
PP05	0.399	0.488	0.235	0.655	0.502	0.575	0.284	0.330	0.468	**0.799**	0.271	0.200	0.418	0.356	0.314	0.300	0.176	0.261	0.171	0.142
TTOOL01	0.160	0.124	0.338	0.326	0.434	0.308	0.318	0.313	0.246	0.274	**0.861**	0.707	0.339	0.325	0.367	0.368	0.229	0.265	0.309	0.200
TTOOL02	0.202	0.051	0.057	0.161	0.238	0.133	0.280	0.221	0.070	0.139	**0.799**	0.548	0.211	0.266	0.143	0.247	0.195	0.211	0.149	0.163
TEFFI01	0.036	0.065	0.105	0.170	0.177	0.175	0.168	0.126	0.112	0.124	0.712	**0.955**	0.162	0.272	0.264	0.252	0.179	0.172	0.217	0.121
TEFFI02	0.174	0.117	0.175	0.193	0.345	0.292	0.293	0.257	0.196	0.195	0.744	**0.956**	0.284	0.286	0.253	0.295	0.285	0.266	0.278	0.161
PMSKL01	0.425	0.395	0.378	0.514	0.558	0.539	0.229	0.301	0.407	0.478	0.439	0.313	**0.644**	0.175	0.401	0.367	0.144	0.236	0.196	0.197
PMSKL02	0.338	0.523	0.314	0.482	0.452	0.463	0.175	0.271	0.540	0.465	0.221	0.163	**0.841**	0.378	0.425	0.318	0.177	0.316	0.305	0.278
PMSKL03	0.404	0.318	0.255	0.235	0.357	0.214	0.195	0.185	0.425	0.181	0.201	0.130	**0.794**	0.484	0.288	0.173	0.179	0.240	0.118	0.205
PMSKL04	0.482	0.350	0.324	0.279	0.328	0.380	0.375	0.372	0.373	0.243	0.182	0.118	**0.679**	0.531	0.255	0.153	0.250	0.260	0.174	0.239
SDSKL01	0.237	0.283	0.206	0.361	0.256	0.226	0.274	0.260	0.404	0.406	0.296	0.251	0.474	**0.804**	0.349	0.229	0.123	0.196	0.137	0.119
SDSKL02	0.230	0.287	0.311	0.299	0.280	0.129	0.228	0.237	0.357	0.289	0.272	0.249	0.511	**0.848**	0.379	0.175	0.076	0.191	0.131	0.164
SDSKL03	0.128	0.324	0.238	0.389	0.371	0.298	0.515	0.507	0.334	0.268	0.318	0.221	0.330	**0.815**	0.429	0.167	0.094	0.169	0.032	0.077
CONTR01	0.223	0.458	0.381	0.396	0.282	0.309	0.191	0.306	0.431	0.242	0.200	0.219	0.440	0.303	**0.806**	0.094	0.147	0.278	0.170	0.212
CONTR02	0.258	0.367	0.403	0.494	0.350	0.276	0.153	0.214	0.404	0.386	0.289	0.163	0.413	0.482	**0.843**	0.293	0.175	0.220	0.164	0.152
CONTR03	0.223	0.362	0.329	0.372	0.268	0.291	0.092	0.129	0.338	0.344	0.311	0.308	0.297	0.384	**0.872**	0.265	0.217	0.274	0.201	0.211
MAINT01	0.347	0.356	0.278	0.397	0.387	0.407	0.120	0.114	0.390	0.368	0.369	0.261	0.357	0.208	0.296	**0.899**	0.649	0.615	0.493	0.618
MAINT02	0.169	0.303	0.112	0.291	0.252	0.291	-0.003	-0.055	0.250	0.286	0.310	0.247	0.255	0.141	0.153	**0.871**	0.616	0.604	0.539	0.588
MAINT03	0.236	0.396	0.292	0.349	0.343	0.344	0.113	0.080	0.339	0.352	0.314	0.249	0.267	0.266	0.242	**0.875**	0.529	0.603	0.441	0.554
RELIAB01	0.157	0.211	0.101	0.172	0.176	0.252	-0.017	-0.015	0.238	0.227	0.150	0.191	0.185	0.078	0.177	0.588	**0.867**	0.772	0.635	0.758
RELIAB02	0.202	0.148	0.067	0.098	0.238	0.239	0.228	0.230	0.333	0.181	0.286	0.249	0.239	0.182	0.108	0.493	**0.816**	0.626	0.542	0.540
RELIAB03	0.234	0.242	0.210	0.174	0.327	0.292	0.088	0.082	0.262	0.161	0.230	0.185	0.224	0.049	0.255	0.644	**0.858**	0.627	0.458	0.585
EFFICI01	0.277	0.391	0.194	0.202	0.233	0.278	0.066	0.049	0.371	0.326	0.198	0.147	0.298	0.174	0.289	0.662	0.775	**0.935**	0.662	0.846
EFFICI02	0.228	0.275	0.250	0.276	0.215	0.225	0.124	0.097	0.303	0.335	0.345	0.286	0.365	0.249	0.275	0.615	0.711	**0.920**	0.630	0.679
FUNCT01	0.133	0.239	0.234	0.071	0.120	0.082	-0.037	-0.018	0.282	0.161	0.242	0.196	0.259	0.171	0.282	0.540	0.667	**0.729**	**0.859**	0.778
FUNCT02	0.165	0.169	0.141	0.157	0.206	0.201	0.064	0.070	0.162	0.118	0.274	0.282	0.227	0.093	0.137	0.512	0.530	0.563	**0.921**	0.622
FUNCT03	0.179	0.157	0.129	0.218	0.206	0.250	0.064	0.097	0.189	0.246	0.233	0.212	0.219	0.048	0.119	0.409	0.494	0.526	**0.866**	0.542
USABIL01	0.208	0.309	0.241	0.191	0.187	0.217	0.003	0.017	0.343	0.200	0.212	0.161	0.305	0.129	0.243	0.619	0.712	0.819	0.738	**0.960**
USABIL02	0.186	0.245	0.250	0.156	0.204	0.261	0.042	0.034	0.332	0.206	0.230	0.145	0.280	0.152	0.203	0.657	0.724	0.777	0.694	**0.971**
USABIL03	0.209	0.317	0.260	0.195	0.212	0.272	0.090	0.069	0.341	0.262	0.196	0.122	0.315	0.146	0.209	0.654	0.733	0.798	0.727	**0.967**

projects (Standish, 2015). Muller, Geraldi and Turner (2011), when investigating the interaction between project managers' leadership and project complexity, likewise found a negative impact for project complexity on project success.

The results showed that of the control variables, only project (team) size impacted software quality (β=-0.212, $p \leq 0.01$), such that larger projects were associated with lower software quality and smaller projects with higher software quality. Together

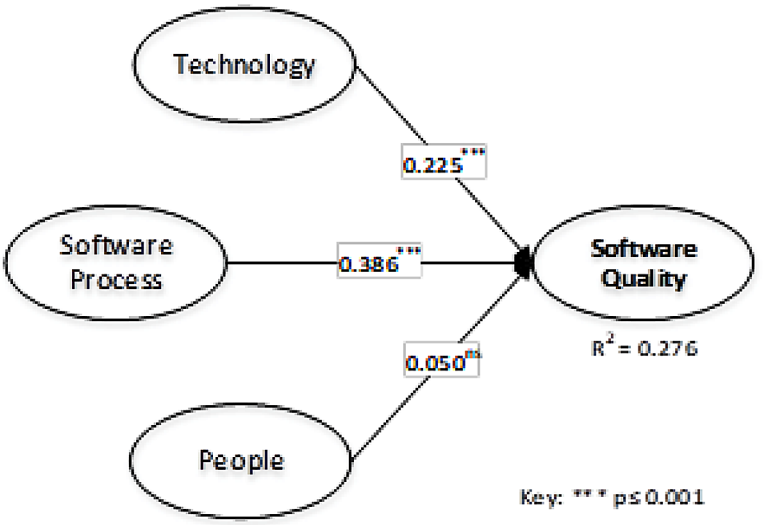
Table 6. Weights and loadings for second order variables

Variable (# of Items)	Description	Weights	Loadings
Software Process			
RSKM (4)	Risk Management	-0.081	0.587***
TS (3)	Technical Solution	0.185	0.763***
OT (3)	Organization Training	0.171	0.544***
RMRD (4)	Requirements Management + Requirements Development	0.034	0.605***
IPM (3)	Integrated Project Management	0.217	0.654***
PP (5)	Project Planning	0.120	0.704***
OPD (3)	Organization Process Definition	0.401†	0.188
OPF (3)	Organization Process Focus	-0.792**	0.159
PMC (4)	Project Monitoring and Control	0.233	0.715***
VV (4)	Verification + Validation	0.550**	0.818***
People			
CONTR (3)	Contribution	0.431*	0.747***
PMSKL (4)	Project Management Skills	0.780***	0.930***
SDSKL (3)	Systems Development Skills	-0.088	0.542**
Technology			
TTOOL (2)	Technology Tools	0.910**	0.997***
TEFFI (2)	Technology Efficiency	0.114	0.808***
IS Quality			
MAINT (3)	Maintainability	0.296***	0.847***
RELIAB (3)	Reliability	0.205***	0.882***
EFFICI (2)	Efficiency	0.246***	0.919***
FUNCT (3)	Functionality	0.184***	0.812***
USABIL (3)	Usability	0.215***	0.904***

Key: *** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.10$; † $p \leq 0.20$

with the main effects, the augmented model accounted for a total variance observed of 0.309. To further understand the significance of team size, the change in R^2 was examined; more specifically the effect size f^2 was calculated for the change in R^2. The results showed a small effect size of 0.04 for project team size (Chin, 2010). Taken altogether the post-hoc test provides further evidence that even though project size does matter, the main impacts on software success for small software development firms derive from process and technology.

Figure 2. Research model results



DISCUSSION AND IMPLICATIONS

The purpose of this study was to propose and evaluate a simplified software process improvement model for small firms (SPIM-S). This was done by examining the impact of the software process as well as people and technology on software quality; the impacts of project size and project complexity were also assessed. Using data from small software development firms in developing countries of the English-speaking Caribbean (ESC) the results show that quality of the software process and technology have a positive impact on software quality. The model collectively explains 27.6% of the variance observed for software quality, with software process having the greater impact. The results are consistent with prior research which have explained 21% to 32% of the variance observed for IS quality (Dooley et al., 2001).

Although the study did not show a significant impact for the people element in explaining the variance observed for software quality, having adequate people 'resources' in terms of project management and systems development skills and, the quality of their contribution to the development process is nevertheless essential to software development and producing quality products (Kaltio and Kinnula, 2000).

The results also show that project team size significantly impacts software quality, such that smaller projects were associated with higher software quality and larger projects with lower software quality. This provides support of the importance of project size (with smaller projects being the more successful) for software quality

(Standish Group, 2015). This finding is also consistent with the expectation of agile approach to software development (Cockburn and Highsmith, 2001).

This study evaluated the SPIM-S by examining the impacts of the software practices of small firms on the quality of the software product. It also made an assessment of the current state of small firms in the ESC with respect to these SPI practices. The results confirmed that most software development firms in the ESC are, in general, operating at Level 2 or Level 3 in terms of process maturity. While the software process had the greatest impact on software quality, only three out of ten practices were significant in respect of software quality - organization process definition, organization process focus and, verification and validation – all Level 3 practices. A probable explanation for why these three practices were significant could be the emphasis that firms place on the importance of project activities like reviews, inspections and quality assurance in software development (Niazi and Babar, 2009).

The results further suggest that the other software practices may not have been well-embedded in the software development process and so had no significant impact on the quality of the software product. This is likely because the majority of software development firms in the ESC are not fully aware of SPI practices or were not explicitly using direct forms of SPI initiatives to support their software delivery process (Chevers and Duggan, 2010). With limited system development processes in place, these firms have a long way to go to improve their software development processes and comply with international quality standards for competing effectively in a global market. Such can be achieved through improved awareness, and incremental adoption and adaptation of SPI practices and programs to support their software development processes. However, as small firms often do not have sufficient resources to engage in cumbersome compliance systems, industry resources, development agencies and advocates for small firms, and 'IT professional associations' may be able to assist by enabling educational and other opportunities to increase awareness of best practices to help firms improve their processes.

Another key outcome of this study is the validation of a simple yet potentially feasible software process improvement model for small firms (SPIM-S), which can be used as a diagnostic tool to evaluate SPI programs and as a guide to identify practices that should be prioritized for improving software quality and qualifying themselves to compete globally (Niazi et al., 2010). The proposed framework can also be used to assess and understand the relative impact of various software process improvement practices on software quality, and identify practices that warrant further attention. Business and technical managers in small firms can therefore avail themselves of a set of tools to assess their software development process and help them identify and address gaps in their practices, and increase their capacity to produce high quality software. The proposed framework is considered to be more in line with the context and constraints of small firms, particularly in developing

countries, given the setting in which the model was developed and assessed. It is therefore expected that access to a simpler framework, such as the SPIM-S, may help increase the adoption and use of SPI methods in these firms. Indeed as the current study shows, on average many firms (whether they were fully aware or not) to some extent have incorporated aspects of various practices into their software development processes. Thus, compared with the CMMI and other process improvement models, the SPIM-S with fewer practices should be less complex, and so less costly and disruptive to implement. It is hoped that through improved SPI awareness, a simpler framework, such as the one offered in this study, will be useful for helping firms produce higher-quality software.

The proposed framework also has diagnostic value for any stage of the development cycle. For example, it can be used to assess a firm's level of software process maturity by benchmarking current practices against desired standards and identifying opportunities for improvement. The measures that accompany the SPIM-S can also be used to assess industry averages as well as the standards exemplified by high performing firms, against which individual firms can evaluate their performance and again, identify areas for further attention. This should assist with identifying practices with greatest potential for benefit and provide guidance to help small firms progress from one maturity level to the next. Although the proposed model is not exhaustive of CMMI Level 2 and Level 3 practices, it does provide a starting point from which firms can then look to incorporating the remaining Level 2/3 practices into their software process and the longer term goal of embracing Level 4 and Level 5 practices (SEI, 2010). This progressive approach is indicative of a CMMI continuous representation roll-out, in which achievement at each level are used to measure process improvement and maturity (SEI, 2010).

As far as we are aware this is one of the few studies to evaluate the relationship between these factors and software quality for small firms which are often challenged by constraints. As such, this study also provides impetus for further research. First, the results show that while ten (10) practice areas are considered a priority (so were included in the simplified software process improvement model for small firms, SPIM-S), for the firms that participated in this study only three practices had a significant predictive impact on the variance observed for software quality (i.e. organization process definition, organization process focus and, verification and validation). However this does not mean that the remaining practices are not important – only that they did not significantly explain the software quality observed in the study context. Replicating the study in other countries to further validate the suggested practice areas and determine those that most impact software quality is encouraged. The results also suggest the usefulness of the survey instrument and of Zubrow's 'Maturity Questionnaire', for future studies of software quality and CMMI/SPI based research.

LIMITATIONS

This study offers useful insights into the practices of small software development firms in developing countries. At the same time some elements may limit the applicability of the findings to other settings. First, the scope of the study was limited to those small software development organisations that responded to the survey in Barbados, Guyana, Jamaica and Trinidad; these four countries account for 83% of the ESC population. While this suggests greater confidence in the representativeness of the findings across the ESC, there may be factors such as culture (Yadav, Adya, Sridhar and Nath, 2009), that distinguish the software practices in this region from other regions. Future research should consider replicating the study in other settings to extend the applicability of the model and findings beyond the current bounds.

Second, this study returned a relatively small sample. Although the sample size was sufficient for the data analyses (Chin, 2010) with smaller samples often returned for studies involving paired-responses (Ko, Kirsch and King, 2005), it is suggested that future work aim for a larger sample. Third, the findings may be subject to the possibility of response bias, poor recall, and other factors that impact reporting accuracy. Having a separate assessor for IS quality may help to address the problem. At the same time, it is possible that the organisation contacts may select respondents who report more favourably on the practices of the firm and project quality. Future replications may even out possible impacts of such effects on findings.

Fourth, the proposed model is not exhaustive of CMMI Level 2/3 practices; it also does not cover Level 4/5 practices. This is intentional as the aim is to suggest a more feasible starting point that can help firms improve their software development capabilities. Firms would still need to demonstrate compliance with the respective SPI model, such as the CMMI to attain the requisite maturity level.

In addition to these limitations, it is likely that other factors impact the outcome but were not considered in the research model. For example, technology characteristics such as ease of use (Gorla and Lin, 2010) and firm-level factors such as culture and decision style (Martinsons and Davison, 2007) may also impact quality outcomes. In assessing software quality this study also relied on subjective measures. Although the study accounted for project manager and user views to reduce bias, future research may consider using objective metrics such as code coverage and bug rates to measure quality.

Finally, this study focused on SPI practices that had been used for the target project, but did not consider projects that were not governed by these practices, or initiatives that were in place but not being used, or practices that the firm believed 'should' be in place. Providing more in-depth insight into the software practices and capabilities of small firms will enable a better understanding of the capacities of small firms to implement SPI initiatives. Given the progressive nature of software

process maturity, it is worthwhile also revisiting the firms over the long term to review changes in their software practices and how these impact software quality, and progression along the 'software maturity' continuum.

CONCLUSION

Despite improvements far too many software projects continue to fail (Standish, 2015). This is even more problematic for small software development firms in developing countries with a lower capacity to absorb such failures compared with large firms (Niazi et al., 2010). Software process improvement models aim to address these problems. However many of these models are too cumbersome and costly for small firms to implement. To avail them of the benefits that these practices bring, this study suggests a simplified model of software process improvement practices (SPIM-S) aimed at helping small firms, especially those in developing countries, improve the quality of their software development process. Drawing on established practices, the study presents a set of standards that are deemed to be more feasible to implement given the resource limitations and other constraints of such firms. As small firms advance their software development processes, the phased adoption of software improvement practices are expected to improve their competiveness and provide a stepping stone to the next stage of process maturity.

In this study, three key contributors to software quality, that is, people, technology and process are evaluated. The results confirm the importance of software process and technology –related factors as major determinants of software quality. A post-hoc test further showed that project characteristics, more specifically, project size (measured in terms of team size) was also important with smaller projects being linked to higher software quality, and larger projects associated with lower software quality. Altogether, the study showed all ten of the suggested software process improvement practices were present in some form in the participating firms. However, only three of the practices were impactful in term of the quality of software development among small software firms in the English-speaking Caribbean (ESC). As such, the challenge for SPI lies not as much with the absence of various practices from the software development process, but that greater effort is needed to incorporate them more fully into their project implementations, with a view to institutionalizing them in the development process. To enhance the awareness of SPI and to educate IS professionals and users of the benefits of SPI initiatives, training and associated workshops are recommended. Equally important also is the drive to increase the maturity of the delivery process by encouraging firms to engage in continuous improvement of their software development practices.

Finally, it is hoped that the findings will be useful to IS researchers for future work and to practitioners in their efforts to improve software quality. By focusing on core practices such as those suggested in the SPIM-S framework, it is expected that small software development firms will be better able to realise the benefits of SPI in their software development process, improve their competitiveness, and reduce the digital distance between themselves and others in their own countries and in more developed settings.

REFERENCES

Avgerou, C. (2008). Information systems in developing countries: A critical research review. *Journal of Information Technology*, *23*(3), 133–146. doi:10.1057/palgrave.jit.2000136

Balasubramanian, S., & Raja, V. A. (2010). Assessment of CMM and its impact on software quality. *International Journal of Management*, *1*(1), 65–75.

Chevers, D. A., & Duggan, E. W. (2007). A Modified Capability Framework for Improving Software Production Processes in Jamaican Organizations. *The Electronic Journal on Information Systems in Developing Countries*, *30*(4), 1–18. doi:10.1002/j.1681-4835.2007.tb00207.x

Chevers, D. A., & Duggan, E. W. (2010). *A preliminary study of the use of software process improvement initiatives in Jamaica.* Paper presented at the 3rd International Conference on Information Resources Management (Conf-IRM), Montego Bay, Jamaica.

Chevers, D. A., Mills, A. M., Duggan, E. W., & Moore, S. (2017). Towards a simplified software process improvement framework for small software development organizations. *Journal of Global Information Management*, *20*(2), 110–130. doi:10.1080/1097198X.2017.1321356

Chevers, D. A., Moore, S., Duggan, E. W., & Mills, A. M. (2008). *Identifying key software development practices in the English-speaking Caribbean using the nominal group technique.* Paper presented at the 19th Australasian Conference on Information Systems (ACIS), Christchurch, New Zealand.

Chi, J., & Sun, L. (2015). IT and competitive advantage: A study from micro perspective. *Modern Economy*, *6*(03), 404–410. doi:10.4236/me.2015.63038

Chin, W. W. (2010). *How to write-up and report PLS analysis*. Berlin: Springer - Verlag.

Chou, J., & Yang, J. (2012). Project management knowledge and effects on construction project outcomes: An empirical study. *Project Management Journal*, *43*(5), 47–67. doi:10.1002/pmj.21293

Cockburn, A., & Highsmith, J. (2001). Agile Software Development: The People Factor. *Computer*, *34*(11), 131–133. doi:10.1109/2.963450

Coupe, R. T., & Onodu, N. M. (1996). An empirical evaluation of the impact of CASE on developer productivity and software quality. *Journal of Information Technology*, *11*(2), 173–181. doi:10.1177/026839629601100207

Dalton, J. (2016). A guide to Scrum and CMMI: Improving agile performance with CMMI. CMMI Institute, 1-130.

Day, B., Ke-Zun, S. C., & Lovelock, L. (2009). *Climbing the ladder: CMMI level 3*. Paper presented at the IEEE International Enterprise Distributed Object Computing Conference, Auckland, New Zealand. 10.1109/EDOC.2009.29

Dooley, K., Subra, A., & Anderson, J. (2001). Maturity and its impact on new product development project performance. *Research in Engineering Design*, *13*(1), 23–29. doi:10.1007001630100003

Duggan & Reichgelt. (2006). The Panorama of Information Systems Quality. In *Measuring Information Systems Delivery Quality* (pp. 1-27). Hershey, PA: Ideal Group Inc.

Espinosa-Curiel, I. E., Rodriguez-Jacobo, J., & Fernandez-Zepeda, J. A. (2013). A framework for evaluation and control of the factors that influence the software process improvement in small organizations. *Journal of Software: Evolution and Process*, *25*, 393–406.

European Commission. (2005). The new SME definition: User guide and model declaration. Enterprise and Industry Publications, 1-51.

Fiestas, I. (2011). Constraints to private investment in the poorest developing countries - A review of the literature. *Nathan*, 1-34.

Gorla, N., & Lin, S. (2010). Determinants of software quality: A survey of information systems project managers. *Information and Software Technology*, *52*(6), 602–610. doi:10.1016/j.infsof.2009.11.012

Hair, J. F. Jr, Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

Harter, D. E., Slaughter, S. A., & Krishnan, M. S. (2000). Effects of process maturity on quality, cycle time, and effort in software product development. *Management*, *46*(4), 451–466.

Humphrey, W. (1989). *Managing the Software Process*. Reading, MA: Addison-Wesley.

Iqbal, J., Ahmad, R. B., Nasir, M. H. N., Niazi, M., Shamshirband, S., & Asim Noor, M. A. (2016). Software SMEs' unofficial readiness for CMMI_-based software process improvement. *Software Quality Journal*, *24*(4), 997–1023. doi:10.100711219-015-9277-3

ISO/IEC. (2014). ISO/IEC 25000:2014. *International Standard*, 1-7.

Iversen, J., & Ngwenyama, O. (2005). Problems in measuring effectiveness in software process improvement: A longitudinal study of organizational change at Danske Data. *International Journal of Information Management*, *26*(1), 30–43. doi:10.1016/j.ijinfomgt.2005.10.006

Kaltio, T., & Kinnula, A. (2000). Deploying the defined SW process. *Software Process Improvement and Practice*, *5*(1), 65–83. doi:10.1002/(SICI)1099-1670(200003)5:1<65::AID-SPIP112>3.0.CO;2-R

Kharagpur, I. I. T. (2008). Lesson 37: Basic ideas on CASE tools. Indian Institute of Technology, 1-6.

Ko, D., Kirsch, L. J., & King, W. R. (2005). Antecedents of knowledge transfer from consultants to clients in enterprise system implementations. *Management Information Systems Quarterly*, *29*(1), 59–85. doi:10.2307/25148668

Larrucea, X., O'Connor, R. V., Colomo-Palacios, R., & Laporte, C. Y. (2016). Software Process Improvement in Very Small Organizations. *IEEE Software*, *33*(2), 85–89. doi:10.1109/MS.2016.42

Lee, G., & Xia, W. (2005). The ability of information systems development project teams to respond to business and technology changes: A study of flexibility measures. *European Journal of Information Systems*, *14*(1), 75–92. doi:10.1057/palgrave.ejis.3000523

Lee, J., Shiue, Y., & Chen, C. (2016). Examining the impacts of organizational culture and top management support of knowledge sharing on the success of software process improvement. *Computers in Human Behavior*, *54*, 462–474. doi:10.1016/j.chb.2015.08.030

Lewis, J. R. (1995). IBM Computer Usability Satisfaction Questionnaire: Psychometric Evaluation and Instructions for Use. *International Journal of Human-Computer Interaction*, *7*(1), 57–78. doi:10.1080/10447319509526110

Luo, L., He, Q., Xie, J., Yang, D., & Wu, G. (2017). Investigating the relationship between project complexity and success in complex construction projects. *Journal of Management Engineering*, *33*(2), 1–13.

Martinsons, M. G., & Davison, R. (2007). Strategic decision making and support systems: Comparing American, Japanese and Chinese management. *Decision Support Systems*, *43*(1), 284–300. doi:10.1016/j.dss.2006.10.005

Muller, R., Geraldi, J., & Turner, J. (2011). Relationships between leadership and success in different types of project complexities. *IEEE Transactions on Engineering Management*, *59*(1), 77–90. doi:10.1109/TEM.2011.2114350

Niazi, M., & Babar, M. A. (2009). Identifying high perceived value practices of CMMI level 2: An empirical study. *Information and Software Technology*, *51*(8), 1231–1243. doi:10.1016/j.infsof.2009.03.001

Niazi, M., Babar, M. A., & Verner, J. M. (2010). Software process improvement barriers: A cross-cultural comparison. *Information and Software Technology*, *52*(11), 1204–1216. doi:10.1016/j.infsof.2010.06.005

Pane, E. S., & Sarnob, R. (2015). Capability Maturity Model Integration (CMMI) for Optimizing Object-Oriented Analysis and Design (OOAD). *Procedia Computer Science*, *72*, 40–48. doi:10.1016/j.procs.2015.12.103

Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management*, *12*(4), 531–544. doi:10.1177/014920638601200408

Remington, K., Zolin, R., & Turner, R. (2009). A model of project complexity: Distinguishing dimensions of complexity from severity. *Proceedings of the 9th International Research Network of Project Management Conference*.

Richardson, I., & von Wangenheim, C. G. (2007). Why are small software organizations different? *IEEE Software*, *24*(1), 18–22. doi:10.1109/MS.2007.12

SEI. (2010). *CMMI for Development, Version 1.3*. Carnegie Mellon University, Software Engineering Institute, CMU/SEI-2010-TR-033.

Standish Group. (2015). *Chaos Report 2015*. Author.

Staples, M., & Niazi, M. (2008). Systematic review of organizational motivations for adopting CMM-based SPI. *Information and Software Technology*, *50*(7-8), 605–620. doi:10.1016/j.infsof.2007.07.003

Subramanian, G. H., Jiang, J. J., Klein, G., Huang, S., & Bramanian, G. H. (2007). Software quality and IS project performance improvements from software development process maturity and IS implementation strategies. *Journal of Systems and Software*, *80*(4), 616–627. doi:10.1016/j.jss.2006.06.014

Tan, M. (1996). Software quality practice in Singapore: Is it adequate for today's global information systems? *Journal of Global Information Management*, *4*(4), 23–32. doi:10.4018/jgim.1996100103

Techatassanasoontorn, A. A., Huang, H., Trauth, E., & Juntiwasarakij, S. (2011). Analyzing ICT and development: Thailand's path to the information economy. *Journal of Global Information Management*, *19*(1), 1–29. doi:10.4018/jgim.2011010101

Torrecilla-Salinasa, C. J., Sedeñoa, J., Escalonaa, M. J., & Mejíasa, M. (2016). Agile,Web Engineering and Capability Maturity Model Integration: Asystematic literature review. *Information and Software Technology*, *71*, 92–107. doi:10.1016/j.infsof.2015.11.002

Vasconcellos, F. J. S., Landre, G. B., Cunha, J. O. G., Oliveira, J. L., Ferreira, R., & Vincenzi, A. M. R. (2017). Approaches to strategic alignment of software process improvement: A systematic literature review. *Journal of Systems and Software*, *123*, 45–63. doi:10.1016/j.jss.2016.09.030

Vijayasarathy, L. R., & Butler, C. W. (2017). Choice of software development methodologies: Do organizational, project and team characteristics matter? *IEEE Software*, 86–94.

Wilson, K. (2007). *What's new in Microsoft Project 2007? Advantages and benefits of upgrading from Microsoft Project 2000/2003 to Microsoft Project 2007*. Accessed on September 22, 2009. http://www.epmconnect.com/Project%20Professional%20Documents/What's%20New%20In%20Project%202007.pdf, 1-5.

Wong, B. (2006). The Different Views of Software Quality. In Measuring Information Systems Delivery Quality (pp. 55-88). Hershey, PA: Idea Group Inc. doi:10.4018/978-1-59140-857-4.ch003

Yadav, V., Adya, M., Sridhar, V., & Nath, D. (2009). Flexible global software development (GSD) antecedents of success in requirements analysis. *Journal of Global Information Management*, *17*(1), 1–31. doi:10.4018/jgim.2009010101

Zubrow, D., Hayes, W., Siegel, J., & Goldenson, D. (1994). *Maturity Questionnaire*. Accessed on January 1, 2006. www.sei.cmu.edu/publications/documents/94.reports/94.sr.007.html

APPENDIX A: SOFTWARE PROCESS IMPROVEMENT PRACTICES – KEY DEFINITIONS

Table 7.

1. **Requirements Management & Requirements Development** are about analysing and producing the system requirements and managing customer requirements. 2. **Project Planning** establishes and maintains the plans that define project activities 3. **Verification** describes the steps taken to ensure that the activities are performed in compliance with processes such as reviews, audits and software quality assurance while **Validation** is checking that the software process produced the intended results such as formal walkthroughs and inspections 4. **Project Monitoring & Control** provides an understanding of the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan 5. **Technical Solution** is about designing, developing and implementing solutions to user requirements 6. **Organization Process Definition** establishes and maintains a usable set of software development procedures and standards 7. **Organization Process Focus** plans, implements and deploys process improvements based on a thorough understanding of the strengths and weaknesses of the organization's software development processes 8. **Organization Training** is about developing the skills and knowledge of project personnel so they can perform their roles effectively and efficiently 9. **Integrated Project Management** is about managing the project in a manner that brings team members together in a coordinated manner 10. **Risk Management** is about identifying potential problems before they occur so that risk-management activities can be planned and put into action as needed

Source: Zubrow et al.,1994; SEI, 2010

APPENDIX B: SURVEY ITEMS

Figure 3.

Software Process Improvement Practices

Requirements Management & Requirements Development

RMRD01. Requirements were well established for this project
RMRD02. Detailed records were kept of the requirement changes in this project
RMRD03. Requirement management and requirement development on this project were guided by organization policy
RMRD04. Performance measures (e.g. total number of requirements changes that were proposed, opened, approved or closed) were in place on this project for requirement management and requirement development

Project Planning

PP01. Detailed cost estimates were in place for managing this project
PP02. Detailed time estimates were in place for managing this project
PP03. All relevant tasks were identified for successful execution of this project
PP04. Adequate resources were in place for the planning of this project (e.g. funding, expertise, etc.)
PP05. Performance measures (e.g. completion of milestones) were in place for planning this project

Project Monitoring & Control

PM01. Corrective actions were always taken to manage variances (actual vs plan) in this project
PM02. Changes to development plans were always signed off by relevant stakeholders in this project
PM03. Organization policies were in place for guiding project monitoring and control in this project
PM04. Performance measures were in place to assess project monitoring and control in this project

Technical Solution

TS01. A well-established plan was developed to address all requirements for this project
TS02. All needed resources were in place to execute the solution for all the requirements in this project
TS03. Performance measures were in place to assess the effectiveness of technical solution for this project

Verification & Validation

VV01. Verification activities were effectively planned for this project
VV02. Validation activities were effectively planned for this project
VV03. Adequate resources were provided to perform verification activities in this project
VV04. Adequate resources were provided to perform validation activities in this project

Organization Process Definition

OPD01. The organization's software development processes were adequately documented in this project
OPD02. The organization's software development processes were clearly understood in this project
OPD03. Performance measures were in place to assess if key stakeholders understand the firm's software development processes and procedures covered by this project

Organization Process Focus

OPF01. There were established software development processes to be followed by key stakeholders in this project
OPF02. Adequate measures were taken to adjust the organization's software development processes based on performance indicators for this project
OPF03. Performance measures were in place to assess the effectiveness of all organization software development processes in this project

Figure 4.

Organization Training

OT01. Project team members were adequately trained to perform their roles in this project
OT02. Adequate resources were provided to facilitate training for this project
OT03. Performance measures were in place to assess the effectiveness of training in this project

Integrated Project Management

IPM01. A well-established policy document regarding the integration of all relevant project team members was in place for this project
IPM02. High levels of co-operation were encouraged among all relevant project groups in this project
IPM03. Performance measures were in place to assess the integration of project team members in this project

Risk Management

RSKM01. Potential risks were clearly identified for this project
RSKM02. A clearly defined action plan was established for possible risks in this project
RSKM03. All needed resources were in place to address potential risks in this project
RSKM04. Performance measures were in place to assess the management of risk in this project

People Skills

Project Management Skills

PMSK01. High levels of project management skills (e.g. project estimating, planning, controlling) were displayed on this project
PMSK02. High levels of process expertise were available during the execution of this project
PMSK03. High levels of system analysis and design expertise were available during the execution of this project
PMSK04. Adequate understanding of modelling techniques were displayed during the execution of this project

Systems Development Skills

SDSK01. Competent data analysts and database administrators were assigned to this project
SDSK02. Competent systems construction personnel were assigned to this project (e.g. programmers, networkers, etc.)
SDSK03. Competent code testers and documentation personnel were assigned to this project

Contribution

CONT01. Project members contributed greatly to the success of this project
CONT02. Project members participated equally in the execution of the project
CONT03. Project members contributed to the project achieving its stated objectives

Technological Tools

Technology Tools

TTOOL01. Project management software (e.g. Microsoft Project, Primavera, Timeline, Rational, or others) was used in the execution of this project
TTOOL02. Computer aided software engineering (CASE) systems were used in the execution of this project

Technology Effectiveness

TTEFFI3. Using technological tools (such as project management software, modeling technologies, CASE tools, etc.) increased the efficiency of this project
TTEFFI4. Using technological tools (such as project management software, modeling technologies, CASE tools, etc.) increased the effectiveness of this project

Figure 5.

Software Quality

Functionality

FUNCT01. The delivered system features are suitable for achieving the business objectives
FUNCT02. The system generally provides the support I need to do my job
FUNCT03. I am not tempted to work around the system to perform system tasks

Reliability

RELIAB01. The delivered system is usually available when needed
RELIAB02. I can easily recover from input errors
RELIAB03. The system is usually restored quickly after a failure

Usability

USABIL01. The delivered system is easy to understand
USABIL02. The delivered system is easy to learn
USABIL03. The delivered system is easy to use

Efficiency

EFFIC01. The response time of the system is generally acceptable
EFFIC02. It is generally easy to invoke systems features

Maintainability

MAINT01. The delivered system provides diagnostics that help to identify causes of failures
MAINT02. Relatively little effort is expended to correct faults whenever system errors occur
MAINT03. Relatively little effort is needed to test system modifications

Chapter 4
National Culture on Knowledge Sharing in the U.S. and China

Yu-Wei Chang
National Taichung University of Science and Technology, Taiwan

Ping-Yu Hsu
National Central University, Taiwan

Wen-Lung Shiau
Zhejiang University of Technology, China

ABSTRACT

A major challenge for multinational companies is how to motivate employees with different individual cultural characteristics and national cultures to share knowledge. The purpose of this study is to investigate the effects of individual and national cultures on knowledge sharing. Individual cultural characteristics are incorporated into the model as antecedents of knowledge-sharing motivations (organizational rewards, image, and reciprocal benefits). National cultural differences are examined by conducting studies with subjects in the U.S. and China. The results show that power distance is significantly related to reciprocal benefits in the U.S. but not in China. Individualism/collectivism is related to organizational rewards and image in the U.S. but not in China, while individualism/collectivism is significantly related to reciprocal benefits in China but not in the U.S. Uncertainty avoidance is significantly related to reciprocal benefits in the U.S. but not in China. This study provides knowledge-sharing practices and management implications for multinational companies.

DOI: 10.4018/978-1-7998-1786-4.ch004

INTRODUCTION

In today's knowledge-based business environments, a mass of knowledge is growing and increasing in organizations. Knowledge can be viewed as the most valuable resource because it helps organizations increase competitive advantage (Huang et al., 2008; Wasko & Faraj, 2005). As knowledge is critical for organizations, how can organizations motivate their employees to share knowledge? Based on social exchange theory (SET) (Blau, 1964), knowledge sharing can be driven by motivational factors, such as organizational rewards, image, reciprocal benefits, knowledge self-efficacy, and altruism (Bock & Kim, 2002; Bock et al., 2005; Chen et al., 2012; Huang et al., 2008; Hung et al., 2011; Hsu & Lin, 2008; Kankanhalli et al., 2005; Lin, 2007; Lin et al., 2015; Sedighi et al., 2016; Yan et al., 2016; Zhang et al., 2017; Zhou, 2018).

If knowledge-sharing motivations are provided for employees, will all employees be willing to share their knowledge? According to prior research results, the answers seem to be equivocal. For example, U.S. samples show that image has a significant impact on knowledge-sharing intentions (Wasko & Faraj, 2005), but Chinese samples do not (Hung et al., 2011). In another case, reciprocal benefits positively affect knowledge-sharing intentions for Chinese employees (Lin, 2007; Zhang et al., 2017) but not for U.S. employees (Wasko & Faraj, 2005). This implies that even if organizations provide the same motivations, employee behavioral intentions do not universally hold across cultures and countries (Srite & Karahanna, 2006; Zhang et al., 2014).

To deeply understand cultural contexts, some existing studies have employed Hofstede's (2001) multidimensional national cultural framework to analyze the main knowledge-sharing differences (Chiu et al., 2018; Chow et al., 2000; Griffith et al., 2006; Jiacheng et al., 2010; Jin et al., 2017; Scuotto et al., 2017; Posey et al., 2010). The cultural dimensions include individualism/collectivism, power distance, uncertainty avoidance, and masculinity/femininity (Hofstede, 1980). Additionally, Hofstede's country scores are used to theorize about differences between countries. For example, the U.S. and China can be classified as individualistic and collectivistic countries (the U.S. has a score of 91 and China has a score of 20). China and the U.S. can be classified as high and low power distance countries (China has a score of 80 and the U.S. has a score of 40).

Behavioral models can be influenced and modified by national culture, but individual beliefs, values, and self-motivated behaviors may also be shaped by individual cultural characteristics (Chiu et al., 2018; Tyler et al., 2000; Kivrak et al., 2014). Although two individuals both belong to the same country, they may have different cultural characteristics because of religion, ethnic background, region, and linguistic background (Lee et al., 2007; Karahanna et al., 2005). Thus, cultural characteristics are treated as individual difference variables and should be measured at the individual level of analysis (Srite & Karahanna, 2006; Zhang et al., 2014).

However, current knowledge-sharing studies have investigated the effects of culture at the national level rather than at the individual level (Chiu et al., 2018; Chow et al., 2000; Griffith et al., 2006; Jiacheng et al., 2010; Jin et al., 2017; Scuotto et al., 2017; Posey et al., 2010). Thus, the purpose of this study is to understand how cultural characteristics influence knowledge-sharing motivations, which in turn influence knowledge-sharing intentions. We incorporate Hofstede's cultural dimensions into knowledge-sharing models. In addition to individual cultural characteristics, national cultural differences are examined by conducting studies with subjects in the U.S. and China. We choose the U.S. and China because the two countries have salient differences in most of Hofstede's country scores (Hofstede, 2001). The U.S. is characterized as an individualistic, high uncertainty avoidance, and low power distance country, while China is characterized as a collectivistic, low uncertainty avoidance, and high power distance country.

This study is the first to develop a model that includes the effects of both individual and national cultures on knowledge sharing. We confirm that individual cultural characteristics influence knowledge-sharing motivations, which in turn influence knowledge-sharing intentions. The results also show that there are significant differences between the U.S. and Chinese model. Thus, individual and national cultures both influence employees' knowledge sharing. These findings can help organizations better understand employees' knowledge-sharing motivations. In particular, understanding can help improve knowledge management based on employees' individual cultural characteristics and national cultural backgrounds.

The remainder of this paper is organized as follows. In the next section, the theoretical bases of this study are described. Based on Hofstede's cultural framework, individual cultural characteristics are incorporated into the model as antecedents of knowledge-sharing motivations. Section three describes the hypotheses and research model. Section four explains the methodology and data collection, followed by the results from the U.S. and China in Section five. Section six discusses the research findings. Section seven concludes the theoretical and managerial contributions. The conclusions and limitations are presented in the last section.

LITERATURE REVIEW

Social Exchange Theory

Social exchange theory derives from economic exchange theory (Liao, 2008). However, there are some differences between the two theories. The former concerns intrinsic benefits, whereas the latter focuses on extrinsic benefits. The intrinsic benefits (e.g., approval, status, and respect) have no exact price or future return in terms of

a single quantitative medium of exchange. As such, social exchange differs from economic exchange, as it entails unspecified obligations (Organ & Konovsky, 1989).

Blau (1964) posited that individuals engage in social exchange. Social exchange factors have accounted for the social and individual cost and benefit factors (Kankanhalli et al., 2005). Cost factors can be opportunity costs or an actual loss of resources (Molm, 1997), such as loss of knowledge power and codify effort. Benefit factors can be organizational rewards, image, reciprocity, knowledge self-efficacy, enjoyment in helping others, and sense of self-worth (Deci & Ryan, 1980; Bock et al., 2005; Kankanhalli et al., 2005).

Thibaut and Kelley (1959) suggested that widely cited social exchange factors include direct reward, anticipated reciprocity, expected gain in reputation and influence on others, altruism and perception of self-efficacy. Bock et al. (2005) argued that knowledge sharing can be seen as a form of social exchange. Knowledge-sharing studies have confirmed that social exchange factors are associated with knowledge-sharing behavior on blogs, electronic networks, and electronic knowledge repositories, online health communities, and social medias (Bock & Kim, 2002; Constant et al., 1994; Chen et al., 2012; Ham et al., 2019; Hsu & Lin, 2008; Huang et al., 2008; Hung et al., 2011; Hung et al., 2011; Lin, 2007; Wasko & Faraj, 2005; Yan et al., 2016; Zhang et al., 2017).

This study investigates how organizational rewards, image, and reciprocity motivate employees' knowledge-sharing intentions. These factors can be classified as extrinsic benefits that the organization or management typically provides for good job performance (Deci & Ryan, 1985; Ryan & Deci, 2000). Organizational rewards are defined as the degree to which individuals believe that they will receive extrinsic incentives for their knowledge sharing (Bock et al., 2005). Image is defined as the degree to which individuals believe that they will increase reputation through knowledge sharing. Reciprocal benefits are defined as the degree to which individuals believe that their knowledge sharing will lead to future requests for knowledge being met (Kankanhalli et al., 2005).

Culture

Several scholars have proposed different definitions of national culture. Kluchhohn (1951) defined culture as consisting "in patterned ways of thinking, feeling and reacting, acquired and transmitted by symbols, constituting the distinctive achievements of human groups, including their embodiments in artifacts; the essential core of culture consists of traditional (i.e., historically derived and selected) ideas and especially their attached values." Kroeber and Parsons (1958) defined the concept of culture as "transmitted and created content and patterns of values, ideas, and other symbolic-meaningful systems as factors in the shaping of human behavior and

the artifacts produced through behavior." Hofstede (1980) defined culture as "the collective programming of the mind that distinguishes the members of one group or category of people from another."

Although a variety of cultural dimensions have been proposed by scholars (Clark, 1990; Triandis, 1995), Hofstede's (1980) national culture is the most widely accepted explanation in cross-cultural studies. From 1967 to 1973, Hofstede collected 1,160,000 comparative attitude surveys from IBM employees in 72 countries. National cultures from 53 countries were classified into four cultural dimensions: power distance, individualism/collectivism, masculinity/femininity, and uncertainty avoidance.

Power distance is defined as the extent to which the less powerful individuals of organizations and institutions accept and expect that power is distributed unequally. Individualism/collectivism is defined as the degree to which individuals are integrated into groups. Masculinity/femininity is defined as the degree to which individuals express masculine values (e.g., assertive and competitive) or feminine values (e.g., nurturing). Uncertainty avoidance is defined as the extent to which individuals feel either uncomfortable or comfortable in unstructured situations (Hofstede, 1980; Hofstede & Bond, 1988).

Culture and Knowledge Sharing

Based on Hofstede's cultural framework, Griffith et al. (2006) argued that culture can afford an understanding of how societies manage exchange. Thus, culture has also been applied to knowledge-sharing realms. Most of the knowledge-sharing studies mainly used Hofstede's country scores to theorize about differences between countries. For example, the U.S. and China's country scores for each cultural dimension are listed in Table 1. The U.S. has strong individualism (score 91) and China has strong collectivism (score 20). The U.S. (score 46) has more uncertainty avoidance than China (score 30). China (score 80) has more power distance than the U.S. (score 40). The U.S. and China are less different in terms of masculinity (scores 62 and 66, respectively).

Table 1. Comparison of Hofstede's country scores between the U.S. and China

Cultural Dimensions	United States	China
Power distance	40	80
Individualism/collectivism	91	20
Masculinity/femininity	62	66
Uncertainty avoidance	46	30

The country-level assessments of culture have been applied to address knowledge-sharing issues (Chiu et al., 2018; Griffith et al., 2006; Jiacheng et al., 2010; Kivrak et al., 2014; Posey et al., 2010). Chiu et al. (2018) explored the influence of optimism, pessimism, and positive effects on knowledge sharing in Taiwan and Malaysia. The findings indicated that national cultures of collectivism and power distance play moderating roles in these hypothesized relationships. Griffith et al. (2006) investigated the influence of culture on relationship resources (i.e., the relationship between trust and commitment) and knowledge resources (i.e., the relationship between information sharing and problem resolution) in Japan and the U.S. Their results showed that culture influences the relationship resources, which in turn influences information sharing. Jiacheng et al. (2010) investigated how intrinsic (i.e., social and personal norms) and extrinsic motivations (i.e., reward and punishment) shape the intention to share knowledge in a cross-cultural context. After considering the influence of Hofstede's culture, there are significant differences in Chinese and American knowledge-sharing motivations. Posey et al. (2010) proposed an online community self-disclosure model in a cross-cultural setting. Their results indicated that social influence and reciprocal benefits influence French people's self-disclosure, while trust and privacy risk belief influence British people's self-disclosure.

Hofstede's model has been applied to knowledge management in entrepreneurial settings (Jin et al., 2017; Scuotto et al., 2017). Jin et al. (2017) investigated the effects of psychological capital (i.e., hope, resilience, optimism, and self-efficacy) on young start-up entrepreneurs' performance, knowledge, and skills in China and Korea. Psychological capital differs across countries based on Hofstede's cultural dimensions. Scuotto et al. (2017) followed Hofstede's model and found that national and generational cultures influence global family firms' knowledge management.

Research Model and Hypotheses

Previous studies have investigated the effects of culture at the national level. It is inappropriate to use Hofstede's country scores on cultural dimensions to predict individual behaviors (Srite & Karahanna, 2006). Culture is a macro-level phenomenon and lacks precision in explaining individual behaviors (Straub et al., 2002). Individuals may have different cultural characteristics even though they all belong to the same country (Lee et al., 2007). Thus, culture should be treated as an individual variable, that is, a cultural characteristic. Srite and Karahanna (2006) defined cultural characteristics as the degree to which an individual embraces the values of his or her national culture. As Tyler et al. (2000) argued, cultural characteristics can shape individual beliefs, values, and self-motivated behaviors. Given the above discussion, this study investigates the effects of individual and national cultures on knowledge-sharing motivations and intentions. Only the three cultural dimensions (i.e., power

distance, individualism/collectivism, and uncertainty avoidance) are chosen for this study. The cultural dimension of masculinity/femininity mainly distinguishes men's and women's values according to one's sex. Masculine people are assertive and competitive, while feminine people are nurturing and helping others (Hofstede, 1980; Yoon, 2009). Because femininity implies enjoying helping others, the cultural dimension may be closely related to intrinsic benefits of knowledge sharing. This study focuses on only extrinsic benefits from the organization or management. Further, we propose a research model, as shown in Figure 1.

Knowledge Sharing Motivations

Organizational rewards range from monetary rewards (e.g., increased pay and bonus) to nonmonetary rewards (e.g., job security and career advancement) (Bock and Kim, 2002; Chen et al., 1999). Monetary incentives and points toward promotion are regarded as extrinsic motivations for knowledge sharing (Granovetter, 1985). Prior studies have confirmed that such organizational rewards can effectively motivate individuals to share knowledge (Chang et al., 2015a,b; Huang et al., 2008; Husted & Michailova, 2002; Kankanhalli et al., 2005; Sedighi et al., 2016). Thus, if an employee believes he/she can receive rewards for his/her knowledge sharing, he/she will be likely to share knowledge. This study hypothesizes the following:

H1: Organizational rewards positively affect knowledge-sharing intentions.

Figure 1. Research model

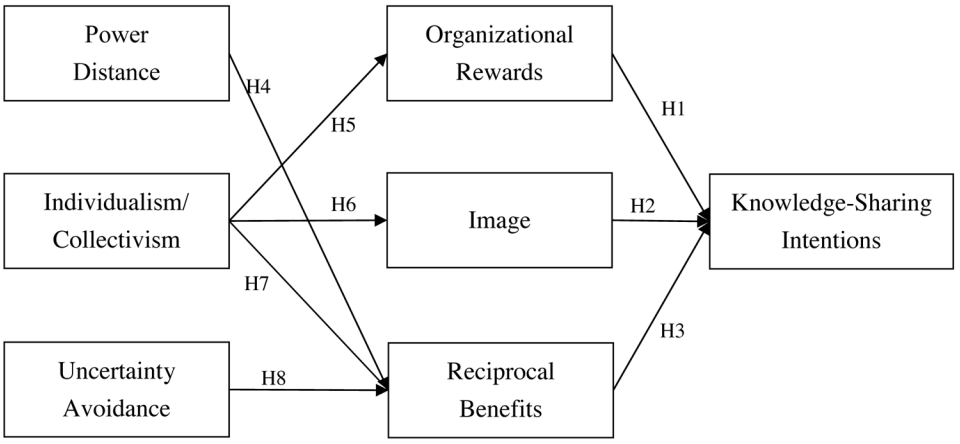


Image can be regarded as a social reward, such as approval, status, and respect (Blau, 1964). In the workplace, employees can show their valuable expertise to earn respect and achieve a better image (Constant et al., 1994; 1996). Huang et al. (2008) also argued that people can establish their status as experts in organizations while they share their professional knowledge with colleagues. Several studies have confirmed that image can cause individuals to share useful knowledge (Chang et al., 2015a,b; Huang et al., 2008; Hsu & Lin, 2008; Lin, 2007; Wasko & Faraj, 2005). Thus, if an employee believes that he/she can build a personal image through knowledge sharing, he/she will be willing to share knowledge. This study hypothesizes the following:

H2: Image positively affects knowledge-sharing intentions.

Reciprocal benefits serve as mutual factors for knowledge contributors because they expect future help from others (Bock & Kim, 2002; Connolly & Thorn, 1999). They can establish reciprocal relationships with colleagues in organizations (Bock et al., 2005). Some studies have also confirmed that reciprocal benefits can facilitate individuals' knowledge sharing and achieve long-term mutual cooperation (Bock & Kim, 2002; Bock et al., 2005; Chang et al., 2015a,b; Lin, 2007; Sedighi et al., 2016; Zhang et al., 2017). Thus, if an employee believes that he/she can obtain reciprocal benefits from other colleagues through knowledge sharing, he/she will enhance his/her knowledge-sharing intentions. This study hypothesizes the following:

H3: Reciprocal benefits positively affect knowledge-sharing intentions.

Power Distance

People with a high power distance refer to their superiors, peers, or subordinates' decisions and then perform a specific action (Chiu et al., 2018; Li et al., 2009; Zhang et al., 2014). In other words, their behaviors could be affected by superiors' and peer influences (Taylor & Todd, 1995). Such influences are called norms in organizations. Similar to this concept, a norm of reciprocity also exists in knowledge-sharing environments (Wasko & Faraj, 2005). When an employee is influenced by reciprocal relationships between colleagues, he/she is willing to contribute his/her knowledge (Hsu & Lin, 2008). Thus, an employee with a high power distance is likely to perceive the reciprocal benefits of knowledge sharing. This study hypothesizes the following:

H4: Power distance positively affects reciprocal benefits.

Individualism/Collectivism

Individualists are expected to take care of their own interests (Lee et al., 2007). In knowledge-sharing realms, organizational rewards can be regarded as a kind of personal interest. In addition, Lee et al. (2007) noted that individualistic users appreciate monetary value more than collectivistic users do. That is, they are sensitive to monetary rewards, such as increased pay and bonuses. Thus, an individualistic employee may be concerned about organizational rewards when sharing knowledge. This study hypothesizes the following:

H5: Individualism positively affects organizational rewards.

People with high individualism seek to satisfy and emphasize personal goals (Lee et al., 2007; Radford et al., 1991; Yu, 2014). They think that personal identity is determined by individual achievement (Srite & Karahanna, 2006). Such achievements in terms of knowledge sharing can be social images. Thus, an individualistic employee tends to build personal identity and recognition through knowledge sharing. Individualism may have a positive effect on image. This study hypothesizes the following:

H6: Individualism positively affects image.

Reciprocal benefits are based on social relationships (Huang et al., 2008; Sedighi et al., 2016). Because individualists do not emphasize strong relationships (Yoon, 2009), they believe less that benefits derive from reciprocal relationships. In addition, there is a strong norm of reciprocity in the collective (Wasko & Faraj, 2005). When individualists tend not to follow social norms and collective goals in organizations (Steenkamp et al., 1999; Choi & Geistfeld, 2004; Sedighi et al., 2016; Srite & Karahanna, 2006), individualism may reduce the perception of reciprocal benefits. Thus, this study hypothesizes the following:

H7: Individualism negatively affects reciprocal benefits.

Uncertainty Avoidance

Uncertainty avoidance is expected to be inversely associated with trust (Lee at al., 2018; Yoon, 2009). People with high uncertainty avoidance tend to distrust other people (Fukuyama, 1995). In general, reciprocal benefits are uncertain and unknown in knowledge-sharing environments (Chang et al., 2015a; Huang et al., 2008). We

expect that uncertainty avoidance may reduce trust and reciprocal benefits among employees. Thus, an employee with high uncertainty avoidance may be less concerned about reciprocal benefits when sharing knowledge. This study hypothesizes the following:

H8: Uncertainty avoidance negatively affects reciprocal benefits.

METHODOLOGY

Measures

A survey methodology was used to measure the constructs of this study. Organizational rewards were measured using scales derived from Davenport and Prusak (1998). Image and reciprocal benefits were measured using scales derived from Kankanhalli et al. (2005). Knowledge-sharing intentions were measured using scales adapted from Moon and Kim (2001). The cultural characteristics of power distance, individualism/collectivism, and uncertainty avoidance were measured using scales derived from Yoon (2009). All items were measured using a seven-point Likert scale ranging from strongly disagree (1) to strongly agree (7). A pretest was conducted in Taiwan's branch company to verify the measurement scales. Based on the pretest, we modified the wording of some scale items. The back-translation method was applied to ensure consistency of the questionnaire between the U.S. and China. Appendix 1 shows the final items used in this study.

Data Collection

Engineers were selected for this study since engineer samples usually come from knowledge-concentrated departments in a company. These engineers were from a large multinational company that manufactures machines in the semiconductor industry and has plants and service departments in 14 countries. The final data collections were distributed to 520 U.S. and 480 Chinese engineers. A total of 153 U.S. and 154 Chinese respondents participated in this study, of whom 261 were employees (85%) and 46 were managers (15%). Half of the respondents had a bachelor's degree (69.4%). Approximately 45% of the respondents were between the ages of 26 and 35. Demographic profiles for the respondents in the two countries are shown in Appendix 2.

Data Analysis

The partial least squares (PLS) method supports both confirmatory and exploratory research (Gefen et al., 2000). PLS also allows researchers to use a smaller sample size than other structural equation modeling techniques. Thus, this study uses PLS to assess measurement and structural models. The measurement model examines the convergent and discriminant validity of items and constructs. The structural model examines the hypothesized relationships between constructs in the research model.

RESULTS

Common Method Bias

To assess common method bias, Harman's one-factor test is examined using a principal component analysis. If a single construct accounts for more than 50% of the variance, the common method bias might threaten the validity (Harman, 1976; Mattila & Enz, 2002; Pee et al., 2010). The results show that the combined 11 constructs account for 89.75% of the total variance. The variance of the 6 constructs ranges from 7.23% to 19.64%, which is less than 50% of the variance. Therefore, the common method bias might be excluded by the items in this study.

Non-response Bias

Among 307 data in this study, 235 respondents completed the survey during an early stage and 72 respondents completed the survey during a later stage. Late respondents might resemble non-respondents more than early respondents (Armstrong & Overton, 1977). To assess non-response bias, we conducted t-tests to compare gender and age between early and late respondents. The results indicate no significant differences between the two groups. Since the non-response bias is excluded, we can pool data from these two groups together.

Measurement Model

PLS is used to assess the reliability and discriminant validity of the measurement model. The reliability is calculated using the composite reliability (CR) and the average variance extracted (AVE) (Fornell & Larcker, 1981). Table 2 shows that CRs for all constructs range from 0.61 to 0.85, which exceeds the recommended level of 0.60. AVEs range from 0.55 to 0.78, which also exceeds the recommended level of 0.50. This therefore supports the reliability of the measurement items.

Table 2. Results for reliability test

Construct	Mean	Std. Deviation	CR	AVE
Power distance (PD)	3.14	1.39	0.61	0.59
Individualism/collectivism (IC)	3.31	1.30	0.70	0.65
Uncertainty avoidance (UA)	3.56	1.18	0.64	0.55
Organizational rewards (OR)	3.29	1.52	0.83	0.78
Image (IMG)	4.44	1.35	0.82	0.73
Reciprocal benefits (RB)	5.64	1.15	0.85	0.75
Knowledge-sharing intentions (KSI)	5.42	1.18	0.85	0.76

The discriminant validity is evaluated using the factor loading and the square root of the AVE (Chin, 1998). Table 3 shows the factor loadings for all items ranging from 0.74 to 0.93, which exceeds the recommended level of 0.7. Additionally, the factor loadings for each construct are higher than cross-loadings on other constructs. Table 4 shows that the square root of the AVE for each construct is larger than its correlations with the other constructs. This demonstrates reasonable discriminant validity in our models.

Structural Model

PLS is used to examine all hypothesized relationships between constructs in the U.S. and Chinese models. Figure 2 shows the results for U.S. samples. The model accounts for 57.3% of the variance in knowledge-sharing intentions. As hypothesized, organizational rewards and reciprocal benefits have significant effects on knowledge-sharing intentions, providing support for hypotheses 1 and 3. However, image has no direct influence on knowledge-sharing intentions, and hypothesis 2 is not supported. Individualism/collectivism has a significant effect on organizational rewards and image but not on reciprocal benefits. Thus, hypotheses 5 and 6 are supported. Power distance and uncertainty avoidance significantly affect reciprocal benefits, supporting hypotheses 4 and 8.

Figure 3 shows the results for Chinese samples. The model explains approximately 54% of the variation in knowledge-sharing intentions. As a result of the U.S. model, the results also provide support for hypotheses 1 and 3 but not for hypothesis 2. Contrary to expectations, power distance and uncertainty avoidance have no significant effect on reciprocal benefits. Thus, hypotheses 4 and 8 are not supported. Individualism/collectivism significantly affects reciprocal benefits. Unexpectedly,

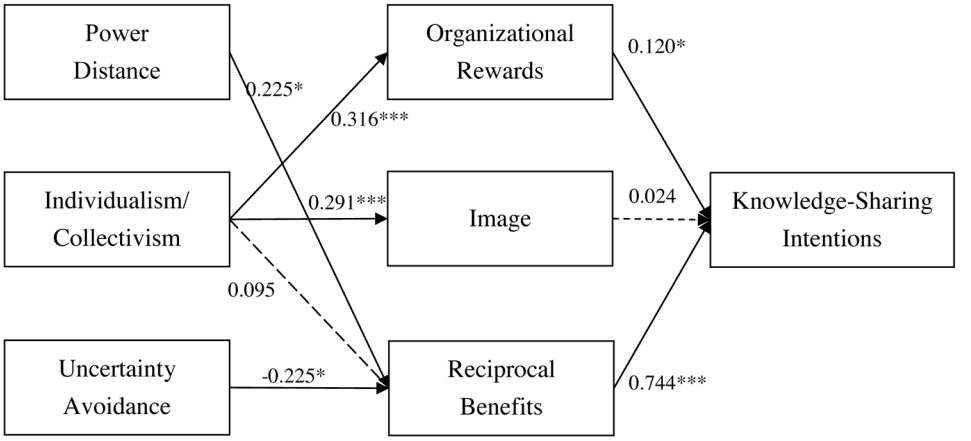
Table 3. PLS confirmatory factor analysis

	PD	IC	UA	OR	IMG	RB	KSI
PD1	**0.84**	0.08	0.21	0.06	0.16	0.05	0.02
PD2	**0.86**	0.07	0.19	0.10	0.04	-0.02	0.02
IC1	0.15	**0.83**	0.21	0.00	0.09	0.05	0.02
IC2	0.04	**0.89**	0.19	0.13	0.08	-0.04	-0.04
IC3	-0.02	**0.81**	-0.04	0.12	0.12	-0.06	0.02
UA1	0.14	0.14	**0.81**	0.08	0.02	0.05	-0.09
UA2	0.21	0.11	**0.81**	0.11	0.10	-0.02	-0.07
UA3	0.08	0.08	**0.80**	-0.04	0.08	-0.08	0.18
OR1	0.14	0.09	0.09	**0.82**	0.25	0.09	0.08
OR2	-0.01	0.14	0.04	**0.93**	0.13	0.03	0.12
OR3	0.06	0.01	0.02	**0.92**	0.18	0.03	0.09
OR4	0.03	0.08	0.04	**0.81**	0.28	0.13	0.13
IMG1	0.06	0.08	0.04	0.16	**0.85**	0.19	0.16
IMG2	0.10	0.09	0.11	0.27	**0.81**	0.11	0.19
IMG3	0.05	0.08	0.06	0.23	**0.84**	0.19	0.13
IMG4	0.08	0.14	0.05	0.24	**0.77**	0.25	0.11
RB1	0.00	-0.06	-0.02	0.08	0.24	**0.80**	0.33
RB2	0.03	-0.02	-0.04	0.06	0.22	**0.84**	0.33
RB3	0.00	-0.01	0.00	0.13	0.29	**0.74**	0.36
KSI1	0.02	0.03	0.06	0.13	0.19	0.32	**0.82**
KSI2	-0.01	-0.02	-0.01	0.18	0.20	0.25	**0.86**
KSI3	0.04	-0.01	-0.03	0.10	0.14	0.36	**0.81**

Table 4. Inter-construct correlations

	PD	IC	UA	OR	IMG	RB	KSI
PD	**0.76**						
IC	0.23	**0.80**					
UA	0.54	0.36	**0.74**				
OR	0.20	0.22	0.16	**0.88**			
IMG	0.29	0.23	0.22	0.50	**0.85**		
RB	0.09	-0.05	-0.02	0.25	0.56	**0.87**	
KSI	0.10	0.00	0.03	0.33	0.48	0.76	**0.87**

Figure 2. Results for U.S. model
**p < .05, **p < .01, ***p < .001*



individualism/collectivism has no direct influence on organizational rewards and image. Thus, hypothesis 7 is supported, while hypotheses 5 and 6 are not. Table 5 shows the hypothesis test results between the U.S. and China.

Table 5 further shows differences in hypothesized relationships between the U.S. and China. There are no significant differences in organizational rewards, image, and reciprocal benefits between the two countries. The effects of power distance and uncertainty avoidance on reciprocal benefits are larger in the U.S. than in China. The effect of individualism/collectivism on reciprocal benefits is weaker

Figure 3. Results for Chinese model
**p < .05, **p < .01, ***p < .001*

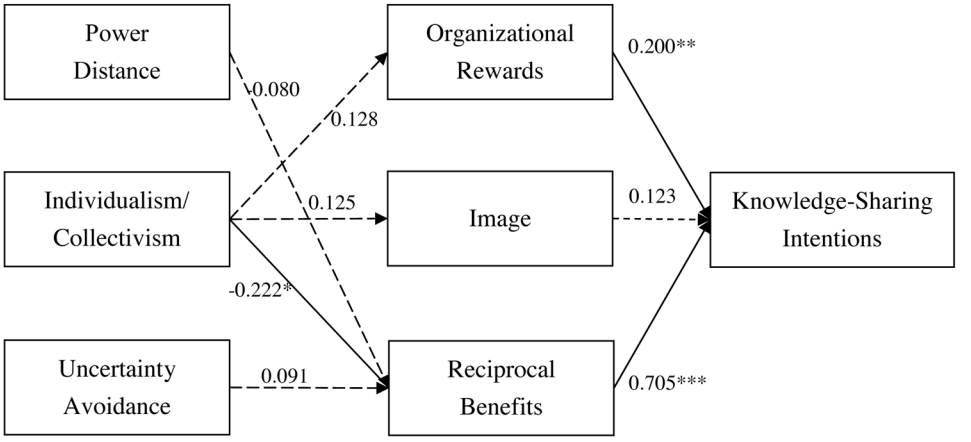


Table 5. Hypothesis test results

Hypothesis		U.S. Model		Chinese Model		Statistical Difference
		Path Coefficient	t-Value	Path Coefficient	t-Value	
H1	OR→KSI	0.120	1.99*	0.200	2.67**	n.s.
H2	IMG→KSI	0.024	0.40	0.123	1.62	n.s.
H3	RB→KSI	0.744	10.85***	0.705	6.75***	n.s.
H4	PW→RB	0.225	1.98*	-0.080	-0.60	p<0.05
H5	IC→OR	0.316	3.77***	0.128	1.47	n.s.
H6	IC→IMG	0.291	3.45***	0.125	1.389	n.s.
H7	IC→RB	0.095	1.06	-0.222	-2.19*	p<0.05
H8	UA→RB	-0.225	-1.97*	0.091	0.71	p<0.05

***Significant at 0.001; **Significant at 0.01; *Significant at 0.05

in the U.S. than in China. However, we do not find significant differences in the effect of individualism/collectivism on organizational rewards and image between the two countries.

DISCUSSIONS

This study explores the role of motivational factors in explaining knowledge sharing and incorporates power distance, individualism/collectivism, and uncertainty avoidance into the research model as antecedents of motivational factors. Data were collected for the U.S. and Chinese samples. Six of the eight hypothesized relationships are found to be significant in the U.S. and three of the eight hypothesized relationships are significant in China. The findings related to the hypotheses are discussed below.

Knowledge-Sharing Motivations

According to the research results of this study, the direct paths between organizational rewards and knowledge-sharing intentions and between reciprocal benefits and knowledge-sharing intentions are significant and positive in the two countries. Image does not significantly affect knowledge-sharing intentions in the two countries. One possible explanation is the interface with knowledge management systems. The investigating system does not provide any feedback functions, such as a reply, a like button, browser time, or download time. Thus, U.S. and Chinese employees may perceive that they do not gain reputation feedback when sharing their knowledge.

Power Distance

The direct effect of power distance on reciprocal benefits is significant in the U.S. but not in China. We find that Chinese employees with high power distance are unwilling to share knowledge for reciprocal benefits. Chinese employees may not trust each other because people in high power distance societies consider each other as unequal (Yoon, 2009). In addition, reciprocal expectations are expected to be intimately associated with trust (Putam, 1995). Thus, the effect of power distance is statistically insignificant on reciprocal benefits. In other words, they may not trust that they can obtain others' knowledge after sharing knowledge.

Individualism/Collectivism

Individualism has no significant influence on organizational rewards and image in China. This may be influenced by national culture. China is characterized as a collectivistic country (Hofstede, 2001). Thus, some of the individualistic employees tend not to emphasize personal interests (i.e., organizational rewards and image). The converse dual effects reduce the effect of individualism on organizational rewards and image for Chinese employees.

On the other hand, individualism does not significantly affect reciprocal benefits in the U.S. One possible explanation for the result is that U.S. employees who are individualists may trust reciprocal benefits. Yoon (2009) proposed that individualists are not sensitive to the in- and out-group boundary. They are still willing to trust reciprocal relationships even if they do not follow collective goals. Thus, the converse dual effects may decrease the effect of individualism on reciprocal benefits for U.S. employees.

Uncertainty Avoidance

The direct effect of uncertainty avoidance on reciprocal benefits is significant in the U.S. but not in China. On the one hand, because China is representative of a weak uncertainty avoidance country (Hofstede, 2001), some of the employees still trust reciprocal benefits. On the other hand, Li et al. (2009) proposed that people with high uncertainty avoidance rely on social norms. Since reciprocal benefits become a norm in organizations, uncertainty avoidance may strengthen the effect of reciprocal benefits. The two reasons may reduce the effect of uncertainty avoidance on reciprocal benefits.

IMPLICATIONS FOR THEORY AND PRACTICE

Implications for Theory

In knowledge-sharing fields, most motivational issues have been studied in a single country (Bock & Kim, 2002; Bock et al., 2005; Huang et al., 2008; Hung et al., 2011; Hung et al., 2011; Hsu & Lin, 2008; Kankanhalli et al., 2005; Lin, 2007; Sedighi et al., 2016; Yan et al., 2016; Zhang et al., 2016; Zhou, 2018). Although some studies have used Hofstede's country scores to theorize about differences between countries, prior research models have been developed and assessed at the national level (Chiu et al., 2018; Chow et al., 2000; Griffith et al., 2006; Jiacheng et al., 2010; Posey et al., 2010). This study is the first to investigate the effects of individual and national cultures on knowledge-sharing motivations and intentions.

In the past, few existing studies have focused on the antecedents of these knowledge-sharing motivations. In this study, Hofstede's cultural dimensions are integrated into the research model as the antecedents of knowledge-sharing motivations. Our results show that individual cultural characteristics influence motivational factors, which in turn influence knowledge-sharing intentions. This implies that individual cultural characteristics play important roles in knowledge sharing. Further research may use a similar framework and methodology to investigate the effects of other individual characteristics (e.g., personality traits) on knowledge-sharing motivations.

After considering the effect of national culture, our models and hypothesized relationships are verified in the U.S. and China. In this study, the relationships between knowledge-sharing motivations (i.e., organizational rewards, image, and reciprocal benefits) and intentions are found to be similar in the two countries. However, individual cultural characteristics (i.e., power distance, individualism/collectivism, and uncertainty avoidance) exhibit salient differences in knowledge-sharing motivations. The results of this study demonstrate the importance of individual cultural characteristics across different countries. If future research is undertaken in a cross-cultural context, the effects of individual and national cultures should be accounted for.

Implications for Practice

The findings of this study provide insights for managers to develop knowledge-sharing practices and management implications across countries. Organizational rewards and reciprocal benefits are important knowledge-sharing motivations in the U.S. and China. However, after considering the effect of individual cultural characteristics, power distance, individualism/collectivism, and uncertainty avoidance play significant roles as antecedents of knowledge-sharing motivations in the U.S.

and China. The results indicate that organizations should use different approaches to motivate employees' knowledge sharing.

Organizational rewards provide an effective mechanism to encourage U.S. and Chinese employees to share knowledge. Although several organizational rewards (such as promotion, salary, bonus, job security) have been used to motivate knowledge sharing, they should be used with caution in organizations. Scholars have proposed that organizational rewards are only triggers for knowledge sharing (Kelman, 1958); temporary compliance cannot maintain employees' attitudes toward sharing knowledge in the long term.

Reciprocal benefits are the important determinants of U.S. and Chinese employees' intention to share knowledge. Managers should strengthen the sense of mutual indebtedness among employees. That is, employees perceive that they will receive knowledge from others after contributing their own knowledge. Meanwhile, managers should endeavor to establish a norm of reciprocity in organizations. Employees can also be encouraged to create and share their knowledge to maintain a good social relationship with their colleagues.

High power distance increases U.S. employees' perception of reciprocal benefits, which in turn increases their knowledge-sharing intentions. The tendency of the cultural characteristic makes employees follow a norm of reciprocity in organizations. Thus, organizations should place more emphasis on relationships between superiors and peers. In addition, good knowledge sharing behaviors of managers may foster their employees to follow and imitate.

Individualism increases the perception of organizational rewards and image, which in turn increases knowledge-sharing intentions in the U.S. Individualistic employees are willing to engage in knowledge sharing because they usually view organizational rewards and image as important incentives. Thus, managers should provide an effective reward mechanism and recognition strategy for encouraging the knowledge-sharing behaviors of individualistic employees.

High uncertainty avoidance may reduce the perception of reciprocal benefits for U.S. employees. These findings suggest that these employees are reluctant to engage in knowledge sharing because they perceive reciprocal benefits as uncertain outcomes. First, managers should endeavor to reduce uncertainty in employees' minds. Thus, managers can create and maintain a norm of reciprocity in the workplace, which in turn helps employees trust each other.

On the other hand, individualism may reduce the perception of reciprocal benefits in China. That is, this inclination might indirectly hinder knowledge sharing among employees. Thus, managers should set knowledge sharing as the collective goal of the organization and encourage individualistic employees to attain it. Since employees have a primary orientation toward shared goals and objectives, they will progressively raise the perception of reciprocal benefits in a cooperative organizational context.

CONCLUSION AND LIMITATIONS

Effective knowledge sharing can help organizations increase competitive advantage. Thus, more and more organizations hope to motivate their employees to share knowledge. However, to the best of our knowledge, few studies have addressed knowledge-sharing issues at both the individual and the national levels. This study examines how cultural characteristics influence knowledge-sharing motivations, which in turn influence knowledge-sharing intentions. Our models are tested using data collected from the U.S. and China. In this study, Hofstede's three cultural dimensions of power distance, individualism/collectivism, and uncertainty avoidance are measured at the individual level and incorporated into our model as antecedents of knowledge-sharing motivations.

The results show that power distance is significantly related to reciprocal benefits in the U.S. but not in China. Individualism/collectivism is significantly related to organizational rewards and image in the U.S. but not in China, while individualism/collectivism is significantly related to reciprocal benefits in China but not in the U.S. Uncertainty avoidance is significantly related to reciprocal benefits in the U.S. but not in China. Since the empirical findings show different effects of both individual and national cultures on knowledge sharing, we also contribute to knowledge-sharing practices in the U.S. and China. The findings can help organizations effectively manage employees' knowledge sharing based on different individual cultural characteristics and national cultural backgrounds.

This study has some limitations. First, we focused on only extrinsic benefits from the organization or management. Future research may also examine intrinsic benefits, such as altruism and knowledge self-efficacy. Second, this study focused on the effects of the three cultural dimensions that were closely related to extrinsic benefits. When future studies investigate other motivational factors, masculine/femininity may be accounted for. Third, this study was conducted with respect to employees in a single multinational company. The generalizability of the results may be limited due to a single sample. Finally, our data were collected from the U.S. and China. The results may differ across other countries. Future research can extend the framework to investigate samples in other countries.

REFERENCES

Andreassen, T. W. (1994). Satisfaction, loyalty and reputation as indicators of customer orientation in the public sector. *International Journal of Public Sector Management*, *7*(2), 16–34. doi:10.1108/09513559410055206

Blau, P. M. (1964). *Exchange and Power in Social Life*. New York: John Wiley and Sons.

Bock, G. W., & Kim, Y. G. (2002). Breaking the myths of rewards: An exploratory study of attitudes about knowledge sharing. *Information Resources Management Journal*, *15*(2), 14–21. doi:10.4018/irmj.2002040102

Bock, G. W., Zmud, R. W., Kim, Y. G., & Lee. (2005). Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *Management Information Systems Quarterly*, *29*(1), 87–111. doi:10.2307/25148669

Chang, Y. W., Hsu, P. Y., Shiau, W. L., & Tsai, C. C. (2015). Knowledge sharing intention in the United States and China: A cross-cultural study. *European Journal of Information Systems*, *24*(3), 262–277. doi:10.1057/ejis.2014.28

Chang, Y. W., Hsu, P. Y., Shiau, W. L., & Yi, R. (2015). The effect of customer power on enterprise internal knowledge sharing: An empirical study. *Aslib Journal of Information Management*, *67*(5), 505–525. doi:10.1108/AJIM-02-2015-0028

Chen, C. C., Cameron, M. F., & George, F. F. (1999). Do rewards benefit the organization? The effects of reward types and the perceptions of diverse R&D professionals. *IEEE Transactions on Engineering Management*, *46*(1), 47–55. doi:10.1109/17.740037

Chen, S. S., Chuang, Y. W., & Chen, P. Y. (2012). Behavioral intention formation in knowledge sharing: Examining the roles of KMS quality, KMS self-efficacy, and organizational climate. *Knowledge-Based Systems*, *31*, 106–188. doi:10.1016/j.knosys.2012.02.001

Chin, W. W. (1998). The partial least squares approach for structural equation modelling. In G. A. Marcoulides (Ed.), *Modern Methods for Business Research* (pp. 295–336). London: Lawrence Erlbaum.

Chiu, C. K., Lin, C. P., Tsai, Y. H., & Teh, S. F. (2018). Enhancing knowledge sharing in high-tech firms: The moderating role of collectivism and power distance. *Cross Cultural & Strategic Management*, *25*(3), 468–491. doi:10.1108/CCSM-03-2017-0034

Choi, J., & Geistfeld, L. V. (2004). A cross-cultural investigation of consumer e-shopping adoption. *Journal of Economic Psychology*, *25*(6), 821–838. doi:10.1016/j.joep.2003.08.006

Chow, C. W., Deng, J., & Ho, J. L. (2000). The openness of knowledge sharing within organizations: A comparative study of the United States and the people's republic of china. *Journal of Management Accounting Research*, *12*(1), 65–95. doi:10.2308/jmar.2000.12.1.65

Clark, T. (1990). International marketing and national character: A review and proposal for an integrative theory. *Journal of Marketing*, *54*(4), 66–79. doi:10.1177/002224299005400406

Connolly, T., & Thorn, B. K. (1999). Discretionary databases: Theory, data, and implications. In J. Fulk & C. Steinfield (Eds.), *Organizations and Communication Technology*. Newbury Park, CA: Sage Publications.

Constant, D., Kiesler, S., & Sproull, L. (1994). What's mine is ours, or is it? A study of attitudes about information sharing. *Information Systems Research*, *5*(4), 400–421. doi:10.1287/isre.5.4.400

Constant, D., Sproull, L., & Kiesler, S. (1996). The kindness of strangers: The usefulness of electronic weak ties for technical advice. *Organization Science*, *7*(2), 119–135. doi:10.1287/orsc.7.2.119

Davenport, T. H., & Prusak, L. (1998). *Working Knowledge: How Organizations Manage What They Know*. Boston: Harvard Business School Press.

Deci, E. L., & Ryan, R. M. (1980). The empirical exploration of intrinsic motivational processes. *Advances in Experimental Social Psychology*, *13*, 39–80. doi:10.1016/S0065-2601(08)60130-6

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equations with unobservable variables and measurement error. *JMR, Journal of Marketing Research*, *18*(1), 39–50. doi:10.1177/002224378101800104

Fukuyama, F. (1995). *Trust: The Social Virtues and the Creation of Prosperity*. New York: Free Press.

Gefen, D., Straub, D. W., & Boudreau, M. C. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems*, *4*(7), 1–70.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, *91*(3), 481–510. doi:10.1086/228311

Griffith, D. A., Myers, M. B., & Harvey, M. G. (2006). An investigation of national culture's influence on relationship and knowledge resources in interorganizational relationships between Japan and the united states. *Journal of International Marketing*, *14*(3), 1–32. doi:10.1509/jimk.14.3.1

Ham, C. D., Lee, J., Hayes, J. L., & Bae, Y. H. (2019). Exploring sharing behaviors across social media platforms. *International Journal of Market Research*, *61*(2), 157–177. doi:10.1177/1470785318782790

Harman, H. H. (1976). *Modern Factor Analysis*. New York: University of Chicago Press.

Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-Related Values*. Beverly Hills, CA: Sage.

Hofstede, G. (2001). *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations across Nations* (2nd ed.). Thousand Oaks, CA: Sage.

Hofstede, G., & Bond, M. H. (1988). The Confucius connection from cultural roots to economic growth. *Organizational Dynamics*, *16*(4), 5–21. doi:10.1016/0090-2616(88)90009-5

Hsu, C. L., & Lin, J. C. C. (2008). Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & Management*, *45*(1), 65–74. doi:10.1016/j.im.2007.11.001

Huang, Q., Davison, R. M., & Gu, J. (2008). Impact of personal and cultural factors on knowledge sharing in China. *Asia Pacific Journal of Management*, *25*(3), 451–471. doi:10.100710490-008-9095-2

Hung, S. Y., Durcikova, A., Lai, H. M., & Lin, W. M. (2011). The influence of intrinsic and extrinsic motivation on individuals' knowledge sharing behaviour. *Journal of Human-Computer Studies*, *69*(6), 415–427. doi:10.1016/j.ijhcs.2011.02.004

Hung, S. Y., Lai, H. M., & Chang, W. W. (2011). Knowledge-sharing motivations affecting R&D employees' acceptance of electronic knowledge repository. *Behaviour & Information Technology*, *30*(2), 213–230. doi:10.1080/0144929X.2010.545146

Husted, K., & Michailova, S. (2002). Diagnosing and fighting knowledge-sharing hostility. *Organizational Dynamics*, *31*(1), 60–73. doi:10.1016/S0090-2616(02)00072-4

Jiacheng, W., Lu, L., & Francesco, C. A. (2010). A cognitive model of intra-organizational knowledge-sharing motivations in the view of cross-culture. *International Journal of Information Management*, *30*(3), 220–230. doi:10.1016/j.ijinfomgt.2009.08.007

Jin, C. H. (2017). The effect of psychological capital on start-up intention among young start-up entrepreneurs: A cross-cultural comparison. *Chinese Management Studies*, *11*(4), 707–729. doi:10.1108/CMS-06-2017-0162

Kankanhalli, A., Tan, B. C. Y., & Wei, K. K. (2005). Contributing knowledge to electronic knowledge repositories: An empirical investigation. *Management Information Systems Quarterly*, *29*(1), 113–143. doi:10.2307/25148670

Karahanna, E., Evaristo, J. R., & Srite, M. (2005). Levels of culture and individual behavior: An integrative perspective. *Journal of Global Information Management*, *13*(2), 1–20. doi:10.4018/jgim.2005040101

Kelman, H. C. (1958). Compliance, identification, and internalization: Three processes of attitude change. *The Journal of Conflict Resolution*, *2*(1), 51–60. doi:10.1177/002200275800200106

Kivrak, S., Arslan, G., Tuncan, M., & Birgonul, M. T. (2014). Impact of national culture on knowledge sharing in international construction projects. *Canadian Journal of Civil Engineering*, *41*(7), 642–649. doi:10.1139/cjce-2013-0408

Kluckhohn, C. (1951). *The Study of Culture*. Stanford, CA: Stanford University Press.

Kroeber, A. L., & Parsons, T. (1958). The concept of culture and of social system. *American Sociological Review*, *23*(5), 582–583.

Lee, A. B. S., Chan, F. T. S., & Pu, X. (2018). Impact of supplier development on supplier's performance. *Industrial Management & Data Systems*, *118*(6), 1192–1208. doi:10.1108/IMDS-05-2017-0229

Lee, I., Choi, B., Kim, J., & Hong, S. J. (2007). Culture-technology fit effects of cultural characteristics on the post-adoption beliefs of mobile Internet users. *International Journal of Electronic Commerce*, *11*(4), 11–51. doi:10.2753/JEC1086-4415110401

Li, X., Hess, T. J., Mcnab, A. L., & Yu, Y. (2009). Culture and acceptance of global web sites: A cross-country study of the effects of national cultural values on acceptance of a personal web portal. *The Data Base for Advances in Information Systems*, *40*(4), 62–87. doi:10.1145/1644953.1644959

Liao, L. F. (2008). Knowledge-sharing in R&D departments: A social power and social exchange theory perspective. *International Journal of Human Resource Management*, *19*(10), 1881–1895. doi:10.1080/09585190802324072

Lin, H. F. (2007). Effects of extrinsic and intrinsic motivation on employee knowledge sharing intentions. *Journal of Information Science*, *33*(2), 135–149. doi:10.1177/0165551506068174

Lin, T. C., Lai, M. C., & Yang, S. W. (2015). Factors influencing physicians' knowledge sharing on web medical forums. *Health Informatics Journal*. PMID:25888432

Mattila, A. S., & Enz, C. A. (2002). The role of emotions in service encounters. *Journal of Service Research*, *4*(4), 268–277. doi:10.1177/1094670502004004004

Molm, L. D. (1997). *Coercive power in social exchange*. Cambridge University Press. doi:10.1017/CBO9780511570919

Moon, J. W., & Kim, Y. G. (2001). Extending the TAM for a world-wide-web context. *Information & Management*, *38*(4), 217–230. doi:10.1016/S0378-7206(00)00061-6

Organ, D. W., & Konovsky, M. (1989). Cognitive versus affective determinants of organizational citizenship behavior. *The Journal of Applied Psychology*, *74*(1), 157–164. doi:10.1037/0021-9010.74.1.157

Pee, L. G., Kankanhalli, A., Ong, L. L., & Vu, M. K. (2010) Antecedents, and impact of knowledge management capability in public organizations. *2010 Pacific Asia Conference on Information Systems*, 713-724.

Posey, C., Lowry, P. B., Roberts, T. L., & Ellis, T. S. (2010). Proposing the online community self-disclosure model: The case of working professionals in France and the U.K. who use online. *European Journal of Information Systems*, *19*(2), 181–19. doi:10.1057/ejis.2010.15

Putam, R. D. (1995). Tuning in, tuning out: The strange disappearance of social capital in America. *PS, Political Science & Politics*, *28*(4), 664–683. doi:10.1017/S1049096500058856

Radford, M. H., Mann, L., Ohta, Y., & Nakane, Y. (1991). Differences between Australian and Japanese students in reported use of decision processes. *International Journal of Psychology*, *26*(1), 35–52. doi:10.1080/00207599108246848

Ryan, R. M., & Deci, E. L. (2000). Self-Determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American Psychologist*, *55*(1), 68–78. doi:10.1037/0003-066X.55.1.68 PMID:11392867

Scuotto, V., Giudice, M. D., Holden, N., & Mattiacci, A. (2017). Entrepreneurial settings within global family firms: Research perspectives from cross-cultural knowledge management studies. *European Journal of International Management*, *11*(4), 469–489. doi:10.1504/EJIM.2017.085586

Sedighi, M., van Splunter, S., Brazier, F., van Beers, C., & Lukosch, S. (2016). Exploration of multi-layered knowledge sharing participation: The roles of perceived benefits and costs. *Journal of Knowledge Management*, *20*(6), 1247–1267. doi:10.1108/JKM-01-2016-0044

Srite, M., & Karahanna, E. (2006). The role of espoused national cultural values in technology acceptance. *Management Information Systems Quarterly*, *30*(3), 679–704. doi:10.2307/25148745

Steenkamp, J. B. E., Hofstede, F. T., & Wedel, M. (1999). A cross-national investigation into the individual and national cultural antecedents of consumer innovativeness. *Journal of Marketing*, *63*(2), 55–69. doi:10.1177/002224299906300204

Straub, D., Loch, W., Aristo, R., Karahanna, E., & Strite, M. (2002). Toward a theory-based measurement of culture. *Journal of Global Information Management*, *10*(1), 13–23. doi:10.4018/jgim.2002010102

Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*, *6*(2), 144–176. doi:10.1287/isre.6.2.144

Thibaut, J. W., & Kelley, H. H. (1959). *The social psychology of groups*. New York: John Wiley.

Triandis, H. C. (1995). *Individualism and collectivism*. Boulder.

Tyler, T. R., Lind, E. H., & Huo, Y. J. (2000). Cultural values and authority relations: The psychology of conflict resolution across cultures. *Psychology, Public Policy, and Law*, *6*(4), 1138–1163. doi:10.1037/1076-8971.6.4.1138

Wasko, M. M., & Farjaj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *Management Information Systems Quarterly*, *29*(1), 35–57. doi:10.2307/25148667

Yan, Z., Wang, T., Chen, Y., & Zhang, H. (2016). Knowledge sharing in online health communities: A social exchange theory perspective. *Information & Management*, *53*(5), 643–653. doi:10.1016/j.im.2016.02.001

Yoon, C. (2009). The effects of national culture values on consumer acceptance of e-commerce: Online shoppers in China. *Information & Management*, *46*(5), 294–301. doi:10.1016/j.im.2009.06.001

Yu, M. (2014). Examining the effect of individualism and collectivism on knowledge sharing intention. *Chinese Management Studies*, *8*(1), 149–166. doi:10.1108/CMS-06-2011-0037

Zhang, X., Pablos, P. O. d., & Xu, Q. (2014). Culture effects on the knowledge sharing in multi-national virtual classes: A mixed method. Elsevier Science Publishers B. V.

Zhang, X., Liu, S., Chen, X., & Gong, Y. (2017). Social capital, motivations, and knowledge sharing intention in health Q&A communities. *Management Decision*, *55*(7), 1536–1557. doi:10.1108/MD-10-2016-0739

Zhou, T. (2018). Understanding online knowledge community user continuance: A social cognitive theory perspective. *Data Technologies and Applications*, *52*(3), 445–458. doi:10.1108/DTA-10-2017-0077

APPENDIX 1

Measurement Items of Constructs

Table 6.

Construct	Measurement Items	Source
Organizational rewards	1. I will receive a higher salary in return for my knowledge sharing. 2. I will receive a higher bonus in return for my knowledge sharing. 3. I will receive increased promotion opportunities in return for my knowledge sharing. 4. I will receive increased job security in return for my knowledge sharing.	Davenport and Prusak (1998)
Image	1. Sharing my knowledge improves my image within the organization. 2. Engineers in the organization who share their knowledge have more prestige than those who do not. 3. Sharing my knowledge improves others recognition of me. 4. When I share my knowledge, the people I work with respect me.	Kankanhalli et al. (2005)
Reciprocal benefits	1. When I share my knowledge, I believe that I will get an answer for giving an answer. 2. When I share my knowledge, I expect somebody to respond when I'm in need. 3. When I share my knowledge, I expect to get back knowledge when I need it.	Kankanhalli et al. (2005)
Knowledge-sharing intention	1. I will share my knowledge on a regular basis in the future. 2. I will frequently share my knowledge in the future. 3. I will strongly recommend others to share knowledge.	Moon and Kim (2001)
Power distance	1. Subordinates should follow their superiors' decisions unconditionally. 2. Subordinates should not question their superiors' decisions.	Yoon (2009)
Individualism/ collectivism	1. Individual rewards are more important than group welfare. 2. Individual success is more important than group success. 3. Having independence is more important than being accepted as a member of a group.	Yoon (2009)
Uncertainty avoidance	1. When starting a new job, I fear doing it. 2. I fear ambiguous situations and unfamiliar adventures. 3. It is risky to do something that has never been done before.	Yoon (2009)

APPENDIX 2

Descriptive Statistics of Respondents' Characteristics

Table 7.

Measure		Total		U.S.		China	
		Value	**Freq**	**Value**	**Freq**	**Value**	**Freq**
Position	Management	46	15.0%	24	15.7%	22	14.3%
	Employee	261	85.0%	129	84.3%	132	85.7%
Gender	Male	248	80.8%	125	81.7%	123	79.7%
	Female	59	19.2%	28	18.3%	31	20.3%
Education	Senior high school	32	10.4%	25	16.3%	7	4.6%
	University	213	69.4%	110	71.9%	103	66.9%
	Master	54	17.6%	15	9.8%	39	25.3%
	Doctor	8	2.6%	3	2%	5	3.2%
Age	18-25	9	2.9%	5	3.3%	4	2.6%
	26-35	139	45.3%	41	26.8%	98	63.6%
	36-45	118	38.4%	67	43.8%	51	33.1%
	46-55	39	12.7%	38	24.8%	1	0.7%
	56-65	2	0.7%	2	1.3%	0	0%
Work experience	<3	49	16.0%	8	5.2%	41	26.6%
	3-5	73	23.8%	18	11.7%	55	35.7%
	6-10	78	25.4%	39	25.5%	39	25.3%
	11-15	65	21.2%	48	31.4%	17	11.1%
	16-20	28	9.1%	26	17.0%	2	1.3%
	>20	14	4.5%	14	9.2%	0	0%

Chapter 5
A Comparative Study of Mobile Banking Adoption: An Analysis of Banking Customers in U.S. and Thailand

Jomjai Sampet
Faculty of Business Administration, Chiang Mai University, Thailand

Chuleeporn Changchit
Texas A&M University, Corpus Christi, USA

Ravi Lonkani
Faculty of Business Administration, Chiang Mai University, Thailand

ABSTRACT

Recently, mobile banking has gained significant importance, and the growth of the field is accelerating. Due to a rapid increase in smart phone users, banks have shifted the competitive landscape from physical banking branches to internet banking and mobile banking services. However, many customers remain reluctant to use this banking channel. It is crucial for banks to meet customers' need and understand which factors play an important role in encouraging or discouraging them from using mobile banking. Culture can also play an important role on these factors. This study compares the mobile banking perceptions between the consumers in the U.S. and in Thailand and reveal various factors that influence mobile banking adoption for these two nationalities. The findings suggest factors that banks should consider when implementing mobile banking services, thus allowing them to design the services that meet the needs of their customers.

DOI: 10.4018/978-1-7998-1786-4.ch005

INTRODUCTION

Emerging technologies often result in new opportunities, choices, and possibilities, which allow businesses to open new channels for offering products or rendering services to meet their customers' need (Bhattacharjee et al. 2006, Changchit et al., 2017). The increasing popularity of the Internet has created great challenges for companies to offer products or services via this new distribution channel (Chau & Lai, 2003). As with other types of online businesses, Internet and mobile banking has gained significant importance, and the growth of the field is accelerating (Afshan & Sharif, 2016; Kim et al, 2013). The Internet-based technologies enable banks to provide customized content that can educate and cross-sell while strengthening the long-term relationship between banks and customers (Chau & Lai, 2003). Banks around the world have invested about $115 billion for the purpose of increasing mobile banking adoption (Baadullah et al., 2019).

With a growing number of households turning towards the world of e-commerce, it is crucial for online businesses to realize the need to run their business to suit the convenience of their customers. Recently, the number of consumers owning sophisticated mobile handheld devices, i.e., smart phones, has rapidly increased (Gerpott et al., 2013; Kim et al., 2013). The functionalities of this communication device not only enable consumers to make voice calls but also allow them to perform several transactions via mobile applications (West & Mace, 2010). The mobile devices can be used not only for personal activities, but also for business-related activities, particularly in mobile environments (Zhang & Jasimuddin, 2015). Rapid advances in mobile technologies and devices have made mobile banking increasingly important in mobile commerce and financial services (Lin, 2011). This service provides a more convenient means for customers to meet their banking needs with more complete and timely information (Baptista & Oliveira, 2015; Gerrard & Cunningham, 2003). However, many customers remain reluctant to use the mobile banking due to its security (Muñoz-Leiva, Climent-Climent, & Liébana-Cabanillas, 2017). These situations increase the number of mobile banking users and it is interesting issue of finding which factors the users use in adopting the mobile banking services.

Research in this area have expanded to investigate the reason of using mobile banking outside U.S. Cross cultural effect has been found to be important in many studies (Al-Refaie, 2014; Ao & Liu, 2014; Bin et al., 2003; Greenberg et al., 2008; Yan et al., 2014; Lippert & Volkmar, 2007; Chang et al., 2015). For instance, Chang et al. (2015) gathered survey data from university students in Cambodia, Iran, and South Korea producing results showing that country development index has a significant effect on the levels of the digital divide. A study conducted by Hung et al. (2012) revealed that respondents from different cultures prefer different communication methods. Shin and Choo (2012) use the sample from U.S. and Korea to study the

cross-cultural effect on smart phone users and find that different value preferences, intention, and adoption patterns were observed for the two countries.

Even though the literature on the adoption of mobile banking is quite extensive (Afshan & Sharif, 2016; Lee et al., 2013; Lin, 2011; Nel & Boshoff, 2014; Staff, 2013), few studies have explored the motivations for mobile banking adoption in a cross-cultural manner (Baptista & Oliveira, 2015; Yu & Chantatub, 2015). In particular, there is no prior study comparing consumers' attitude toward the usage of mobile banking between the U.S. and Thailand. The comparison between the U.S. and Thailand was chosen because both countries show a high percentage of mobile banking usage (64% in Thailand and 42% in the U.S.), as reported by Statista (2015). In addition, despite many prior studies in mobile banking, this study provides several contributions to the literature. First, since smart phone technology has dramatically changed since the last five years, many mobile banking features have been either added or improved as well. Although some constructs in the proposed model were examined in the past, the findings may not be relevant nowadays. Second, this research extends the study of factors investigated in prior studies to include the factor "Previous Experiences". It was hypothesized that consumers' experiences on using mobile banking should influence their attitudes toward mobile banking adoption. Third, unlike prior studies that did not track whether subjects have used mobile banking before or not, subjects in this study contain only those who have experience using mobile banking before. Attracting potential customers and retaining existing customers is crucial to the long-term business success of mobile banking firms (Gu et al., 2009). Therefore, the responses gathered from this target group of subjects should not only help banking services understand the needs of their customers in regard to the adoption of mobile banking but also help them improve the retention rate of their existing customers.

Contributions from this study can be obviously obtained both academically and practically. The findings should provide a better understanding of localized demand for mobile banking. It is apparent that better serve quality should be met by the devotion to serving local need (Singh et al., 2003). In other words, suggestions from this study should allow banking institutions to provide a better quality of mobile banking services and expand their target customer base by providing information regarding the specific needs of customers from different cultures. This study aims at comparing the mobile banking perceptions between the consumers in the U.S. and in Thailand. The findings should reveal various factors that influence mobile banking adoption for these two nationalities. These results should help banks gain an understanding of these factors, and thus direct their efforts to develop features that satisfy the needs of their target customers and alter their business model to promote factors that have a positive influence on mobile banking adoption.

This study is structured as follows. First, the rationale of the study is mentioned. The second section discusses the literature review, which will present related empirical studies. The mobile banking situation in Thailand as well as related literature on cross-cultural influences is also discussed in this section. In the third section, a theoretical framework, a research model, and hypotheses are proposed. The fourth section presents the data and analytical model with the results. The fifth section is the conclusion. Practical implication is also discussed in this section.

LITERATURE REVIEW

Internet banking has emerged as one of the most profitable e-commerce applications over the last decade (Intana et al., 2013). The annual survey of 1,000 U.S. adults conducted by the American Bankers Association (ABA) revealed that nearly one-third of respondents (32 percent) indicated Internet banking as the method they used most often to manage their bank accounts (American Bankers Association, 2015). The Internet banking application provides many advantages, such as faster transaction speed and lower handling fees (Lee et al., 2011).

Internet banking brings advantages both to customers and banks. It provides customers with a fast and convenient way to undertake various banking transactions from the comfort of their home, office, or other preferred space, during and after banking hours. Customers can avoid travel time and the need to wait in queues to access banking services. For the banks, Internet banking has improved productivity and efficiency, reduced costs, and enhanced customer service. Furthermore, Internet banking usually requires less staff and fewer physical branches resulting in much lower operating costs (Yaghoubi & Bahmani, 2010).

In parallel with the growth of Internet banking, mobile banking has gained significant importance, and the growth of the field is accelerating (Lin, 2011; Salehi & Alipour, 2010). Mobile banking is a channel whereby the customer interacts with a bank via a mobile device (Singh et al., 2010). Due to a rapid increase in smart phone users, banks have shifted the competitive landscape from physical banking branches to Internet banking and mobile banking services (Nasri & Charfeddine, 2012). In this digital age, financial technology offers a new service platform for banking sector in the world. The number of mobile payment transactions has increased by approximately 58.33 percent from 2014 to 2015 (Dapp, Slomka, & Hoffmann, 2015). According to a recent survey, although Internet banking is still America's most popular banking method, mobile banking continues to grow. Mobile banking is now preferred by 12 percent of consumers—up from 3 percent when it was surveyed five years ago (American Bankers Association, 2015). With the help of mobile banking, bank customers can easily access banking facilities such

as information inquiry, account managing, bill payment and money transfers etc. (Luarn & Lin, 2005).

Several studies were conducted to examine the factors influencing the usages of mobile banking. For instance, Alalwan et al. (2017) investigated the extended UTAUT factors and trust in influencing behavioural intention and adoption of mobile banking. The results showed that all extended UTAUT2 factors, except social influence, and trust affect mobile banking adoption through behavioral intention. Afshan and Sharif (2016) analysed the dimensions of mobile banking acceptance and found a significant association of task technology fit, initial trust, and facilitating condition with intention to adopt mobile banking. Lin (2011) developed a research model to examine the effect of proposed factors on attitude and behavioral intention about adopting (or continuing to use) mobile banking across potential and repeat customers. The results indicated that perceived relative advantage, ease of use, compatibility, competence and integrity significantly influence attitude, which in turn lead to behavioral intention to adopt (or continue to use) mobile banking. Trust also plays an important construct in explaining the intention to use mobile banking in the research of Sharma and Sharma (2019) whose finding shows that satisfaction is intermediary factor to the relationship between trust, service quality, information quality and intention to use mobile banking.

Kang et al. (2012) developed a model that explains sustained use of mobile banking services. The study results pointed out that perceived usability, channel preference, and perceived value were three major determinants of sustained mobile banking use. Another study proposed a model to predict users' intention to use mobile banking (Song, 2015). The results found that perceived usefulness, perceived ease of use, social influence, and trust perception significantly effects user adoption. AlSoufi and Ali (2014) studied the mobile banking adoption in Bahrain. The results revealed that the intention to adopt mobile banking is mainly affected by perceived usefulness and perceived ease of use. Using Technology Acceptance Model (TAM) with social image, trust and perceived risk integrated, Muñoz-Leiva et al. (2017) found both direct and indirect effects of these factors on users' attitude and intention to use mobile banking apps.

Gu et al. (2009) examined and validated determinants of users' intention to adopt mobile banking. The study found that self-efficiency was the strongest antecedent of perceived ease-of-use. In addition, Structural assurances were the strongest antecedent of trust. Another study found that performance expectancy, task technology fit, social influence, and facilitating conditions had significant effects on mobile banking adoption (Zhou et al., 2010).

Internet and Mobile Banking in Thailand

Internet in Thailand was dated back to 1987 (Thailand Chapter of Internet Society, 2015). The first Internet email services were operated under an agreement made by the Asian Institute of Technology (AIT) and the Department of Computer Science at the University of Melbourne in Australia (Intana et al., 2013). A major breakthrough occurred in 1991 when Chulalongkorn University became an Internet gateway in Thailand, becoming fully operational in July of 1992 (Thailand Chapter of Internet Society, 2015). Nowadays, over one third of the population in Thailand has regular access to the Internet (National Statistical Office, 2014).

The Bank of Thailand (BOT) regulates and supervises financial institution operated in the country (Suanmali, 2015). Internet banking offers many benefits to banks as well as their customers. One study summarized the advantages of Internet banking services as follows: (1) cost saving, (2) increased customers, (3) enabling of mass customization for e-business services, (4) extended marketing and communication channels, (5) search for new innovation services, and (6) exploration and development of non-core businesses (Ongkasuwan & Tantichattanon, 2002).

The number of mobile subscribers in Thailand had exceeded its population since 2010 (Suanmali, 2015) and this situation leads to an increasing usage of mobile banking services. Although Internet banking in Thailand is increasing, not all customers are ready to adopt this channel of banking services (Intana et al., 2013). It is a challenge for banking businesses to revise their strategies to attract more customers for Internet banking. One study reported that Thai people find security to be insufficient and thus holding them back from adopting Internet banking (Esichaikul & Janecek, 2009). The study also revealed that the lack of customer service was a major reason preventing them from adopting Internet banking as well.

Rotchanalitumnuai and Speece (2003) studied barriers to Internet banking adoption. The research findings from interviews with Thai firms suggested that the security of the Internet is a major factor inhibiting a wider adoption of Internet banking in Thailand. Subjects revealed that they did not feel comfortable making financial transactions via Internet channels. The management also has negative attitudes toward Internet banking adoption and usually cites the reason as lacking resources. Jaruwachirathanakul and Fink (2005) applied the decomposed planned behavior to identify the factors that encourage customers to adopt Internet banking services in Thailand. The research findings revealed that "Features of the Web Site" and "Perceived Usefulness" are the two factors that encourage the adoption of Internet banking in Thailand. They also reported that the factor that inhibits the adoption is "Perceived Behavioral Control." Another study conducted by Namahoot and Laohavichien (2015) reported that information quality (i.e. the accuracy of the online transaction record) of online banks in Thailand was negatively correlated with

trust to use Internet banking. Trust was also found to be the critical factor leading to the adoption of using Internet banking in Thailand

With more advanced computing ability and connectivity, smart phone applications become more popular in this era. Based on Payment Systems Report 2017 by Bank of Thailand, mobile banking customers have been dramatically increasing since 2015 as shown in Figure 1. Since then, customers prefer mobile banking to Internet banking. The number of mobile banking users at the end of 2017 grew by 51% from 2016. These increasing numbers were driven by banking applications, which are easy to use and offer a variety of services. Moreover, banks use aggressive marketing campaigns to attract more customers. Another important factor that drove the use of mobile banking is a PromptPay operation since the beginning 2017. The number of registered PromptPay users in 2017 were 40.4 million and the PromptPay transactions via mobile and internet banking grew approximately 26.3% per month (Bank of Thailand, 2017).

Figure 2 shows that the volume of mobile banking transactions in 2017 increased from 2016 by 110%. This trend is consistent with an increasing number of mobile banking users. At the same time, Figure 2 shows that internet banking transactions is lower in terms of both volume and growth (Bank of Thailand, 2017).

Figure 3 shows the value of internet and mobile banking transactions. Although mobile banking transactions had a higher growth compared to internet banking during 2015-2017, the value was significantly lower. This is due to the reason that the maximum transfer amount allowed per transaction for mobile banking (500,000 baht per transaction) is lower than which of internet banking (10 million baht per transaction). Therefore, internet banking was mostly used for business purposes.

Boonsiritomachai & Pitchayadejanant (2017) investigated mobile banking adoption by Thai generation Y using UTAUT and TAM. The results show that facilitating conditions and security in mobile banking application have an indirect

Figure 1. Number of internet banking and mobile banking accounts
(Bank of Thailand, 2017)

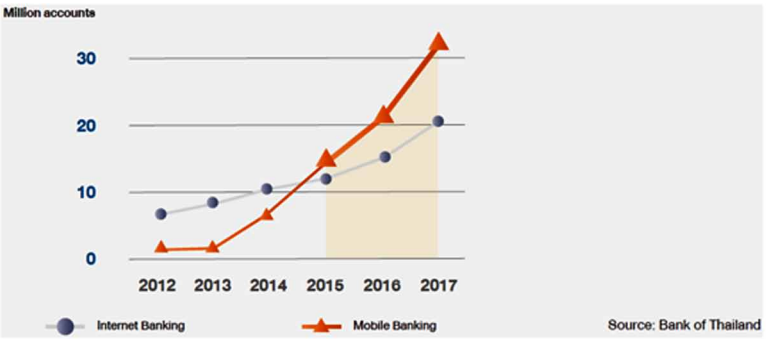
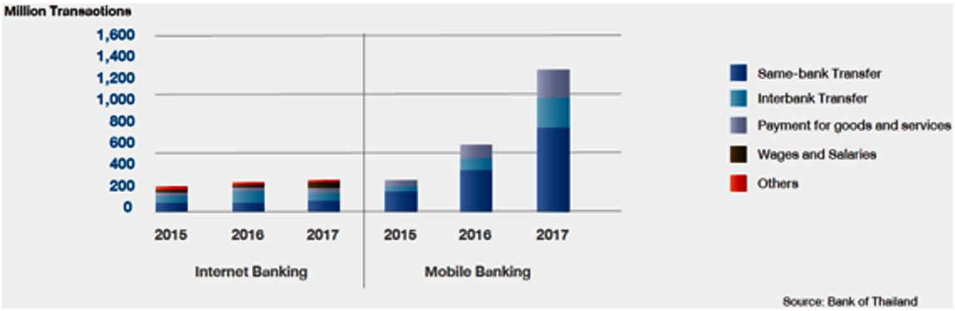


Figure 2. Volume of internet banking and mobile banking transactions
(Bank of Thailand, 2017)



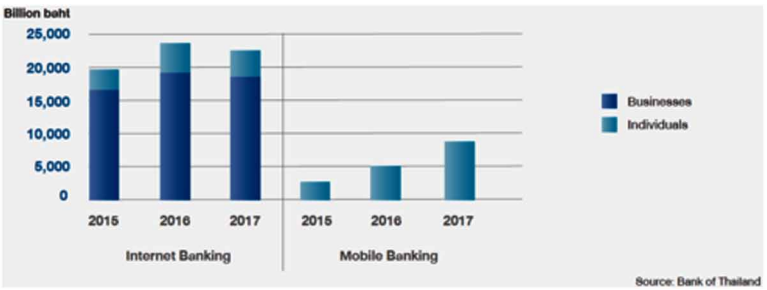
effect on behavioral attention via hedonic motivation while self-efficacy has both direct and indirect effect on behavioral attentions.

Cultural Considerations

Culture has long been recognized as an important factor shaping consumer behavior (Changchit et al., 2014). Culture has been defined by Matsumoto (1994) as the degree to which people share attributes, values, beliefs, and behaviors. The most popular definition of culture is Hofstede's, which defines culture as, "the collective programming of the mind which distinguishes the members of one group from another" (1984, p.21).

In his work, Hofstede (1984) identified four dimensions of culture. The first dimension is power distance, which is described as the extent that less powerful members of an organization accept that power is distributed unequally. The second dimension is individualism, which refers to the degree to which individuals emphasize self-interest over that of the group. The third dimension is that of masculinity,

Figure 3. Value of internet banking and mobile banking transactions
(Bank of Thailand, 2017)



which attaches importance to goals such as career and material success versus social goals such as relationships and helping others. The fourth dimension is uncertainty avoidance, which addresses the degree to which people of a society feel uncomfortable with uncertainty and ambiguity. Table 1 below shows the comparison of these cultural dimensions between people in U.S. and Thailand.

As the globalization of business and systems continues, there is a need for studies on the cross-cultural adoption and use of information technology as cultural issues play a significant role in the development, design, and use of Information Systems (Hasan & Ditsa, 1999; McCoy et al., 2004). The national culture of IT development, operation, and use is important for the research on global information management (Markus & Soh, 2002). Effect of cultural differences on IT perception and use is studied from various perspectives. For instance, Kim et al. (2014) revealed that perceived usefulness, perceived risk, and trial ability are determinants of consumers' perception on the IT process in China, Korea, and Japan and are affected by different cultures.

Cultural difference is the significant factor that can limit the online activities such as the use of online searches or even blocking E-commerce activities (Bin et al., 2003). Different cultures reflect differing social norms and propensity to trust (Greenberg et al., 2008). Locally, usage of IT may be affected by different political systems (Elbeltagi et al., 2005). For global business, the integration of IT is recognized as a global competitive pressure. This challenge can be achieved by the cross-cultural study to gain more knowledge on the differences in value and attitude (Lippert & Volkmar, 2007). For instance, Rouibah and Hamdy (2009) revealed that curiosity can be one additional factor to the Technology Acceptance Model (TAM) for a study conducted in Kuwait. Gefen and Heart (2006) also found that trust and trust beliefs differ markedly in individualism, uncertainty avoidance, and power distance for subjects in Israel. The results showed that the effects of predictability and familiarity on trust beliefs might differ across national cultures.

Culture has been considered as a factor influencing IT adoption (Ein-Dor et al., 1993; Harvey, 1999; Palvia, 1998). Straub et al. (1997) found that the TAM could

Table 1. The comparison of cultural dimensions between U.S. and Thailand

	U.S.	**Thailand**
Power distance	40	64
Individualism	91	20
Masculinity	62	34
Uncertainty avoidance	46	64

(Hofstede, 1984)

not predict technology usage across all cultures. The study examined the accuracy of TAM across three countries, Japan, Switzerland, and the U.S. and found that TAM could not explain subject's behavioral intention in Japan while the model was found to be a good explanation for IT use in Switzerland. The difference in these results was explained to be the influence of national culture. Results in another study also suggested that culture could impede IT implementation efforts because of differences in the way IT were interpreted and given meaning (Robey et al., 1989).

Cross country differences should be considered in the agenda of technology challenges (Malquias and Hwang, 2019). The differences in term of level of development of the country implies an effect on the variables that can facilitate or create obstacles to the adoption of new technologies. Malaquias and Hwang (2019) use 375 Brazillian students who are mobile banking user and 174 U.S. students who are the U.S. mobile user. They found that perceived usefulness and trust are among the main factors on explaining the mobile banking in Brazil.

Baker et al. (2010) conducted a study with Saudi subjects to examine the cultural effect on technology adoption behavior. The result reported that collectivist culture and the worker's focus on the managerial father figure influences the individual acceptance of technology. In addition, a study conducted by Srite et al. (2008) also revealed that cultural values significantly influence technological acceptance and use. Hung et al. reported that culture is an important element when choosing investment options in communication media and also revealed that respondents from the U.S. and Taiwan preferred different communication methods. Shin and Choo (2012) explored the cross-cultural effect on smart phone users in the U.S. and Korea. The results found that the two countries showed different value preferences as well as intention and adoption patterns. Brown et al. (2004) studied the Internet banking adoption in two countries, Singapore and South Africa. They concluded that attitude and behavioral control factors influenced consumer adoption of Internet banking but with differences in the number of determinants and the degree of influence of certain determinants. Susanto et al. (2013) conducted another cross-cultural study between subjects in Indonesia and Korea. The results revealed that Indonesians' use of Internet banking is strongly influenced by perceived security, while Koreans' use of Internet banking is strongly influenced by privacy concerns. In addition, trust and user satisfactions have a greater influence on loyalty for Indonesians while commitment has a greater influence on loyalty for Koreans.

THEORETICAL BACKGROUND

The Technology Acceptance Model (TAM) developed by Davis in 1986 (Davis et al., 1989) is derived from the Theory of Reasoned Action (TRA), developed by

Fishbein and Ajzen (1975). The TAM was a big hit for modeling user acceptance of information systems (Bagozzi, 2007; Davis et al., 1989). The TAM model was proposed to address the question why users accept or reject information technology. The key purpose of TAM is to trace the impact of external variables on internal beliefs, attitudes, and intentions. The TAM suggests that two factors - perceived usefulness and perceived ease of use - are the two main factors in explaining system use. The TAM has several strengths, including its specific focus on information system use, its theory base of social psychology, and the validity and reliability of its instruments. Overall, the TAM has received widespread support based on a meta-analysis of 22 articles. The model is successful in predicting about 40% of a system's use (Legris et al., 2003). Lee et al. (2003) stated that TAM is considered the most influential and commonly employed theory for describing an individual's acceptance of information systems.

A review of prior studies suggested that the Technology Acceptance Model (TAM) was widely used to study users' acceptance of the new technology. Quite a few studies in many countries have widely used TAM to study the use of mobile banking. For example, studies took place in Iran by Hanafizadeh et al. (2014), in China by Song (2015) and Zhou et al. (2010), in Bahrain by AlSoufi and Ali (2014), in Korea by Gu et al. (2009), in Taiwan by Luarn and Lin (2005). The original TAM model is shown in Figure 4 below.

RESEARCH MODEL

In this study, the TAM model was modified to fit within the context of mobile banking adoption. Five additional factors: (1) Perceived Security (PS), (2) Perceived Privacy (PP), (3) Previous Experience (PEX), (4) Normative Beliefs (NB), and (5) Technology Competency (TC) were examined in the proposed model. Despite many prior studies in mobile banking, this study provides several contributions to the literature. First, since smart phone technology has dramatically changed since the last five years, many mobile banking features have been either added or improved as

Figure 4. Technology acceptance model (TAM)
(Davis, et al., 1989)

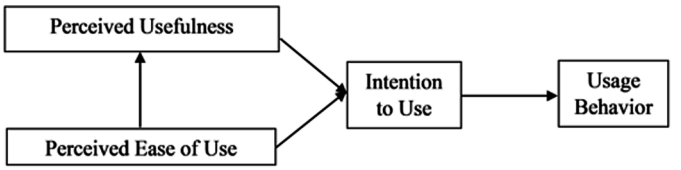
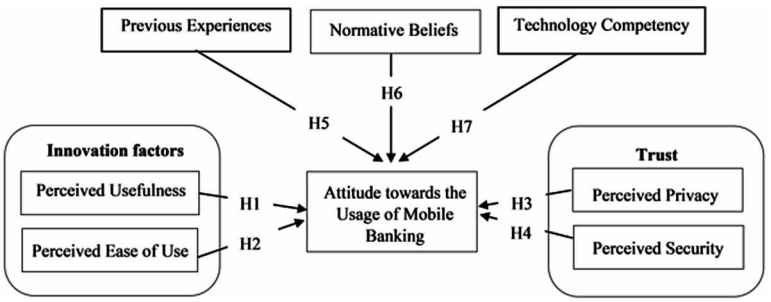


Figure 5. Research model and hypotheses



well. Although some constructs in the proposed model were examined in the past, the findings may not be relevant nowadays. This research also extends the study of factors investigated in prior studies to include the factor "Previous Experiences". It was hypothesized that consumers' experiences on using mobile banking should influence their attitudes toward mobile banking adoption. Third, unlike prior studies that did not track whether subjects have used mobile banking before or not, subjects in this study contain only those who have experience using mobile banking before. Attracting potential customers and retaining existing customers is crucial to the long-term business success of mobile banking firms (Gu et al., 2009). The responses gathered from this target group of subjects should not only help banking services understand the needs of their customers in regard to the adoption of mobile banking but also help them improve the retention rate of their existing customers. The proposed research model is shown in Figure 5 below.

Factors Influencing Mobile Banking Adoption

In the proposed model shown in Figure 3, seven factors are investigated as potential determinants of consumers' attitude toward the usage of mobile baking as follows: 1) perceived usefulness (PU); 2) perceived ease of use (PEU); 3) perceived privacy (PP); 4) perceived security (PS); 5) previous experiences (PEX); 6) normative belief (NB), and 7) technology competency (TC). Survey questions for this empirical research were compiled from previous studies (Alomaim et al., 2003; Changchit, 2006; Joines et al., 2003; Koivumäki, 2001; Koyuncu & Lien, 2003; Lin, 2003; Posnock, 2004).

- **Perceived Usefulness of Mobile Banking (PU):** The construct perceived usefulness is defined as the prospective users' subjective probability that using a specific application system will increase his or her job performance

within an organizational context (Davis et al., 1989). This factor has a significant effect on usage intention (Agarwal & Prasad, 1999; Davis et al., 1989; Venkatesh & Davis, 2000). Perceived usefulness is, thus, predicted to be a positive driver for the attitude towards the usage of mobile banking. A study conducted by Elbeltagi et al. (2005) reported that perceived usefulness significantly affected a decision support system (DSS) usage by senior managers in Egypt. Based on these discussions, the following hypothesis was proposed:

H1: *Perceived usefulness (PU) positively affects the attitude towards the usage of mobile banking.*

- **Perceived Ease of Use of Mobile Banking (PEU):** The construct perceived ease of use is defined as the degree to which the prospective user expects the target system to be free of effort (Davis et al., 1989). This factor plays a crucial role in understanding individual response to information technology (Agarwal & Karahanna, 2000; Chau & Hu, 2001; Hong et al., 2001). Research over the past decade provides evidence of the significant effect perceived ease of use has had on usage intention (Agarwal & Prasad, 1999; Venkatesh & Davis, 2000). Similar to the construct perceived usefulness, Elbeltagi et al. (2005) also revealed that perceived ease of use significantly affected a decision support system (DSS) usage by senior managers in Egypt. Therefore, it was posited that:

H2: *Perceived ease of use (PEU) positively affects the attitude towards the usage of mobile banking.*

- **Perceived Privacy of Mobile Banking (PP):** The concept of privacy is defined as a security principle that protects individuals from the collection, storage, and dissemination of information about themselves, and the possible compromises resulting from unauthorized release of that information (Forcht, 1994). Invasion of privacy is a situation in which someone tries to find out details about another person's private affairs in a way that is upsetting and often illegal. With mobile banking, invasion of privacy can occur in the form of hacking. Through recent advances in technology, hackers have the ability to use mobile banking to illegally access personal consumer information quicker and easier than ever before.

Concern regarding the responsibility of organizations to protect consumer privacy has become an increasingly major obstacle to the spread of E-commerce (Islam, 2014). It appears that many customers do not trust most websites enough to engage in "relationship exchanges," or the exchange of personal information (Liu et al., 2004). The construct perceived privacy can be defined as the possibility that companies collect data about individuals and use them inappropriately (Jarvenpaa & Todd, 1996; Roca et al., 2009). Zorotheos and Kafeza (2009) stated that a customers' willingness to transact online depended on their perceived privacy control (PPC). Privacy concerns are revealed to vary between different cultures. A study conducted by Dinev et al. (2006) revealed that Italians exhibit lower Internet privacy concerns than individuals in the U.S. Based on this reasoning, it is postulated that:

H3: *Perceived privacy (PP) positively affects the attitude towards the usage of mobile banking.*

- **Perceived Security of Mobile Banking (PS):** Security awareness is an important issue for all individuals who are dealing with sensitive data in everyday life (Changchit, 2008). Within the context of mobile banking, customers' perception of security depends largely on how confident a bank can make them feel their financial data is safe and secure. Yenisey et al. (2005) defined perceived security in E-commerce as the level of security users feel while they are shopping online. Flavia´n and Guinalı´u (2006) presented their view of perceived security as a subjective probability with which consumers believe their personal information (private and monetary) will not be viewed, stored, and manipulated during transit and storage by inappropriate parties in a manner inconsistent with their confident expectations. Customers usually feel that the degree of risk is higher when performing transactions via the Internet (Black et al., 2001; Rotchanalitumnuai & Speece, 2003). They worry that their money may disappear from their account without any trace.

Security has been studied and defined in several prior studies. Luarn and Lin (2005) reported that information security is one of the greatest concerns in the adoption of mobile banking. Roca et al. (2009) defined overall perceived security as a threat that creates a circumstance, condition, or event with the potential to cause economic hardship to data or network resources in the form of destruction, disclosures, modification of data, denial of service, and/or fraud, waste, and abuse. Therefore, it is postulated that:

H4: *Perceived security (PS) positively affects the attitude towards the usage of mobile banking.*

- **Previous Experiences with Mobile Banking (PEX):** Research indicates that consumers evaluate their online experiences in terms of perceptions regarding product information, payment, delivery, service, privacy and other such factors (Parasuraman & Zinkhan, 2002; Mathwick et al., 2001). Consumers will choose whether or not to continue future online transactions based on their past experiences (Shim et al., 2001). If the experiences have been positive, they will likely continue to initiate online transactions. Hung et al. (2012) reported that users' experience in Taiwan have a strong effect on National Healthcare Services Information Systems. Another study also revealed that shoppers experience influenced the amount spent on Internet purchases (Doolin et al., 2005). The following is the hypothesis for this factor:

H5: *Previous experience (PEX) positively affects the attitude towards the usage of mobile banking.*

- **Normative Beliefs (NB):** Normative beliefs represent the social pressures to perform certain behaviors (Ajzen, 1991). It can also be defined as an individual's perception about a particular behavior, which is influenced by the judgment of significant others such as parents, spouse, friends, teachers, co-workers, and the individual's boss. Hernandez and Mazzon (2007) stated that normative beliefs can be defined as the degree of disagreement among the opinions of key reference groups such as friends, peers or colleagues, superiors, and subordinates in an organizational environment.

According to a recent boom in public opinion and widespread use of new technology such as smartphones or tablet devices, people are influenced to adopt technologies used by their relatives and friends. This demonstrates that normative beliefs act as an important factor shaping the direction in which consumers do business. Sprott et al. (2003) stated that normative beliefs can lead to a socially desirable behavior in a specific situation, and should thus be included as a fundamental component of any predictive variables. For cross cultural results, social structure also plays an important role on explaining the adoption of IT. As reported by Kamal et al. (2013), the adoption of electronic implementation by the government (e-Government adoption) was affected by the existing social structure in Pakistan. Based on the foregoing, the following hypothesis was proposed:

H6: *Normative beliefs (NB) positively affects the attitude towards the usage of mobile banking.*

- **Technology Competency (TC):** Technology competency is defined as the extent to which an individual is knowledgeable about and effectively utilizes Information Technology to manage information (Tippins & Sohi, 2003). Typically, consumers with a high level of self-efficacy are more motivated to use technology-based services. Moreover, they have a more positive attitude and specific intent to use technology-based services than consumers with a low level of technology self-efficacy. Therefore, consumers with a high technology self-efficacy are expected to have positive attitudes and behavioral intentions to use mobile banking. For these reasons, consumers who are highly competent with technology are more likely to perceive mobile banking as easy to use than consumers who are less competent (Yang, 2010). We, therefore posit that:

H7: *Technology competency (TC) of subjects positively affects the attitude towards the usage of mobile banking.*

RESEARCH METHODOLOGY

Instrument Development and Pretest

The questionnaire designed for this study adapted the instrument and scales developed from TAM with additional constructs as described in the proposed research model (Venkatesh & Davis, 2000; Venkatesh et al., 2003). The questions used to measure other additional constructs were adapted from prior studies (Intana et al., 2013; Pikkarainen et al., 2004; Venkatesh & Davis, 2000; Vijayasarathy, 2004; Wong & Hsu, 2008).

The questionnaire consisted of fifty-five (55) questions. Thirty-five (35) questions with the five-point Likert scale were designed to measure subjects' perceptions on mobile banking. One question (Question# 36) asked, "Overall, I prefer to do mobile banking transactions than other forms of banking" as a measurement for subjects' attitude on intention to use mobile banking. Another question (Question# 37) asks, "Have you ever used mobile banking?" to measure subjects' actual use of mobile banking. The remaining eighteen (18) questions were asked to gather some demographic data on the subjects. To validate the clarity of these questions, three professors and three researchers were asked to read through the survey questions. Revisions to the survey were made based on the feedback received (see Table 8 in Appendix A for the research questionnaire).

Data Collection

Surveys were distributed to students enrolled at a South-western United States university for the U.S. subjects and a Northern university in Thailand for Thai subjects during the fall and spring semester of 2015-2016 academic year. The researcher contacted the instructors to gain their consents to distribute the surveys in their classes. In the class, the researcher spent about ten minutes explaining the importance of the study and asked students to read each item carefully as their responses are very important to this study. Then, all students were provided with sufficient class time to respond to the survey. Students were informed that participation in the study was voluntary and that their responses would be kept anonymous.

For subjects in the U.S., four hundred and forty-seven (447) subjects participated in this study. However, only three hundred and fifty-five (355) responses are valid. Of the three hundred and fifty-five (355) subjects, three hundred and nine (309) of them are mobile banking customers. The remaining forty-six (46) subjects have never used mobile banking before and thus have been removed from the data analysis. Subjects' demographics are shown in Table 2.

For the Thai subjects, four hundred (400) subjects participated in this study. Of the four hundred (400) subjects, two hundred fifty-three (253) or 63.25% of them are mobile banking customers. The remaining one hundred forty-seven (147) or 36.75% of the subjects have never used mobile banking before and therefore have been disregarded from further analysis. Subjects' demographics are shown in Table 3.

DATA ANALYSIS AND DISCUSSION

Analysis of Measurement Model

In order to examine the internal consistency of the research instrument, a reliability test was conducted. The test confirms the reliability of the research items with Cronbach's alpha coefficient of 0.947 for the U.S. subjects and 0.946 for the Thai subjects.

The measurement model for the seven constructs was assessed by a confirmatory factor analysis with Varimax rotation in order to test whether the questionnaire items produced the expected number of factors and whether each item was loaded on their appropriated factor. Results from the factor analysis indicates that all items are loaded into six factors. As shown in Table 3, the result from the factor analysis reveals that the ten (10) questionnaire items designed to measure the perceived privacy and perceived security constructs are loaded into the same factor. We, therefore, combined the two factors and labelled it as the "Perceived Trust" (PT)

Table 2. U.S. subjects' demographics n = 309

	No.	%
Gender		
Male	139	44.98
Female	170	55.02
Age		
Under 18	0	0.00
18-24	237	76.70
25-34	56	18.12
35-44	14	4.53
45 and over	2	0.65
Smartphone		
Yes	301	97.42
No	6	1.94
No answer	2	0.65
Data Package on Smart Phone		
Yes	281	90.93
No	19	6.15
Not applicable	9	2.9
Heard About Mobile Banking		
Yes	307	99.36
No	1	0.32
No answer	1	0.32
Credit Card or Debit Card		
Yes	294	95.14
No	12	3.88
No answer	3	0.97
Online Purchase or Payment		
Yes	301	95.49
No	4	4.51
No answer	4	1.29
Use Internet Banking		
Yes	298	96.44
No	6	1.94
No answer	5	1.62
Employment Status		
Yes	208	67.31
No	101	32.69
Highest Education		
High school	174	56.31

continued on following page

Table 2. Continued

	No.	%
Associates	2	0.65
Bachelors	89	28.80
Graduate	29	9.39
No answer	15	4.85
Student		
Undergraduate	243	78.64
Graduate	60	19.42
No answer	6	1.94
Area of Study		
Science and Technology	67	21.68
Health Sciences	49	15.86
Social Sciences	101	32.68
No Answer	92	29.77
Annual Income		
<15K	164	53.07
15K-30K	64	20.71
30K-45K	27	8.74
45K-60K	11	3.56
>60K	23	7.44
No answer	20	6.47
Internet Use per Month		
None	0	0
1-5	6	1.94
6-10	12	3.88
11 and up	289	93.53
No answer	2	0.65
Make Purchase via the Internet on a Computer per Month		
None	14	4.53
1-5	213	68.92
6-10	46	14.88
11 and up	30	9.71
No answer	6	1.94
Make purchase via the Internet on a Smart Phone per Month		
None	54	17.48
1-5	194	62.78
6-10	30	9.71
11 and up	26	8.41
No answer	5	1.62

continued on following page

Table 2. Continued

	No.	%
Perform Banking Transaction at the Bank Site per Month		
None	36	11.65
1-5	164	53.07
6-10	62	20.06
11 and up	43	13.92
No answer	4	1.29
Perform Banking Transaction via the Internet on a Computer per Month		
None	37	11.97
1-5	109	54.69
6-10	51	16.50
11 and up	46	14.89
No answer	6	1.94

factor. In addition, the factor loading of 0.1633 on item PU 2 for Thai subjects was below the threshold, indicating that this item should not be used to measure the PU factor, and thus was removed from the data analysis.

The measurement model was further assessed for construct reliability. The composite reliability for all the constructs was above .70, conforming to an acceptable threshold (0.7) suggested by Nunnally and Bernstein (1994). Table 4 presents the mean, standard deviation, factor loading, and composite reliability of all items assessed in this study.

As shown in Tables 5 and 6, a correlation analysis was conducted to test the relationship between each variable. The correlation between the attitude towards the usage of mobile banking (ATT) and its determinants ranged from 0.274 to 0.697 for U.S. subjects and from 0.357 to 0.675 for Thai subjects, indicating a high likelihood that these factors influence the attitude towards the usage of mobile banking. To ensure that there is no problem with multicollinearity, the Variance Inflation Factor (VIF) was also tested and reported along with the regression analysis (please see Table 6).

Model Testing Results

In order to validate the relationship of factors in the proposed research model, a multiple regression analysis was conducted to test the six (6) hypotheses. As mentioned above, H3 and H4 variables, which are perceived privacy (PP) and perceived security (PS), were grouped into one variable, which is perceived trust (PT), as suggested by the factor analysis results. The dependent variable in this test is

Table 3. Thai subjects' demographics n = 253

	No.	%
Gender		
Male	91	35.97
Female	162	64.03
Age		
Below 18	1	0.40
18 - 34	200	79.05
35 - 44	50	19.76
above 44	1	0.40
No answer	1	0.40
Smartphone		
Yes	248	98.02
No	4	1.58
No answer	1	0.40
Data Package on Smart Phone		
Yes	226	89.33
No	23	9.09
Not applicable	3	1.19
No answer	1	0.40
Heard About Mobile Banking		
Yes	249	98.42
No	4	1.58
Use Credit Card or Debit Card		
Yes	203	80.24
No	50	19.76
Online Purchase or Payment		
Yes	243	96.05
No	10	3.95
Use Internet Banking		
Yes	238	94.07
No	14	5.53
No answer	1	0.40
Employment Status		
Yes	98	38.74
No	155	61.26
Student		
Bachelor	177	69.96
Master	74	29.25
Not a Student	2	0.79

continued on following page

Table 3. Continued

	No.	%
Area of Study		
Science and Technology	52	20.55
Health Science	6	2.37
Social Science	195	77.08
Monthly Income		
Below 15,000 Baht	172	67.98
15,000 - 30,000	70	27.67
30,001 - 45,000	7	2.77
45,001 - 60,000	3	1.19
Above 60,000	1	0.40
Internet Use per Month		
None	1	0.40
1-5	3	1.19
6 - 10	7	2.77
11 and up	242	95.65
Make purchase via the Internet on a computer per month		
None	39	15.42
1-5	194	76.68
6 - 10	10	3.95
11 and up	10	3.95
Make Purchase via the Internet on a Smart Phone per Month		
Never	55	21.74
1-5	180	71.15
6 - 10	9	3.56
11 and up	9	3.56
Perform Banking Transaction at the Bank Site per Month		
None	40	15.81
1-5	186	73.52
6 - 10	13	5.14
11 and up	14	5.53
Perform Banking Transaction Via the Internet on a Computer per Month		
None	59	23.32
1-5	161	63.64
6 - 10	18	7.11
11 and up	15	5.93

Table 4. Summary of measurement scales

Construct	U.S. (n=309)				Thai (n=253)			
	M	SD	Factor Loading	Reliability	M	SD	Factor Loading	Reliability
Perceive Usefulness				0.741				0.758
PU 1	4.385	1.059	0.732		4.462	0.809	0.5963	
PU 2 (removed from Thai data)	3.340	1.213	0.479		3.565	1.131	0.1633	
PU 3	4.155	1.123	0.701		4.427	0.787	0.7412	
PU 4	4.553	0.846	0.483		4.609	0.762	0.7760	
PU 5	4.592	0.803	0.464		4.514	0.795	0.7318	
Perceived Ease of Use				0.906				0.908
PEU 1	4.472	0.913	0.688		3.806	0.890	0.7726	
PEU 2	4.304	0.925	0.765		3.972	0.852	0.7702	
PEU 3	4.294	0.977	0.731		3.834	0.893	0.7662	
PEU 4	4.440	0.879	0.650		4.040	0.835	0.8170	
PEU 5	4.087	1.091	0.580		3.957	0.874	0.7168	
Perceived Trust				0.936				0.943
PP 1	3.437	1.120	0.809		3.178	1.029	0.8218	
PP 2	3.608	1.090	0.821		3.182	1.050	0.8586	
PP 3	3.725	1.047	0.835		3.423	1.003	0.7985	
PP 4	3.699	1.164	0.635		3.419	1.042	0.7022	
PP 5	3.210	1.299	0.715		3.079	1.044	0.7651	
PS 1	3.634	1.019	0.709		3.182	0.903	0.7878	
PS 2	3.508	1.062	0.756		3.186	0.922	0.8024	
PS 3	3.327	1.179	0.760		3.202	0.919	0.7552	
PS 4	3.618	1.180	0.635		3.289	0.886	0.6738	
PS 5	3.718	1.048	0.743		3.277	0.892	0.8115	
Previous Experiences				0.913				0.906
PEX 1	4.168	0.959	0.715		3.866	0.885	0.6264	
PEX 2	4.197	0.969	0.762		3.917	0.889	0.7429	
PEX 3	4.194	0.937	0.759		3.929	0.884	0.7656	
PEX 4	4.074	1.046	0.775		4.162	0.808	0.7227	
PEX 5	3.861	1.098	0.766		3.704	0.906	0.6174	
Normative Beliefs				0.823				0.768
NB 1	3.424	1.095	0.651		3.352	0.877	0.6546	
NB 2	3.340	1.150	0.680		3.213	0.977	0.5080	
NB 3	2.799	1.357	0.820		2.933	1.087	0.7882	
NB 4	3.275	1.263	0.722		3.727	1.004	0.5580	
NB 5	3.372	1.241	0.755		3.625	1.014	0.6593	
Technology Competency				0.785				0.866

continued on following page

Table 4. Continued

Construct	U.S. (n=309)				Thai (n=253)			
	M	SD	Factor Loading	Reliability	M	SD	Factor Loading	Reliability
TC 1	4.511	0.956	0.657		4.202	1.081	0.6617	
TC 2	4.573	0.809	0.733		4.403	0.838	0.7712	
TC 3	4.440	0.901	0.815		4.174	0.855	0.8715	
TC 4	4.314	0.975	0.778		4.273	0.831	0.8118	
TC 5	4.236	1.041	0.791		4.111	0.875	0.8298	

Rotation Method: Varimax with Kaiser Normalization.

Table 5. Correlation matrix; U.S. subjects

Variable	PU	PEU	PT	PEX	NB	TC	ATT
PU	1						
PEU	0.640**	1					
PT	0.423**	0.482**	1				
PEX	0.541**	0.673**	0.573**	1			
NB	0.282**	0.237**	0.431**	0.260**	1		
TC	0.431**	0.545**	0.320**	0.433**	0.166*	1	
ATT	0.545**	0.635**	0.567**	0.697**	0.274**	0.423**	1

** p<.0001, * p<.01

Table 6. Correlation matrix; Thai subjects

Variable	PU	PEU	PT	PEX	NB	TC	ATT
PU	1						
PEU	0.615**	1					
PT	0.266**	0.420**	1				
PEX	0.524**	0.608**	0.581**	1			
NB	0.343*	0.376**	0.514**	0.521**	1		
TC	0.424**	0.323**	0.130**	0.336**	0.282**	1	
ATT	0.468**	0.643**	0.598**	0.645**	0.542**	0.357**	1

** p<.0001, * p<.01

the attitude towards the usage of mobile banking (ATT). The independent variables include perceived usefulness (PU), perceive ease of use (PEU), perceived trust (PT), previous experience (PEX), normative beliefs (NB), and technology competency (TC). The analysis controls for three subjects' demographics, which are gender (DGender), employment status (DEmploy), and areas of study (DStudy). Based on previous literature, these control variables are included in the model as they have a potential to influence the IT adoption (Guo & Zhang, 2010; Lippert & Volkmar, 2007; Trauth et al., 2008). DGender is assigned the value of 1 if the respondents are male and 0 otherwise. DEmploy is assigned the value of 1 if the respondents are employed and 0 if they are not employed. DStudy is assigned the value of 1 if respondents study in field of science and 0 otherwise. The regression equation was written as follows:

$$ATT_i = \alpha_0 + \alpha_1 PU_i + \alpha_2 PEU_i + \alpha_3 PT_i + \alpha_4 PEX_i + \alpha_5 NB_i$$
$$+\alpha_6 TC_i + \alpha_7 DGender_i + \alpha_8 DEmploy_i + \alpha_9 DStudy_i + \varepsilon_i$$

The results from Table 7 show the R2 and Adjusted R2 of 48.4% and 46.8% respectively for U.S. subjects and 54.5% and 52.8% for Thai subjects, indicating that the factors investigated are suitable to explain the attitude towards the usage of

Table 7. Relationship between factors and attitude towards the use of mobile banking

Ha	Independent Variables	U.S. Subjects; n = 309			Thai Subjects; n = 253		
		β	*t*	VIF	β	*t*	VIF
H1	PU	0.215 **	2.52	1.83277	0.115	1.35	1.9048
H2	PEU	0.277 ***	3.15	2.55430	0.436***	5.73	2.0218
H3, H4	PT	0.112 *	1.69	1.75887	0.144**	2.18	1.7356
H5	PEX	0.423 ***	5.40	2.25066	0.241***	3.00	2.2844
H6	NB	0.030	0.56	1.27133	0.170**	2.45	1.5714
H7	TC	0.063	0.87	1.47769	0.084	1.31	1.3863
	Gender	0.059	0.64	1.05806	-0.047	-0.52	1.1795
	Employment	-0.032	-0.33	1.02487	0.084	1.00	1.0702
	Areas of study	-0.086	-0.76	1.06196	-0.032	-0.31	1.1162
		U.S. Subjects			Thai Subjects		
		R-Square Adj R-Square F-stat	0.484 0.468 31.11***		R-Square Adj R-Square F-stat	0.545 0.528 32.37***	

*** Significant at 1% level

** Significant at 5% level

* Significant at 10% level

mobile banking. The F-stat was reported to be at 31.11 for U.S. subjects and 32.37 for Thai subjects, both were significant at a 1% significant level. This also indicates that the combined factors are able to simultaneously explain the attitude quite well.

Regarding each variable factor, the results from the regression analysis showed noticeable differences between the determinants of mobile banking adoption in the U.S. and Thailand as follows:

- Perceived usefulness (H1): The result showed the significant effect of this factor on the attitude towards the usage of mobile banking for the U.S. subjects ($\beta = 0.214$, $t = 2.52$). However, this factor does not significantly influence the attitude of Thai subjects ($\beta = 0.115$, $t = 1.35$). This result indicated that perceive usefulness played an important role in determining whether U.S. subjects will use mobile banking while it was not important to Thai subjects. The significance of perceived usefulness is also found in earlier studies (Hanafizadeh et al., 2014; Püschel et al., 2010).
- Perceived ease of use (H2): The result revealed that this factor significantly affected subjects' attitude towards the usage of mobile banking in both countries ($\beta = 0.277$, $t = 3.15$ for U.S. subjects and $\beta = 0.436$, $t = 5.73$ for Thai subjects). Consumers nowadays tended to live with an idea that all technology should require minimum effort to use it. This finding suggested that banks in both countries must ensure their target customers are aware that it is easy to use mobile banking. This result confirms the findings of some prior studies (Dasgupta et al., 2011; Sripalawat et al., 2011) but contradicts to some previous findings (Koenig-Lewis et al., 2010; Liébana-Cabanillas et al., 2016).
- Perceived trust (H3 and H4): This factor played an important role in determining subjects' attitude toward the usage of mobile banking for subjects in both countries ($\beta = 0.112$, $t = 1.69$ for U.S. subjects and $\beta = 0.144$, $t = 2.18$ for Thai subjects). Trust is always a major concern for any technology use. It is not surprising that the perception about trust should play an important role in whether subjects will use mobile banking. It is apparent that they are not willing to transact via a mobile device if the transaction is not considered safe and secured from unauthorized usage. This result confirms prior studies that perceived security plays a crucial role in explaining the mobile banking services adoption (Alalwan et al., 2017; Bhatt, 2016; Svilar & Zupančič, 2016). The result for both countries reveals that subjects are more likely to use mobile banking if they can trust that their banking transactions will be kept confidential and secure. The result suggests that banks in U.S. and in Thailand should consider educating their customers about the privacy and security of mobile banking transactions.

- Previous experiences (H5): The result revealed a strong relationship between this factor and subjects' attitude towards the usage of mobile banking for subjects in both countries ($\beta = 0.423$, $t = 5.40$ for U.S. subjects and $\beta = 0.241$, $t = 3.00$ for Thai subjects). The finding pointed out that subjects in both countries would be more likely to use mobile banking if they have a good experience with their previous mobile banking transactions.
- Normative Beliefs (H6): This factor did not significantly impact the attitude of subjects in the U.S., but appeared to be a significant factor for the attitude of Thai subjects ($\beta = 0.030$, $t = 0.56$ for U.S. subjects and $\beta = 0.170$, $t = 2.45$ for Thai subjects). This finding is consistent with prior studies showing that social norm is a determinant factor for mobile banking adoption (Bhatiasevi, 2015; Malaquias & Hwang, 2016; Puschel et al., 2010; Sripalawat et al., 2011; Yu, 2014; Kazi & Mannan, 2013). This result indicated that U.S. subjects' attitude on the use of mobile banking were not influenced by peers, family members, and other social factors. This finding may result from subjects' belief that banking transactions are high-risk activities and require serious measures of protection. In this situation, peers or social factors may have less influence on their attitudes toward the usage of mobile banking. In contrast, this factor was found to be of importance in encouraging Thai subjects to use mobile banking.
- Technology competency (H7): The result revealed that this factor did not have a significant effect on subjects' attitude toward the usage of mobile banking in both countries ($\beta = 0.063$, $t = 0.87$ for U.S. subjects and $\beta = 0.084$, $t = 1.31$ for Thai subjects). The finding suggested that users' ability in using technology did not play an important role in encouraging or discouraging them from adopting mobile banking. This finding contradicts with prior studies (Masrek et al., 2014; Malaquias & Hwang, 2016; Oliveira et al., 2014; Yu, 2014; Yadav, 2016) whose findings revealed that technology competency has a significant effect on attitude towards the usage of mobile banking. A possible explanation is that the majority of subjects in both studies are in the range of 18 to 24. Subjects in this age group tend to be highly competent in using technology and are typically not afraid of using new technology. For this reason, this factor does not play a significant role in determining whether subjects will use mobile banking or not.

The Variance Inflation Factors (VIF) for all factors range between 1.025 and 2.554 for U.S. subjects and between 1.070 and 2.284 for Thai subjects. All VIFs are not greater than 10, indicating that there is no problem of multicollinearity (Hair et al., 2009; Diamantopoulos et al., 2008).

CONCLUSION

This study examined the mobile banking acceptance model in a comparative way in order to identify possible cross-cultural differences in behavioral intentions to adopt mobile banking between U.S. and Thai consumers. Although there are quite a few prior studies investigated the factors influencing the adoption of mobile banking (Afshan & Sharif, 2016; Lee et al., 2013; Lin, 2011; Nel & Boshoff, 2014; Staff, 2013), not many of them have explored the motivations for mobile banking adoption in a cross-cultural manner (Baptista & Oliveira, 2015; Yu & Chantatub, 2015). In particular, there is no prior study comparing consumers' attitude toward the usage of mobile banking between the U.S. and Thailand. The comparison between the U.S. and Thailand was chosen because both countries show a high percentage of mobile banking usage (64% in Thailand and 42% in the U.S.), as reported by Statista (2015).

In the research model, seven factors predicted to influence the attitude toward the usage of mobile banking were investigated and compared between the two nationalities. The factor analysis result suggested that the ten questions used to measure the factors perceived privacy and perceived security should be grouped into one factor, which was labeled perceived trust (PT).

The findings revealed that four factors: perceived usefulness, perceived ease of use, perceived trust, and previous experiences were determinants of mobile banking adoption for U.S. users. Although four factors were also found to significantly affect mobile banking adoption for Thai users, these factors differ from U.S.'s. The findings revealed that perceived ease of use, perceived trust, previous experiences, and normative beliefs are determinants of mobile banking adoption in Thailand.

For both nationalities, subjects who perceive mobile banking as easy to use and can be trusted generally show a positive attitude towards the usage of mobile banking. These findings conform to the study conducted by Malaquias and Hwang (2019) which compared subjects in Brazil and U.S. In addition, those who had good experiences in using this banking channel are more likely to report a positive attitude towards the usage of mobile banking. However, the technology competency did not appear to be a determinant of mobile banking for both nationalities. This similarity in the results may be due to the fact that both countries are two of the top ranked in mobile usage (Statista, 2015). Therefore, the IT competency may not be the main influencing factor to adopt mobile banking for people in both countries.

The results showed that the users in the two countries differ in the significance of two factors, perceived usefulness and normative beliefs, affecting the attitude toward the usage of mobile banking. For U.S. users, perceived usefulness plays a significant role in influencing their attitude about mobile banking. The results suggested that it is important to banks in the U.S. to educate their customers about the benefits of using mobile banking. In contrast, this factor did not impact Thai subjects' attitudes

about mobile banking. This may be due to the fact that 77.2% of Thai consumers already use their mobile phones. As mobile phones are already integrated into daily life of Thai consumers, most of them realize the benefits of mobile banking. In addition, horrible traffic conditions in Thailand (National Statistical Office, 2014) also discourage them from visiting bank sites. For this reason, the perceived usefulness factor did not influence their attitude on mobile banking adoption.

It is also interesting to note that normative beliefs appears to be a significant factor influencing mobile banking adoption for Thai consumers, but not for U.S. consumers. Typically, banking transactions have been viewed as high-risk activities and require a serious mean of protection. This result pointed out that the influence from family members, peers, and social factors were perceived to be more important for Thai consumers than for U.S. consumers. The finding suggested that banks in Thailand could use this strategy to attract more mobile banking customers by investing more on social programs that affect the use of mobile phone banking. These results point out that culture plays an important role in explaining the mobile banking adoption. The findings confirm suggestions from other studies that culture should be considered in explaining the IT adoption (Chan & Lu, 2004; Kim et al., 2013; Niederman et al., 2012; Hung et al., 2012; Susanto et al., 2013).

The study results address the widely used technology acceptance model (TAM) and demonstrate that when the model is used on different culture settings, which some patterns are predominated, different results are expected. For strong social cultures as found in Thailand, national cultures predominate while in strong task cultures like in the U.S., professional cultures predominate (Karahanna et al., 2005). These findings lead to the following suggestions to practical implication.

PRACTICAL IMPLICATION AND LIMITATION

Mobile banking technology provides the essential capacity of banking transaction. This innovative technology has led banking activities to the new platforms using Internet and mobile phone. With this new platforms, competitive challenge faces by banking industry is questioned on how to induce bank customer to use the mobile banking. The findings in this study suggest factors that are crucial to the success of mobile banking adoption. In order to encourage customers to adopt mobile banking, the study reveals that before implementing this technology, a bank should educate their target mobile banking customers about the usefulness of mobile banking. This is especially true in the U.S. where this factor significantly influences mobile banking adoption. It is also important to ensure that their customers are aware that this technology is easy to use, and all transactions conducted via mobile banking are secure and will be kept confidential. Since customers' past experiences are important

factors in determining whether they will use mobile banking, it will be crucial for a bank to gather feedback from their customer to ensure that they are informed about any bad experiences and thus be able to prevent it from happening again in the future. This implementation scheme can be applied to both countries since both countries share similar view of the positive influence of previous experiences on mobile banking adoption.

The result in this study also indicates that users' attitude on the use of mobile banking are not influenced by peers, family members, and other social factors for the U.S. customers. This may due to the uncertainty and high-risk associated with mobile banking transactions. However, peers, family members, and other social factors play important roles in explaining mobile banking adoption in Thailand. Therefore, banking institutions in Thailand may consider attracting more mobile banking customers via a social marketing channel such as Facebook or LinkedIn. The finding also reveals that users' ability to adeptly use technology does not play an important role in encouraging or discouraging users from adopting mobile computing. These findings are similar for both countries. Therefore, banks may not have to invest too many resources on these factors and can instead spend more money promoting the other four factors, which are more important to users

As in most empirical studies, there is an inherent limitation in this paper. The sample in this research was limited to subjects in two universities. The main reasons why students were employed as the subjects in this study are (1) students are no doubt the heavy users of mobile phone (i.e., 97.42% of US subjects and 98.02% of Thai subjects in this study have a smart phone) and (2) only those who currently use mobile banking are included in this study. Despite prior studies have proposed students as good surrogates to mirror typical consumers (Luo et al., 2010; Remus, 1986; Zhou, 2012), there might exist a threat to the external validity since they do not symbolize the entire population of mobile banking. So, to improve the generalizability of the findings, future research should consider expanding demographics to include non-student subjects and users in various countries. In addition, a future study could provide a more detailed investigation into which features of mobile banking are deemed necessary or unnecessary when deciding whether or not to adopt this technology.

REFERENCES

Afshan, S., & Sharif, A. (2016). Acceptance of mobile banking framework in Pakistan. *Telematics and Informatics*, *33*(2), 370–387. doi:10.1016/j.tele.2015.09.005

Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *Management Information Systems Quarterly*, *24*(4), 665–694. doi:10.2307/3250951

Agarwal, R., & Prasad, J. (1999). Are individual differences germane to the acceptance of information technologies? *Decision Sciences*, *30*(2), 361–391. doi:10.1111/j.1540-5915.1999.tb01614.x

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. doi:10.1016/0749-5978(91)90020-T

Al-Refaie, A. (2014). Examining factors affect supply chain collaboration in Jordanian organizations. *Journal of Management Analytics*, *1*(4), 317–337. doi:10.1080/23270012.2014.991357

Alalwan, A. A., Dwivedi, Y. K., & Rana, N. P. (2017). Factors influencing adoption of mobile banking by Jordanian bank customers: Extending UTAUT2 with trust. *International Journal of Information Management*, *37*(3), 99–110. doi:10.1016/j.ijinfomgt.2017.01.002

Alomaim, N., Tunca, M., & Zairi, M. (2003). Customer satisfaction @ virtual organizations. *Management Decision*, *41*(7), 666–670. doi:10.1108/00251740310495595

AlSoufi, A., & Ali, H. (2014). Customer's perception of m-banking adoption in Kingdom of Bahrain: An empirical assessment of an extended TAM model. *International Journal of Managing Information Technology*, *6*(1), 1–13.

American Bankers Association. (2015). *ABA Survey: More Consumers Turning to Mobile Banking.* Retrieved January 27, 2016, from http://www.aba.com/Press/Pages/081115MobileBankingSurvey.aspx

Ao, J., & Liu, Z. (2014). What impact entrepreneurial intention? Cultural, environmental, and educational factors. *Journal of Management Analytics*, *1*(3), 224–239. doi:10.1080/23270012.2014.994232

Baabdullah, A. M., Alalwan, A. A., Rana, N. P., Kizgin, H., & Patil, P. (2019). Consumer use of mobile banking (M-Banking) in Saudi Arabia: Towards an integrated model. *International Journal of Information Management*, *44*, 38–52. doi:10.1016/j.ijinfomgt.2018.09.002

Bagozzi, R. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the Association for Information Systems*, *8*(4), 244–254. doi:10.17705/1jais.00122

Baker, E., Al-Gahtani, S., & Hubona, G. (2010). Cultural impacts on acceptance and adoption of information technology in a developing country. *Journal of Global Information Management*, *18*(3), 35–58. doi:10.4018/jgim.2010070102

Bank of Thailand. (2017). *Payment systems report 2017*. Retrieved July 15, 2019, from https://www.bot.or.th/English/PaymentSystems/Publication/PS_Annually_Report/Documents/Payment_2017_E.pdf

Baptista, G., & Oliveira, T. (2015). Understanding mobile banking: The unified theory of acceptance and use of technology combined with cultural moderators. *Computers in Human Behavior*, *50*, 418–430. doi:10.1016/j.chb.2015.04.024

Bhatiasevi, V. (2015). An extended UTAUT model to explain the adoption of mobile banking. *Information Development*, *32*(4), 799–814. doi:10.1177/0266666915570764

Bhatt, A. (2016). Factors affecting customer's adoption of mobile banking services. *Journal of Internet Banking and Commerce*, *21*(1).

Bin, Q., Chen, S., & Sun, S. (2003). Cultural differences in E-commerce: A comparison between the U.S. and China. *Journal of Global Information Management*, *11*(2), 48–55. doi:10.4018/jgim.2003040103

Black, N., Lockett, A., Winklhofer, H., & Ennew, C. (2001). The adoption of internet financial services: A qualitative study. *International Journal of Retail & Distribution Management*, *29*(8), 390–398. doi:10.1108/09590550110397033

Boonsiritomachai, W. & Pitchayadejanant, K. (2017). Determinants affecting mobile banking adoption by generation Y based on the Unified Theory of Acceptance and Use of Technology Model modifed by the Technology Acceptance Model concept. *Kasetsart Journal of Social Sciences.*

Brown, I., Hoppe, R., Mugera, P., Newman, P., & Stander, A. (2004). The impact of national environment on the adoption of Internet banking: Comparing Singapore and South Africa. *Journal of Global Information Management*, *12*(2), 1–26. doi:10.4018/jgim.2004040101

Chan, S., & Lu, M. (2004). Understanding Internet banking adoption and use behavior: A Hong Kong perspective. *Journal of Global Information Management*, *12*(3), 21–43. doi:10.4018/jgim.2004070102

Chang, Y., Kim, H., Wong, S., & Park, M. (2015). A comparison of the digital divide across three countries with different development indices. *Journal of Global Information Management*, *23*(4), 55–76. doi:10.4018/JGIM.2015100103

Changchit, C. (2006). Consumer Perceptions of Online Shopping. *Issues in Information Systems*, *7*(2), 177–181.

Changchit, C. (2008). Data protection and privacy issue. *Journal of Information Privacy and Security*, *4*(3), 1–2. doi:10.1080/2333696X.2008.10855842

Changchit, C., Cutshall, R., & Tzong-Ru, L. (2014). Shopping preference: A comparative study of American and Taiwanese perceptions. *Journal of International Technology and Information Management*, *23*(1), 83–103.

Changchit, C., Lonkani, R., & Sampet, J. (2017). Mobile Banking: Exploring Determinants of Its Adoption. *Journal of Organizational Computing and Electronic Commerce*, *27*(3), 239–261. doi:10.1080/10919392.2017.1332145

Chau, P., & Hu, P. (2001). Information technology acceptance by individual professionals: A model comparison approach. *Decision Sciences*, *32*(4), 699–719. doi:10.1111/j.1540-5915.2001.tb00978.x

Chau, P., & Lai, V. (2003). An empirical investigation of the determinants of user acceptance of internet banking. *Journal of Organizational Computing and Electronic Commerce*, *13*(2), 123–145. doi:10.1207/S15327744JOCE1302_3

Dapp, T. F., Slomka, L., & Hoffman, R. (2015). *Fintech reload-traditional banks as digital ecosystems*. Frankfurt am Main, Germany: Deutsche Bank Research.

Dasgupta, S., Paul, R., & Fuloria, S. (2011). Factors affecting behavioral intentions towards mobile banking usage: Empirical evidence from India. Romanian. *Journal of Marketing*, *6*(1), 6–28.

Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly*, *13*(3), 319–340. doi:10.2307/249008

Davis, F., Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(3), 982–1003. doi:10.1287/mnsc.35.8.982

Diamantopoulos, A., Riefler, P., & Roth, K. (2008). Advancing formative measurement models. *Journal of Business Research*, *58*(12), 1203–1218. doi:10.1016/j.jbusres.2008.01.009

Dinev, T., Bellotto, M., Hart, P., Russo, V., Serra, I., & Colautti, C. (2006). Internet users' privacy concerns and beliefs about government surveillance: An exploratory study of differences between Italy and the United States. *Journal of Global Information Management*, *14*(4), 57–93. doi:10.4018/jgim.2006100103

Doolin, B., Dillon, S., Thompson, F., & Corner, J. (2005). Perceived risk, the Internet shopping experience and online purchasing behavior: A New Zealand perspective. *Journal of Global Information Management*, *13*(2), 66–88. doi:10.4018/jgim.2005040104

Ein-Dor, P., Segev, E., & Orgad, M. (1993). The Effect of National Culture on IS: Implications for International Information Systems. *Journal of Global Information Management*, *1*(1), 33–44. doi:10.4018/jgim.1993010103

Elbeltagi, I., McBride, N., & Hardaker, G. (2005). Evaluating the factors affecting DSS usage by senior managers in local authorities in Egypt. *Journal of Global Information Management*, *13*(2), 42–65. doi:10.4018/jgim.2005040103

Esichaikul, V., & Janecek, P. (2009). A survey of e-banking performance in Thailand. *International Journal of Electronic Finance*, *3*(4), 354–373. doi:10.1504/IJEF.2009.028976

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Flavia'n, C., & Guinalı'u, M. (2006). Consumer trust, perceived security and privacy policy: Three basic elements of loyalty to a web site. *Industrial Management & Data Systems*, *106*(5), 601–620. doi:10.1108/02635570610666403

Forcht, K. (1994). *Computer security management*. Boston, MA: Boyd & Fraser.

Gefen, D., & Heart, T. (2006). On the need to include national culture as a central issue in E-commerce trust beliefs. *Journal of Global Information Management*, *14*(4), 1–30. doi:10.4018/jgim.2006100101

Gerpott, T., Thomas, S., & Weichert, M. (2013). Characteristics and mobile Internet use intensity of consumers with different types of advanced handsets: An exploratory empirical study of iPhone, Android and other web-enabled mobile users in Germany. *Telecommunications Policy*, *37*(4-5), 357–371. doi:10.1016/j.telpol.2012.04.009

Gerrard, P., & Cunningham, J. (2003). The diffusion of Internet banking among Singapore consumers. *International Journal of Bank Marketing*, *21*(1), 16–28. doi:10.1108/02652320310457776

Greenberg, R., Wong-On-Wing, B., & Lui, G. (2008). Culture and consumer trust in online businesses. *Journal of Global Information Management*, *16*(3), 26–44. doi:10.4018/jgim.2008070102

Gu, J., Lee, S., & Suh, Y. (2009). Determinants of behavioral intention to mobile banking. *Expert Systems with Applications*, *36*(9), 11605–11616. doi:10.1016/j.eswa.2009.03.024

Guo, X., & Zhang, N. (2010). User attitude towards mandatory use of information systems: A Chinese cultural perspective. *Journal of Global Information Management*, *18*(4), 1–18. doi:10.4018/jgim.2010100101

Hair, J., Black, W., Babin, B., & Anderson, R. (2009). *Multivariate Data Analysis: A Global Perspective* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Hanafizadeh, P., Keating, B., & Khedmatgozar, H. (2014). A systematic review of Internet banking adoption. *Telematics and Informatics*, *31*(3), 492–510. doi:10.1016/j.tele.2013.04.003

Harvey, F. (1999). National Cultural Differences in Theory and Practice: Evaluating Hofstede's National Cultural Framework. *Information Technology & People*, *10*(2), 132–146. doi:10.1108/09593849710174986

Hasan, H., & Ditsa, G. (1999). The impact of culture on the adoption of it: An interpretive study. *Journal of Global Information Management*, *7*(1), 5–15. doi:10.4018/jgim.1999010101

Hernandez, J., & Mazzon, J. (2007). Adoption of internet banking: Proposition and implementation of an integrated methodology approach. *International Journal of Bank Marketing*, *25*(2), 72–88. doi:10.1108/02652320710728410

Hofstede, G. (1984). *Culture's consequences: international differences in work-related values*. Beverly Hills, CA: Sage Publications.

Hong, W., Thong, J., Wong, W., & Tam, K. (2001). Determinants of user acceptance of digital libraries: An empirical examination of individual differences and system characteristics. *Journal of Management Information Systems*, *18*(3), 97–124. doi:10.1080/07421222.2002.11045692

Hung, S., Kang, T., Yen, D., Huang, A., & Chen, K. (2012). A cross-cultural analysis of communication tools and communication outcomes. *Journal of Global Information Management*, *20*(3), 55–83. doi:10.4018/jgim.2012070103

Intana, M., Chansa-ngavej, C., Changchit, C., & Satjawathee, T. (2013). Factors Encouraging the Internet Banking Adoption in Thailand. *International Journal of Electronic Finance*, *7*(3/4), 196–212. doi:10.1504/IJEF.2013.058602

Islam, S. (2014). Systematic literature review: Security challenges of mobile banking and payments system. *International Journal of u- and e- Service. Science and Technology*, *7*(6), 107–116.

Jaruwachirathanakul, B., & Fink, D. (2005). Internet banking adoption strategies for a developing country: The case of Thailand. *Internet Research*, *15*(3), 295–311. doi:10.1108/10662240510602708

Jarvenpaa, S., & Todd, P. (1996). Consumer reaction to electronic shopping on the World Wide Web. *International Journal of Electronic Commerce*, *1*(2), 59–88. doi:10.1080/10864415.1996.11518283

Joines, J., Scherer, C., & Scheufele, D. (2003). Exploring motivations for consumer Web use and their implications for e-commerce. *Journal of Consumer Marketing*, *20*(2), 90–108. doi:10.1108/07363760310464578

Kamal, M., Hackney, R., & Sarwar, K. (2013). Investigating factors inhibiting e-government adoption in developing countries: The context of Pakistan. *Journal of Global Information Management*, *21*(4), 77–102. doi:10.4018/jgim.2013100105

Kang, H., Lee, M., & Lee, J. (2012). Are you still with us? A study of the post-adoption determinants of sustained use of mobile-banking services. *Journal of Organizational Computing and Electronic Commerce*, *22*(2), 132–159. doi:10.1080/10919392.2012.667710

Karahanna, E., Evaristo, R., & Srite, M. (2005). Levels of culture and individual behavior: An integrative perspective. *Journal of Global Information Management*, *13*(2), 1–20. doi:10.4018/jgim.2005040101

Kazi, A. K., & Mannan, M. A. (2013). Factors affecting adoption of mobile banking in Pakistan: Empirical evidence. *International Journal of Research in Business and Social Science*, *2*(3), 54–61.

Kim, H., Gupta, S., & Jeon, Y. (2013). User Continuance intention towards mobile Internet service: The case of WIMAX in Korea. *Journal of Global Information Management*, *21*(4), 121–142. doi:10.4018/jgim.2013100107

Kim, J., Yuan, X., Kim, S., & Lee, Y. (2014). How perceived quality works in new technology adoption process: A cross-national comparison among China, Korea and Japan. *Journal of Global Information Management*, *22*(2), 23–47. doi:10.4018/jgim.2014040102

Koenig-Lewis, N., Palmer, A., & Moll, A. (2010). Predicting young consumers' take up of mobile banking services. *International Journal of Bank Marketing*, *28*(5), 410–432. doi:10.1108/02652321011064917

Koivumäki, T. (2001). Customer Satisfaction and Purchasing Behavior in a Web-based Shopping Environment. *Electronic Markets*, *11*(3), 186–192. doi:10.1080/101967801681008022

Koyuncu, C., & Lien, D. (2003). E-commerce and consumer's purchasing behavior. *Applied Economics*, *35*(6), 721–725. doi:10.1080/0003684022000020850

Lee, H., Zhang, Y., & Chen, K. (2013). An investigation of features and security in mobile banking strategy. *Journal of International Technology and Information Management*, *22*(4), 23–45.

Lee, K., Tsai, M., & Lanting, M. (2011). From marketplace to marketspace: Investigating the customer switch to online banking. *Electronic Commerce Research and Applications*, *10*(1), 115–125. doi:10.1016/j.elerap.2010.08.005

Lee, Y., Kozar, K., & Larsen, K. (2003). The technology acceptance model: Past, present, and future. *Communications of the Association for Information Systems*, *12*, 752–780. doi:10.17705/1CAIS.01250

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, *40*(3), 191–204. doi:10.1016/S0378-7206(01)00143-4

Liébana-Cabanillas, F., Alonso-Dos-Santos, M., Soto-Fuentes, Y., & Valderrama-Palma, V. A. (2016). Unobserved heterogeneity and the importance of customer loyalty in mobile banking. *Technology Analysis and Strategic Management*, *29*(9), 1015–1032. doi:10.1080/09537325.2016.1262021

Lin, C. (2003). A critical appraisal of customer satisfaction and e-commerce. *Managerial Auditing Journal*, *18*(3), 202–212. doi:10.1108/02686900310469952

Lin, H. (2011). An empirical investigation of mobile banking adoption - The effect of innovation attributes and knowledge-based trust. *International Journal of Information Management*, *31*(3), 252–260. doi:10.1016/j.ijinfomgt.2010.07.006

Lippert, S., & Volkmar, J. (2007). Cultural effects on technology performance and utilization: A comparison of U.S. and Canadian users. *Journal of Global Information Management*, *15*(2), 5–10. doi:10.4018/jgim.2007040103

Liu, C., Marchewka, J., Lu, J., & Yu, C. (2004). Beyond concern: A privacy–trust–behavioral intention model of electronic commerce. *Information & Management*, *42*(1), 127–142. doi:10.1016/j.im.2004.01.002

Luarn, P., & Lin, H. (2005). Toward an understanding of the behavioral intention to use mobile banking. *Computers in Human Behavior*, *21*(6), 873–891. doi:10.1016/j.chb.2004.03.003

Luo, X., Li, H., Zhang, J., & Shim, J. P. (2010). Examining multi-dimensional trust and multi-faceted risk in initial acceptance of emerging technologies: An empirical study of mobile banking services. *Decision Support Systems*, *49*(2), 222–234. doi:10.1016/j.dss.2010.02.008

Malaquias, F. F., & Hwang, Y. (2016). Trust in mobile banking under conditions of information asymmetry: Empirical evidence from Brazil. *Information Development*, *32*(5), 1600–1612. doi:10.1177/0266666915616164

Malaquias, R. F., & Hwang, Y. (2019). Mobile banking use: A comparative study with Brazilian and U.S. participants. *International Journal of Information Management*, *44*, 132–140. doi:10.1016/j.ijinfomgt.2018.10.004

Markus, M., & Soh, C. (2002). Structural influences on global E-commerce activity. *Journal of Global Information Management*, *10*(1), 5–12. doi:10.4018/jgim.2002010101

Masrek, M. N., Mohamed, I. S., Daud, N. M., & Omar, N. (2013). Technology trust and mobile banking satisfaction: A case of Malaysian consumers. *Procedia: Social and Behavioral Sciences*, *129*, 53–58. doi:10.1016/j.sbspro.2014.03.647

Mathwick, C., Malhotra, N., & Rigdon, E. (2001). Experiential value: Conceptualization, measurement and application in the catalog and Internet shopping environment. *Journal of Retailing*, *77*(1), 39–56. doi:10.1016/S0022-4359(00)00045-2

Matsumoto, D. (1994). *Psychology from a Cultural Perspective*. Brookes/Cole.

McCoy, S., Loiacono, E., & Abitia, G. (2004). Cross Cultural Information Systems Research. *Journal of Global Information Technology Management*, *7*(4), 1–2. doi:10.1080/1097198X.2004.10856381

Muñoz-Leiva, F., Climent-Climent, S., & Liébana-Cabanillas, F. (2017). Determinants of intention to use the mobile banking apps: An extension of the classic TAM model. *Spanish Journal of Marketing-ESIC*, *21*(1), 25–38. doi:10.1016/j.sjme.2016.12.001

Namahoot, K. S., & Laohavichien, T. (2015). An analysis of behavioral intention to use Thai internet banking with quality management and trust. *Journal of Internet Banking and Commerce*, *20*(3), 1–15.

Nasri, W., & Charfeddine, L. (2012). Factors affecting the adoption of Internet banking in Tunisia: An integration theory of acceptance model and theory of planned behavior. *The Journal of High Technology Management Research*, *23*(1), 1–14. doi:10.1016/j.hitech.2012.03.001

National Statistical Office. (2014). *The 2014 Household Survey on the Use of Information and Communication Technology*. Retrieved December 26, 2015, from http://web.nso.go.th/en/survey/ict/ data_ict/2014_Full%20Report.pdf

Nel, J., & Boshoff, C. (2014). An invariance analysis of online-mobile cross-channel evaluations in the banking industry. In *Proceeding of 13th International Conference WWW/Internet 2014* (pp. 307-314). Lisbon: IADIS Press.

Niederman, F., Alhorr, H., Park, Y., & Tolmie, C. (2012). Global information management research: What have we learned in the past decade? *Journal of Global Information Management*, *20*(1), 18–56. doi:10.4018/jgim.2012010102

Nunnally, J., & Bernstein, I. (1994). *Psychometric Theory* (3rd ed.). New York: McGraw-Hill.

Oliveira, T., Faria, M., Thomas, M. A., & Popovič, A. (2014). Extending the understanding of mobile banking adoption: When UTAUT meets TTF and ITM. *International Journal of Information Management*, *34*(5), 689–703. doi:10.1016/j.ijinfomgt.2014.06.004

Ongkasuwan, M., & Tantichattanon, W. (2002). A comparative study of internet banking in Thailand. *Proceedings of The First National Conference on Electronic Business*.

Palvia, P. (1998). Research issues in global information technology management. *Information Resources Management Journal*, *11*(2), 27–36. doi:10.4018/irmj.1998040103

Parasuraman, A., & Zinkhan, G. (2002). Marketing to and serving customers through the Internet: An overview and research agenda. *Journal of the Academy of Marketing Science*, *30*(4), 286–295. doi:10.1177/009207002236906

Pikkarainen, T., Pikkarainen, K., Karjaluoto, H., & Pahnila, S. (2004). Consumer acceptance of online banking: An extension of the technology acceptance model. *Internet Research*, *14*(3), 224–235. doi:10.1108/10662240410542652

Posnock, S. (2004). Customer satisfaction up online. *American Demographics*, *26*(3), 16.

Püschel, J., Mazzon, J. A., & Hernandez, J. M. C. (2010). Mobile banking: Proposition of an integrated adoption intention framework. *International Journal of Bank Marketing*, *28*(5), 389–409. doi:10.1108/02652321011064908

Remus, W. (1986). Graduate students as surrogates for managers in experiments on business decision making. *Journal of Business Research*, *14*(1), 19–25. doi:10.1016/0148-2963(86)90053-6

Robey, D., Farrow, D., & Franz, C. (1989). Group process and conflict in system development. *Management Science*, *35*(10), 1172–1189. doi:10.1287/mnsc.35.10.1172

Roca, J., Garcia, J., & De la Vega, J. (2009). The importance of perceived trust, security and privacy in online trading systems. *Information Management & Computer Security*, *17*(2), 96–113. doi:10.1108/09685220910963983

Rotchanakitumnuai, S., & Speece, M. (2003). Barriers to internet banking adoption: A qualitative study among corporate customers in Thailand. *International Journal of Bank Marketing*, *21*(6/7), 312–323. doi:10.1108/02652320310498465

Rouibah, K., & Hamdy, H. (2009). Factors affecting information communication technologies usage and satisfaction: Perspective from instant messaging in Kuwait. *Journal of Global Information Management*, *17*(2), 1–29. doi:10.4018/jgim.2009040101

Salehi, M., & Alipour, M. (2010). E-banking in emerging economy: Empirical evidence of Iran. *International Journal of Economic and Finance*, *2*(1), 201–209. doi:10.5539/ijef.v2n1p201

Sharma, S. K., & Sharma, M. (2019). Examining the role of trust and quality dimensions in the actual usage of mobile banking services: An empirical investigation. *International Journal of Information Management*, *44*, 65–75. doi:10.1016/j.ijinfomgt.2018.09.013

Shim, S., Eastlick, M., Lotz, S., & Warrington, P. (2001). An online prepurchase intentions model: The role of intention to search. *Journal of Retailing*, *77*(3), 397–216. doi:10.1016/S0022-4359(01)00051-3

Shin, D., & Choo, H. (2012). Exploring cross-cultural value structures with smartphones. *Journal of Global Information Management*, *20*(2), 67–93. doi:10.4018/jgim.2012040104

Singh, N., Zhao, H., & Hu, X. (2003). Cultural adaptation on the web: A study of American companies' domestic and Chinese websites. *Journal of Global Information Management*, *11*(3), 63–80. doi:10.4018/jgim.2003070104

Singh, S., Srivastava, V., & Srivastava, R. (2010). Customer acceptance of mobile banking: A conceptual framework. SIES. *Journal of Management*, *7*(1), 55–64.

Song, H. (2015). Customer adoption of mobile banking: An integration of TAM with trust and social influence. *Applied Mechanics and Materials*, (701-702), 1323–1327. doi:10.4028/www.scientific.net/AMM.738-739.1323

Sprott, D., Spangenberg, E., & Fisher, R. (2003). The importance of normative beliefs to the self-prophecy effect. *The Journal of Applied Psychology*, *88*(3), 423–431. doi:10.1037/0021-9010.88.3.423 PMID:12814292

Sripalawat, J., Thongmak, M., & Ngramyarn, A. (2011). M-banking in metropolitan Bangkok and a comparison with other countries. *Journal of Computer Information Systems*, *51*(3), 67–76.

Srite, M., Thatcher, J., & Galy, E. (2008). Does within-culture variation matter? An empirical study of computer usage. *Journal of Global Information Management*, *16*(1), 1–25. doi:10.4018/jgim.2008010101

Staff, J. (2013, Nov. 1). ABA survey: Popularity of mobile banking continues to climb. *Banking & Wealth Management, The Central New York Business Journal*.

Statista. (2015). *Usage of mobile banking apps worldwide in 2014*. Retrieved January 27, 2016, from http://www.statista.com/statistics/468943/usage-of-mobile-banking-apps-worldwide-by-country/

Straub, D., Keil, M., & Brenner, W. (1997). Testing the technology acceptance model across cultures: A three country study. *Information & Management*, *33*(1), 1–11. doi:10.1016/S0378-7206(97)00026-8

Suanmali, S. (2015). Factors influencing the adoption of using mobile banking on smartphone: An empirical case study in Bangkok, Thailand. In L. Wang, S. Uesugi, I. H. Ting, K. Okuhara, & K. Wang (Eds.), *Multidisciplinary Social Networks Research, MISNC 2015. Communications in Computer and Information Science* (pp. 415–424). Berlin: Springer. doi:10.1007/978-3-662-48319-0_34

Susanto, A., Lee, H., Zo, H., & Ciganek, A. (2013). Factors affecting Internet banking success: A comparative investigation between Indonesia and South Korea. *Journal of Global Information Management*, *21*(2), 72–95. doi:10.4018/jgim.2013040104

Svilar, A., & Zupančič, J. (2016). User experience with security elements in Internet and mobile banking. *Organizacija*, *49*(4), 251–260. doi:10.1515/orga-2016-0022

Thailand Chapter of Internet Society. (2015). *History of the Internet in Thailand*. Retrieved December 26, 2015, from http://www.isoc-th.org/History_ITH.htm

Tippins, M., & Sohi, R. (2003). IT competency and firm performance: Is organizational learning a missing link? *Strategic Management Journal*, *24*(8), 745–761. doi:10.1002mj.337

Trauth, E., Quesenberry, J., & Huang, H. (2008). A multicultural analysis of factors influencing career choice for women in the information technology workforce. *Journal of Global Information Management*, *16*(4), 1–23. doi:10.4018/jgim.2008100101

Venkatesh, V., & Davis, F. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204. doi:10.1287/mnsc.46.2.186.11926

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *Management Information Systems Quarterly*, *27*(3), 425–478. doi:10.2307/30036540

Vijayasarathy, L. (2004). Predicting consumer intentions to use on-line shopping: The case for an augmented technology acceptance model. *Information & Management*, *41*(6), 747–762. doi:10.1016/j.im.2003.08.011

West, J., & Mace, M. (2010). Browsing as the killer app: Explaining the rapid success of Apple's iPhone. *Telecommunications Policy*, *34*(4–5), 270–286. doi:10.1016/j.telpol.2009.12.002

Wong, Y., & Hsu, C. (2008). A confidence-based framework for business to consumer (B2C) mobile commerce adoption. *Personal and Ubiquitous Computing*, *12*(1), 77–84. doi:10.100700779-006-0120-5

Yadav, A. (2016). Factors influencing the usage of mobile banking among customers. The IUP. *Journal of Brand Management*, *15*(4), 7–18.

Yaghoubi, N., & Bahmani, E. (2010). Factors Affecting the Adoption of Online Banking an Integration of Technology Acceptance Model and Theory of Planned Behavior. *International Journal of Business and Management*, *5*(9), 159–165. doi:10.5539/ijbm.v5n9p159

Yan, G., He, W., Shi, H., & Rawat, D. B. (2014). Applying a bilingual model to mine e-commerce satisfaction sentiment. *Journal of Management Analysis*, *1*(4), 285–300.

Yang, K. (2010). The effects of technology self-efficacy and innovativeness on consumer mobile data service adoption between American and Korean consumers. *Journal of International Consumer Marketing*, *22*(2), 117–127. doi:10.1080/08961530903476147

Yenisey, M., Ozok, A., & Salvendy, G. (2005). Perceived security determinants in e-commerce among Turkish university students. *Behaviour & Information Technology*, *24*(4), 259–274. doi:10.1080/0144929042000320992

Yu, C., & Chantatub, W. (2015). Consumers' resistance to using mobile banking: Evidence from Thailand and Taiwan. *International Journal of Electronic Commerce Studies*, *7*(1), 21–38. doi:10.7903/ijecs.1375

Yu, C. S. (2014). Consumer switching behavior from online banking to mobile banking. *International Journal of Cyber Society and Education*, *7*(1), 1–28. doi:10.7903/ijcse.1108

Zhang, W., Yang, X., Wang, Q., Zheng, C., & Sia, C. (2015). Investigation on the factors determining consumers' use of online intermediated shopping (OIS): A behavioral intention perspective. *Journal of Organizational and End User Computing*, *27*(1), 77–97. doi:10.4018/joeuc.2015010104

Zhang, Z., & Jasimuddin, S. M. (2015). A model-based analysis for mobile knowledge management in organizations. *Journal of Management Analytics*, *2*(1), 35–52. doi :10.1080/23270012.2015.1012232

Zhou, T. (2012). Understanding users' initial trust in mobile banking: An elaboration likelihood perspective. *Computers in Human Behavior*, *28*(4), 1518–1525. doi:10.1016/j.chb.2012.03.021

Zhou, T., Lu, Y., & Wang, B. (2010). Integrating TTF and UTAUT to explain mobile banking user adoption. *Computers in Human Behavior*, *26*(4), 760–767. doi:10.1016/j.chb.2010.01.013

Zorotheos, A., & Kafeza, E. (2009). Users' perceptions on privacy and their intention to transact online: A study on Greek internet users. *Direct Marketing: An International Journal*, *3*(2), 139–153. doi:10.1108/17505930910964795

APPENDIX: RESEARCH QUESTIONNAIRE

Table 8.

Perceived Usefulness (PU)
It is less time consuming than doing transactions at bank sites
I usually get better transaction fees than doing transactions at bank sites
I usually get a faster service than doing transactions at bank sites
Mobile banking allows me to do transactions at any time
Mobile banking allows me to do transactions at my own pace
Perceived Ease of Use (PEU)
Learning to use mobile banking is easy for me
I find it easy to get mobile banking to do what I want it to do for my banking purposes
My interaction with mobile banking is clear and understandable
I find mobile banking easy to use
It is easier to use mobile banking than other forms of banking
Perceived Privacy (PP)
I believe that the mobile banking system will protect the privacy of my personal banking data
I believe that the mobile banking systems will not disclose my personal banking data
I believe that banks will keep mobile banking transaction confidentially
I am not afraid to do transactions via mobile banking
I am not afraid to lose my confidential data via mobile banking transactions
Perceived Security (PS)
Using mobile banking enables me to conduct transaction securely
Using Internet banking makes me believe that the existing regulations are sufficient to ensure that users are protected
Overall, I am not worried about the security of the mobile banking
I believe that my banks protect me from unauthorized charges
I believe that my transactions are secured
Previous Experience (PEX)
I am usually satisfied with the mobile banking services
My mobile banking transactions are always accurate
I usually have a good experience with mobile banking services
My transactions are always processed in a timely manner
I never feel disappointed with mobile banking
Normative Beliefs (NB)
People in my organization think that I should use mobile banking
My family thinks that I should use mobile banking

continued on following page

Table 8. Continued

My friends influence my decision to use mobile banking
The image of the bank has influence on my using mobile banking
Using mobile banking makes me feel current in the trend
Technology Competency (TC)
I use computer everyday
I am not afraid of using technology
My ability to learn new technology is high
I am always interested in new technology
I enjoy working with technology
Attitude Towards the Usage of Mobile Banking (ATT)
Overall, I prefer to do mobile banking transaction than other forms of banking

Chapter 6
Predicting Consumer Trust in an Intermediary in B2C Online Marketplaces:
Insights From the Korean Experience

Ilyoo Barry Hong
Chung-Ang University, South Korea

ABSTRACT

Trust is a central element in online transactions in B2C e-marketplaces where a buyer needs to evaluate intermediary trust as well as seller trust to make a purchase decision. The authors develop and test a consumer trust model to predict first-time buyer's trust in an intermediary in Korean online marketplaces. Data were collected via a questionnaire survey using 218 respondents. Results from an empirical analysis indicate that while all the three factors of trustworthiness were found to be a predictor of overall initial trust in the intermediary, 'integrity' turned out to have the strongest association with overall trust. The findings suggest that trustworthiness beliefs and trust are conceptually distinct from each other and that the former is a predictor of the latter. The chapter offers implications for both academics and practitioners of online marketplaces.

INTRODUCTION

An electronic marketplace (or e-marketplace) is an interorganizational information system that allows the participating buyers and sellers in some market to exchange information about prices and product offerings (Bakos, 1997; Hong, 2018). It is

DOI: 10.4018/978-1-7998-1786-4.ch006

an intermediary that brings together sellers and buyers by providing an online marketplace. Buyers in an e-marketplace are exposed to an even greater risk of opportunistic seller behaviour than those in an online storefront. In fact, the Internet Crime Complaint Centre (2018) received 26,967 consumer auction fraud complaints between May 2014 and December 2017 with an adjusted dollar loss of $54,032,396. The reasons that online marketplaces are riskier than digital storefronts are twofold. Foremost, e-marketplaces typically consist of SOHO (small office home office) sellers who process a limited volume of transactions daily and handle returns or exchanges with limited manpower resources. Moreover, e-marketplace buyers routinely engage in transactions with a community of unknown sellers within the marketplace with whom they have little or no prior interaction, whereas buyers on a digital storefront develop business relationships with the single seller over time to the extent that they get to place trust in the e-commerce firm. Therefore, trust remains a key to the success of online marketplaces today. From the standpoint of consumers, buying from an online store that is not trustworthy is like accepting foreseen risks of financial or other possible losses. For that reason, it is critical for vendors to successfully build trust to overcome consumer perceptions of uncertainty and risk. Likewise, it is important to understand how a consumer places trust in an online marketplace.

The literature on consumer trust in electronic commerce reveals a rich body of knowledge on the antecedents of trust, which predominantly focuses on the context of digital storefronts. However, little work has been dedicated to understanding what affects consumer's trustworthiness beliefs in an intermediary in an online marketplace especially when a consumer has no buying experience with that e-marketplace. While Kim & Ahn(2001) investigated the antecedents of trust in an online marketplace, their study is not applicable to a situation where a consumer has no transactional experience to form trusting beliefs concerning the e-marketplace. A trust model for an online storefront is distinct from that for an e-marketplace. While trust in a single vendor is of importance in an online storefront, consumers in an e-marketplace have a prime concern with trust in the marketplace intermediary. Thus consumer trust in an intermediary will be first formed, and then trust is transferred from the intermediary to the vendors selling within the marketplace (Hong & Cho, 2011). To help online marketplaces successfully build consumer trust, a consumer trust model specifically tailored to e-marketplaces that articulates the sources of trust for this particular type of e-commerce firm is needed. In particular, the way initial trust is formed in online marketplaces differs from the way subsequent trust is developed; development of subsequent trust can be importantly influenced by consumer's buying experience (i.e., length of relationship). In order to examine how trust is formed with first-time buyers, this paper will focus on initial trust that consumers have to deal with who have not yet shopped in a given e-marketplace.

In addition, one trend that is noticeable with some of the recent trust-related research is that the trust concept is interpreted and used in two different ways. While trust can be measured by a single dimension such as reliability, the trust construct can be viewed as multi-dimensional(Ou, Pavlou, & Davison, 2014). The first view focuses on the concept of general trust, which is not related to a specific behaviour of the other party, or any component of trust(Chen & Dhillon, 2003). On the other hand, the second view assumes that trust is comprised of such differing dimensions as competence, integrity, and benevolence, which are termed factors of trustworthiness in the literature (Mayer, Davis, & Schoorman, 1995). Based on the second view, some researchers tend to identify trust with trustworthiness and measure the trust construct using items created for the trustworthiness construct. While the aggregate perception of the three dimensions may influence the overall trust of the consumer (Chen & Dhillon, 2003), trust can by no means be conceptually equated with trustworthiness. In particular, the magnitude of influence of the individual attributes of trustworthiness on the overall trust may be unequal to one another in e-marketplaces due to the very nature of the online-marketplace business model. It is imperative to examine the association between the attributes of trustworthiness and overall trust.

This paper aims at examining the influence of e-commerce firm and site characteristics on the formation of trustworthiness beliefs in an intermediary in online marketplaces and at exploring the relationships between trustworthiness attributes and initial trust in an intermediary. To this end, we will first conduct an extensive review of the related literature to discover factors that are central to e-commerce firm and site characteristics and to trustworthiness beliefs in an intermediary. Next, we will conduct an empirical examination to take an in-depth look at the relationships between e-commerce firm characteristics and trustworthiness attributes and between site characteristics and trustworthiness attributes. At the same time, we will empirically analyse the linkage between trustworthiness and overall trust in the context of e-marketplaces. The findings of this research are expected to contribute to our understanding of how initial trust in an intermediary is formed in business-to-consumer online marketplaces, enabling practitioners to formulate strategies to build trust for first-time buyers on such marketplaces.

TRUST IN AN ELECTRONIC COMMERCE CONTEXT

The Trust Concept

Researchers agree that trust plays a critical role when consumers buy from Internet vendors, but that it is a concept that is least agreed upon by researchers in all related

academic disciplines. There is no universally accepted definition of trust. Scholars have given different definitions from the perspectives of their respective domains. Nevertheless, many researchers concur with the Mayer, Davis and Schoorman's (1995) definition that trust is the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party. This definition is widely accepted because it adequately captures the very nature of the relationship between the trustor and the trustee. We will use this definition of trust throughout the paper.

Overall, researchers agree that trust represents an expectation or belief that a partner will behave with goodwill and in a favourable way, although the acceptance of trust involves taking certain risks. Their view implies that trust builds up over a period of time as the trusting party has repeated experience with the trusted party. Unlike this cumulative concept of trust, initial trust, for which a conceptual framework has been introduced by McKnight, Cummings, and Chervany (1998), can be formed without acquiring related knowledge or having prior experience. McKnight et al. (1998) state that Web consumers may develop institution-based trust as they discover technological and legal safeguards such as data security measures, guarantees, and regulations.

Trust and Electronic Commerce

Electronic commerce (e-commerce) involves business transactions in which a buyer decides to engage in exchange relationships with a seller to make an online purchase. Trust plays a crucial role in such a business relationship (Lu, Zhang, Wang, & Keller, 2016; Palvia, 2009). Buying on the Internet presents numerous risks for consumers over and above the perceived risk of the transaction process itself (Einwiller & Will, 2001); for example, online consumers may experience financial loss from online fraud, product performance failure, mismatch between the product and the consumer's sense of self-identity, or wrong delivery of an order. Trust has the potential to mitigate risk when exchange relationships accompany risks due to uncertainty and interdependence (Etzioni, 2019). Therefore, e-commerce firms must establish online trust by employing trustmark seals, reputation systems, payment intermediaries, insurance providers, or other measures. Besides, maintaining trust on an ongoing basis is as important as initiating and building trust, since the level of trust can change over time with variations in the perceived risk and interdependence.

Trust in e-commerce typically is associated with two categories of relationships between the trusting and trusted parties. The first category represents a trust relationship between a consumer and an online store. In most Internet stores where the salesperson is absent or plays hardly any role, the primary target of the consumer's

trust is the e-commerce firm itself (Jarvenpaa, Tractinsky, & Vitale, 2000). Consumers continue to develop perceptions of e-commerce firm's trustworthiness through personal shopping experience in the online store. For this reason, the formation of buyer-seller trust may evolve over a long period of time, while a single occasion of unsatisfactory experience may terminate the growing trust relationship. The other category is concerned with the relationship between a consumer and a website that houses an online store. Researchers treat websites as objects of trust, assuming that a consumer enters into relationships with computers and websites, as they buy online (Corritore, Kracher, & Wiedenbeck, 2003). An e-tailing website with repeated incidences of leakage of personal data will lead to minimal consumer trust in the website as a result of consumers' perceptions of poor system security.

Existing research in electronic commerce indicates that the trust that consumers perceive in an online store is determined by the perceived trustworthiness (Hong, 2018; Hong, 2019). It is pointed out in the literature (Barney & Hansen, 1994) that trust is an attribute of a relationship between exchange partners, while trustworthiness is an attribute of individual exchange partners involved in the relationship. Furthermore, researchers (Gefen, 2002; Mayer et al., 1995) agree that trustworthiness is the characteristics of a trustee, whereas trust is "a willingness to be vulnerable" to the trustee and thus to take risk. For this reason, trustworthiness of a trading partner is a predictor of trust in that partner (Chen & Dhillon, 2003), since perceptions about trustworthiness contribute to the formation of overall trust. That is, the more trustworthy transaction partners are perceived to be, the more likely they are to place trust in each other. It is a widely accepted notion among trust researchers that trustworthiness is a multi-dimensional concept that consists of three characteristics including competence, benevolence, and integrity (Mayer et al., 1995). These three characteristics are often referred to as the factors of trustworthiness (Chen & Dhillon, 2003). The first dimension of trustworthiness, *competence*, is defined as the belief that an electronic commerce firm is able to fulfil its promises communicated to consumers. It has to do with perceptions of how well the firm does its job or how knowledgeable the firm is (McKnight, Choudhur, & Kacmar, 2002). Secondly, *benevolence* is the extent to which a trustee is believed to want to do good to the trustor, aside from an egocentric profit motive (Mayer et al., 1995). For first-time buyers, this belief is formed with perceptions of how effectively the focal website supports the users' needs and the welfare of the customers (Chen & Dhillon, 2003). *Integrity* is the third dimension that is associated with the belief that a company will act in a consistent, reliable, and honest manner when fulfilling its promises (Chen & Dhillon, 2003; Everard & Galletta, 2005). This dimension encompasses consumer perceptions of vendor honesty, truthfulness, and keeping commitments.

Due to the risk of the transaction, the buyer must evaluate the trustworthiness of the seller by envisioning the seller's likely behaviour, and then choose to participate

in the transaction, if and only if the seller is trustworthy enough (Good, 1988; Ring & Van de Ven, 1994). McKnight, Choudhury, and Kacmar (2002) call these trustworthiness factors 'trusting beliefs' which are distinguishable from trusting intentions. According to D. H. McKnight et al. (2002), beliefs in trustworthiness attributes (such as competence, benevolence, and integrity) have a positive effect on the intentions to be vulnerable to the behaviour of the other party. Their line of reasoning is consistent with the view that trustworthiness attributes affect the overall trust.

Trust in a B2C E-marketplace vs. Trust in a B2C Digital Storefront

One striking distinction between a B2C online storefront and a B2C e-marketplace lies in the target of trust (Pavlou & Gefen, 2004). The main target of trust in an online storefront is the single seller, and online transactions in this context involve a dyadic relationship, i.e., one-to-one relationship between buyers and sellers. The consumer trust model for B2C digital storefronts therefore deals with trust in the seller only. Trust in a dyadic relationship is formed when the buyer believes that the seller will behave with goodwill and in a favourable way (Donney & Cannon, 1997). The relationship among parties who have had no prior association is expected to emerge incrementally and to begin with small actions that initially require little reliance on trust (Jarvenpaa et al., 2000). Trust either increases or decreases as the two parties reciprocate the actions. For that reason, trust is often regarded as a governance mechanism in exchange relationships (Hong, 2015).

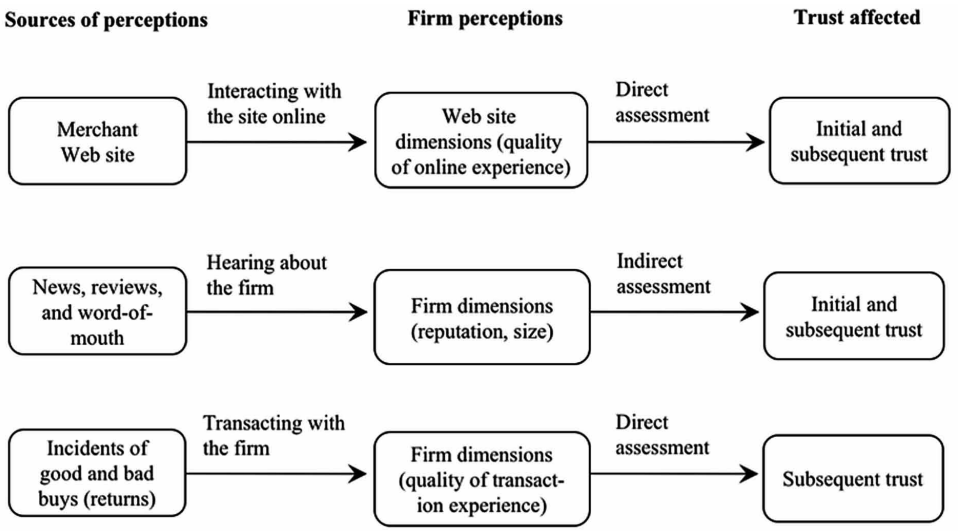
However, a B2C e-marketplace provides online transactions in a setting involving one-to-many relationship between buyers and sellers. The e-commerce firm in this setup consists of two components, including an intermediary providing the transaction infrastructure and the sellers doing business within that infrastructure (Hong & Cho, 2011). The intermediary in an online marketplace furnishes an online marketplace (for example, providing a transactional infrastructure including institutional mechanisms), whereas the sellers therein are responsible for a broad range of activities, from marketing the Web site, to fulfilling online orders, to handling customer services. Thus, for a transaction to occur in B2C e-marketplaces, consumers have to deal with both trust in an intermediary (i.e., one to one relationship) and trust in the community of sellers (i.e., one-to-many relationship). That is, the buyer has to ensure that overall the community of multiple sellers as well as the intermediary in the marketplace is trustworthy.

THE E-MARKETPLACE TRUST MODEL AND HYPOTHESES

The E-Marketplace Trust Model

A review of the related literature indicates that numerous trust models exist showing relationships between consumer trust and related constructs in a B2C electronic commerce setting. These models incorporate a wide range of trust antecedents such as trustworthiness, online store's characteristics, media (website) characteristics, disposition to trust, and institutional mechanisms. For example, Koufaris and Hampton-Sosa (2004) proposed a model of initial trust in an online company based on company perceptions and website perceptions. Their model indicates that the perceptions about a company and a website directly influence initial trust. However, given that trust refers to the willingness of a trustor to be vulnerable to the actions of a trustee (Mayer et al., 1995), those perceptions will first affect trustworthiness beliefs (e.g., competence, integrity, and benevolence) that then will contribute to the formation of the ultimate trust. Despite an extensive review of the literature, we could hardly find a research model of trust formation specifically for first-time buyers in online marketplaces. This research is unique in that it focuses on the formation of initial trust, rather than subsequent trust, in B2C e-marketplaces, with trustworthiness dimensions as a mediator between trust antecedents and trust.

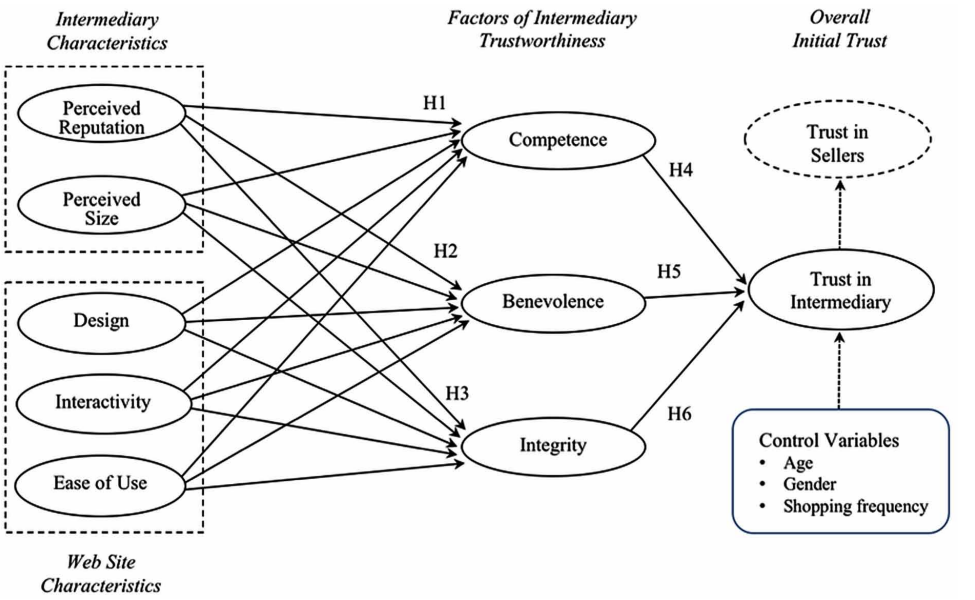
Figure 1. How consumer perceptions about e-commerce firm are formed



Perceived trustworthiness of an e-commerce firm is closely related to perceptions that a consumer develops concerning the reliability of that firm (Corbitt, Thanasankit, & Yi, 2003). As shown in Figure 1, perceptions about an e-commerce firm are formed through three paths. A consumer typically perceives the trustworthiness of the firm from personal online experience (Everard & Galletta, 2005; Karake-Shalhoub & Westport, 2002) or by word-of-mouth (Brown, Broderick, & Lee, 2007; Dellarocas, 2003) or from transaction experience (Donney & Cannon, 1997). First, a consumer can gain perceptions about an e-commerce firm (e.g., easy navigation, painful payment process, fast feedback to online inquiries) while interacting with the firm's Web site to gather product information or to buy online. Since the Web site of an online firm is regarded as the primary interface linking the firm with its customers (Hong & Cho, 2011), perceptions of the firm's Web site can directly impact the consumer's impression on the firm. Second, a consumer's perception about an e-commerce firm's reliability can also result from his or her indirect experience with the firm (e.g., word-of-mouth). Brown et al. (2007) point out that word of mouth has a greater impact on product judgments, attitude formation, and decision making than formal marketing communications. Information that a consumer obtains over time both online and offline, such as firm-related postings, customer reviews, and social network recommendations, can importantly help shape the consumer's perceptions about the reputation or size of the firm. Third, a consumer can also perceive trustworthiness of a firm from transactional experience. Donney and Cannon (1997) states that when a trustor learns more about the trustee through repeated and broader experience, the trustor develops confidence that the trustee will behave in a predictable manner (i.e., either trustworthy or untrustworthy). As the consumer continues to buy online from that firm over time, he or she will develop very concrete firm-specific perceptions (e.g., good product quality, poor service, difficult returns). As shown in Figure 1, of the three categories of e-commerce firm perceptions, only the first two are associated with initial trust, whereas all the three contribute to the formation of subsequent trust. Based on this observation, we determined that our B2C e-marketplace trust model should include two key categories of dimensions, including website characteristics and intermediary characteristics.

The above conceptual development results in a research model shown in Figure 2. Based on the existing studies summarized in Table 1, perceived reputation and perceived size have been designated as key firm dimensions, while site design, interactivity, and ease of use have been chosen as website dimensions. The research model shows that the three factors of trustworthiness are not linked to trust in a community of sellers. One reason why we excluded from the model such relationships for sellers is that this research focuses on trust in an e-marketplace intermediary, rather than trust in sellers, as an important dependent variable in itself.

Figure 2. The research model



Based on the above theoretical grounds, it is posited that intermediary and site characteristics positively influence the factors of perceived intermediary trustworthiness in an e-marketplace, which then, in the aggregate, affect the initial trust in the intermediary. In addition, consumer trust in the intermediary influences trust in the community of sellers.

Research Hypotheses

Based on the research model, we have formulated a total of eighteen hypotheses to explore the relationships among the constructs under consideration in the present study. The first six hypotheses are concerned with the effects of intermediary characteristics on the factors of intermediary trustworthiness, and the subsequent nine hypotheses with the effects of website characteristics on the factors of intermediary trustworthiness. The remaining three hypotheses are designed to delve into the relationship between the factors of multi-dimensional trustworthiness and initial trust in the intermediary.

Table 1. Online trust antecedents in existing studies

Study	Trust Object	Trust Antecedents	Trust Items
Wang et al. (2015)	Mobile bank	Vendor familiarity, structural assurance, disposition to trust, situational normality, calculative-based trust	Trustworthiness, integrity, benevolence
McKnight et al. (2002)	Online store	Institution-based trust, perceived site quality, disposition to trust	Trusting beliefs (competence, belevolence, integrity); trusting intentions (willingness to depend, subjective probability of depending)
Gefen et al. (2003)	Online store	Calculative-based beliefs, structural assurances, situational normality, familiarity, perceived ease of use	Integrity, benevolence, ability, and predictability
Flavian et al. (2006)	Online store	Website usability, satisfaction,	Honesty, benevolence, competence
Kim et al. (2008)	Online store	Cognition-based (information quality, privacy protection, security protection), affect-based (third-party seal, reputation), experience-based (familiarity), personality-oriented (disposition to trust),	Trustworthiness, integrity, benevolence
Lu et al. (2016)	Online microsourcing marketplace	Resource complementarity, resource utilization, resource availability, resource suitability, marketplace effectiveness	Dependability, willingness to use, reuse intention
Kim & Ahn (2007)	Online market-maker	Market-maker reputation, Web usability, Web security	Benevolence, integrity, and trustworthiness
Guo et al. (2014)	User in a social rating network	Global trustworthiness (ability, integrity, benevolence), local trustworthiness (ability, integrity, benevolence), trust propensity	Trustworthiness (local & global)

Intermediary Characteristics and Factors of Trustworthiness

Reputation: A review of the trust literature indicates that the reputation and size of an Internet store as perceived by the user does influence the store's trustworthiness (Jarvenpaa et al., 2000). A corporate reputation is a collective representation of a firm's past actions and results that describes the firm's ability to deliver valued outcomes to multiple stakeholders (Fombrum & Riel, 1997). The reputation measures the extent to which a firm is honest and concerned with its customers (Donney & Cannon, 1997), and directly affects trusting beliefs (McKnight & Chervany, 2002).

Donney and Cannon (1997) suggest that the trustworthiness of a firm can be inferred through the words and actions of other people and organizations. In other words, a trusting party draws on "proof sources" from which trust is transferred to the target. In particular, the costs for a firm that acts in an untrustworthy manner can be quite high for firms with good reputations.

Hypothesis H1-1: Reputation is positively related to competence in the e-marketplace.
Hypothesis H2-1: Reputation is positively related to benevolence in the e-marketplace.
Hypothesis H3-1: Reputation is positively related to integrity in the e-marketplace.

Firm Size: Meanwhile, a firm's size encompasses the overall size and market-share position, and provides a signal that the firm can be trusted (Donney & Cannon, 1997). A large size and market share indicate that the firm has a large number of customers and has followed through with commitments made to its customers (Chen & Dhillon, 2003). Typically, a large organization will deliver on its promises, have better support capabilities, control its suppliers for improved reliability and credibility, and know the potential costs of acting in an untrustworthy manner (Jarvenpaa et al., 2000). Based on the existing research evidence, we can establish the following hypotheses that show how the reputation and perceived size of an intermediary, respectively, are related to each factor of trustworthiness in an e-marketplace.

Hypothesis H1-2: Perceived size is positively related to competence in the e-marketplace.
Hypothesis H2-2: Perceived size is positively related to benevolence in the e-marketplace.
Hypothesis H3-2: Perceived size is positively related to integrity in the e-marketplace.

Site Characteristics and Factors of Trustworthiness

Hampton-Sosa and Koufaris (2005) report that a website appears to influence a person's initial trust in the e-commerce firm. In addition, the characteristics of a website significantly influence the perceptions of the competence, integrity, and benevolence of the associated online seller (Chen & Dhillon, 2003). The site characteristics in our model consist of three dimensions, including design, interactivity, and ease of use.

Design: The design of a website refers to the extent to which the information and visual elements of the site are effectively designed to provide maximum navigability (Bauer & Scharl, 2000). Navigation is facilitated when the information (i.e., content) on the website is structured such that it will allow for quick and easy access to any webpage that the user wants (Nielsen, 1999). For example, an optimal organization of the content together with an adequate menu system can enable efficient move from

page to page. Meanwhile, website navigation can also be improved by optimizing the visual elements (e.g., fonts, colours, page layouts, etc.), because they can dramatically affect the readability of the page content. The related literature as a whole agrees that a properly designed Web site with good navigability fosters all the three user beliefs on trustworthiness of an e-commerce firm. First, a favourable site design can improve competence belief since, as Jakob Nielsen (Nielsen, 1999) wrote, "professional appearance feels solid and clear navigation conveys respect for customers and an implied promise of good service." Flavian, Guinaliu, and Gurrea (2006) also found that self-confidence generated by solid design (e.g., related links in and out) is likely to escalate consumer credibility in the website. In particular, correct and up-to-date content and product selection importantly influence user's perceptions on competence. For example, findings of a usability study indicate that users who viewed a map site that did not show a recently constructed bridge instantly lost faith in the site and wondered what else was missing in the maps (Nielsen, 1999). Second, a carefully thought-out website design has the potential to increase integrity belief. Nielsen (1999) warns that up-front disclosure of all aspects of the customer relationships (e.g., shipping charges) can assure users that the e-commerce firm is honest and doesn't intend to cheat customers by showing such information of prime interest to a customer only at the end of the order. Finally, a professionally designed, usable website is likely to improve user's benevolence belief. A site that users find satisfactory is one that provides users with comfort and acceptability of use (Zazelenchuk & Boling, 2003). Such a comfortable and user-friendly site will lead users to believe that the electronic commerce firm does care about the individual user and best supports the user's needs and interests. Based on this evidence, the following hypotheses can be formulated regarding the relationships between website design and each factor of trustworthiness.

Hypothesis H1-3: Design is positively related to competence in the e-marketplace.
Hypothesis H2-3: Design is positively related to benevolence in the e-marketplace.
Hypothesis H3-3: Design is positively related to integrity in the e-marketplace.

Interactivity: Interactivity in an e-commerce context involves interactions between a buyer and a seller, between customers, and between a user and the website (Wu, Hu, & Wu, 2010). Online interactions are facilitated when a Web site functions to support a user-to-user as well as user-to-website communication. Questions and answers (Q&A), frequently asked questions (FAQ), customer reviews, online chat, and user communities are well-known examples of Web-based tools to support such communication. These tools can make site visitors feel that the e-commerce firm not only cares about customers trying to listen to them, but also is self-confident and honest in the sense that users' feedback is made available on the Website for other

visitors to view. Wu et al. (2010) conducted a survey of the members of online travel communities, and concluded that interactivity and trust affected each other, and that improvement in interactivity on a website can lead to a more favourable attitude towards the website. In a related study, Merrilees and Fry (2003) have also shown that the more a site is perceived to be interactive, the more the users trust that site. From the results of an experiment, Chen, Griffith, and Shen (2005) reported that through greater interactivity, individuals develop greater trust in the Internet vendor and a better understanding of its products. They argue that superior interactivity can positively affect both online and offline purchase intentions. These prior research outcomes suggest the following hypotheses concerning the relationships between interactivity and each factor of trustworthiness.

Hypothesis H1-4: Interactivity is positively related to competence in the e-marketplace.
Hypothesis H2-4: Interactivity is positively related to benevolence in the e-marketplace.
Hypothesis H3-4: Interactivity is positively related to integrity in the e-marketplace.

Ease of Use: Ease of use is one of the two central beliefs of the Technology Acceptance Model that posits that the perceived ease of use and perceived usefulness significantly influence users' acceptance of computer technology (Davis, Bagozzi, & Warshaw, 1989). Davis et al. (1989) define the perceived ease of use as the degree to which the prospective user expects the use of the target system to be free of effort. In their empirical study of experienced repeat online shoppers, Gefen, Karahanna, and Straub (2003) find that an easy-to-use Web site interface is among the key factors that significantly influence online trust. Researchers (Flavian et al., 2006; Liao, Chen, & Yen, 2007) agree that the more a website is easy to use, the more are customers satisfied and come to trust the website. Indeed, a Web site requiring users to consume much time to figure out how to perform necessary tasks (e.g., locating a particular webpage) would no doubt give users an impression that they are not quite cared for and that there is a lack of expertise associated with the development of quality Web site. Based on the evidence from the existing related studies, we can infer that the ease of use of an e-marketplace Web site positively affects the individual dimensions of trustworthiness.

Hypothesis H1-5: Ease of use is positively related to competence in the e-marketplace.
Hypothesis H2-5: Ease of use is positively related to benevolence in the e-marketplace.
Hypothesis H3-5: Ease of use is positively related to integrity in the e-marketplace.

Trustworthiness and Overall Trust in the Intermediary

Ganesan (1994) states that the concept of trust conveys two central components: (1) credibility (i.e., the expertise and reliability of the vendor) and (2) benevolence (i.e., the vendor's intentions and motives that are beneficial to the retailer). Flavian et al. (2006) states that trust in an e-commerce context is a construct made up of three dimensions: honesty, benevolence, and competence perceived in the website. However, as we pointed out earlier, numerous authors suggest that trust and trustworthiness factors are inter-related but distinct concepts. For example, trust is conceptualized as the result of attributes of the other party such as that party's competence, concern, openness, and reliability (Mishra, 1996; Ring & Van de Ven, 1994). In the trust model proposed by Mayer et al. (1995), the antecedents of trust are competence, benevolence, and integrity, which are independent of one another. These related studies imply that the overall trust is determined by the integrated trustworthiness construct that is a composite measured by three dimensions: competence, benevolence, and integrity. Therefore, we now have the following hypotheses.

Hypothesis H4: Competence is positively related to the overall trust in the intermediary.

Hypothesis H5: Benevolence is positively related to the overall trust in the intermediary.

Hypothesis H6: Integrity is positively related to the overall trust in the intermediary.

RESULTS

Research Method

Table 2 provides a listing of the measures associated with the constructs, along with the definition and items for each measure. Data were collected via a questionnaire survey using Korean consumers who all had hands-on experience in Internet shopping within the six months preceding the date of the survey. Prior to the main questionnaire survey, a pilot test of a preliminary instrument was conducted using 24 college students enrolled at a major university in Korea, and the survey items were clarified and refined, based on the results. Then, the main survey was conducted in which a total of 236 participants. 216 responses were taken and used for data analysis, after 20 responses were excluded due to incompleteness or invalidity. Responses were classified as incomplete if one or more items were not answered or as invalid if it was apparent that most of the questionnaire items were consistently answered with either '1' or '5' on a 5-point scale.

Table 2. Measures and scales

Measure	Definition	Label	Scale	Source
Reputation	Perception of the brand name and standing of the e-marketplace	rep1 rep2 rep3 rep4	This e-marketplace is well known. This e-marketplace has a good reputation in the market. I can easily recognize the name of the e-marketplace. The e-marketplace is perceived as a superior e-commerce firm.	Jarvenpaa et al. (2000)
Perceived size	Perception of the size of the e-marketplace	siz1 siz2 siz3 siz4	This e-marketplace is a very large company. There is a large collection of products. The website has many visitors. There are many sellers in the e-marketplace.	Jarvenpaa et al. (2000)
Design	Organization of information and visual elements	dgn1 dgn2 dgn3	Product information is well organized by category. The visual layout of products is appealing. I am satisfied with the overall design.	Hong (2003); Flavian et al. (2006)
Interactivity	Responsiveness of the web-based system to the user's needs	iav1 iav2 iav3 iav4 iav5	I had some control over the content of this website that I wanted to see. I was in control of my navigation through this website. The site had the ability to respond to my specific questions quickly and efficiently. I could communicate in real time with other customers who shared my interest in this product category. The e-marketplace sends a confirmation email upon the completion of an order.	Wu (1999)
Ease of use	Perceived ease of using the website	eou1 eou2 eou3 eou4 eou5	The site content is easy to understand. The site is easy to use even for beginners. Product information is easy to browse. I can easily access my transaction pages. I can easily move from page to page.	Davis et al. (1989); Gefen et al. (2003)
Trustworthiness - competence	A company's ability to fulfill the promises that it has communicated to consumers	trc1 trc2 trc3	I think that this website has the necessary abilities to carry out its work. I think that this website has sufficient experience in the marketing of the products and services that it offers. I think that this website has the necessary resources to successfully carry out its activities.	Flavian et al. (2006); Mayer et al. (1995)
Trustworthiness - benevolence	The belief that a company holds consumers' interests ahead of its own self-interest	trb1 trb2 trb3 trb4 trb5 trb6	I think that the advice and recommendations given on this website are made towards mutual benefit. I think that this website is concerned with the present and future interests of its users. I think that this website takes into account the repercussions that its actions could have on the consumer. I think that this website would not do anything intentional that would prejudice the user. I think that the design and commercial offer of this website take into account the desires and needs of its users. I think that this website is receptive to the needs of its users.	Flavian et al. (2006)
Trustworthiness - integrity	The belief that a company will act in a consistent, reliable, and honest manner when fulfilling its promises.	tri1 tri2 tri3 tri4 tri5	I think that this website usually fulfils the commitments it assumes. I think that the information offered by this site is sincere and honest. I think I can have confidence in the promises that this website makes. This website does not make false statements. This website is characterized by the frankness and clarity of the services that it offers to the consumer.	Hong & Cho (2011); McKnight & Chervany (2002); Flavian et al. (2006)
Overall trust in the intermediary (single-item measure)	The general trusting belief in the vendor	tro	Overall, I trust the vendor and would buy from them.	Hong & Cho (2011)

Table 3. Characteristics of the sample (N=216)

Attribute	Category	Frequency	Percentage
Gender	Male	143	66.2
	Female	73	33.8
Age	Teens	1	0.5
	20's	213	98.6
	30's	2	0.9
Products of chief interest	Clothing/fashion	137	63.4
	Books/CDs/office products	31	14.4
	Computers/home appliances	23	10.6
	Others	25	11.6
Online shopping frequency	More than once a week	74	34.3
	More than once a month	94	43.5
	More than once every 3 months	32	14.8
	More than once a year	16	7.4

At the start of our main online survey, written instructions were given to the respondents to inform them that it was not the digital storefront, but the online marketplace, portion of Interpark.com that their answers to the questionnaire items should be based upon. Interpark.com, founded in 1997, is Korea's first Internet shopping mall selling a broad range of goods and services. We screened out respondents with buying experience on Interpark.com e-marketplace by inviting to the survey only those students who have never ordered online on that marketplace. Although Interpark.com originally started out as a digital storefront selling a wide range of products directly to consumers, they added an online marketplace component to their business only recently. Therefore, the online marketplace portion of Interpark.com is relatively new to many consumers in Korea, and was considered suitable in surveying the initial trust of consumers in Korea.

The reliability and validity of the survey instrument were tested using Cronbach's alpha and confirmatory factor analysis, respectively. In addition, the hypotheses were tested using the structured equation modelling (SEM) technique. The statistical analysis was performed using SPSS Win 15.0 and Amos 17.0. The characteristics of the sample are shown in Table 3.

Reliability and Validity of the Measurement Items

As shown in Table 4, an analysis of the reliability of the measuring instrument yielded Cronbach's alpha figures that exceeded 0.7 on all the constructs, meaning that the constructs were measured using test items with adequate internal consistency.

Meanwhile, the scale items of each measure were examined for unidimensionality, and purified using confirmatory factor analysis. Based on the scale reliability (Cronbach's α), SMC and goodness-of-fit indices, we purified scales. First, we deleted two items from reputation, one item from design, three items from interactivity, one item from competence, three items from benevolence, and two

Table 4. Validity and reliability of the measurement model

Measure	No. of Items (1)	Cronbach's α	No. of Items (2)	Items	Standardized Factor Loadings	SMC	AVE	Composite Reliability
Reputation	5	.801	3	rep2	0.754	0.569	0.768	0.882
				rep4	0.940	0.884		
				rep5	0.923	0.851		
Perceived size	4	.897	4	siz1	0.791	0.626	0.736	0.906
				siz2	0.882	0.778		
				siz3	0.874	0.764		
				siz4	0.881	0.777		
Design	3	.726	2	dgn2	0.779	0.607	0.646	0.709
				dgn3	0.828	0.686		
Interactivity	3	.752	3	iav1	0.871	0.759	0.760	0.837
				iav2	0.873	0.762		
Ease of use	5	.884	3	eou1	0.676	0.458	0.616	0.781
				eou2	0.721	0.520		
				eou3	0.933	0.871		
Trustworthiness – competence	4	.852	3	trc2	0.765	0.585	0.613	0.781
				trc3	0.824	0.678		
				trc4	0.758	0.574		
Trustworthiness – benevolence	5	.760	2	trb4	0.765	0.465	0.628	0.729
				trb5	0.900	0.811		
Trustworthiness – integrity	5	.919	3	tri3	0.880	0.775	0.813	0.906
				tri4	0.948	0.899		
				tri5	0.876	0.767		
Overall trust in the intermediary	1	.800	1	tro	0.893	-	0.797	0.701

NOTE: The numbers of items (1) and (2) refer to the number of items remaining before and after adjusting the measurement items, respectively.

items from integrity. The unidimensionality analysis was conducted with regard to convergent validity, discriminant validity, and nomological validity. Convergent validity refers to the degree to which two measures of constructs that theoretically should be related are, in fact, observed to be related to each other (Trochim, 2006). Convergent validity was examined by checking the factor loadings, squared multiple correlations (SMCs), average variance extracted (AVE), and composite reliability (CR) estimates. In general, the convergent validity is supported if factor loadings, SMC's, AVE's, and CR values are greater than 0.5, 0.5, 0.5, and 0.7 respectively (Nunnally & Bernstein, 1994). The related values in Table 4 satisfy these thresholds, and thus, it was determined that the convergent validity was acceptable. Next, discriminant validity (or divergent validity) tests whether constructs that should have no relationship do, in fact, not have any relationship. We verified discriminant validity by checking the minimum of AVE values for all scales against the squared values of the correlation coefficients. Fornell and Larcker (1981) suggest that in order to assure discriminant validity, the smallest AVE between a construct and its measures should be greater than the variance shared (i.e., the squared correlation) between that construct and other constructs. As can be seen in Table 4, the smallest AVE is 0.613 for trustworthiness-competence, and thus no correlation coefficient should exceed 0.783 (= square root of 0.613). Table 5 shows that the largest correlation coefficient is 0.679 that is the correlation between overall trust and trustworthiness-integrity and that it is smaller than 0.783. Therefore, the evidence of discriminant validity can be established for our constructs. Finally, nomological validity refers to the degree to which a construct behaves, as it should within a system of related constructs called a nomological set. A measure of a construct is regarded as having nomological validity if it correlates with those of other constructs in a theoretically predicted manner (Walford, Tucker, & Viswanathan, 2010). An examination of the between-measure correlation matrix shown in Table 5 indicates that correlation coefficients are mostly significant at the level of 0.01 except for the insignificant relationship between design and perceived size and that trustworthiness beliefs are significantly correlated both with their antecedents (i.e., reputation, perceived size, and design) and with their consequence (i.e., overall trust). Thus nomological validity is supported for the measurement model. In summary, the analysis revealed that convergent, discriminant, and nomological validity were established.

Finally, we assessed common method bias that may exist with all self-report data. To assess the severity of common method bias, Harman's single-factor test (Podsakoff & Organ, 1986) has been performed. For the Harman's single-factor test, all the variables data in our model were entered into an unrotated exploratory factor analysis. Results from this test showed that the most covariance explained by one factor was 37.29% that was well below the 50% threshold, meaning that common method biases are not a notable concern for this study (Podsakoff & Organ, 1986).

Table 5. Correlation matrix among research constructs

Measure	Reputation	Perceived Size	Design	Interactivity	Ease of Use	Trustworthiness – Competence	Trustworthiness – Benevolence	Trustworthiness – Integrity	Overall Trust in Intermediary
Reputation	1								
Perceived size	0.464***	1							
Design	0.363***	0.088	1						
Interactivity	0.382***	0.468***	0.446***	1					
Ease of use	0.302***	0.154**	0.432***	0.465***	1				
Trustworthi-ness – competence	0.474***	0.466***	0.281***	0.430***	0.381***	1			
Trustworthi-ness – benevolence	0.428***	0.229***	0.430***	0.358***	0.252***	0.510***	1		
Trustworthi-ness – integrity	0.494***	0.186***	0.391***	0.310***	0.322***	0.458***	0.600***	1	
Overall trust in intermediary	0.589***	0.309***	0.393***	0.389***	0.407***	0.495***	0.508***	0.679***	1
Mean	4.542	5.798	3.866	4.796	4.514	4.605	4.228	3.994	4.472
Std. Dev.	1.023	0.968	1.113	1.046	0.988	0.990	0.997	1.087	0.295

*p < 0.1 **p < 0.05 ***p < 0.01

Then we assessed the goodness of fit of the measurement model, and the result is shown in Table 6. GFI (goodness-of-fit-index) is slightly below the recommended threshold. However, the indices as a whole satisfy the respective thresholds, and thus, suggest that the measurement model was reasonably fitted to the analysed dataset.

Hypotheses Testing

The hypotheses were validated using a path analysis method based on the structured equation modelling technique by analysing the relationships between site characteristics and factors of trustworthiness and between factors of trustworthiness and overall trust in an intermediary.

The results of hypothesis testing are given in both Figure 3 and Table 7. It was revealed that 10 of the 18 hypotheses were accepted, while the remaining eight were rejected. First of all, as to the paths linking either intermediary or website characteristics to the factors of trustworthiness, a total of seven hypotheses were supported. The perceived reputation of the online marketplace was found to have a positive effect on all the factors of trustworthiness, i.e., competence (0.22**), benevolence (0.30**), and integrity (0.37**), providing support for H1-1, H2-1, and H3-1. Meanwhile, the perceived size of the e-marketplace had a significant effect on competence (0.36**) supporting H1-2, while its influence on benevolence or integrity turned out to be not significant providing no support for H2-2 and H3-2. The site design had no significant effect on competence, but a noticeable effect on both benevolence (0.45***) and integrity (0.34***), and thus both H2-3 and H3-3 were supported. Interactivity had no effect on the factors of trustworthiness, and

Table 6. Goodness of fit of the measurement model

Category	Measure	Acceptable Values	Value
Absolute fit indices	χ^2(Chi-square)		466.513
	d.f		203
	χ^2/d.f	1~3	2.298
	GFI	0.90 or above	0.895
	SRMR	0.080 or below	0.070
Incremental fit indices	IFI	0.90 or above	0.925
	TLI	0.90 or above	0.905
	CFI	0.90 or above	0.924
Other fit indices	RMSEA	0.050~0.080	0.077

Figure 3. Result of path analysis

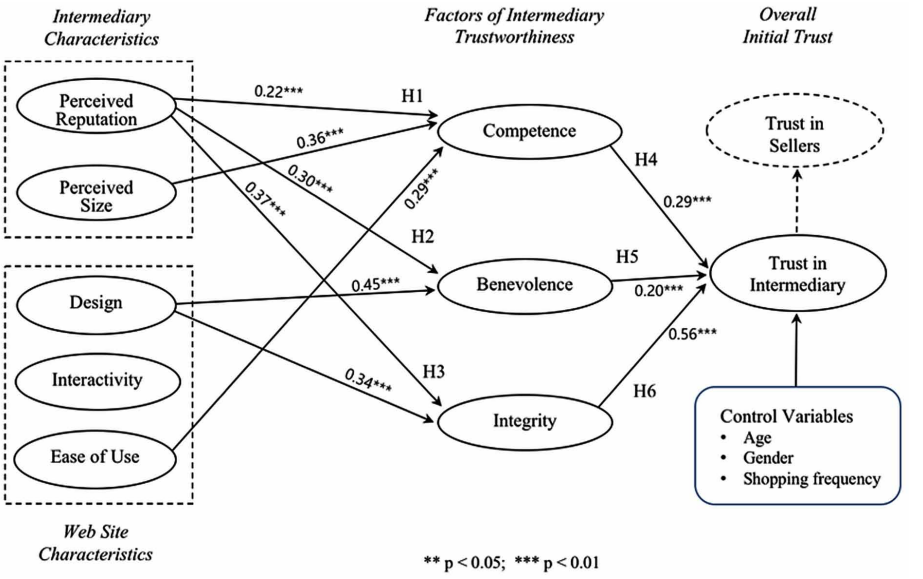


Table 7. Result of hypothesis testing

Hypothesis	Path	Path-Coefficient	Standard Error	Critical Ratio	Significance Level	Result
H1-1	REPUT → COMPET	0.217	0.077	2.610	0.01	Supported
H1-2	SIZE → COMPET	0.364	0.088	3.297	0.01	Supported
H1-3	DESGN → COMPET	0.145	0.094	-	-	Rejected
H1-4	INTVTY → COMPET	-0.035	0.106	-	-	Rejected
H1-5	EOU → COMPET	0.293	0.084	3.160	0.01	Supported
H2-1	REPUT → BENEV	0.300	0.072	3.297	0.01	Supported
H2-2	SIZE → BENEV	0.041	0.075	-	-	Rejected
H2-3	DESGN → BENEV	0.452	0.095	3.714	0.01	Supported
H2-4	INTVTY → BENEV	0.071	0.094	-	-	Rejected
H2-5	EOU → BENEV	-0.014	0.072	-	-	Rejected
H3-1	REPUT → INTEG	0.372	0.085	4.513	0.01	Supported
H3-2	SIZE → INTEG	-0.006	0.093	-	-	Rejected
H3-3	DESGN → INTEG	0.344	0.107	3.284	0.01	Supported
H3-4	INTVTY → INTEG	-0.105	0.116	-	-	Rejected
H3-5	EOU → INTEG	0.157	0.089	-	-	Rejected
H-4	COMPET → TRUST	0.287	0.085	4.102	0.01	Supported
H-5	BENEV → TRUST	0.197	0.102	2.765	0.01	Supported
H-6	INTEG → TRUST	0.562	0.074	8.323	0.01	Supported

none of H1-4, H2-4, and H3-4 was supported. Finally, ease of use was shown to affect competence only (0.290***) supporting H1-5. However, it was found that it had no effect on benevolence or interactivity giving no support for H2-5 or H3-5.

On the other hand, all the three paths representing the relationships between each factor of trustworthiness and overall initial trust in an intermediary proved significant. The path coefficients for the three paths respectively turned out to be 0.56*** (integrity), 0.29*** (competence), and 0.20*** (benevolence). An examination of correlation coefficients among the related variables in Table 5 also indicated that initial trust in an intermediary is more closely related to integrity (0.679) than to benevolence (0.508) or competence (0.495).

DISCUSSION

It was found that both intermediary and Web site characteristics influence attributes of trustworthiness. Of the two intermediary-related dimensions, reputation showed significant impact on all the trustworthiness factors, while perceived size had a significant effect only on competence. Reputation helps consumers avoid the uncertainty and risks that may exist with e-commerce firms who are relatively unknown or unheard of, thereby making a big name e-commerce firm (e.g, Amazon.com) trustworthier. Although numerous researchers have reported positive effects of reputation on overall trust in an e-commerce firm, no one has systematically investigated the relationship between reputation and factors of trustworthiness. On the other hand, the perceived size of an e-marketplace was found to affect competence, but not integrity nor benevolence. It implies that consumers often use the size as a measure of the extent to which a seller is capable of smoothly executing transactions.

The results showed that all the website-related dimensions but interactivity had positive effects on the trustworthiness beliefs. First, *site design* had no significant effect on competence, but a noticeable effect on both benevolence and integrity. This implies that the ability to impress website visitors visually and intuitively plays a key role in shaping their beliefs in the intermediary's benevolence and integrity. From the perspective of a consumer who buys online using website-supplied information only, a good design implies one that fosters efficient access to product-related information so that consumers will find it easier to make purchase decisions. For that reason, highly effective and professional design elements enable users to feel that the intermediary is doing its best to service the customers faithfully and to be an honest e-commerce firm. However, such desirable design elements are not regarded as a sign of superior competency for conducting business transactions, as reflected in the finding. A consumer is likely to feel that even an e-commerce firm with no expertise in business operations can easily have a great looking website

built through outsourcing, as long as it is willing to spend a good sum of money. Second, *interactivity* was found to have insignificant influence on all the three factors of trustworthiness, although numerous past studies have found that it significantly affects trust in digital storefronts. Our observation is that the culture seems to have played a crucial role in bringing about such a contradictory result. Related studies reported that Koreans exhibited greater collectivist, as opposed to individualist, values exhibiting greater affiliations to groups than Americans (Hofstede, 1980; Lewis & George, 2008). Given that under a collectivist culture individuals act predominantly as members of a lifelong and cohesive group or organization (Hofstede, 1980), it is presumed that Koreans are more apt to take as given a socially prevailing system like a popular online store and that their perceptions of the vendor trustworthiness are less likely to be affected by some challenges they face when interacting with the e-commerce website. Finally, *ease of use* was found to influence competence, but not benevolence nor integrity. This finding allows us to figure that an easy-to-use and consistent website gives consumers an impression that the online marketplace is competent in handling online transactions and therefore trustworthy. If users perceive the website to be easy to manoeuvre and its content to be clear and self-explanatory, then they are likely to use it as a signal that the intermediary has good experience in the online business and excels in the business infrastructure with rich resources. However, a usable website does not necessarily mean that the e-commerce firm sincerely cares about consumers or fulfils their promise to consumers.

An examination of the relationships between trustworthiness factors and trust in an intermediary suggests that integrity is the most important contributor to the overall trust in an intermediary, with competence being the next in importance. It can be inferred that e-marketplaces need to place top priority on strengthening consumer's belief in integrity by valuing honesty. This finding indicates that the extent to which the individual factors of trustworthiness influence the overall trust differs across factors. More specifically, the differences in the path coefficients among the trustworthiness factors are attributed to the very characteristics of an online marketplace. This means that an empirical analysis using websites of categories other than e-marketplaces is presumed to yield differing coefficients. For example, users of an Internet banking website are likely to place greater emphasis on competence than on the other factors, as their foremost priority will be to ensure that their bank will be competent in system security. These findings concerning the effects of trustworthiness dimensions on trust are in parallel with the theoretical perspective presented by the related literature. In their model of trust, Mayer et al. (1995, p. 720) maintain that "trust for a trustee is a function of the trustee's perceived ability, benevolence, and integrity," implying that the three beliefs of trustworthiness all contribute to the overall trust. As stated earlier, these trustworthiness attributes are conducive to the building of trust. Therefore, it is not

surprising that all the three dimensions were found to be significantly related to overall trust in this study. Nevertheless, findings from some recent empirical studies indicate that the three attributes of trustworthiness do not always have significant relationships with trust. For example, Gefen's (2002) study involving an online book purchase setting found that belief in integrity and benevolence were significantly related to overall trust, whereas belief in competence was not. As Mayer and Davis (1999) state, "depending on the circumstances, only some of these three specific trustworthiness-beliefs increase trust."

IMPLICATIONS AND LIMITATIONS

Online marketplaces are growing at an unprecedented rate and thus becoming increasingly important in electronic commerce today. However, consumers' reluctance to trust e-marketplaces remains a chief barrier to the continued growth of e-marketplaces. Practicing mangers in e-marketplaces need to comprehend potential antecedents of trust in the intermediary, in order to successfully remove such barriers. This research represents one step towards understanding the relationship between the attributes of trustworthiness and website's as well as intermediary's characteristics that affect these attributes in online marketplaces. In addition, we have sought to study the effect that trustworthiness attributes have upon the overall trust in an intermediary.

The results of the present research point to a set of implications for managers and practitioners who are – or will be – involved in a B2C e-marketplace business. First, the extent to which the factors of trustworthiness influence the overall trust is shown to differ across factors. Integrity proved to have the most influence, with competence coming next and benevolence having the least influence. This order is attributed to the fact that online shoppers are most interested in ensuring that they are buying from an honest e-commerce firm who fulfils their stated promises with their customers. In so doing, they will be better off by checking, and revising if necessary, the transaction-related rules and online policies to make sure that the statements that are publicly released on their website will be realistic enough to be in accordance with their day-to-day practices. Second, the following positive effects of variables on each factor of trustworthiness were uncovered: integrity is affected by reputation, competence by perceived size, and benevolence by site design. Therefore, firms needing a boost in consumers' belief in integrity should focus on building reputations via a range of online marketing campaigns; firms needing an enhancement in consumers' belief in their competence should try to improve their perceived size by partnering with larger online players (e.g., banner exchanges); and firms needing betterment in customers' belief in their benevolence

should endeavour to address the issue by remodelling the website or modifying the website's user interface such that the newly designed website gives an impression that the e-commerce firm is now more caring and more responsive to customers' concerns or inquiries.

The present results also offer theoretical implications for academics. It was proved that trustworthiness in a B2C e-marketplace is a multi-dimensional construct that can be measured through a combination of variables, including competence, benevolence, and integrity. In particular, it was found that the extent to which these factors influence the overall trust in the intermediary differs across factors. This suggests that the relative weightings of the individual factors may vary with the type of electronic-commerce website (e.g., digital storefront, e-marketplace, Internet banking, etc.). For this reason, future research will need to address such an empirical issue, viz., how the type of electronic-commerce website affects the relative importance of each trustworthiness factor. Such research will help firms to develop a strategy to build consumer trust by better meeting consumers' online needs for a specific category of electronic-commerce website.

The present research bears some limitations. First, the research model suffers from failing to incorporate a comprehensive list of factors found by prior studies to potentially influence the trustworthiness of an intermediary. For example, not included in the model are consumer characteristics, such as disposition to trust, attitude toward online shopping, past purchase behaviour, and personal values. These factors may potentially influence the process by which initial trust in an online marketplace is formed. Second, this study made use of student respondents in the data collection process. College students may not quite represent the consumer population for online marketplaces.

REFERENCES

Bakos, J. (1997). Reducing buyer search costs: Implications for electronic marketplace. *Management Science*, *43*(12), 1–27. doi:10.1287/mnsc.43.12.1676

Barney, J. B., & Hansen, M. H. (1994). Trustworthiness as a Source of Competitive Advantage. *Strategic Management Journal*, *15*(S1), 175–190. doi:10.1002mj.4250150912

Bauer, C., & Scharl, A. (2000). Quantitative Evaluation of Web Site Content and Structure. *Internet Research: Electronic Networking Applications and Policy*, *10*(1), 31–43. doi:10.1108/10662240010312138

Brown, J., Broderick, A. J., & Lee, N. (2007). Word of mouth communication within online communities. *Journal of Interactive Marketing*, *21*(3), 2–20. doi:10.1002/dir.20082

ICC Center (IC3). (2018). *2018 Internet Crime Report*. Retrieved from https://www.ic3.gov/media/annualreport/2018_IC3Report.pdf

Chen, Q., Griffith, D. A., & Shen, F. (2005). The Effects of Interactivity on Cross-Channel Communication Effectiveness. *Journal of Interactive Advertising*, *5*(2), 19–28. doi:10.1080/15252019.2005.10722098

Chen, S. C., & Dhillon, G. S. (2003). Interpreting Dimensions of Consumer Trust in E-Commerce. *Information Technology Management*, *4*(2/3), 303–318. doi:10.1023/A:1022962631249

Corbitt, B. J., Thanasankit, T., & Yi, H. (2003). Trust and E-Commerce: A Study of Consumer Perception. *Electronic Commerce Research and Applications*, *2*(3), 203–215. doi:10.1016/S1567-4223(03)00024-3

Corritore, C. L., Kracher, B., & Wiedenbeck, S. (2003). On-line trust: Concepts, evolving themes, a model. *International Journal of Human-Computer Studies*, *58*(6), 737–758. doi:10.1016/S1071-5819(03)00041-7

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(8), 982–1003. doi:10.1287/mnsc.35.8.982

Dellarocas, C. (2003). The digitization of word of mouth: Promise and challenges of online feedback mechanisms. *Management Science*, *49*(10), 1407–1424. doi:10.1287/mnsc.49.10.1407.17308

Donney, P. M., & Cannon, J. P. (1997). An Examination of the Nature of Trust in Buyer-Seller Relationships. *Journal of Marketing*, *61*, 35–51.

Einwiller, S., & Will, M. (2001). The role of reputation to engender trust in electronic markets. *Proceedings of the Fifth International Conference on Corporate Reputation, Identity, and Competitiveness*.

Etzioni, A. (2019). Cyber Trust. *Journal of Business Ethics*, *156*(1), 1–13. doi:10.100710551-017-3627-y

Everard, A., & Galletta, D. F. (2005). How presentation flaws affect perceived site quality, trust, and intention to purchase from an online store. *Journal of Management Information Systems*, *22*(3), 56–95. doi:10.2753/MIS0742-1222220303

Flavian, C., Guinaliu, M., & Gurrea, R. (2006). The role played by perceived usability, satisfaction and consumer trust on website loyalty. *Information & Management*, *43*(1), 1–14. doi:10.1016/j.im.2005.01.002

Fombrum, C., & Riel, C. V. (1997). The reputational landscape. *Corporate Reputation Review*, *1*(1), 5–14. doi:10.1057/palgrave.crr.1540008

Fornell, C. R., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *JMR, Journal of Marketing Research*, *18*(1), 39–50. doi:10.1177/002224378101800104

Ganesan, S. (1994). Determinants of long-term orientation in buyer-seller relationship. *Journal of Marketing*, *58*(2), 1–19. doi:10.1177/002224299405800201

Gefen, D. (2002). Reflections on the Dimensions of Trust and Trustworthiness among Online Consumers. *ACM SIGMIS Database*, *33*(3), 38–53. doi:10.1145/569905.569910

Gefen, D., Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: An integrated model. *Management Information Systems Quarterly*, *27*(1), 51–90. doi:10.2307/30036519

Good, D. (1988). Individual, interpersonal relations and trust. In D. G. Gambetta (Ed.), *Trust* (pp. 131–185). New York: Blackwell.

Guo, G., Zhang, J., Thalmann, D., & Yorke-Smith, N. (2014). *ETAF: An extended trust antecedents framework for trust prediction.* Paper presented at the 2014 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2014), Beijing, China. 10.1109/ASONAM.2014.6921639

Hampton-Sosa, W., & Koufaris, M. (2005). The Effect of Website Perceptions on Initial Trust in the Owner Company. *International Journal of Electronic Commerce*, *10*(1), 55–81. doi:10.1080/10864415.2005.11043965

Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-related Values*. Beverly Hills, CA: Sage Publications.

Hong, I. B. (2015). Understanding the consumer's online merchant selection process: The roles of product involvement, perceived risk, and trust expectation. *International Journal of Information Management*, *35*(3), 322–336. doi:10.1016/j.ijinfomgt.2015.01.003

Hong, I. B. (2018). Building Initial Trust in an Intermediary in B2C Online Marketplaces: The Korean Evidence from Interpark.com. *Journal of Global Information Management*, *26*(2), 27–47. doi:10.4018/JGIM.2018040102

Hong, I. B. (2019). Understanding and Predicting Behavioral Intention to Adopt Mobile Banking: The Korean Experience. *Journal of Global Information Management*, *27*(3), 182–202. doi:10.4018/JGIM.2019070110

Hong, I. B., & Cho, H. (2011). The impact of consumer trust on attitudinal loyalty and purchase intentions in B2C e-marketplaces: Intermediary trust vs. seller trust. *International Journal of Information Management*, *31*(5), 469–479. doi:10.1016/j.ijinfomgt.2011.02.001

Jarvenpaa, S. L., Tractinsky, N., & Vitale, M. (2000). Consumer trust in an Internet store. *Information Technology Management*, *1*(1), 45–71. doi:10.1023/A:1019104520776

Karake-Shalhoub, Z., & Westport, C. T. (2002). *Trust and Loyalty in Electronic Commerce: An Agency Theory Perspective*. Quorum Books.

Kim, D. J., Ferrin, D. L., & Rao, H. R. (2008). A trust-based consumer decision-making model in electronic commerce: The role of trust, perceived risk, and their antecedents. *Decision Support Systems*, *44*(2), 544–564. doi:10.1016/j.dss.2007.07.001

Kim, M. S., & Ahn, J. H. (2007). Management of trust in the e-marketplace: The role of the buyer's experience in building trust. *Journal of Information Technology*, *22*(2), 119–132. doi:10.1057/palgrave.jit.2000095

Koufaris, M., & Hampton-Sosa, W. (2004). The development of initial trust in an online company by new customers. *Information & Management*, *41*(3), 377–397. doi:10.1016/j.im.2003.08.004

Lewis, C. C., & George, J. F. (2008). Cross-cultural deception in social networking sites and face-to-face communication. *Computers in Human Behavior*, *24*(6), 2945–2964. doi:10.1016/j.chb.2008.05.002

Liao, C., Chen, J. L., & Yen, D. C. (2007). Theory of planned behavior(TPB) and customer satisfaction in the continued use of e-service: An integrated model. *Computers in Human Behavior*, *23*(6), 2804–2822. doi:10.1016/j.chb.2006.05.006

Lu, B., Zhang, T., Wang, L., & Keller, L. R. (2016). Trust antecedents, trust and online microsourcing adoption: An empirical study from the resource perspective. *Decision Support Systems*, *85*, 104–114. doi:10.1016/j.dss.2016.03.004

Mayer, R. C., & Davis, J. H. (1999). The effect of the performance appraisal system on trust for management: A field quasi-experiment. *The Journal of Applied Psychology*, *84*(1), 123–136. doi:10.1037/0021-9010.84.1.123

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of Management Review*, *20*(3), 709–734. doi:10.5465/amr.1995.9508080335

McKnight, D. H., & Chervany, N. L. (2002). What Trust Means in E-Commerce Customer Relationships: An Interdisciplinary Conceptual Typology. *International Journal of Electronic Commerce*, *6*(2), 35–59. doi:10.1080/10864415.2001.11044235

McKnight, D. H., Choudhur, V., & Kacmar, C. (2002). Developing and validating trust measures for e-commerce: An Integrative Typology. *Information Systems Research*, *13*(3), 334–359. doi:10.1287/isre.13.3.334.81

McKnight, D. H., Choudhury, V., & Kacmar, C. (2002). The impact of initial consumer trust on intentions to transact with a Web site: A trust building model. *The Journal of Strategic Information Systems*, *11*(3-4), 297–323. doi:10.1016/S0963-8687(02)00020-3

McKnight, D. H., Cummings, L. L., & Chervany, N. L. (1998). Initial trust formation in new organizational relationships. *Academy of Management Review, 23*(3), 473-490.

Merrilees, B., & Fry, M. (2003). E-trust: the influence of perceived interactivity on e-retailing users. *Marketing Intelligence & Planning, 21*(2), 123-128.

Mishra, A. K. (1996). Organizational responses to crisis: The centrality of trust. In R. M. K. T. R. Tyler (Ed.), *Trust in Organizations: Frontiers of Theory and Research* (pp. 261–287). Thousand Oaks, CA: Sage. doi:10.4135/9781452243610.n13

Nielsen, J. (1999). *Trust or Bust: Communicating Trustworthiness in Web Design*. Academic Press.

Nunnally, J. C., & Bernstein, I. (1994). *Psychometric Theory* (3rd ed.). New York: McGraw-Hill.

Ou, C. X., Pavlou, P. A., & Davison, R. M. (2014). Swift Guanxi in online marketplaces: The role of computer-mediated communication technologies. *Management Information Systems Quarterly*, *38*(1), 209–230. doi:10.25300/MISQ/2014/38.1.10

Palvia, P. (2009). The role of trust in e-commerce relational exchange: A unified model. *Information and Management, 46*(4), 213-220.

Pavlou, P. A., & Gefen, D. (2004). Building Effective Online Marketplaces with Institution-Based Trust. *Information Systems Research*, *15*(1), 37–59. doi:10.1287/isre.1040.0015

Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management*, *12*(4), 531–544. doi:10.1177/014920638601200408

Ring, P. S., & Van de Ven, A. H. (1994). Developing processes of cooperative inter-organizational relationships. *Academy of Management Review*, *19*(1), 90–118. doi:10.5465/amr.1994.9410122009

Trochim, W. M. K. (2006). *Convergent and Discriminant Validity for Social Research Methods*. Retrieved from http://www.socialresearchmethods.net

Walford, G., Tucker, E., & Viswanathan, M. (2010). *The SAGE Handbook of Measurement*. London: SAGE Publications Ltd.

Wang, S. W., Ngamsiriudom, W., & Hsieh, C.-H. (2015). Trust disposition, trust antecedents, trust, and behavioral intention. *Service Industries Journal*, *35*(10), 555–572. doi:10.1080/02642069.2015.1047827

Wu, G., Hu, X., & Wu, Y. (2010). Effects of Perceived Interactivity, Perceived Web Assurance and Disposition to Trust on Initial Online Trust. *Journal of Computer-Mediated Communication*, *16*(1), 1–26. doi:10.1111/j.1083-6101.2010.01528.x

Zazelenchuk, T. W., & Boling, E. (2003). Considering User Satisfaction in Designing Web-based Portals. *EDUCAUSE Quarterly*, *1*, 35–40.

Chapter 7
Communicating Corporate Social Responsibility in Healthcare Through Digital and Traditional Tools:
A Two-Country Analysis

Gianpaolo Tomaselli
University of Malta, Malta

Lalit Garg
https://orcid.org/0000-0002-3868-0481
University of Malta, Malta

Vipul Gupta
Thapar University, India

Peter A. Xuereb
University of Malta, Malta

Sandra C. Buttigieg
https://orcid.org/0000-0002-0572-2462
University of Malta, Malta

Paula Vassallo
University of Malta, Malta

DOI: 10.4018/978-1-7998-1786-4.ch007

ABSTRACT

Health systems are currently facing a series of challenges dealing with continuous technology advances and social demands, which require changes at managerial and policy level that fully incorporate social responsibilities within healthcare organizations' strategy. Thus, communicating corporate social responsibility (CSR) takes an important role in today's health contexts worldwide. This work aims to investigate CSR communication in healthcare through the use of both traditional and interactive technologies by adopting a mixed qualitative-quantitative research approach. To this extent, a comparative research was conducted in two different countries with different health systems and contexts, namely Malta and India. Findings show that healthcare organisations of both countries are increasing their awareness towards their social responsibilities and the different ways of communicating their CSR activities. A mixed strategy—including both digital (interactive technologies) and traditional tools—was identified as the most effective way of communicating CSR in a healthcare context.

INTRODUCTION

The rising interest on the social and environmental side of corporations has recently shifted attention towards the communication of Corporate Social Responsibility (CSR) and, has increasingly focused on the tools adopted to communicate these activities to stakeholders (Chaudhri & Wang, 2007).

CSR is a complex subject and is the result of long-existing concepts, consisting of numerous and contrasting theories, as well as individual interpretations (Collins, 2010). However, it is possible to summarize CSR as responsibilities of enterprises that go beyond the mere economic aspect of maximizing profits. These responsibilities should be directed towards society, environment and different stakeholders (Carroll, 1999; Davis, 1992; Hart, 1997; Shamir, 2005).

Healthcare organizations' interest towards CSR is relatively recent (Russo, 2016). The health care sector has not received systematic attention to CSR, despite its critical importance worldwide (Collins, 2010; Tomaselli et al., 2018). Indeed, there is scant literature in the field of CSR communication in health care, and scarce literature that deals with the use of interactive technologies for CSR communication in the health care context. Even though CSR should interest organizations across all sectors, CSR is crucial to the health care sector, which is facing challenges, namely rapid technological advances as well as financial, economic and sustainability pressures. Over the last few years, health care organizations have been under severe public scrutiny and this pressure has led to an increase in consciousness and conscientiousness

of CSR-related issues (Collins, 2010). Moreover, they are required to provide high clinical quality, a high level of functional quality and cost-effective patient care with the limited resources that they are allocated (Fottler & Blair, 2002). To achieve this level of awareness, the health care sector is paying increasing attention to the different methods of CSR communication and, particularly, on the use of technologies to communicate on their CSR activities. In this regard, the interactive technologies are being popularly used in the health care sector for communicating CSR activities. Today health care organizations have different choices and tools to communicate their CSR activities. The use of traditional means of CSR communication (social, sustainability and integrated reports, codes of ethics, certification standards, etc.) is often complemented by the implementation of interactive communication technologies (internet, web sites, social media, social networks, mobile apps, etc.), which have been gaining ground year after year. The importance of communicating CSR lies in the fact that it may influence leaders and public opinions, as well as their behavior (Tomaselli & Melia, 2014). According to Watts and Holme (1999), public opinion does not trust organizations whose efforts are not directed in observing CSR-related issues. Moreover, public opinion has an important role in regulating healthcare organizations behaviors (Esrock & Leichty 1998). Thus, CSR communication has a key role in influencing stakeholders' relations (Arvidsson, 2009) and helps organizations to increase their image, reputation and credibility (Dawkins, 2004; Hooghiemstra, 2000; Chaudhri & Wang, 2007).

In this context, the research presented in this chapter aims to: i) analyse CSR communication in the healthcare context; ii) investigate the use of both traditional and interactive technologies for healthcare CSR communication (as well as differences and similarities); and iii) compare CSR communication between two countries with extremely different contexts, Malta and India. We adopted quantitative methodology in order to understand the different perception and applications of CSR commutation between the two contexts analysed. By doing do, this work may provide a contribution to the development of novel theories and applications of global information resource management.

The work is structured as follows: First, the authors discuss the peculiarities of the Maltese and Indian healthcare systems and CSR application in both countries. Then they review literature dealing with healthcare CSR communication and the tools (both traditional and interactive technologies) used by healthcare organizations to communicate their CSR activities. The following sections outline the study design and discussion of results. Researchers conclude the chapter by discussing the implications, main limitations and further research directions.

THEORETICAL BACKGROUND

Application of CSR in the Healthcare Context

CSR is a topic of significant importance for the healthcare sector, although few studies have been done on the application of CSR in the healthcare context. On June 2019, the authors conducted a keyword search on Scopus (using the keywords combination "corporate social responsibility" OR csr AND healthcare) which yielded a total of only 78 peer-reviewed journal articles (in English language) published from 2001 onwards in this field. Despite that, Lee (2005) sustained that the healthcare sector is a leader in the field of CSR. The author identified some of the reasons in the close relationship that exists between healthcare systems and their multiple stakeholders in society, the government, and the private sector. The healthcare sector's way of making profits is closely connected to people's lives, since it affects people's health problems and not just business entities (Lee, 2005). According to Kakabadse and Rozuel's (2006) study on the application of CSR in healthcare, which analyzes the case of a local public hospital in France, CSR in healthcare is strictly related to the notion of dialogue with stakeholders (Weiss, 2003), thus, developing CSR in healthcare (especially for medical care) means, substantially, building a dialogue between the healthcare structures, the patients, and their families, as well as listening to their needs. However, developing CSR in this sector does not involve medical care only, since it also involves dialogue between managers, clinicians, and support staff, as well as listening to employees' and staff's needs. The application of CSR in healthcare also requires the establishment of good dialogue between the healthcare structures, the communities and different kinds of stakeholders (internal, external, and interface) with which they are associated (Tomaselli et al, 2015, 2018).

Applying CSR in the healthcare context is about providing extended care, and meeting the needs of patients, staff, the community and stakeholders (Kakabadse & Rozuel, 2006). The issue of dialogue and communication in healthcare as a part of CSR has also been sustained and developed by authors such as Szwajkowski (2000), Minkes, Small and Chatterjee (1999). Their contributions emphasized the importance of dialogue and communication in this sector and the key role that top management plays in dealing with CSR issues.

Furthermore, building on Boatright (2003), applying CSR in healthcare is not merely focusing on the quality of health services, competitive prices, and advanced technologies, but it also implies being respected by stakeholders (including customers, professionals, and society) (Boatright, 2003; Brandao et al., 2012).

Thus, CSR is fundamental for the healthcare sector, considering the different new challenges and pressures that health systems are currently facing (Fottler & Blair, 2002; Tomaselli et al. 2015, 2018).

All these reasons have contributed to making CSR widely accepted and incorporated into the healthcare sector (Morrison, 2006). According to Lee (2005), the perception of CSR in the healthcare context is stronger when compared to other sectors of industry. Although CSR may not have direct benefits on organizations' growth, customers tend to be more judgmental towards healthcare organizations when they are engaged in CSR-related issues (Lee, 2005).

CSR Application in Malta and India

The study presented in this chapter analyzes and compares CSR communication in the Maltese and Indian healthcare sector. Two different countries with extremely different contexts related to their population, size, Gross Domestic Product (GDP), healthcare systems, healthcare industry and CSR application.

Malta is a small state located in the Mediterranean Sea and is an archipelago composed by three main islands: Malta, Gozo and Comino. It is an EU member since 2004 and is the most densely populated country with the lowest total population compared to other EU member states (Europa.eu, 2016). Malta population (2019) is estimated to be 422.00 people and its density is 1,562,0 people per square kilometer on a total area of 320 Km^2. Total life expectancy (both sexes) at birth is 81.80 years and 94.15% of adult population (aged 15 years and above) in Malta are able to read and write in both national languages (Maltese and English). Malta GDP is 30,074.7USD (World Bank, 2018) while its unemployment rate in 2019 is 3.5% (EUROSTAT, 2019).

Maltese healthcare system has universal coverage and is free at the point of use. It is primarily financed through taxation. Maltese citizens are not obliged to have health insurance; however, all workers are required to pay National Insurance contributions on a weekly basis. All residents have access to the Maltese National Health system and migrants resident in Malta are covered by the Maltese social security system (Grech et al, 2014). The National Health Service (NHS) allows some free medicines and access to certain medical devices for individuals with low incomes. The Maltese NHS is inspired by the British one and provides comprehensive health packages to citizens (Buttigieg, Schuetz and Bezzina, 2016). The private healthcare sector is small compared to the public sector (Tomaselli et al, 2015). In 2014, the total health expenditure as a percentage of GDP in Malta was 9.7% (World Bank, 2016).

In contrary, India is a large country located in Southern Asia and is the seventh large country by area and the second in the world by population (to 17.74% of the total world population). India population (2019) is estimated to be 1,369,218,923 people and its density is 460 people per Km^2. Total life expectancy (both sexes) at

birth for India is 68.56 years and 74% of adult population (aged 15 years and above) in India are able to read and write. India GDP is 2,015.6USD (World Bank, 2018) and unemployment rate in 2019 is 6,1%.

Healthcare in India represents one of the largest economic sectors in terms of both revenues and employment rate (Ibef.org, 2016). Indian healthcare sector includes both public and private hospitals as well as specialized hospitals. While private hospitals usually offer adequate standards of care, the situation is different for public hospitals, which usually provide only basic care and present infrastructures gaps. Regarding health insurance, it covers manly cost for hospitalization and emergency issues (Tomaselli et al, 2015, 2018). Indian healthcare industry is also cost competitive compared to its peers in Asia and Western countries. The overall Indian healthcare market has and amount of around 10 billion USD and is estimated to reach 280 billion USD by 2020 (Ibef.org, 2016). Thus, healthcare spending (as a percentage GDP) is strongly rising in India.

CSR needs to be understood within the contexts analyzed, in order to track differences in both CSR perception and application between different countries. Malta and India have several differences in terms of CSR. These differences are due to extremely different contexts, historical backgrounds, cultures, laws, economies, markets and healthcare systems. However, these topics have not been compressively treated in literature with regard to these two specific countries. Results of keyword search mentioned in the previous sub-heading showed that 7 articles treated the topic of CSR in healthcare in India and only 1 in the Maltese context. Thus, in this section authors do not provide an exhaustive survey of CSR application and communication in both countries, but they attempt to highlight main issues that help readers to better understand results of this paper.

Table 1 shows some key differences between Malta and India in terms of CSR application in general, business and healthcare contexts according to the little literature available and policy documents.

As table 1 show, CSR application in Malta is strictly influenced by EU laws and statements and is commonly agreed as related to business ethics; while in India CSR has different historical roots and today has mainly a business/marketing importance. These aspects are fundamental to better understand results and implications of our research.

Healthcare CSR Communication

According to Verk, Golob and Podnar (2019), there has been a growing interest towards the topic of CSR communication in the academic literature of recent years; however, these studies have mainly focused on the business and industry context and just a few investigated the topic of CSR communication in the healthcare

Table 1. CSR application in Malta and India

Malta	India
CSR application in Malta reflects EU standards. European Commission (2011) defined CSR as *"The responsibility of enterprises for their impacts on society*".	Business in Asia and in India is part of a social philosophy embedded in corporate philanthropy (Mohan, 2001). Thus, CSR has own historical roots in India.
Most CSR initiatives are focused on Large companies and multinational corporations (Harwood, 2006).	The importance of CSR is largely agreed by Indian companies, although its application is still in confusion state (Arora & Puranik, 2004).
Maltese enterprises are annually communicating and reporting about CSR through reports (Mifsud, 2009).	CSR communication and annual reporting is increasing in India (Chaudhri & Wang, 2007)
High-importance of CSR. Its application is mainly related to ethical issues (Tomaselli et al, 2015, 2018).	Medium-high importance of CSR. Its application is mainly related to business and marketing issues (Tomaselli et al., 2015, 2018).

sector (Tomaselli et al., 2015; 2018). Today's healthcare organizations, being aware of the importance of CSR (Collins, 2010), are paying particular attention to the communication of their CSR activities. CSR should made visible and accessible to their different stakeholders, both internal and external (Arvidsson, 2009). Moreover, CSR communication is of key importance for organizations since it helps increasing in transparency, business ethics and value creation (Dawkins, 2004; Hooghiemstra, 2000; Chaudhri & Wang, 2007; Etter, 2013), and represents a "key issue of concern" for all organizations (Capriotti & Moreno, 2007).

Healthcare organizations have different options to communicate their CSR activities. It is possible to identify two main categories of CSR communication tools: i) traditional technologies; and ii) interactive technologies.

Traditional Technologies

Among the category of traditional technologies for healthcare CSR communication, reporting tools, codes of ethics and standards for certification are the main tools.

Reporting tools include social, sustainability and integrated reports. They allow healthcare organizations to report to different stakeholders about their CSR and sustainability activities. These tools supplement the consolidated financial reports with CSR and sustainability reporting (GRI, 2014).

The code of ethics is the document which contains rights and moral duties that identify the ethical and social responsibilities of organizations. It is the main tool that allows the implementation of ethics within organizations and prevents illegal and irresponsible behaviors by their members (Pritchard, 1998; Valentine & Barnett, 2003; Serra, 1997; Sacconi, 2002).

Standards of certification for CSR communication allow healthcare organizations to convert CSR into their routine practices (Beck & Walgenbach, 2005; Walgenbach, 2001). Main standards for CSR communication are: ISO 9000/9001, 26000, 14001, AA 1000, SA 8000.

Traditional technologies include also tools such as TV, radio, billboards, print, booklets, flyers, brochures, events (Tomaselli et al., 2016).

Table 2 summarizes traditional technologies for healthcare CSR communication and related literature (Table 2).

Interactive Technologies

Among the category of interactive technologies, eHealth, mHealth/apps, web sites, and Social Network Sites (SNS) are the main tools.

Electronic Healthcare (eHealth) identifies healthcare practices that are supported by electronic processes and communication (Della Mea, 2001). It provides several logistical advantages to health care organizations including: efficiency, enhancing quality of care, empowerment of customers and patients, enabling information exchange and communication in a standardized way between healthcare establishments, ease-of-use, CSR communication, dialogue and interaction between patients and health professionals, and equity (Eysenbach, 2001).

Mobile apps have also made their appearance in the healthcare sector. Building on Kjeldsko and Paay (2012), Smartphones have revolutionized the way people think and function, and their use has led to a new era in the way humans interact in their respective environments (Scerri et al., 2015). Thus, it is imperative for healthcare organizations to interact effectively with mobile phone owners. To this

Table 2. Traditional technologies

Tool	Features	References
Reporting tools	Social report Sustainability report Integrated report	GRI (2014)
Code of ethics	Rights, moral duties, business ethics and CSR to prevent illegal irresponsible behaviors	Pritchard (1998) Valentine & Barnett (2003) Serra (1997) Sacconi (2002)
Standards of certification	ISO 9000/9001 ISO 26000 ISO 14001 AA 1000 SA 8000	Beck & Walgenbach (2005) Walgenbach (2001)
Other	TV, radio, billboards, print, booklets, flyers, brochures, events	Tomaselli et al. (2016)

regard, Mobile Healthcare (mHealth) refers to the use of mobile devices in support of medicine and public health. It deals with applications (apps) for mobile phones. Its features include: time-reducing (since it is easier to use and allows stakeholders to be reached in a faster way); user-friendly (since it is a rapid, learning health system); data-sharing feasibility (since it provides the platform for patients to collect and share relevant data at any time, not just when they visit a clinic); and treatment plan integration (since it allows more rapid convergence to optimal treatments) (Estrin & Sim, 2010; Stone et al., 2007).

The corporate web site is today's main tool used by organizations for CSR communication (Tomaselli & Melia, 2014). Web site features include: easy access, low costs, wider coverage, timeless benefits (information can be updated fast and easily), connection between businesses, consumers and society (Wheeler & Elkington, 2001; Adam & Frost, 2004; Bolivar, 2009; Darus et al., 2013).

Health organizations are also implementing the use of SNS in their CSR communication practices. SNS refers to a number of different interactive technologies and applications that include social media, social networks, social software and web 2.0. They enable the connection between the participants, although the individual motif and the specific subject may differ (Schaar, Calero Valdez & Ziefle, 2012). Interactive technologies also include the use of other social media, namely videos, blogs and chat (Tomaselli & Melia, 2014).

Table 3 summarizes interactive technologies for healthcare CSR communication and related literature (Table 3).

Traditional vs. Interactive Technologies

Today ICT, web 2.0 and social media are the main channels for CSR communication (Harmoni 2012; Tomaselli & Melia, 2014). However, these technologies have not totally replaced traditional tools. In contrary, organizations tend to use both traditional and interactive technologies to communicate their CSR activities, adopting a "communication-mix strategy" in which both tools are used in a complementary and integrated way (Tomaselli et al, 2016). Thus, the importance of traditional communication is still largely recognized by organizations,

Interactive technologies are not only used for information and dissemination. They allow to better reach and maintain stakeholder relations, and help managing patients (Eysenbach, 2001; Schaar, Calero Valdez & Ziefle, 2012; Estrin & Sim, 2010; Stone et al., 2007). These technologies enable to bridge the gaps of traditional tools, which provide only information to stakeholders but do not allow to dialogue and interact with them.

Table 3. Interactive technologies

Tool	Features	References
eHealth	Efficiency Quality of care Patients management Information exchange Communication Ease-of-use Dialogue/interaction Equity	Della Mea (2001) Eysenbach (2001)
mHealth & Mobile apps	Time-reducing User-friendly Data-sharing feasibility Treatment integration	Estrin & Sim (2010) Stone et al. (2007) Kjeldsko and Paay (2012) Scerri et al. (2015)
Corporate web site	Easy access Low costs Wider coverage Timeless benefits Businesses-consumers-society connection	Wheeler & Elkington (2001) Adam & Frost (2004) Bolivar (2009) Darus et al. (2013)
SNS & Social Media	Participants connection Dialogue/interaction Time-reducing	Schaar, Calero Valdez & Ziefle (2012)
Other	Videos, Blogs and Chat	Tomaselli & Melia (2014)

Interactive technologies imply additional investments and costs for organizations who want to implement these tools for their CSR communication strategies. These requirements are in terms of infrastructures (computing equipment, software, databases, rooms, etc.) and news skills and competence for employees (IT skills, marketing trends updating, etc.) (Detmer, 2003; Bose, 2003; Rolim et al., 2010).

SETTING

This study analyzes best practices within the Maltese and Indian health care sectors that are using both traditional and interactive technologies to communicate their CSR activities. Within the sample of organizations investigated, key managers were identified and contacted in order to better understand the importance of CSR communication in healthcare and the use of interactive technologies.

In order to compare CSR communication between Malta and India, the authors approached with cluster analysis (Ketchen & Shook, 1996). Cluster analysis is a suitable methodology to group data and information from different contexts and extrapolates features and their relationships. The intention was to observe and analyze how CSR communication is perceived and implemented in extremely different countries and healthcare contexts. To this regard, researchers chose Malta

as representative for small size European countries and for the peculiarities of its healthcare context (Buttigieg, Schuetz and Bezzina, 2016). On the other hand, India is a relevant example of a large country with different features concerning the healthcare sector (Tomaselli et al, 2015).

Research Approach

A literature review was first carried out in order to understand the state of the art on the topic of CSR communication in health care. The theoretical framework was then developed. Quantitative methods were used. A total of 72 participants expressed interest in participating in the questionnaire.

Data Collection

Primary data were first collected through questionnaire surveys administered to managers of the organizations analyzed in this research. Questionnaires allowed participants to freely express their views on healthcare CSR communication and the tools used (both traditional and interactive technologies) for this regard. Online questionnaires were sent (via URL) using snail mails to collect data. Emails were sent to all the participants, who agreed to take part in the study. Researchers ensured that all responses to the questionnaire were fully voluntary and anonymous, since questionnaires via URL allow respondents to answer questions without giving their names and personal information. The questionnaire focused on the following issues: i) the importance of CSR communication for the healthcare organizations; ii) the targets of healthcare CSR communication; iii) the different tools (both traditional and interactive technologies) adopted by healthcare organizations for CSR communication, as well as differences and similarities; and iv) advantages and requirements for interactive technologies implementation.

Prior to starting the questionnaire, researchers presented to all participants a participant information sheet consisting of a detailed description of the research and security/privacy information of the data collected. The reason of this choice was to ensure that all participants were briefed on the purpose of the questionnaire and that they felt comfortable taking part in it. researchers' contact details were also provided to participant in order to ensure a direct contact with the researchers in case of any question/information. Informed consent forms were collected from all participants.

Data Analysis

Data analysis was carried out using quantitative methods. A total of 72 respondents (63 from India and 9 from Malta) participated in the survey. Participants were categorized

by country, city, the typology of the organization (public or private hospitals; center for research; ICT company involved in the health domain; etc.) and size.

Within the sample of Indian organizations surveyed, 63,5% were private hospitals and clinics, 34,9% public hospitals and 1,6% research centers. 50,8% were medium-size organizations, 42,9% small, 6,3% large, and 1,6% were multinational organizations. Healthcare organizations investigated in India were from the following cities: Panchkula, Chandigarh, Patiala, Gwalior and Rajkot.

Within the sample of Maltese respondents, except for one ICT company involved in the healthcare domain, all were public organizations.

Researchers further analyzed data to understand CSR communication and the use of both traditional and interactive technologies to this regard. First, a separate data analysis was conducted for the two countries, and then results were compared.

Since all results generated were quantitative, data were extrapolated using analytical tools in order to accurately identify differences and similarities between the two countries, Malta and India.

Margins of error were also calculated for each category of results using total number of ICT professionals (estimated) as population size and a confidence level of 95%. Margins of error results were, respectively, 33% for Maltese results and 13% for results of Indian healthcare organizations. Margins of error related to Maltese results may seem too high compared to Indian ones (we surveyed 9 Maltese health professionals and 63 Indian ones); however, one must keep in mind the small size of the country and its population density. These margins of error influenced generalizability and reliability of the results presented in this chapter and suggested that further research is required to strengthen the coverage of this study.

FINDINGS

Results can be grouped into four categories: i) the importance and aims of healthcare CSR communication; ii) the targets; iii) the tools used for healthcare CSR communication (traditional and interactive technologies and their relative differences); and iv) advantages and requirements for implementing interactive technologies in surveyed healthcare organizations.

The first key findings of this quantitative survey concerned the importance and aims of CSR communication for healthcare organizations. Communicating CSR in the Indian healthcare sector is perceived as an issue of medium-high importance (47,6%), while in the Maltese context it is considered a very important issue (44,4%). Table 4 shows the reasons why healthcare organization of Malta and India are communicating CSR. Data suggest that for the majority of Indian organizations

(90,5%) the aim of healthcare CSR is to be competitive in the sector, while for the majority of Maltese organization (33,3%) it is important to communicate CSR because this is the right thing to do (and, thus, for ethical reasons).

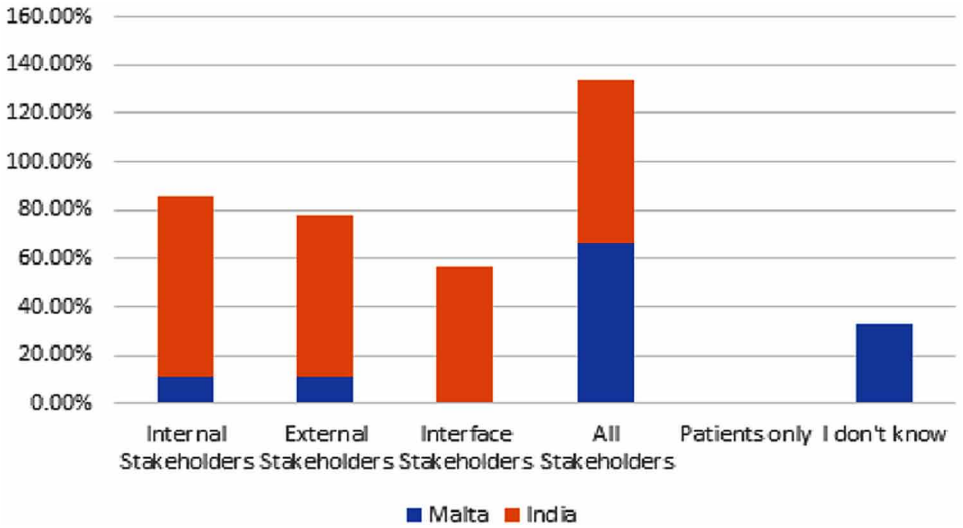
The second key finding observed in the data sets was related to the target of healthcare CSR communication (Figure 1). According to Indian respondents, the 74,6% affirmed that their main target are internal stakeholders, followed by external stakeholders (66,7%), all stakeholders (66,7%) and interface stakeholders (57,1%). According to 66,7% of Maltese respondents, the main target of their CSR communication are all stakeholders (internal, external and interface), while 33,3% of respondents do not know who their targets are.

This research also investigated the use different tools (both traditional and interactive) for healthcare CSR communication and identified differences and similarities. According to Indian respondents (74,6%), healthcare organizations use both traditional and interactive technologies at the same level to communicate their

Table 4. The aims of healthcare CSR communication

Aim	Malta (%)	India (%)
To be competitive in the sector	11,1	90,5
Due to an evolution of corporate objectives	22,2	85,7
To deal with a corporate crisis/scandal/trouble	11,1	85,7
Because it is the right thing to do	33,3	82,5

Figure 1. Targets of healthcare CSR communication in Malta and India



CSR activities. According to Maltese respondents, 50% do not know whether they are using more traditional o interactive technologies for their CSR communication, while 25% sustained that they are using both at the same level. Additional 25% of respondents affirmed that they are using more traditional technologies, and 12.5% of participants sustained that they are using more interactive technologies. Results are illustrated below in Figure 2.

Figure 3 shows and compares traditional tools used by Maltese and Indian healthcare organization for communicating CSR.

Figure 2. Traditional vs. interactive technologies for healthcare CSR communication

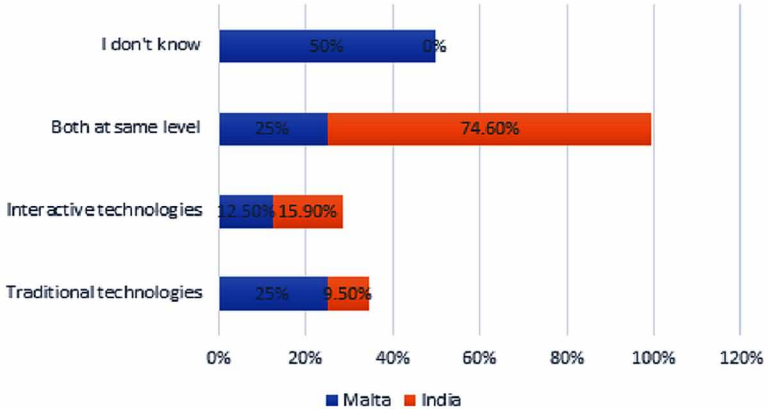
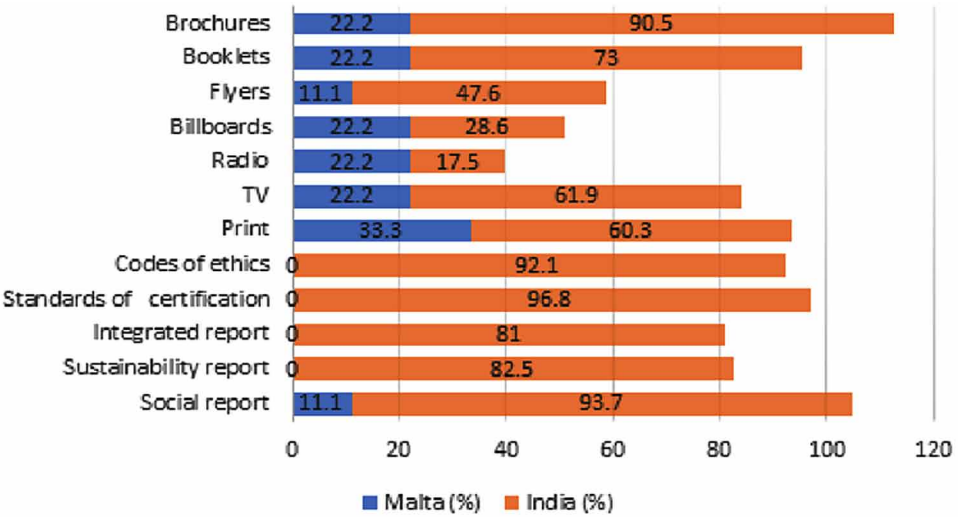


Figure 3. Traditional tools for CSR communication (Malta and India)



Main traditional tools used by Maltese healthcare organizations for CSR communication are print (33,3%), TV, radio, billboards and brochures (22,2%); while in India standards of certifications (96,8%), social (93,7%), sustainability (82,5%) and integrated (81%) reports, and codes of ethics (92,1%) are the main tools.

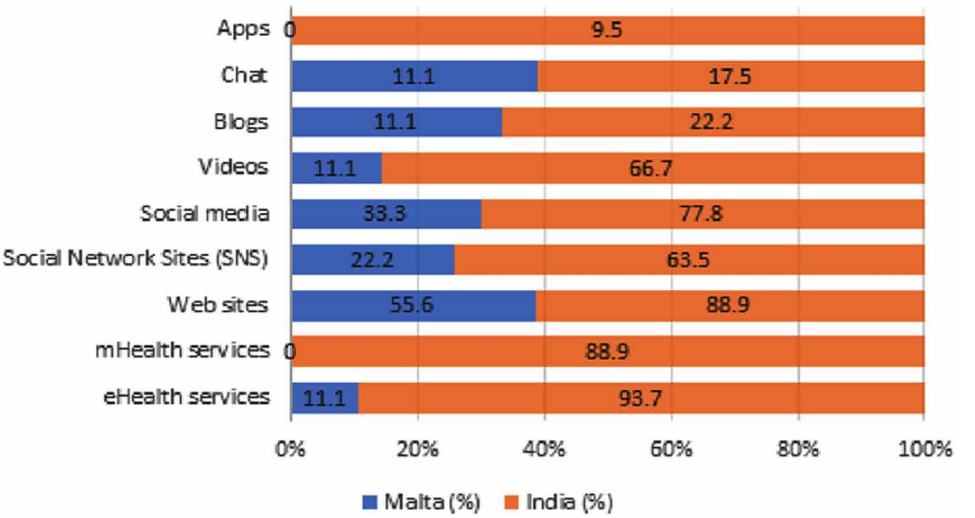
Among the category standards of certification, Maltese respondents affirmed that they are abiding by legal requirements and no one of the identified standards (e.g. ISO 9000, ISO 9001, ISO 26000) were selected. In India, ISO 9000 (68.3%) and ISO 9001 (93.7%) were the predominant standards selected for healthcare CSR communication.

Figure 4 shows and compares interactive technologies used by Maltese and Indian healthcare organization for communicating CSR.

In Malta web sites (55,6%), social media (33,3%) and SNS (22,2%) are the main interactive technologies used for CSR communication. In India, there is the prevalence of eHealth (93,7%), mHealth (88,9%), web sites (88,9%), social media (77,8%), SNS (63,5%) and videos (66,7%).

Both Maltese and Indian healthcare organizations (respectively 44,4% and 100%) agree that they communicated different content when using interactive and traditional technologies. Specifically, interactive technologies enable to communicate more, include additional information and interact with stakeholders (22,2% of Maltese and 90,0% of Indian healthcare organizations), while traditional tools are used mainly for reporting reasons (22,2% in Malta and 98,4% in India).

Figure 4. Interactive technologies for CSR communication (Malta and India)



Among interactive technologies, 100% of Indian respondents affirmed that eHealth is the most effective and efficient for healthcare organizations that want to communicate their CSR activities, followed by mHealth and social media (93,7%), SNS (76,2%) and videos (73,0%). In Malta 33,3% of respondents do not know which interactive technologies is the more effective and efficient, while additional 33,3% chose SNS and Social Media.

The final objective of the survey was to investigate the advantages and requirements (e.g. infrastructures, skills, competences, etc.) of interactive technologies. About the advantages of interactive technologies, 100% of Indian and 66,7% of Maltese respondents agree that interactive technologies bring several advantages to organizations in the health sector. According to 33,3% of Maltese respondents, the main advantages of interactive technologies implementation in healthcare are: speed and low costs (93,7% in India), easy access to information (90,5% in India), easy-to-use (87,3% in India), reducing the use of printed documents (100% in India), and making it easier to reach stakeholders (84,1% in India).

The implementation of interactive technologies requires the availability of supporting infrastructures as well as specific skills and competences. 96,8% of Indian respondents and 33,3% of Maltese ones already have those infrastructures. Table 5 shows results of Indian and Maltese respondents according to infrastructures required.

Table 6 shows results of Indian and Maltese respondents according to skills and competences required.

Finally, in the light of the results obtained, 44,4% of Maltese respondents and 55,6% of Indian ones affirmed that they wish to improve their eHealth, mHealth and SNS communication in the next future.

Table 5. Required infrastructures

Features	Malta (%)	India (%)
Computing equipment	22,2	96,8
Fast internet and wi-fi	22,2	84,1
Qualified employees	11,1	84,1
Software, databases, app developers	11,1	81
Rooms and desks	11,1	63,3
Uninterruptible power supply (UPS) or battery backups	11,1	44,4
None of the above/Unknown	66,6	0

Table 6. Required skills and competences

Features	Malta (%)	India (%)
Good use of internet and web-based technologies	44,4	93,7
Knowledge of operating systems, software, data bases, apps	33,3	92,1
Continuous updating about new trends in technologies	22,2	73
Knowledge of social media and network marketing	44,4	68,3
Knowledge of foreign languages	11,1	44,4
Knowledge of algorithms, cryptic languages (as HTML)	0	30,2
None of the above/Unknown	33,3	0

DISCUSSION AND IMPLICATIONS

Healthcare organizations should be more aware of the importance of CSR communication. They are using both traditional and interactive technologies to communicate their CSR activities. However, interactive technologies enable them to communicate more and additional information compared to traditional ones, as well as to dialogue and interact with stakeholders at different level. Thus, interactive technologies implementation also brings several advantages to healthcare organizations, according to 100% of Indian and 66,7% of Maltese respondents. Among the category of interactive technologies, eHealth is perceived as the most effective and efficient for Indian organization, while main Maltese answers were "I do not know" or SNS/Social Media.

In both Malta and India, CSR communication is perceived as an issue of medium to high importance by, respectively, 44,4% and 47,6% of respondents. However, healthcare organizations of both countries are paying growing interest on how to communicate their CSR activities to their stakeholders. Their reasons to communicate CSR are different: while Indian organisations do this mainly to be competitive in the sector (and hence for business/marketing reasons), the main reason that Maltese organizations do this is because it is simply the right thing to do (thus, for ethical reasons).

Indian organizations (96,8%) seem to be more aware of Maltese ones (33,3,%) that implementing interactive technologies require infrastructures and costs, such as computing equipment, operating systems, software, databases, etc. Furthermore, in India is higher the awareness that implementing interactive technologies requires also investments in new skills and competences for employees, such as computer literacy, knowledge of software, social media management and network strategies.

However, when interpreting results of this study one must keep in mind that the research was conducted in two countries with very different healthcare contexts and

type of economies. First, CSR has different perceptions and applications in both countries. While in Malta CSR refers mainly to the concept of business ethics and is mainly regulated by EU statements, in India CSR has different roots and today is used mainly for business-related issues.

Malta and India are also characterized by extremely different healthcare systems. Maltese healthcare system provides universal coverage and is free at the point of use, since it is primarily financed through taxation. The private sector is small compared to the public sector and this makes competition less of a problem in Malta. India, in contrast, shows that competition is important. The Indian health system includes both public and private hospitals as well as specialized hospitals offering traditional Indian system of alternative medicine. However, since public health often lacks quality of treatment and care, only private centers allow an excellent and adequate standard of care. Thus, it is more important for Indian healthcare organization to be competitive in the sector rather than Maltese ones. For these reasons aims of healthcare CSR communication are different in the two countries analyzed.

This research has implications for both theory, research and practice. The theoretical debate and empirical research on healthcare CSR communication is still scant. Furthermore, to the authors' knowledge, there have not been any relevant developments and contributions in this fields since the first publication of these results (Tomaselli et al., 2015, 2018). Thus, this work attempts to provide a contribution to the scientific debate on CSR communication in the healthcare contexts and to bridge the existing gaps in literature by offering some theoretical and practical insights in this field. From a managerial perspective, this work may provide a contribution to the development of novel theories and applications of global information resource management. Health care organizations are aware of the impact of their activities on the society, the communities and environment in which they do operate. They are brought to communicate more about their CSR activities in order to facilitate dialogue and better meet the expectations of their stakeholders. In this perspective, CSR communication is a highly relevant topic for today's healthcare organizations, which have to answer for their actions to different stakeholders and to society. These organizations are particularly careful to communicate CSR to their stakeholders to respond to ethical standards, build corporate image and reputation, strengthen stakeholders' relations, and create value. While traditional tools are still predominant, ICT and interactive technologies are gaining ground in the healthcare context. These technologies enable a more effective and efficient CSR communication rather than traditional tools.

There are limitations in this study that suggest opportunities for further research. Main limitations identified are two: i) the number of participants (63 respondents from India and 9 from Malta), which also turns into high margins of errors; and ii) the focus on two specific geographical areas (Malta and India). These gaps do not

allow generalization of findings to the global health care context. This study reports first results of ongoing research, the progress of which is directed towards expanding the sample of organizations analyzed and the geographic context.

CONCLUSION

Today's healthcare organizations, being more aware of their responsibilities and impacts for society (Amone et al., 2011), and of their public scrutiny role in influencing behaviors and policies (Collins, 2010; Esrock & Leichty 1998), are paying particular attention to CSR communication in order to improve their reputation (Du, Bhattacharya & Sen, 2010; Middlemiss, 2003), as well as to promote and strengthen stakeholders' relationships (Tomaselli et al., 2016).

Healthcare organizations have different options to communicate their CSR. The use of traditional technologies (reports, codes of ethics and standards of certification) is still used but is increasingly being complemented by ICT and interactive technologies implementation (web sites, social media, SNS), which are gaining ground year by year. To this regard, the study emphasized that these technologies enable several advantages to health services organizations (such as a better dialogue and interaction with different stakeholders, speed, low costs, easy access to information, etc.), as well as they require infrastructures (e.g. computing equipment, software, rooms and desks.) and skills/competences (e.g. ICT knowledge) for their complete implementation.

Communicating CSR may bring several advantages to organizations, including: i) stakeholder engagement; ii) transparency; iii) improvement of the hospital's image and reputation; iv) a more efficient use of scares resources; v) enhancement of patient loyalty; vi) facilitating patient's empowerment and person-centered approaches to care; vii) increasing the attraction and retention of quality employees; viii) responsible competitiveness; ix) attracting investors and business partners; and x) governmental support (Tehemar, 2012).

ACKNOWLEDGMENT

This work was conducted under the XIII Executive Programme for Cultural Collaboration between Malta and Italy, administered by the Maltese Ministry for Education and Employment and the Italian Ministry for Foreign Affairs.

REFERENCES

Adams, C. A., & Frost, G. F. (2006). Accessibility and functionality of them corporate web site: Implications for sustainability reporting. *Business Strategy and the Environment*, *15*(4), 275–287. doi:10.1002/bse.531

Arnone, L., Ferauge, P., Geerts, A., & Pozniak, L. (2011). Corporate Social Responsibility: Internet as Communication Tool Towards Stakeholders. *Journal of Modern Accounting and Auditing*, *7*(7), 697–708.

Arora, B., & Puranik, R. (2004). A Review of Corporate Social Responsibility in India. *Society for International Development*, *47*(3), 93–100.

Arvidsson, S. (2010). Communication of corporate social responsibility: A study of the views of management teams in large companies. *Journal of Business Ethics*, *96*(3), 339–354. doi:10.100710551-010-0469-2

Beck, M., & Walgenbach, P. (2005). Technical Efficiency of Adaptation to Institutional Expectations? – The Adoption of ISO 9000 Standards in the German Mechanical Engineering Industry. *Organization Studies*, *26*(6), 841–866. doi:10.1177/0170840605054599

Bolivar, P. M. R. (2009). Evaluating corporate social and environmental reporting on the internet: The utilities and resource industries in Spain. *Business & Society*, *48*(2), 179–205. doi:10.1177/0007650307305370

Bose, R. (2003). Knowledge management-enabled health care management systems: Capabilities, infrastructure, and decision-support. *Expert Systems with Applications*, *24*(1), 59–71. doi:10.1016/S0957-4174(02)00083-0

Buttigieg, S., Schuetz, M., & Bezzina, F. (2016). Value Chains of Public and Private Health-Care Services in a Small EU Island State: A SWOT Analysis. *Frontiers in Public Health*, *4*, 201. doi:10.3389/fpubh.2016.00201 PMID:27683658

Capriotti, P., & Moreno, A. (2007). Corporate citizenship and public relations: The importance and interactivity of social responsibility issues on corporate websites. *Public Relations Review*, *33*(1), 84–91. doi:10.1016/j.pubrev.2006.11.012

Carroll, A. B. (1999). Corporate social responsibility: Evolution of a definitional construct. *Business & Society*, *38*(3), 268–292. doi:10.1177/000765039903800303

Chaundri, V., & Wang, J. (2007). Communicating corporate social responsibility on the internet: A case of the top 100 information technology companies in India. *Management Communication Quarterly*, *21*(2), 232–247. doi:10.1177/0893318907308746

Collins, S. (2010). Corporate social responsibility and the future health care manager. *The Health Care Manager*, *29*(4), 339–345. doi:10.1097/HCM.0b013e3181fa050e PMID:21045586

Consolandi, C., Phadke, H., Hawley, J. P., & Eccles, R. G. (2018). *Material ESG Outcomes and SDG Externalities: Evaluating the Health Care Sector's Contribution to the SDGs*. Available at SSRN 3277421.

Conte, F., Vitale, P., Vollero, A., & Siano, A. (2018). Designing a Data Visualization Dashboard for Managing the Sustainability Communication of Healthcare Organizations on Facebook. *Sustainability*, *10*(12), 4447. doi:10.3390u10124447

Correa-Garcia, J. A., Garcia-Benau, M. A., & Garcia-Meca, E. (2018). CSR communication strategies of colombian business groups: An analysis of corporate reports. *Sustainability*, *10*(5), 1602. doi:10.3390u10051602

Darus, F., Artini, E., Hamzah, C. K., & Yusoff, H. (2013). CSR web reporting: The influence of ownership structure and mimetic isomorphism. Procedia Economics and Finance, 7, 236-242.

Davis, J. J. (1992). Ethic and Environmental Marketing. *Journal of Business Ethics*, *11*(2), 81–87. doi:10.1007/BF00872314

Dawkins, J. (2004). Corporate responsibility: The communication challenge. *Journal of Communication Management*, *1*, 20–25.

Detmer, D. E. (2003). Building the national health information infrastructure for personal health, health care services, public health, and research. *BMC Medical Informatics and Decision Making*, *3*(1), 1. doi:10.1186/1472-6947-3-1 PMID:12525262

Du, S., Bhattacharya, C. B., & Sen, S. (2010). Maximizing Business Returns to Corporate Social Responsibility (CSR): The Role of CSR Communication International. *Journal of Management Reviews*, *12*(1), 8–19.

Esrock, S. L., & Leichty, G. B. (1999). Corporate world-wide pages: Serving the news media and other publics. *Journalism & Mass Communication Quarterly*, *76*(3), 456–467. doi:10.1177/107769909907600304

Estrin, D. & Sim, I. (2010). Open mHealth Architecture: An Engine for Health Care Innovation. *Science*, *330*(6005), 759-760.

Etter, M. (2013). Reasons for low levels of interactivity (non-) interactive CSR communication in twitter. *Public Relations Review*, *39*(5), 606–608. doi:10.1016/j.pubrev.2013.06.003

Europa.eu.Malta. (2016). Available from: https://europa.eu/european-union/about-eu/countries/member-countries/malta_en

European Commission. (2011). A renewed EU strategy 2011-14 for Corporate Social Responsibility. *European Commission*. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0681

Eurostat. (2019). Available from: http://ec.europa.eu/eurostat/statistics-explained/index.php/Unemployment_statistics

Eysenbach, G. (2001). What is e-health? *Journal of Medical Internet Research*, *3*(2), e20. doi:10.2196/jmir.3.2.e20 PMID:11720962

Fottler, M. D., & Blair, J. D. (2002). Introduction: new concepts in health care stakeholder management theory and practice. Health Care Management Review, 27(2).

Grech, K., Podesta, M., Calleja, A., & Calleja, N. (2015). *Report on the Performance of the Maltese Health System.* Valletta, Malta: Ministry for Health and Energy.

Harmoni, A. (2012). *Official website as a means of stakeholder dialogue on corporate social responsibility*. The International Conference on Eurasian Economies, Almaty, Kazakhstan.

Hart, S. L. (1997). *Beyond Greening: Strategies for Sustainable World*. Boston: Harvard Business Review.

Harwood, M. (2006). *Corporate Responsibility in Small States Like Malta: A Luxury Companies Can Ill Affords?* Msida, Malta: University of Malta, European Studies.

Hooghiemstra, R. (2000). Corporate communication and impression management – New perspectives why companies engage in corporate social reporting. *Journal of Business Ethics*, *27*(1/2), 55–68. doi:10.1023/A:1006400707757

Hossain, M. S., Yahya, S. B., Rahman, S., Sobhani, F. A., & Rahman, R. (2019). Corporate Social Responsibility in Healthcare: A case of Islamic Banks (IBs) in Bangladesh. *Bangladesh Journal of Medical Science*, *18*(3), 567–573. doi:10.3329/bjms.v18i3.41627

Ibef.org. (2016). Available from: http://www.ibef.org/industry/healthcare-india.aspx

Johansen, F., Loorbach, D., & Stoopendaal, A. (2018). Exploring a transition in Dutch healthcare. *Journal of Health Organization and Management*, *32*(7), 875–890. doi:10.1108/JHOM-07-2018-0185 PMID:30465486

Kakabadse, N. K., & Rozuel, C. (2006). Meaning of corporate social responsibility in a local French hospital: A case study. *Society and Business Review*, *1*(1), 77–96.

Ketchen, D. J. Jr, & Shook, C. L. (1996). The application of cluster analysis in strategic management research: An analysis and critique. *Strategic Management Journal*, *17*(6), 441–458. doi:10.1002/(SICI)1097-0266(199606)17:6<441::AID-SMJ819>3.0.CO;2-G

Kim, S., & Ferguson, M. A. T. (2018). Dimensions of effective CSR communication based on public expectations. *Journal of Marketing Communications*, *24*(6), 549–567. doi:10.1080/13527266.2015.1118143

Kjeldsko, J., & Paay, J. A. (2012). Longitudinal review of Mobile HCI research methods. In *the 15th international conference on Human-computer interaction with mobile devices and services*. ACM.

Middlemiss, N. (2003). Authentic not cosmetic: CSR as brand enhancement. *Journal of Brand Management*, *10*(4), 353–361. doi:10.1057/palgrave.bm.2540130

Mifsud, D. (2009). *The adoption of CSR reporting by Maltese enterprises: a survey*. Msida, Malta: University of Malta, Faculty of Economics, Management and Accountancy.

Mohan, A. (2001). *Corporate Citizenship: Perspectives from India. Journal of Corporate Citizenship*. doi:10.9774/GLEAF.4700.2001.su.00012

Morsing, M., & Spence, L. J. (2019). Corporate social responsibility (CSR) communication and small and medium sized enterprises: The governmentality dilemma of explicit and implicit CSR communication. *Human Relations*.

Nisha, N., Iqbal, M., & Rifat, A. (2019). The Changing Paradigm of Health and Mobile Phones: An Innovation in the Health Care System. *Journal of Global Information Management*, *27*(1), 19–46. doi:10.4018/JGIM.2019010102

Pritchard, J. (1998). *Codes of ethics*. Elsevier Inc.

Puncheva-Michelotti, P., Hudson, S., & Jin, G. (2018). Employer branding and CSR communication in online recruitment advertising. *Business Horizons*, *61*(4), 643–651. doi:10.1016/j.bushor.2018.04.003

Rolim, C. O., Koch, F. L., Westphall, C. B., Werner, J., Fracalossi, A., & Salvador, G. S. (2010, February). A cloud computing solution for patient's data collection in health care institutions. In *eHealth, Telemedicine, and Social Medicine, 2010. ETELEMED'10. Second International Conference on* (pp. 95-99). IEEE. 10.1109/eTELEMED.2010.19

Sacconi, L. (2002). Impresa non profit: Efficienza, ideologia e codice etico. Modelli di Governo, Riforma del Welfare e Organizzazioni Non Profit. il Mulino.

Scerri, S., Garg, L., Garg, R., Scerri, C., Xuereb, P., & Tomaselli, G. (2015). Understanding Human-Device Interaction patterns within the context of mobile nutrition. *The 2nd International Conference on Recent Advances in Engineering & Computational Sciences (RAECS 2015)*. 10.1109/RAECS.2015.7453410

Schaar, A. K., Calero Valdez, A., & Ziefle, M. (2012). *Social media for the ehealth context.* In V. Duffy (Ed.), *Advances in Human Aspects of Healthcare* (pp. 1928–1937). Communications, Systems Support and Healthcare Informatics.

Serra, R. (1997). I codici etici nelle aziende. *De Qualitate*.

Shamir, R. (2005). Mind the gap: The commodification of corporate social responsibility. *Symbolic Interaction*, *28*(2), 229–253. doi:10.1525i.2005.28.2.229

Stone, A. A., Shiffman, S., Atienza, A. A., & Nebeling, L. (2007). *The science of real-time data capture: self-reports in health research*. Oxford, UK: Oxford University Press.

Syed Ali Fathima, S. J., & Shankar, S. (2018). AR Using NUI Based Physical Therapy Rehabilitation Framework with Mobile Decision Support System: A Global Solution for Remote Assistance. *Journal of Global Information Management*, *26*(4), 36–51. doi:10.4018/JGIM.2018100103

The World Bank. (2019a). Available from: http://data.worldbank.org/indicator/NY.GDP.MKTP.CD

The World Bank. (2019b). *Health Expenditure, Total (% of GDP).* Available from: http://data.worldbank.org/indicator/SH.XPD.TOTL.ZS

Tomaselli, G., Garg, L., Gupta, V., Xuereb, P., Buttigieg, S., & Vassallo, P. (2015). *Traditional Vs Interactive Technologies for Corporate Social Responsibility Communication in Health Care: A Study in Malta and India*. The 22nd EurOMA International Annual Conference (EurOMA 2015), Neuchâtel, Switzerland.

Tomaselli, G., Garg, L., Gupta, V., Xuereb, P. A., & Buttigieg, S. C. (2018). Corporate Social Responsibility Communication Research: State of the Art and Recent Advances. In Advances in Data Communications and Networking for Digital Business Transformation (pp. 272-305). IGI Global.

Tomaselli, G., Garg, L., Gupta, V., Xuereb, P. A., Buttigieg, S. C., & Vassallo, P. (2018). Healthcare Systems and Corporate Social Responsibility Communication: A Comparative Analysis Between Malta and India. *Journal of Global Information Management*, *26*(4), 52–66. doi:10.4018/JGIM.2018100104

Tomaselli, G., & Melia, M. (2014). The role of interactive technologies for CSR communication. *Journal of International Scientific Publications: Economy & Business*, *8*, 324–340.

Tomaselli, G., Melia, M., Garg, L., Gupta, V., Xuereb, P., & Buttigieg, S. (2016). Digital and traditional tools for communicating corporate social responsibility: A literature review. *International Journal of Business Data Communications and Networking*, *12*(2), 1–15. doi:10.4018/IJBDCN.2016070101

Valentine, S., & Barnett, T. (2003). Ethics code, awareness, perceived ethical values, and organizational commitment. *Journal of Personal Selling & Sales Management*, *23*, 359–367.

Verk, N., Golob, U., & Podnar, K. (2019). A Dynamic Review of the Emergence of Corporate Social Responsibility Communication. *Journal of Business Ethics*, 1–25.

Walgenbach, P. (2001). The production of distrust by means of producing trust. *Organization Studies*, *22*(4), 693–714. doi:10.1177/0170840601224006

Watts, P., & Holme, R. (1999). *Corporate Social Responsibility: Meeting Changing Expectations*. Geneva: World Business Council for Sustainable Development.

Wheeler, D., & Elkington, J. (2001). The end of the corporate social and environmental report? Or the advent of cybernetic sustainability reporting and communication. *Business Strategy and the Environment*, *10*(1), 1–14. doi:10.1002/1099-0836(200101/02)10:1<1::AID-BSE274>3.0.CO;2-0

Chapter 8
The Impact of the Internet on Change in Consumer Values in India:
Internet and Values

Jiban Khuntia
University of Colorado, Denver, USA

Vicki Lane
University of Colorado, Denver, USA

Madhavan Parthasarathy
University of Colorado, Denver, USA

ABSTRACT

Has the Internet impacted the core values of consumers, particularly in developing nations? Unlike one-way mass media vehicles such as television, the internet's two-way, interactive nature allows individuals to communicate in a high-involvement, border-free world via social media, blogs, online forums, and the like. This will result in the trading of values and ideas, and especially in the erosion of traditional value systems in developing nations. This chapter highlights the changes in values in India between 2004 and 2014, with a marked increase in Western individualistic values such as power and achievement, eroding traditional collective values such as universalism among Indian youth during this period. Since consumers buy products that reflect their values, these findings have profound implications for business management and marketing. Further, the general notion that the core values of a society are slow to change is refuted.

DOI: 10.4018/978-1-7998-1786-4.ch008

INTRODUCTION

The notion of globalization of culture and markets, where western cultural values, depicted by international mass media channels, have made the world a "global village," is not new (e.g., McLuhan 1962; Kraidy 2002). The general narrative argues that western television programs and ads were increasingly accessible to developing markets, thanks to satellite and other advanced technology. This, in turn, led to a steady flow of transnational images which encouraged youth in developing countries to adopt a western lifestyle by consuming similar products (e.g., Nike shoes, Coca-Cola, etc.) to their compatriots in developed nations. In the words of Levitt (1984, p. 1) technology "*has made isolated places and impoverished peoples eager for modernity's allurements. Almost everyone everywhere wants all the things they have heard about, seen, or experienced via the new technologies"*.

These assertions would suggest that, over the past 50 years, western individualistic traits, such as power and achievement, would have made inroads into the core collective value system of consumers in developing nations, including India. Evidence suggests, however, that this has not been the case, at least not before 2004. Indeed, core values in India have remained fairly stable from the 1980s until the early 2000s. As an example, the individualism score for India was 48, according to Hofstede's cultural value score in 1980, and 46 in 2004 (Ghemawat and Reiche, 2011; Hofstede 2015). This would suggest that one-way mass media while encouraging Indians to adopt western products, had little influence on changing core values.

However, as we will demonstrate in this paper, all this changed since the advent of the internet and, more recently, social media. The high-involvement, interactive nature of the internet has had a profound impact on the values of Indian youth. Online platforms, such as those afforded by social media, facilitate a high-involvement, interactive exchange of views between people around the world resulting in a true exchange of ideals and values and, in the process, impact the value system of Indian youth. While existing research on human values suggests that, barring a catastrophic event, core values in a society are slow to change (e.g., Rokeach 1968), we show that, in recent years, the internet has been the catalyst for rapid change of values among youth in India.

Specifically, we address the question of how the Internet is changing the values of youth in India. Does the amount of time spent on the Internet affect the rate of change of a person's values? If so, which values change, and which do not? How quickly have these values changed? These questions are noteworthy, both from managerial and academic perspectives. Since consumers buy products that reflect their values, a noteworthy change in core values of society will have a significant impact on the products demanded and, commensurately, on the most effective ways to market them. Academically, newer concepts and theories will evolve, potentially

refuting the long-standing belief that values are slow to change. This chapter reflects on these questions and attempts to provide some insights from existing research, while contextualizing the discussions to India, with observations and reflections on the change due to globalization and mass communication from 2004-2014.

India was specifically chosen for this study because of the tremendous growth in internet connectivity and, more recently, social media membership during the time frame of this study (i.e., from 2004 to 2014). India had just 39.2 million internet users in 2004 (Internet World Stats 2019), a number that has increased to 350 million users by 2014 and over half a *billion* users by 2018 (Internet Live Statistics 2019). This exceeds the entire population of the United States and is second only to China in terms of internet consumption. India currently has over 300 million Facebook users, the largest in the world (Statistica 2019).

In this chapter, we report on a study of Indian youth that took place between 2004 and 2014. We focus on two critical points. First, we anticipated that the two-way interactive nature of the internet and social media, would have led to increased adoption of western individualistic values (Self-Enhancement), and a commensurate erosion of traditional eastern values (Self-Transcendence) that once pervaded Indian society. Second, while traditional mass media would also have exposed consumers to western products and ideals, it would have had less impact than the Internet in changing values. This is because of the internet and social media's high-involvement and interactive nature. Together, the internet and social media facilitate interpersonal influence, by far the most impactful form of communication, more so than do traditional media of TV and print.

VALUES – HIERARCHY, DIMENSIONS, SELF-ENHANCEMENT, AND SELF-TRANSCENDENCE

What Are Values?

Values guide people in their life-paths over the long run (Rokeach 1968). Indeed, values transcend across all behavior and represent both instrumental modes of conduct and terminal end states of existence. Values are not the same as ordinary attitudes and beliefs. The latter applies to specific objects and situations, while values apply across many objects and situations. As evidenced by over 200 studies across 60 nations (Schwartz et al. 2001), values are both absolute (i.e., apply to all situations) and universal.

Values operate together as a system (Rokeach, 1968; Schwartz et al. 2001). Some values can be achieved simultaneously but collide with other conflicting values. A value dimension includes a set of values that operate together and can be fulfilled

without conflict (Schwartz 1992; Smith and Schwartz 1997). Within a dimension, values go hand-in-hand. At the same time, these correlated values sometimes conflict with other values outside of the dimension. Indeed, one dimension may include values that are at opposite poles from the values within another value dimension (e.g., Bond 1988). For example, collectivism conflicts with individualism, change counters tradition, and high-level in-group priorities collide with sensual gratification of individuals (Hawkins and Mothersbaugh 2010). When values conflict, an individual must choose those that are most important over those of lesser importance (e.g., *salvation* versus *pleasure*) (Scott 1965; Rokeach 1968). Thus, values range within a hierarchy in which some are ranked higher than others. This hierarchy, in turn, guides behavioral choices (instrumental values) that lead to preferred end states (terminal values) (Rokeach 1968).

Two overarching value dimensions that are important drivers of consumer behavior and business success are ***Self –Enhancement, and Self-Transcendence*** (Schwartz et al. 2001). Self-enhancement includes both Power and Achievement (Schwartz et al. 2001), which in turn have been shown to overlap with the cultural dimension of individualism (Parthasarathy et al. 2015). Self-transcendence includes both Benevolence and Universalism, subdivisions which research shows are associated with the collectivism cultural dimension. Within each dimension, values are congruent, but across dimensions, values are incongruent. Thus, these dimensions conflict with each other - Self-transcendence (*Benevolence* and *Universalism)* clashes with Self-enhancement (*Power and Achievement)* since each exists on the opposite pole from the other (Schwartz et al. 2001).

How Are Individual Values Measured? What Are Their Dimensions?

Various approaches to measuring values have much in common, and researchers have correlated different measures to one another (Beatty et al. 1985; Bond 1988, Braithwwaite and Law 1985). By doing so, it is possible to apply the Schwartz' theory of the structure of values to other measures. For example, research depicts considerable overlap between Rokeach values and Schwartz values (e.g., Bond 1988) and a relationship between Rokeach scales and Schwartz dimensions of self-transcendence and self-enhancement. Table 1 illustrates the Rokeach scales and Schwartz value dimensions. It is important to note, Power and Achievement are combined as a single construct, but Benevolence is considered separately from Universalism for the following two reasons. First, Benevolence includes values regarding other individuals, while Universalism includes values regarding larger

Table 1. Values and dimensions

A. Power and Achievement Value

Definition: social status and prestige, control or dominance over people and resources, and personal success through demonstrating competence according to social standards (Schwartz et al. 2001).

Dimensions: Together the following 6 personal aspirations move in tandem with one another and constitute Power and Achievement value dimension. Due to the overlapping nature of these value traits, past and current research has construed them as a single dimension (Schwartz et al. 2001)(Rokeach (1968))Lane et al (….)

- Striving for social recognition (i.e., "respect, admiration"), and
- sense of accomplishment (i.e., "lasting contribution"),
- ambition (i.e., "hard-working, aspiring"),
- independent (i.e., "self-reliant, self-sufficient"),
- intellectual (i.e., "intelligent, reflective")
- logical (i.e., "consistent, rational").

B. Benevolence Value

Definition: preservation and enhancement of the welfare of people with whom one is in frequent personal contact" (Schwartz et al. 2001). In support of a value orientation of benevolence towards others, past and current research (Rokeach (1968), Lane et al ….) finds support for the following three modes of being that operate together to constitute the benevolence value dimension.

- forgiving (i.e., "willing to pardon others"),
- helpful (i.e., "working for the welfare of others")
- loving (i.e., "affectionate, tender").

C. Universalism Value

Definition: **U**nderstanding, appreciation, tolerance, and protection for the welfare of all people and for nature (Schwartz et al. 2001). In support of the Universalism value dimension, past and current research (Rokeach (1968), Lane et al ….) demonstrates the following as "ultimate end states of existence", and consistent with past research (e.g., Parthasarathy 2015), together, these terminal goals constitute the Universalism value dimension.

- world at peace (i.e., "free of war and conflict"),
- equality (i.e., "brotherhood, equal opportunity for all),
- freedom (i.e., "independence, free choice"),
- national security (i.e., "protection from attack").

societal groups. Second, Benevolence values are instrumental modes of behavior, while Universalism values are terminal end states of existence, and thus involve different classes of value measures as per Rokeach.

INDIA: COUNTRY CONTEXT

Ever since the liberalization of the Indian economy in the early1990s, there has been growing evidence that Indian consumers have changed in several ways. These changes include a rising middle class, more widespread and greater levels of education, increased affluence and buying power, rapid increase in global media exposure (e.g., Thussu 2007; Sathpathi and Roy 2011), increased global travel, a tremendous increase in the number of internet consumers (Internet Live statistics 2019), and greater exposure to western brands (e.g., Rao 2000), especially among the youth. These changes have led to the position that Indian consumers are becoming

increasingly materialistic (e.g., Eng and Bogeart 2010), more "westernized" (e.g., Batra et al. 2000; Gupta 2011), and more favorably disposed to western brands as opposed to Indian brands (Kinra 2006, Rao 2000). Indeed, as caste barriers slowly erode, they are being replaced by conspicuous consumption as a leading differentiator between the haves and the have-nots, especially among the youth (e.g., Eng and Bogaert 2010).

In addition to greater exposure to global media (via TV channels and online access), Indian consumers have also enjoyed more interaction with citizens of other countries via outsourcing, blogs, forums and chatrooms on the Internet, and the large-scale adoption of smartphones. Currently, India has over half a billion internet users, more than the entire population of the United States and second only to China (Internet Live Statistics 2019). India also has over 370 million smartphone users (Statistica 2019) who use their mobile phones to access the Internet. Unlike Chinese internet users who primarily communicate with one another in Mandarin, the main language of online communication in India is English, and this enables Indian Internet users to communicate seamlessly with other English-language users in the west. Indeed over 300 million Indians have Facebook accounts, and the majority of these users are logging in from their smartphones. There are expected to be over 800 million smartphones users in the country (Bhattacharya 2018).

With increased connectivity comes increased interaction with a western audience (via English language blogs, forums, discussion boards and the like) and hence increased exposure to, and interest in, western products, and western philosophies and values. The evidence above that Indians are getting increasingly materialistic, possibly as a result of their being inundated with western media and products, suggests an erosion of the traditional philosophical pillars of eastern religions. The traditional philosophical pillars, Buddhism, Jainism, and Hinduism, practiced by 70 percent of Indians, encourage their followers to shun desires and attachments to objects in favor of self-transcendence (Basu 2002, pg. 104). The erosion of traditional non-materialistic philosophical bases of the belief systems followed by most Indians suggests that young Indian consumers, those that are most likely to have adopted an online existence or been exposed to global media (and therefore to western ideals), are more likely to favor values associated with self-enhancement over self-transcendence.

THE INTERNET'S IMPACT ON CONSUMER VALUE CHANGE

Arguably, the explosive growth of the internet is having an impact on values. More specifically, this change is most evident in emerging and developing countries. In India, for example, we propose that values have changed among Indian youth in the past

decade and that this change in values has been influenced more by Internet use than by mass media exposure (e.g., television, newspapers, and magazine subscription). Prior research on the impact of the Internet has investigated its positive role in several fields, including education and knowledge sharing (Andrews 2004; Hendriks 1999; Passey and Goodison 2004), productivity and output growth (Black and Lynch 2001), health (Lindsay et al. 2008; O'Mahony and Vecchi 2005), availability of global skilled labor (O'Mahony et al. 2008), and economic development (Gigler 2011).

However, no prior research has investigated the impact of the Internet on changing consumer values, perhaps because values were always considered to be slow to change (Rokeach 1973, p.5) and, thus, such research required a significant inter-temporal time spread. This is also perhaps the reason that, while studies have examined the impact of traditional mass media advertising on children (see review by Villani 2001), the increase in materialism (Richins 1987; Sirgy et al. 2012) and deviant behavior (see review by Anderson et al. 2009), their impact on changing core consumer values has hitherto been left under-researched.

The study of the impact of the Internet and media exposure on changing consumer value systems is important because consumers often buy products and brands that reflect their values (Beatty et al. 1985; Chen et al. 1999; Hawkins and Mothersbaugh 2010; Johnson 2014; Wansink 2000). Indeed, values are differentiated between various groups based on religion, age, and cultural, economic, and political variables that are (Braithwaite and Law 1985), distinguished between various consumer behaviors (Beatty et al. 1985), and then linked to specific brand attributes and benefits (Wansink 2000). Therefore, evolving consumer value systems in India, fueled by information and communication technologies, cell phone penetration, and Internet proliferation, would naturally lead to a similar evolution in product demand. If companies do not grasp the nuances of evolving value systems across large global markets, and strategically adjust their product and brand strategy to cater to those changes, they will be susceptible to failures.

India is an attractive market for many global companies, with an annual purchasing power, adjusted for parity, of more than 10 trillion dollars (IMF 2018). After the liberalization of the Indian economy in the 90s, many multinational companies viewed India as a lucrative and large new market to consider in their market expansion strategies, particularly from the perspective of leveraging the rapidly growing consumer potential in the country (Friedman 2005; Padmanabhan 2012). Furthermore, India has concurrently experienced a rapid increase in global media exposure (Satpathi and Roy 2011; Thussu 2007) and an explosive increase in the number of Internet consumers during the last decade (Internet Live Statistics 2019). These changes have led to the belief that Indian consumers are becoming increasingly materialistic and "Americanized" (Batra et al. 2014; Gupta 2011), and more favorably disposed to global brands as opposed to Indian brands (Kinra 2006;

Rao 2000). Indeed, conspicuous consumption has become a leading differentiator between the rich and the poor (Eng and Bogaert 2010), which would suggest that core consumer values have changed in the past decade.

A recently published study (Lane et al. 2017) empirically tested changing values in India over a period encompassing a full decade, from 2004 to 2014. The study assessed whether the recent rapid increase in Internet access and media exposure have contributed to these changes. This chapter reflects on the findings of this study. A summary of the findings of Lane et al.'s study is as follows:

1. Between 2004 and 2014, the *Power and Achievement* value dimension increased significantly, and the *Universalism* value dimension declined significantly;
2. Increased time spent on the Internet strongly led to increased *Power and Achievement* and decreased *Universalism*; however, increased time watching TV and reading newspapers or magazines had no impact on changing values;
3. The positive effect of internet time on *Power and Achievement* and the negative effect of internet time on *Universalism* progressively increased over the decade.

REASONS ASCRIBED FOR VALUE EVOLUTION AND THE IMPACT OF MEDIA AND THE INTERNET

The change or shift in India and the Internet's effect on those changes is explained by the following:

1. *Value shift congruity*. Value shift congruity is critical to the major theories of value structure and evolution. Value shift congruity indicates that a value dimension includes an amalgamation of values that evolve and shift in tandem. It is based on the notion that it is feasible to pursue the value cluster simultaneously, and it is not necessary to choose between these values within the cluster. If any values within a dimension evolve, the others do so, too. As one becomes more influential, so do the others. As one becomes less critical, so do the others.
2. Conversely, the opposite holds for conflicting values. When values oppose one another, they tend to move in opposite directions. Consequently, a value dimension tends to evolve opposite that of another value dimension with which it conflicts. The implication for the present study is that as Power and Achievement go up, both Benevolence and Universalism will go down. This inverse relationship is part of the Westernization of values.
3. *Value Stability and Evolution.* Values are generally slow to change (e.g., Rokeach 1973) and do so over very long periods of time. As an example, the Hofstede individualism value for India (which is closely related to *Power*

and Achievement) remained unchanged from 2001 to 2015 (Hofstede 2015; Hofstede and Hofstede 2001). While values are very stable, scholars recognize that they do change slowly over time (e.g., Rokeach 1973, pg. 5), across the stages of life and societal changes in demographics, government, education, economic growth and development, business innovation, and technology. Experts believe that a global urban youth cohort that shares values, lifestyles, brands, and brand-based identities, largely as a result of global mass media emerging (Hawkins and Mothersbaugh 2010; NGT 2008; Walker 2008).

4. *The Westernization of Values.* Globalization refers to the dramatic cross-society confluence of information, communication, technology, capital, products, politics, and legal exchanges (Esmer 2006), that impact countries' evolution over time. Many scholars (e.g., Esmer 2006; Ester et al. 1994; Hawkins and Mothersbaugh 2010; Inglehart 1997; Inkeles 1998) argue that these realms of international interaction and modernization shape cultural values, in particular, shifting them toward individualism, power, and achievement (Ester et al. 1994; Inkeles 1998). This phenomenon is frequently referred to as the "Westernization" of values, the exportation of the American ideals of power, achievement, self-aggrandizement, and love of materialism. The United States is considered the most individualistic society in the world with a Hofstede individualism score of 91 (Hofstede.com 2019) and is potentially one of the largest "exporters" of Self-Enhancement values. Other countries, such as India, with traditional philosophical pillars of eastern religions, encourage citizens to shun desires and attachments to objects, in favor of Self-Transcendence (Basu 2002, pg. 104), leading to lower levels of Self-Enhancement traits (India's individualism score, for example, is only 48, Hofstede.com 2015). These countries may become net "importers" of Self-Enhancement as global Westernization occurs. Islamic scholars believe that western materialism threatens eastern core belief system more than secularism (e.g., Mazrui 1996).
5. *English fluency in India facilitated Westernization.* Third, the language of online communication in India is predominantly English, whereas this is not the case in other emerging countries, such as in China. As a result of English fluency, young Indian consumers are more frequent users of social media (e.g., Facebook) (Internet World Stats 2016) than less fluent countries. The use rate of social media is relevant because media is expected to "Westernize" Eastern cultures via the transfer of Western individualistic values. Without a language barrier, connected Indian consumers more easily communicate with their western English-speaking counterparts. This communication then facilitates the transfer of values from one culture to another. Table 2 summarizes the changes in ICT between 2004 and 2014 for India, the span of the data collection efforts of this study.

Table 2. ICT in India

	2004	2014	% Growth
Internet users in India	22 million	275 million	1250%
Facebook accounts	0	108 million	Infinite
Cell Phone Penetration	75 million	965 million	1287%
Mobile Internet Access	0	185 million	Infinite

Sources: Internet Live Statistics, 2014; Internet World Stats 2014; TRAI 2014

6. *Media-Induced Values Evolution.* Of particular interest in this paper is the role of the Internet and media as a potential export/import funnel for values. Scholars believe that one society's media communicates and exports cultural values to other societies that tune in to the original exporter's media (Hawkins and Mothersbaugh 2010). With the growth in media technology, individuals from one side of the world witness events unfolding from across the globe via live communications. With globalized media, young, connected individuals are increasingly watching similar TV programs, visiting similar websites and chatrooms, and forming global friendships. The Western portrayal of lifestyle in ads, movies, music, and brands transfers values from one culture to the other.

In the case of India, the Media Growth during 2004 between 2014 has been substantial. *Ac*cording to TAM media research (http://www.tamindia.com/), India has a strong and growing mass media presence. Out of a total of 234 million households, the number owning TV sets in the country has grown from 105 million in 2004 to over 167 million today, with over 160 million cable and satellite connections, a growth of 11 percent over the previous year. TV reaches 650 million people in India, with 1400 unique television stations in 500 different languages, and over 800 channels (DiehardIndian.com 2012; TAM 2015). India also leads the world with a print media circulation of 330 million daily and is one of the few countries where print media circulation is somewhat stable (DiehardIndian.com 2012; Twocircles.net 2015).

7. *The impact of the Internet on a Culture's Values.* Like mass media (TV, newspapers, and magazines), the Internet may influence values because it exposes consumers to western products and ideals. Such Internet-induced value evolution is more likely to occur amongst youth because they are more connected via online technology. A greater level of online interaction and engagement between the youth of different cultures may lead to a sharing of values; western values will make inroads into eastern cultures and vice versa.

A critical idea of this chapter is that the Internet has the potential to have greater influence on value shifts than traditional media. While traditional media provide one-way communication and are often low-involvement in nature, the Internet encourages greater involvement via personal interaction, friendships, and rich, consistent two-way contact. With greater involvement comes greater persuasion, making the Internet a more influential communication medium.

8. Moreover, engagement on the Internet often occurs between young consumers who are less set in their ways and more open-minded to new ideas. Also, the Internet makes the exchange of ideas easy. It is no more difficult for a tech-savvy student from an Eastern culture to communicate with friends in the USA than to friends from his own country. As a result of these high-involvement interactions, the Eastern student may be awed by the fact that his American friend does not live with his parents, but rather rents an apartment, drives a car, and earns enough money to buy nice brand-centric possessions—traits worth emulating. Such Western, self-aggrandizing lifestyle choices may trickle over to the Eastern student and subsequently dissipate to this student's friends and acquaintances.
9. *The Internet and the impact of Social Influence on Values.* Social media dramatically changed the nature of Internet interactivity from what it was in 2004 when Facebook launched until 2014, when the number of worldwide users had grown to more than 1 billion. Today, those aged 18-34 spend an average of 3.8 hours on social media. Indeed, one of every 7 minutes spent online is on Facebook, with almost 25% of users checking their Facebook account five or more times daily. The average Facebook user has 130 friends, and 88% of teens say that social media helps them stay in touch with those they do not regularly see (Vermeren 2013). Social media has had a tremendous impact on personal and professional relationships, allowing for larger social networks amongst individuals and deeper engagement between individuals in the network, both of which encourage greater interpersonal influence, the most believable form of communication (Liu and Shrum 2002; Van Noort et al. 2012).

Internet-based social networks may have a compounding effect on value diffusion from word-of-mouth influence and opinion leadership. As individual values change, due to interaction with a western audience, so do the values of their friends (face-to-face and online) within the country. The Internet has greatly enhanced the word-of-mouth effect critical to the diffusion of new values and ideas in society (Rogers 2010). Also, opinion leaders can influence thousands of people online via social media, blogs, Youtube, and other connectivity tools today. Opinion leaders influence others, and before long, there is likely to be a significant domino effect. Consider that social media has influenced the way that news, education, law enforcement, political

change, voting behavior, marketing strategy, and music are consumed or practiced, which has in turn impacted and changed economic growth (Vermeren 2013). Such changes support the notion that the diffusion of Westernized values would spread increasingly rapidly, consistent with the increase in Internet adoption (which is 30 percent a year in India) and the evolution of the Internet from informational to social engagement. Mass media, being non-interactive and less social in nature, would be less influential than the Internet.

10. *The growth in Internet Usage in India from 2004-2014 is also substantial.* As indicated in the introduction, internet and other communication technologies have spread dramatically across India over the last decade, with 965.52 million phone users and 462 million internet users, growing at over 30 percent annually (Internet Live Statistics 2014; TRAI 2013). In terms of the total number of Internet users, India has overtaken the USA and is second only to China. These changes are recent phenomena. In 2004, for example, the average Indian consumer was restricted to communication media typical of a developing country. There were just 22 million internet users, and 75 million telephone users, as depicted in Table-1 (as opposed to 462 million internet users and over 200 million smartphone users currently) (Internet Live Statistics 2014; TRAI 2013). The primary media vehicle was television with 104 million households reached in 2004. While TV viewership has grown 50 percent in the past decade, it is the exponential growth in Internet and communication technologies that has truly changed the way the country communicates, from snail mail and phone calls to smartphones, and Internet access.

WHY DOES THIS MATTER FOR BUSINESSES AND WHAT ARE THE IMPLICATIONS?

Media exposure to Western ideals has encouraged the development of an "Indian global citizen," with greater awareness of what is possible via hard work and achievement. Fueled by the Internet revolution, in particular, Indian consumers are increasingly likely to engage in a two-way interaction with Western cultures that value Power and Achievement over Benevolence and Universalism. Engagement with Western culture has influenced India's view of success as one connected with individualism, power, achievement, money, consumption, and materialism. This change in the view of success is reflected by an increasing prevalence of conspicuous brands and flashy fashion (e.g., Independent 2011).

While Power and Achievement values are congruent with one another, they collide with the opposing values of Universalism and Benevolence because the

fulfillment of individualistic values interferes with the fulfillment of collectivist values. Consequently, as the focus on Power and Achievement increases, a natural consequence is that the focus on Benevolence and Universalism decreases. That is, the more time a person spends on enhancing themselves, the less time and attention they have available to help others or society at large. Anecdotal evidence supports this. For example, wealthy Indians neglect philanthropy (Sinha 2014) often preferring to live in ultra-luxury, billion-dollar homes while their countrymen languish in poverty. At the extreme, incidents of chilling public apathy towards those in distress (e.g., Sharma 2013; Stancati and Rana 2014) suggest an increasing aversion to helping others.

Universalism, much like Benevolence, is a value dimension that works in opposition to Power and Achievement, according to values theory (Schwartz et al. 2001). From a logical perspective, this makes sense. For example, national borders become less relevant as people communicate with friends and colleagues around the world, and therefore understand that they perhaps have more in common with someone thousands of miles away in a foreign land, than with their neighbor. Along with this, issues such as national security and pride lose their importance. As Indian consumers, enabled by the Internet and other communication media, increasingly trade and communicate with individuals in countries around the world, national borders, and hence patriotic values associated with the nation and its security, become less important.

The impact of the Internet and media exposure on these value systems is important because consumers often buy products and brands that reflect these values (Beatty et al. 1985; Chen et al. 1999; Hawkins and Mothersbaugh 2010; Johnson 2014; Wansink 2000). If values in a society are rapidly changing, as shown in this research, so do ideals of self-concept (Hawkins and Mothersbaugh 2010), attitude towards product attributes (Gurhan-Canli and Maheswaran 2000), societal innovativeness (Parthasarathy et. al. 1997), reactions to marketing communication (Pornpitakpan and Francis 2001; Choi, Lee, and Kim 2005), preferences for various sources of information (Money, Gilly, and Graham 1998), and consumption symbolism (Robinson 1996). In summary, the study of fast-changing values is critical as it impacts a variety of product development, communication, and consumption related strategies relevant to global organizations.

Given the huge increase in connection with western audiences via the Internet, it has been proposed that Indian buyers would likely adopt more western core values, prioritizing Self-Enhancement ideals related to Power and Achievement over Self-Transcendence related values, specifically Universalism and Benevolence. We hypothesized that internet usage would elevate the importance of Power and Achievement and that this increase would be progressively stronger from 2004-2014, along with the evolution of social media. The opposite would be true for

both Benevolence and Universalism, which would decline over time as western, individualistic ideals erode traditional collectivist values, with this negative effect progressively increasing over a decade.

The fact that increased time spent on the Internet leads to increased individualistic traits as embodied by the *Power and Achievement* dimension, and decreased scores on the collective *Universalism* trait is indeed a significant finding. What is particularly profound is that all this happened in the span of just ten years, belying existing research that core consumer values are slow to change (Rokeach 1973). While a move towards individualism would naturally occur as a country develops, enjoys a growing, empowered middle class, and is more exposed to western media outlets (be they TV channels, magazines, etc.), this study strongly suggests that the Internet caused the rapidness of the change and *not* mass media exposure. Indeed, it is a significant finding that none of the traditional media vehicles measured, namely TV viewership, magazine, and newspaper subscriptions had any impact on the change in values. This is despite the fact that TV penetration increased by approximately 50 percent from 2004 to 2014. As an ever-increasing number of Indian Internet users visit western websites, interact with a global audience, and idolize western products, lifestyles, and values, it stands to reason that they forsake some of their eastern ideals in favor of western ones. Further, *Universalism* traits, e.g., national security, world-at-peace, equality, etc., become less important as Indian Internet users become global citizens, and as Self-Enhancement needs become more important.

Of some significance is that both the impact of the positive effect of Internet time on *Power and Achievement* and its negative effect on *Universalism* are increasing over time. This is further demonstrated by the fact that the number of Internet users in India is likely to continue to grow exponentially. For example, the growth rate of internet users is expected to be 44 percent annually, with over two billion "networked" devices by 2017 (Economic Times 2013). Taken together, this would suggest that individualization of values, propelled by ICT, is likely to progress at an ever-increasing rate, at least in the near future.

The increased westernization of Indian consumers is also reflected in their consumption of products. This increase would suggest an increase in the demand for conspicuous products that adequately portray consumers' newfound individualism. For marketers, the implications are clear; the value and the equity of the brand become important, and brands that are globally recognized and valued will be construed as more desirable. Highlighting the upscale nature of the brand, or its outgoing personality, will be the preferred strategy. When consumers feel that a brand's benefits help them achieve their values, brand preference and loyalty follow. In light of this, marketers need to be especially aware of evolving values. Indeed, they need to anticipate how and when values will change because it often takes many years to change a brand's image. If managers do not foresee value shifts, their brand

could end up representing unimportant values or possibly even clash with newly adopted values. To avoid this, brands need to attach to values that are growing in importance; while these values are on the rise. In other words, brand image must evolve alongside changing values. This also has implications for advertising. The online generation is best reached via email, social media marketing, and websites, and hence, a shift in media strategy may be warranted.

The Internet provides a unifying experience since all Indian consumers online communicate in English. They interact with one another, as well as with their friends around the world, in the English language. They learn from one another, influence one another, and are influenced by one another. This would suggest that young, connected people around India are more similar to one another than they are to the general population or that the similarity within the Internet community is greater than the similarity within the general population of India.

REFERENCES

Anderson, P., De Bruijn, A., Angus, K., Gordon, R., & Hastings, G. (2009). Impact of Alcohol Advertising and Media Exposure on Adolescent Alcohol Use: A Systematic Review of Longitudinal Studies. *Alcohol and Alcoholism (Oxford, Oxfordshire)*, 115. PMID:19144976

Andrews, R. (2004). *The Impact of Ict on Literacy Education*. Psychology Press.

Basu, D. D. (2002). *The essence of Hinduism*. PHI Learning Pvt. Ltd.

Batra, R., Ramaswamy, V., Alden, D. L., Steenkamp, J.-B. E., & Ramachander, S. (2014). Effects of Brand Local and Non-Local Origin on Consumer Attitudes in Developing Countries. *Journal of Consumer Psychology*, *9*(2), 83-95.

Beatty, S. E., Kahle, L. R., Homer, P., & Misra, S. (1985). Alternative Measurement Approaches to Consumer Values: The List of Values and the Rokeach Value Survey. *Psychology & Marketing*, *2*(3), 181-200.

Bhattacharya, A. (2018). The Number of Smartphone Users in India Will More Than Double in Four Years. *Quartz India.* Retrieved from: https://qz.com/india/1483368/indias-smartphone-internet-usage-will-surge-by-2022-cisco-says/

Black, S. E., & Lynch, L. M. (2001). How to Compete: The Impact of Workplace Practices and Information Technology on Productivity. *Review of Economics and Statistics*, *83*(3), 434-445.

Bond, M.H. (1988). Finding universal dimensions of individual variation in multicultural studies of values: The Rokeach and Chinese value surveys. *Journal of Personality and Social Psychology*, *55*(6), 1009-1015.

Braithwaite, V. A., & Law, H. (1985). Structure of Human Values: Testing the Adequacy of the Rokeach Value Survey. *Journal of Personality and Social Psychology*, *49*(1), 250.

Chen, C.-N., Lai, M., & Tarn, D. D. (1999). Feminism Orientation, Product Attributes and Husband-Wife Decision Dominance: A Taiwan-Japan Cross-Cultural Study. *Journal of Global Marketing*, *12*(3), 23-39.

Choi, B., Lee, I., & Kim, J. (2006). Culturability in Mobile Data Services: A Qualitative Study of the Relationship between Cultural Characteristics and User-Experience Attributes. *International Journal of Human-Computer Interaction*, *20*(3), 171–203. doi:10.120715327590ijhc2003_2

DiehardIndian.com. (2012). Retrieved From: Http://Www.Diehardindian.Com/Entertain/Media.Php

Economic Times. (2013). India to Have 348 Million Internet Users by 2017: Cisco. *Economic Times.* Retrieved from: http://articles.economictimes.indiatimes.com/2013-06-04/news/39740674_1_traffic-internet-access-indian-mobile-data)

Eng, T.-Y., & Bogaert, J. (2010). Psychological and Cultural Insights into Consumption of Luxury Western Brands in India. *Journal of Customer Behaviour*, *9*(1), 55-75.

Esmer, Y. (2006). Globalization, Mcdonaldization and Values: Quo Vadis? *Comparative Sociology*, *5*(2), 183-202.

Ester, P., Halman, L., de Moor, R., & de Moor, R. (1994). *The Individualizing Society: Value Change in Europe and North America*. Tilburg University Press Tilburg.

Friedman, T. L. (2005). *The World Is flat: A Brief History of the Twenty-first Century*. New York: Farrar, Straus and Giroux.

Ghemawat, P., & Reiche, S. (2011). *National Cultural Differences and Multinational Business*. Retrieved from https://pdfs.semanticscholar.org/dbb7/0b0e14146d1a5a6c4c85bb815c25557849fa.pdf

Gigler, B.-S. (2011). *Informational Capabilities - the Missing Link for the Impact of Ict on Development.* Available at SSRN: http://ssrn.com/abstract=2191594

Gupta, N. (2011). Globalization Does Lead to Change in Consumer Behavior: An Empirical Evidence of Impact of Globalization on Changing Materialistic Values in Indian Consumers and Its Aftereffects. *Asia Pacific Journal of Marketing and Logistics*, *23*(3), 251-269.

Gürhan-Canli, Z., & Maheswaran, D. (2000). Cultural Variations in Country of Origin Effects. *JMR, Journal of Marketing Research*, *37*(3), 309–317. doi:10.1509/jmkr.37.3.309.18778

Hammond, A. L. (2007). *The Next 4 Billion: Market Size and Business Strategy at the Base of the Pyramid*. Washington, DC: World Resources Institute, International Finance Corp.

Hawkins, D., & Mothersbaugh, D. (2010). *Consumer Behavior: Building Marketing Strategy* (11th ed.). New York: McGraw-Hill/Irwin.

Hendriks, P. (1999). Why Share Knowledge? The Influence of Ict on the Motivation for Knowledge Sharing. *Knowledge and Process Management*, *6*(2), 91-100.

Hofstede, G. (2015/2019). *What About India*. The Hofstede Center. Retrieved from: http://geert-hofstede.com/india.html

Hofstede, G. H., & Hofstede, G. (2001). Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations across Nations. *Sage (Atlanta, Ga.)*.

IMF. (2014). *Gross Domestic Product Based on Purchasing-Power-Parity Share of World Total*. International Monetary Fund.

IMF. (2018). *Report for Selected Country Groups and Subjects (PPP valuation of country GDP).* IMF.

Independent. (2011). Flashy Fasion Grows as India's Rich Flaunt Wealth. *The Independent.* Retrieved from: http://www.independent.co.uk/life-style/flashy-fashion-grows-as-indias-rich-flaunt-wealth-2287713.html

Inglehart, R. (1997). *Modernization and Postmodernization: Cultural, Economic, and Political Change in 43 Societies*. Cambridge Univ Press.

Inkeles, A. (1998). *One World Emerging?: Convergence and Divergence in Industrial Societies*. Westview Press.

Internet Live Statistics. (2019). Retrieved from http://www.internetlivestats.com/internet-users/india/

Internet World Stats. (2019). Retrieved from https://www.internetworldstats.com/asia/in.htm

Johnson, C. (2014). What Would Jesus Buy? New Website Helps Consumers Make Decisions Based on Biblical Values. *Desert News National.* Retrieved from http://national.deseretnews.com/article/1937/what-would-jesus-buy-new-website-helps-consumers-make-decisions-based-on-biblical-values.html

Kinra, N. (2006). The Effect of Country-of-Origin on Foreign Brand Names in the Indian Market. *Marketing Intelligence & Planning*, *24*(1), 15-30.

Kraidy, M. (2002). Globalization of culture through the media. In J. R. Schement (Ed.), *Encyclopedia of Communication and Information* (Vol. 2, pp. 359–363). New York, NY: Macmillan.

Lane V., Khuntia J., Parthasarathy M., Hazarika B. (2017). The Impact of the Internet on Values: Shifts in Self-Enhancement and Self-Transcendence amongst Indian Youth. *Journal of Global Information Managemen*, *25*(3), 98-120.

Levitt, T. (1984, Summer). The Globalization of Markets. *The McKinsey Quarterly*, 1–20.

Lindsay, S., Bellaby, P., Smith, S., & Baker, R. (2008). Enabling Healthy Choices: Is Ict the Highway to Health Improvement? *Health, 12*(3), 313-331.

Liu, Y., & Shrum, L. (2002). What Is Interactivity and Is It Always Such a Good Thing? Implications of Definition, Person, and Situation for the Influence of Interactivity on Advertising Effectiveness. *Journal of Advertising*, *31*(4), 53–64. doi:10.1080/00913367.2002.10673685

Mazrui, A. (1996). *Perspectives: The Muse of Modernity and the Quest for Development*. Academic Press.

McLuhan, M. (1962). *The Glutenberg Galaxy: The Making of the Typographic Man*. University of Toronto Press.

Money, R. B., Gilly, M. C., & Graham, J. L. (1998). Explorations of National Culture and Word-of-Mouth Referral Behavior in the Purchase of Industrial Services in the United States and Japan. *Journal of Marketing*, *62*(4), 76–87. doi:10.1177/002224299806200406

NGT. (2008). Global Youth Panel. *NGT*. Retrieved from www.nextgreatthing.com

O'Mahony, M., Robinson, C., & Vecchi, M. (2008). The Impact of ICT on the Demand for Skilled Labour: A Cross-Country Comparison. *Labour Economics*, *15*(6), 1435-1450.

O'Mahony, M., & Vecchi, M. (2005). Quantifying the Impact of Ict Capital on Output Growth: A Heterogeneous Dynamic Panel Approach. *Economica*, *72*(288), 615-633.

Padmanabhan, M. (2012). Walmart's Struggles in India: How Institutional Contexts Can Limit Foreign Entry. *Journal of Communication, Culture & Technology*, *13*, 1.

Parthasarathy, M., Lane, V., & Stansifer, M. (2015). A Time-Based Analysis of Changing Consumer Values in India. *Journal of Indian Business Research*, *7*(3), 271–291. doi:10.1108/JIBR-12-2014-0091

Passey, D., & Goodison, R. (2004). *The Motivational Effect of Ict on Pupils*. DfES Publications.

Pornpitakpan, C., & Francis, J. N. (2000). The Effect of Cultural Differences, Source Expertise, and Argument Strength on Persuasion: An Experiment with Canadians and Thais. *Journal of International Consumer Marketing*, *13*(1), 77–101. doi:10.1300/J046v13n01_06

Rao, S. (2000). India's Rapidly Changing Consumer Markets. *Economic and Political Weekly*, 3570–3572.

Richins, M. L. (1987). Media, Materialism, and Human Happiness. *Advances in Consumer Research*, *14*(1), 352-356.

Robinson, S. L. (1996). Trust and breach of the psychological contract. *Administrative Science Quarterly*, *41*(4), 574–599. doi:10.2307/2393868

Rogers, E. M. (2010). *Diffusion of Innovations*. Simon and Schuster.

Rokeach, M. (1968). The Role of Values in Public Opinion Research. *Public Opinion Quarterly*, *32*(4), 547-559.

Satpathi, S., & Roy, O. (2011, June). The Impact of the Electronic Media on the Modern Indian Voter: A Study of the Post Liberalization Era. Global Media Journal, 1-29.

Schwartz, S. H. (1992). Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries. Advances in Experimental Social Psychology, 25(1), 1-65.

Schwartz, S. H., Melech, G., Lehmann, A., Burgess, S., Harris, M., & Owens, V. (2001). Extending the Cross-Cultural Validity of the Theory of Basic Human Values with a Different Method of Measurement. *Journal of Cross-Cultural Psychology*, *32*(5), 519-542.

Scott, W. A. (1965). *Values and organizations: A study of fraternities and sororities*. Chicago: Rank McNally.

Sharma, A. (2013). Even Animals Don't Behave Like That: India's Gang Rape Victim's Friends Recalls the Apathy of Police, Public after Deadly Attack. *The National Post.* Retrieved from: http://news.nationalpost.com/2013/01/04/even-animals-dont-behave-like-that-india-gang-rape-victims-friend-recalls-apathy-of-police-public-after-deadly-attack/

Sinha, K. (2014). Why Indian Billionaires Are So Bad at Charity. *The Times of India.*

Sirgy, M. J., Gurel-Atay, E., Webb, D., Cicic, M., Husic, M., Ekici, A., Herrmann, A., Hegazy, I., Lee, D.-J., & Johar, J. (2012). Linking Advertising, Materialism, and Life Satisfaction. *Social Indicators Research*, *107*(1), 79-101.

Smith, P. B., & Schwartz, S. H. (1997). Article. In W. Berry, C. Kagitcibasi, & M. H. Segall (Eds.), Handbook of Cross-Cultural Psychology: Vol. J. Values. Boston: Allyn & Bacon.

Stancati, M., & Rana, P. (2014). Culture of Apathy Haunts India. *Wall Street Journal.* Retrieved From: http://blogs.wsj.com/indiarealtime/2013/04/16/culture-of-apathy-haunts-india/

Statistica. (2019). Retrieved From: https://www.statista.com/statistics/268136/top-15-countries based-on-number-of-Facebook-users/

TAM. (2015). *Tam Report 2015*. Retrieved From: Http://Www.Tamindia.Com/Webview.Php?Web=Ref_Pdf/Overview_Universe_Update_2015.Pdf

Thussu, D. K. (2007). Themurdochization'of News? The Case of Star Tv in India. *Media, Culture & Society*, *29*(4), 593-611.

TRAI. (2013). *Highlights of Telecom Subscription Data*. New Delhi, India: Telecom Regulatory Authority of India.

Twocircles.net. (2015). *Print Media Grows by 6.25%; Urdu at No. 3*. Retrieved From: Http://Twocircles.Net/2011dec30/Print_Media_Grows_625_Urdu_No_3.Html#.Vqtiubdf-Ja

Van Noort, G., Antheunis, M. L., & Van Reijmersdal, E. A. (2012). Social Connections and the Persuasiveness of Viral Campaigns in Social Network Sites: Persuasive Intent as the Underlying Mechanism. *Journal of Marketing Communications*, *18*(1), 39–53. doi:10.1080/13527266.2011.620764

Vermeren, I. (2013). *How Social Media is Changing the World.* Retrieved from https://www.brandwatch.com/2013/08/how-social-media-is-changing-our-world-infographic/

Villani, S. (2001). Impact of Media on Children and Adolescents: A 10-Year Review of the Research. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*(4), 392-401.

Walker, C. (2008). Six Seismic Shifts in Global Teen Culture. *Chief Marketer*. Retrieved from www.chiefmarketer.com

Wansink, B. (2000). New Techniques to Generate Key Marketing Insights. *Marketing Research*, *12*(2), 28-36.

Chapter 9
Fading Challenges in Implementation of Supply Chain Management Information System in the Indian Automobile Industry

Manisha Seth
Noida Institute of Engineering and Technology, India

Ravi Kiran
Thapar Institute of Engineering and Technology, India

D. P. Goyal
https://orcid.org/0000-0003-4144-8082
Indian Institute of Management, Shillong, India

ABSTRACT

With the advent of globalization and fast changing environment, companies are using information and communication systems in the supply chain. Supply chain management information system (SCMIS) has gained a lot of importance because of its ability to reduce costs and increase responsiveness in the supply chain. Review of literature has revealed that the success in implementation of SCMIS and successfully attaining the return expected from the system implemented is a challenge. With such high failure rates scenario, it becomes imperative to identify the risk and the failure factors that may arise during implementation and the ways to tackle these risks. In this chapter, an attempt has been made to establish the challenges, their severity, and

DOI: 10.4018/978-1-7998-1786-4.ch009

improvisation for the successful implementation of SCMIS in the Indian automobile industry. The findings can help the practitioners and managers better understand the challenges, focus the resources, their attention, set up the priorities, and thus improve the chances of successful implementation of SCMIS.

INTRODUCTION

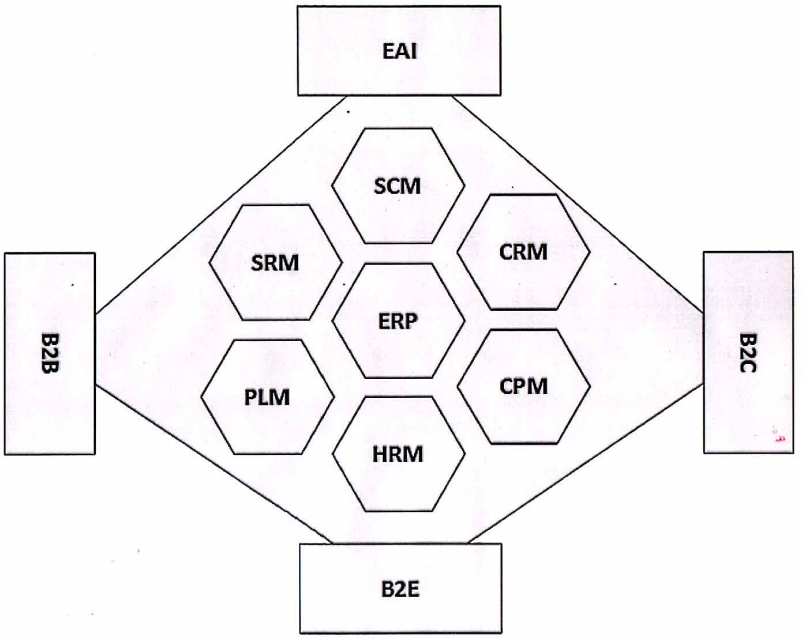
In the contemporary world competitive advantage of an organization depends on the information sharing and flow of information across the supply chain with the help of information technology. Information sharing in SCM is receiving attention for achieving global competitive advantage (Khurana et al., 2011). Through the use of information based upon the use of information technologies, the efficiency and effectiveness of supply chains can be significantly enhanced. Thus IT plays an important role in integrating supply chain. Besides information flow it also helps in various decision making processes. At present focus is on integration of upstream and downstream partners through Supply Chain Management Information System (SCMIS). It is cross-functional, inter-enterprise system that uses information technology to support and manage the linkages between company's processes involved in buying, making and moving a product. It integrates supplier, manufacturer, distributor and customer logistics processes to improve manufacturing efficiency and distribution effectiveness.

Supply chain management information system (SCMIS) extension of Enterprise resource planning (ERP) as shown in Fig 1 (Moller, 2005) integrates companies beyond the boundaries of an organization and with the advent of globalization it has further gained more importance (Marwah, et al., 2012).

It has been recognized by many organizations as a strategy to attain business goals (Chan and Lee 2005). SCMIS involves managing and coordinating all activities associated with goods and information flows from raw material sourcing to product delivery and finally to the end customers (Wei and Chen, 2008). It provides high quality, relevant and timely information flow that effectively supports decision-making for inventory replenishment, capacity activation and for synchronizing material flows at all tiers within the supply chain. Thereby it plays an increasingly critical role in the ability of firms to reduce costs, increase responsiveness (Chopra and Miendl 2005), gain competitive advantage (Dezdar, 2011) and achieve better coordination.

Manufacturing companies including automobile companies have already realised the importance of these systems as it needs to keep control over costs at every stage to remain competitive. The emergence of e-business has thus led to different way in which enterprise communicate, transmit and receive information with the suppliers upstream and customers downstream. Major OEMs have realized the benefits arising

Figure 1.



out of these systems; however, the achievement of these above mentioned benefits depend upon the effective implementation of the SCMIS. Implementing these systems is a complex, lengthy and expensive process. These systems require huge commitment of funds, time and expertise (Motwani et al. 2008). There is a strong evidence in the literature that implementation of SCMIS projects were either not completed on time or did not bring about the planned effects and even exceeded their estimated costs (Davenport 1998).

This is substantiated by the research done by Panorama consulting solutions in 2018 which summarizes the experiences of 237 ERP customers with regards to enterprise software, vendors, consultants and overall implementation as shown in Table 1 and Fig 2

Table 1 shows the average project cost percentage of implementation for last five years is 5.2% and average duration for implementation to be 17.2months. Further for 2017, 64% of the projects have exceeded their planned budgets, 79% have exceeded their planned durations and about 44% of respondent organizations have received less than 50% of the benefits that was expected from the system. Fig 2 shows 42% of the respondents deemed their ERP implementation a success, 28% perceived that

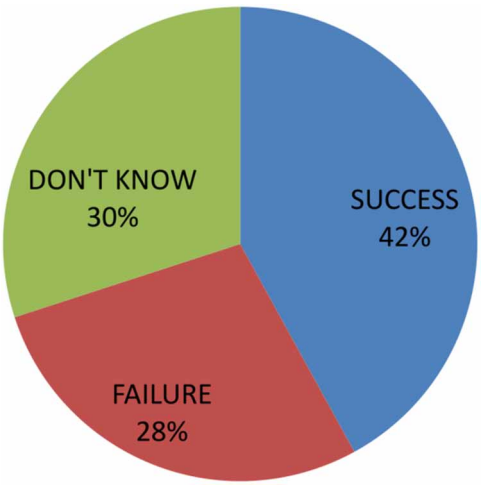
Table 1. Experience of ERP users with regard to enterprise software

Year	Average Project Cost Percentage	% of cost Overruns	Duration	% of Duration Overruns	% Receiving 50% or Less Benefits
2017	3.6%	64%	17.4 months	79%	44%
2016	6.5%	74%	16.9 months	59%	37%
2015	5.9%	57%	21.1 months	57%	46%
2014	4.6%	55%	14.3 months	75%	41%
2013	5.5%	54%	16.3 months	72%	66%

the implementation of ERP has failed and 30% were not sure about the outcome. The overall failures and implementation difficulties in implementing these systems have attracted lot of research (Singh, 2010)

In SCMIS, too much focus is paid on the technical and financial part of the project, and often the non-technical issues are neglected. Leon (2008) defines these systems as people's project. Therefore, SCMIS must be viewed in a different perspective, as a new business endeavour and not just an IT project. Changing this mind-set will reduce the failure rate in the implementation of these enterprise systems. During the course of our detailed research and analysis, it is observed that the technical problems how so ever large it may be are not the main reason for unsuccessful implementation of SCMIS projects.

Figure 2.



Therefore, in addition, there are organizational issues like top management support, change management, BPR ; Human issues like users participation, resistance to change, employees motivation ; inter organizational issues like trust between members, willingness to collaborate, long term relationship among chain members ; and other issues like data quality, product selection, IT infrastructure, project goals, project team and project schedule that needs to be addressed for the successful implementation of SCMIS projects. Further, the management should not expect the rewards for granted that may accrue from implementation of SCMIS projects; but should also consider the risks involved and the ways to tackle these other issues. Henceforth, it is crucial to have conducting research on the SCMIS systems for their successful implementation. Thus, the study has been undertaken with an objective to find out the critical impediments and challenges in implementing SCMIS in the Indian automobile industry of India.

THEORETICAL BACKGROUND

Critical Failure Factors (CFFs) are the key areas where things must go wrong in order for the implementation process to achieve a high level of failure. Huge cost is involved in the implementation of these complex systems, and failure would lead to huge monetary loss to an organization. Therefore to avoid such costly failures researchers are putting in efforts so as to help organizations make better use of their resources. Failure may be defined in terms of project factors like cost or time overruns. It may also be defined as a failure if the system is not able to meet the desired expectations of integrating organizational information, better communication across the organizations, better decision making, and reduction in cost. As is evident from the literature, the failure rate of ERP implementation is very high. It has been observed that about 70%of ERP implementations fail to deliver anticipated benefits and 75% of these projects are unsuccessful (Kumar, 2003). These projects are, on average, 178%over budget took 2.5 times longer than intended and delivered only 30% of promised benefit (Zhang, 2005). With such high failure rates scenario it becomes imperative to identify the risk and the failure factors that may arise during implementation and the ways to tackle these risks. Therefore an extensive review of literature was undertaken to identify the impediments which are defined as an obstacle that prevents an action or event from being carried out successfully (Peng &Nunes, 2010). Two groups of studies have been considered, firstly, failure factors focusing on ERP implementations and secondly, CFFs for implementation of inter-organizational systems.

Venkatraman and Fahd (2016) described challenges, such as ERP customization, BPR and training as the major constraints for ERP adoption in SMEs. Other key factors considered where high cost of upgrades, high integration cost and high maintenance cost.

Ranjan et al., (2016) through in-depth review of literature presented the ERP implementation challenges from four different perspectives of technology selection; change management, knowledge management and emerging technologies. According to them it is important that the organisation and ERP system are compatible with each other for successful implementation.

Basu and Biswas (2013) attempts to empirically assess factors most critical in the ERP implementation process from the Indian perspective. Findings of the study suggest factors like poor quality of testing, poor consultant effectiveness, overreliance for high customization, lack of proper communication, poor quality of BPR and high turnover rate which lead to unsuccessful implementation of Enterprise Business Application.

Garg and Garg (2013) focused on the process of identifying, analyzing and prioritizing the failure factors of ERP implementation using cause-effect and Pareto analysis. Results suggest that 9 critical failure items namely inadequate resources, poor user involvement, users' resistance to change, high attrition rate of project team members, lack of top management commitment, poor project management, inadequate project team composition, ineffective organizational change management and unrealistic project scheduling have a high impact on ERP implementation and therefore deserve serious attention in the process of ERP implementation.

The main purpose of the study by Amid et al. (2012) was identification of the factors and classifies them to help other industries, consultants and implementers to prevent failures in ERP projects implementation. The CFFs were classified in seven groups named as vendor and consultant, human resources, managerial, project management, processes, organizational and technical. They analyzed and concluded the following important CFFs: a) the lack of any clearly defined IT strategies and its alignment with business strategies and goals, b) the lack of a full time and balanced project team, c) poor human resources management d) inaccurate data, and e) the absence of an ERP readiness assessment before project implementation.

Shah et al. (2011) attempted to understand how and why different factors impeded successful ERP implementation in a public organization. The findings showed lack of user involvement, lack of top management support, lack of vendors experience and support, and lack of change management as impediments of ERP successful implementation. Other factors like turnover of ERP developers team members and transfer/posting or retirement from service of top management of beneficiary organization, all thus leading to project run over cost, behind schedule and not able to meet user requirements.

The study by Khurana et al. (2011) identified and measured the perceived importance of information sharing barriers in SCM. The barriers have been categorized as managerial, organizational, technological, individual, financial, social and cultural. The crucial barriers found in the study were financial, technological and organizational barriers for information sharing in SCM industries. The top three barriers were 'financial constraints for high cost of maintenance' under financial barrier category, followed by 'data and information security' from the category of technological barriers and finally 'cost of specialized manpower and training 'from financial barrier category.

Ganesh and Mehta (2010) on the basis of research study identified and validated some of the crucial failure factors affecting ERP implementation in context to Indian small and medium scale enterprises which include: poor quality of testing, unrealistic expectations from top management, poor top management support, poor consultant effectiveness, users resistance to change, software modification, functionality problem with system, poor project management, unclear concept about ERP system, poor quality of BPR, poor IT infrastructure, high turn overrate and informal strategy.

The study by Peng and Nunes (2010) identifies, assesses and discusses potential cultural, organizational and system barriers to the successful exploitation of ERP systems. The findings of this study identified perceived system barriers as most critical to ERP exploitation, but they seemed to overlook the organizational barriers. Thus insufficient supports and services from system vendors, system incompatibility, slow system response time, System inflexibility,Inexperienced and low- qualified system consultants, Power centralization of top management, Lack of in-house IT specialists, high cost for add-ons and further system development were reported as barriers to successful implementation of ERP.

Garg (2010) explores and validates the existing literature empirically to find out the critical failure factors that lead to the failure of ERP in context to Indian retail organizations. The CFFs are classified into the following three dimensions: strategic, tactical and operational. Strategic dimension included top/middle management in implementation of ERP, tactical consists of 11 items that deals with various project managements& selection criteria related issues of ERP product; finally operational dimension consisted of 5 items that deals with the user training and involvement.

Soja (2008) identified barriers to enterprise system (ES) adoption success. The barriers were categorised as economic, technical, organisational and social. He concluded in the study that the most important issues were connected with infrastructure, time, cost, and knowledge. The outcome of the study was that people involved in project teams should represent all areas of the company which are affected by ES adoption and should hold various positions across different levels of

the company's organisational hierarchy. He also stated that it would be beneficial to involve people from outside the organisation, who have expert knowledge and extensive ES implementation experience.

The study by Kumar et al. (2003) investigates critical management issues in ERP implementation. The study concluded that in implementing ERP systems firms face more behavioral and management related challenges; such as the end-user not being ready, resistance to change, lack of training, turnover of key project persons and lack of project planning, rather than pure technical glitches such as software bugs and configuration difficulties.

Tapp et al. (2003) in the study tries to address the potential pitfalls namely inadequate education and training, poor leadership and support from top management, resistance to change, unrealistic expectations for benefits for the implementation of ERP.

Study by Umble and Umble (2003) investigates how to avoid ERP implementation failure. The study divided ERP implementation failures into 10 categories: poor leadership from top management, unrealistic expectations, inadequate education and training, poor project management, a bad match, trying to maintain the status quo, inaccurate data, ERP implementation is viewed as an IT project, automating existing redundant or non-value-added processes in the new system, and significant technical difficulties.

These impediments were categorized into six main barriers

- Financial barriers
- Organizational Barriers
- Inter organizational barriers
- Human Barriers
- Project Management barriers
- Technical barriers

Financial Barriers

The research by Khalifa (2103) and Kang et al. (2012) considers financial hindrance for implementation of information systems. Huge investment is required for the implementation of SCMIS. The general financial barrier includes cost of the system and cost of trainings. Cost benefit analysis is done to justify the investment. The various costs involved are cost of the software, migration of legacy data, implementation consultant cost, internal project team costs, training cost, and post-implementation maintenance cost. Both tangible and intangible benefits accrue from the implementation of the system. Tangible benefits include reduction in inventory, better forecasting, improving supplier on time delivery, reduction of lead time

in production and delivery, better resource planning and reduction in workforce costs. Intangible benefits include improvement in communication, reduced chaos and confusion, real time flow of information and better services to customers. The company analyzes economic feasibility, and often fails to draw a clear return from the investment that is being transpired. Thus, unclear ROI from the system forms one of the major barriers for the implementation of the system (Koh et al., 2008). Cost and time overruns is another problem faced by the organization which adds up to the otherwise expensive IS. According to the study by Soja (2008) lack of funds is one of the main causes of failure of ERP.

Organizational Barriers

One of the prime hindrance factors is the *lack of top management support, vision, and focus*. Various researchers like, Shah et al. (2011), Finney & Corbett (2007) and Bhatti (2005), have stressed that if there is lack of commitment and participation from the top management, there are huge chances of failure. The top management must view SCMIS implementation as an improvement in the way the company is doing the business and not just an IT project. Top management support is needed in all phases of implementation (Sarker & Lee, 2003) like adoption of proper change management, proper understanding of the capabilities and limitations of the system, management of expectation (Tapp et al., 2003) and regular feedback from the project management team. Less active participation (Umble, 2003) and lack of tracking of the project progress by the Top Management becomes one of the barriers for the successful implementation of the system (Bhatti, 2005).

There should be a formal communication about the benefits of the system to the users (Sarker & Lee, 2003), because it is very important to convince the users that ultimately the change is for the betterment of both the company and the individual and ineffective communication with the users would lead to the failure of the system. The proper communication would lead to thorough understanding of "As-Is" & "To-Be" business models and would lead people moving in the right direction from the top to the bottom by understanding the future benefits of collaborating with the partners, both downstream and upstream. Thus *lack of clear formal communication* among implementation team, software provider, and the users would lead to informal channels of communication which may lead to inaccurate flow of information in the organization. Thus it forms a barrier to successful implementation of the system.

Change management (Aleballa& Al-Mudimigh, 2011; Leon, 2008) is one of the factors that affect the ERP adoption in organizations. The organization faces two types of changes namely the way business is done and the way people do their job therefore for successful implementation of the system both these changes needs to be addressed so as to overcome the resistance otherwise lack of commitment to

change forms a barrier in the implementation process. The studies by Lindley et al. (2008), and Umble et al. (2003) consider the lack of change management as a hindrance for successful implementation, and Kim et al. (2005) pointed that unless change management is appropriate in an organization, it would be difficult to adapt to the new system and to obtain total benefits from it.

Poor quality BPR leads to unsuccessful implementation of the system. The role of BPR in the implementation of SCMIS is of prime importance (Hsu et al., 2015). If business processes are not re- engineered properly to fit with the SCMIS system it leads to system configuration problem. Most of the researchers are of the opinion to fit business process to the system so that minimal customization is to be done. According to Bingi et al. (1999), implementing an ERP system involves re-engineering the existing businesses to the best business process standard. Thus BPR outlines how to reengineer human and system behaviors to fit SCMIS to the enterprise and lack of it will be detrimental to the success of the system. Another problem faced is the *absence of readiness assessment before project implementation*. Study by Jagoda and Samaranayake (2017) mention's readiness assessment as a key for eliminating the main causes of many failures. Individuals and organizations might not be ready for complex level of integration leading to unsuccessful implementation of the system.

Finally *an unrealistic expectation from both the management and the user side* forms the barrier to the successful implementation of the system. The management has to be prepared for the decrease in the productivity of the people in the initial phase of the implementation and cannot expect return overnight. Also the users need to understand that they will require time to become efficient in using the new system.

Inter-Organizational Barriers

Study by Weston (2003) has divided barriers to the implementation of ERP II system into two categories, general business issues and issues related to technological infrastructure. The study refers issues of collaborative BPR or business management process as a barrier to implementation. Inter-organization relationship which includes trust, willingness for collaboration and shared vision between the partners is very important for the successful implementation of SCMIS. The *Lack of trust* among supply chain members has been considered by various researchers (Schoorman et al., 2007) as a barrier to information sharing. Premium on trust is placed since an organization allows an outsider to view their transaction level data which in term faces the competitive risk (Young et al., 1999). Thus due to the collaborative nature, trust and security issues which were not there in case of ERP surfaces in case of SCMIS implementation. Another barrier is *inter-rivalry* as researched by Fawcett et al. (2012) which include the lack of willingness to share information, risk, and

rewards. Further due to cultural differences, span of relationship, and volume of transactions, trading partners may be *unwilling to collaborate* leading to the unsuccessful implementation of the system.

Additionally, the *lack of shared vision* between supply chain partners leads to less information sharing (Mentzer et al., 2000) and more resistance from people leading to reduction in the quality of information being shared, causing less successful implementation of the system. Most of the executives' lack business understanding which become more challenging when external partners are included (Koh, 2011).

Human Barriers

The *resistance to change* by the people (Tapp et al., 2003) forms one of the critical barriers to successful implementation of enterprise system. It is the people who can make or break the success of a project without their buy –in and support projects are doomed. Leon (2008) in the study has stressed that system implementation is not a technology but a people project.

According to Umble et al. (2003) people have a natural tendency to be comfortable with the status quo therefore do not require a new system and are resistant to change but it's not a resistant itself that leads to failure, it's the way we handle it. To respond to resistance in an effective and proactive manner we must first understand why we are facing resistance. The study by Umble et al. (2003) have shown that the resistance is due to lack of understanding about the system, lack of process orientation, fear of unknown, fear of computers, transparency of data and information, increase in accountability, not knowing the degree of priority assigned by top management and fear of losing job. Therefore to be successful in SCMIS implementation it is important to overcome this resistance.

Lack of sufficient training will result in users that are unable to run the system properly (Umble et al., 2003). Insufficient training and education will increase the resistance associated with the system. These systems are extremely complex and require thorough training. Unless and until proper training is given the user will not be able to understand about what the new system will achieve and how his way of working will change (Kang et al., 2012). Proper confidence building should be done in the training period otherwise the user will keep on working in the legacy way leading to the failure of the system. Training will help to meet users' expectation and decrease the uncertainty associated with the system. It will help the users' to be satisfied with the system and user satisfaction will act as a measure of information systems success (Wu et al., 2002).

Lack of users' participation, involvement, and motivation will act as a hindrance factor to the successful implementation since users would be less motivated to use it and at the same time they might fear the new system. Studies by Francoise et al.

(2009) and Ngai et al. (2008) includes two important areas for users' participation, i.e., when the organization is defining the need for adoption of the system and during the implementation phase. Lack of participation will lead to more resistance from the users as they will not be in a position to understand the future prospects of adopting the system and how they fit into the system. Thus user acceptance for the project will be less and it would be difficult to achieve project success.

Project Management Barriers

According to Khaparde (2012) one of the top three reasons for the failure of IT projects as cited by 77% of IT managers in Information week was poor planning or poor management. Project management deals with planning, execution, monitoring and controlling of a project. It requires the ability to examine in project details while keeping a perspective on the original business objectives. *Lack of effective project management methodology* plays a major role in the failed implementation of the systems. Without proper project management, system will not be able to deliver the promised functionalities and will experience time overrun and cost overrun. According to the study by Umble et al. (2003) one of the reasons for system implementation failure is the underestimation of the scope, size, and complexity of the project. They also emphasized about the lack of development of achievable schedules and lack of proper communication of realistic expectations unfavorable to the successful implementation of the system. Another reason for poor project management effectiveness was that project team members lacked ERP experience (including top management, the project manager, middle level management and operational staff). The *lack of experienced project leader* also becomes a hindrance factor. He also plays a crucial role in the selection of the implementation team (Sarker & Lee, 2003). The project manager needs to have the ability to overcome the deadlock through a judicious combination of different qualities of visionary, mentor and a leader (Umble et al., 2003). *Weak implementation team* forms a hindrance to the implementation of the system (Gargeya& Brady, 2005) since it is the responsibility of the team to coordinate, communicate, and reduce the resistance among the users. Thus due to limited ERP knowledge, capability and poor project management skills (Sommers and Nelson, 2004) project members fail to plan, lead, manage and monitor the project resulting in the implementation failure.

Technical Barriers

SCMIS involves complex transition from the legacy systems to an integrated inter- organizational system; therefore, problems interfacing with existing systems and hardware difficulties (Umble el al., 2003) lead to the failure of the IT system.

Al-Mashari (2006) in their study emphasize that *lack of adequate IT infrastructure in hardware and networking* will lead to the failure of ERP system. SCMIS implementation faces distinctive technological barriers since different systems in different organizations need to communicate freely with each other. Another important barrier to the successful implementation of the system is related to data standards and accuracy (Kang et al., 2012). In case standardized data is not there between disparate systems, erroneous data will be spanning to various organizations. Therefore *poor data conversion and quality* may cause negative domino effect in the organization, thus causing delay in the implementation of the system and may even lead to a failure of the project (Soja, 2006).

Overreliance on heavy customization would lead to higher implementation cost, causing project delays and unreliable system. Relying heavily on customization to fit with the business processes might lead to sacrificing best practices set in the system (Wong et al., 2005).

Conceptual Model

The conceptual model for impediments in the successful implementation of SCMIS is shown in the figure 3.

RESEARCH OBJECTIVES AND METHODOLOGY

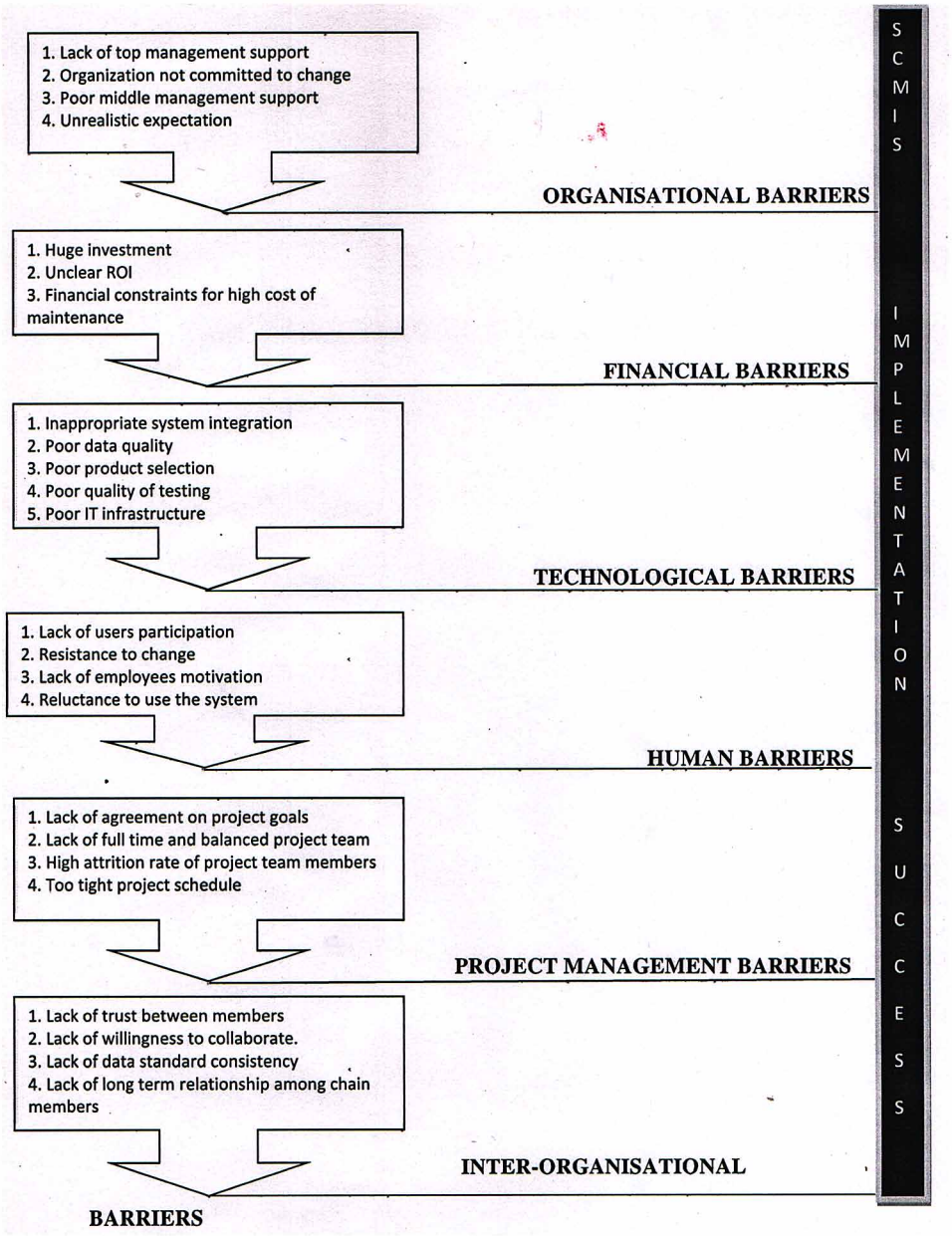
The main objectives of this paper are:

- To identify various impediments and their dimensions for the implementation of SCMIS;
- To calculate the severity of the impediments in the implementation of SCMIS; and
- To suggest measures to reduce the impediments for the successful implementation of SCMIS.

The various impediments identified are based on the previous studies reported in the literature and discussions with the researchers, experts and practitioners in this field. They were categorized into six main barriers

- Financial barriers
- Human Barriers
- Organizational Barriers
- Project Management barriers

Figure 3.



- Inter organizational barriers
- Technical barriers

Each impediment was analysed on multiple dimensions which added up to forty dimensions for all the six impediments together. Each of the dimension was measured on a five point Likert scale ranging from 1 (No Problem at all) to 5 (very serious Problem). The score calculated represented the severity of the problem. Thus, higher the score higher is the severity of the barrier and its related dimensions.

Research Design

In order to satisfy the research objectives, both exploratory and descriptive research design is used. The first objective is to identify the various dimensions of SCMIS in the selected automotive sector. For this, exploratory research design has been used. The second objective of the study is to analyse the hindrance factors for the implementation of SCMIS. For analysing the hindrance factors, a descriptive research design has been used.

Pilot Study and Validity

A pilot test was conducted for measuring the face and content validity of the survey instrument. Validity of the instrument was done to see:

- If the questionnaire is measuring what it is intend to measure
- Is the questionnaire comprehensive enough to collect all the information needed to address the purpose

Thirty practitioners and academics scholars were actively involved in the pilot study. They were provided with the questionnaire and asked to comment on its format, readability, and comprehensiveness. Specifically, experts were asked to provide feedback regarding the factors that were not in the questionnaire but should be addressed. Thus, the validity of questionnaire content was established by taking help from a panel of experts and having discussions with academicians and implementers. The discussion with the experts led to certain changes in the wording of some survey items, which was incorporated, into the draft of the questionnaire.

Data Collection

Questionnaires based survey method was used for data collection. The questionnaires used are directed towards the identification of critical failure factors for successful

implementation of SCMIS in the context of Indian automotive industry. It identifies perception of the respondents' towards the Critical Failure factors in the implementation process of SCMIS.

The pretested questionnaire was given to 150 executives of two major Indian automobile companies namely – Maruti Suzuki India Ltd. and Honda Cars India Ltd. including their suppliers and dealers for their opinion on CFFs. The questionnaires were administered through e-mail and personal meetings with the executives of OEMs. However for dealers and suppliers, personal interviews were held and 2 executives from each supplier and dealer expressed their opinion. The total of 10 dealers in NCR and 1st Tier Suppliers were chosen for Maruti Suzuki India Ltd. and 8 each were chosen for Honda Cars India Ltd. Table 2 shows the actual response and % response rate of the users of SCMIS. A total of one hundred and six respondents' has responded to the questionnaires. The respondents expressed their opinions concerning the importance of subsequent factors for the implementation success.

The data was analysed in SPSS and the reliability was checked. A Cronbach alpha coefficient for the data was 0.83 which is greater than 0.7 and therefore it was acceptable.

Measurement of Severity for Each Barrier

To measure the severity of the barriers, an un-weighted summated scale was used, and was equal to the sum of all the responses of the dimensions for the related barrier by the respondent. The various variables are: OBsum which represents organizational barrier and is the sum of score given to nine dimensions OB1, OB2, OB3, OB4, OB5, OB6, OB7, OB8, and OB9.

Table 2. Response for the opinion on CFFs

S.No.	Company	Population	Sample	Actual Response	% Response Rate
1	Maruti Suzuki India Ltd.	260	52	34	65
	1st Tier Suppliers	10	10	10	100
	Dealers in NCR	10	10	06	60
2	Honda Cars India Ltd	310	62	42	68
	1st Tier Suppliers	08	08	08	100
	Dealers in NCR	08	08	06	67

Thus,

$$OBsum = \sum_{i=1}^{9} OB_i \tag{1}$$

All the dimensions are explained in Table 4. As seen above, the organizational barrier has nine dimensions and the range for each is from 1 to 5, then the range for OBsum is 9 to 45. High score will suggest higher severity of the barrier.

Similarly, FBsum represents financial barrier and is the sum of score given to 3 dimensions FB1, FB2 and FB3.

Technical barrier is represented by TBsum and is the sum of score given to 8 dimensions TB1, TB2, TB3, TB4, TB5, TB6, TB7 and TB8.

Further HBsum represents human barrier and is the sum of score given to 8 dimensions HB1, HB2, HB3, HB4, HB5, HB6, HB7 and HB8.

PMBsum represents project management barrier, which is a sum of 6 dimensions PMB1, PMB2, PMB3, PMB4, PMB5 and PMB6.

Lastly, inter-organizational barrier variable is represented by IOBsum, which is the sum of score given to 6 dimensions IOB1, IOB2, IOB3, IOB4, IOB5 and IOB6.

For the comparison and ranking for each of the barrier, severity was calculated using the formula given in the study by Chaturvedi & Goyal (2012).

$$Severity = 100\left\{\left[\frac{\left(Mean\,score - minimum\,possible\,score\right)}{\left(Maximum\,possible\,score - minimum\,possible\,score\right)}\right]\right\} \tag{2}$$

Higher severity means high barrier to the successful implementation of SCMIS, therefore it was given highest ranking.

DATA ANALYSIS

Profile of The Respondents

Profile of the respondents for the study has been given in the table 3. Out of total 106 respondents, 13.2% were female and 86.8% were male respondents. Based on number of years of work experience, 34% of the respondents had experience less than 5 years, 38.6% of respondents had an experience between 5 to 10 years and 27.4% of respondents had work experience of more than 10 years.

Table 3. Profile of the respondents

Basis		Frequency (n)	Percentage (%)
GENDER	Male	92	86.8
	Female	14	13.2
EXPERIENCE	Less than 5 years	36	34.0
	5-10 years	41	38.6
	More than 10 years	29	27.4

Barriers Leading to the Failure of SCMIS Implementation

Table 4 shows the various variables for the respective barriers. Non parametric analysis of the six barriers using summated score is done.

Table 4 shows 'Organizational' barrier with a mean, minimum value and maximum value of 34.94, 20 and 44, respectively. The standard deviation is 3.113. Likewise Table 4 also shows mean, minimum value, maximum value and standard deviation for all the 'Barriers' considered in the study. These scores cannot be compared since the number of dimensions in various barriers varies between 3 and 9. Therefore, each impediment is converted into severity score which is expressed in percentage as shown in Table 5. The Table 5 shows the severity score of organizational barrier as 72.06%, financial barrier has a score of 70.42%, technical barrier has 68.13% and human barrier has a severity score of 74.62%.

The barriers are arranged in the descending order on the basis of severity score. The Table 6 shows the ranking of the barriers. The highest rank with severity score of 74.62% was that of human followed by organizational barriers with score of 72.06%.

DISCUSSION

The highest severity among the barriers is that of Human which is supported by Leon (2008) who stressed that system implementation is not a technology but a people project. According to the study 69%, 28% and 13% failure rate of the ERP systems is due to people, process and technological problems, respectively. The study by Khalifa (2013) on the barriers to health information system also concluded human barriers as a major challenge in the way of successful implementation of Electronic medical records. The findings from the study by Hawking et al., (2004) also reinforced ERP implementations as people focused projects which rely heavily

Table 4. Descriptive Statistics

Barrier		Variables	Mean	S.D	Min	Max
1. ORGANIZATIONAL (OBsum)	OB 1	Lack of top management support	34.94	3.113	20	44
	OB 2	Lack of alignment between IT and organizational objectives.				
	OB 3	Organization not committed to change				
	OB 4	Poor BPR – failure to redesign business process				
	OB 5	Absence of readiness assessment before implementation				
	OB 6	Poor middle management support				
	OB 7	Perspective of SCMIS as just a technical system				
	OB 8	Unrealistic expectation				
	OB 9	Inexperienced consultants				
2. FINANCIAL (FBsum)	FB 1	Huge investment	11.45	1.56	8	15
	FB 2	Unclear ROI				
	FB 3	Financial constraints for high cost of maintenance				
3. TECHNOLOGICAL (TBsum)	TB 1	Inappropriate system integration	29.80	3.506	18	38
	TB 2	Over reliance on heavy customization				
	TB 3	Poor data quality				
	TB 4	Lack of data standards				
	TB 5	Poor product selection				
	TB 6	Poor quality of testing				
	TB 7	Poor IT infrastructure				
	TB 8	Lack of data and information security				
4. HUMAN (HBsum)	HB 1	Lack of users participation	31.88	3.346	21	39
	HB 2	Resistance to change				
	HB 3	Lack of sufficient training to end users				
	HB 4	Inadequate employee involvement				
	HB 5	Lack of employees motivation				
	HB 6	Users don't understand the benefits of the system				
	HB 7	Ineffective communication with the users.				
	HB 8	Reluctance to use the system				

continued on following page

Table X. Continued

Barrier		Variables	Mean	S.D	Min	Max
5.PROJECT MANAGEMENT (PMBsum)	PMB 1	Lack of effective project management methodology	22.31	2.583	17	30
	PMB 2	Lack of agreement on project goals				
	PMB 3	Lack of full time and balanced project team				
	PMB 4	High attrition rate of project team members				
	PMB 5	Lack of a project champion/ establishment of an inexperienced project manager				
	PMB 6	Too tight project schedule				
6. INTER ORGANISATIONAL (IOBsum)	IOB 1	Lack of trust between members	22.57	3.527	11	29
	IOB 2	Lack of willingness to collaborate.				
	IOB 3	Technological incompetence's within trading partners				
	IOB 4	Culture of the partner may not support sharing of the information				
	IOB 5	Lack of data standard consistency				
	IOB 6	Lack of long term relationship among chain members				

Table 5. Percentage severity of the barriers

Barrier	No of Dimensions	Mean Score	Max Possible Score	Min Possible Score	Severity (%)
OBsum	9	34.94	45	9	72.06
FBsum	3	11.45	15	3	70.42
TBsum	8	29.80	40	8	68.13
HBsum	8	31.88	40	8	74.62
PMBsum	6	22.31	30	6	67.96
IOBsum	6	22.57	30	6	69.03

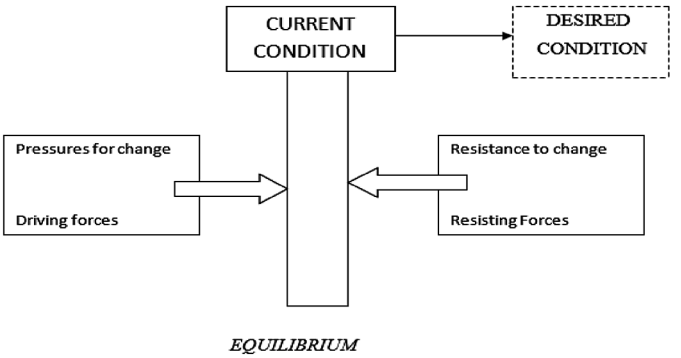
on change management for success. Further studies on information system indicate that failure is largely due to organizational and social factors, rather than technical factors (Fitzgerald & Russo, 2005).

Among the human barriers the most important is users' resistance to change. Resistance to change is better understood by the concept of force-field analysis developed by Lewin Kurt (1951) as shown in Figure 4. According to him any change situation is faced by two opposing forces namely driving forces and resisting forces.

Table 6. Ranking of the barriers

Barrier	Severity	Rank
HBsum	74.62	1
OBsum	72.06	2
FBsum	70.42	3
IOBsum	69.03	4
TBsum	68.13	5
PMBsum	67.96	6

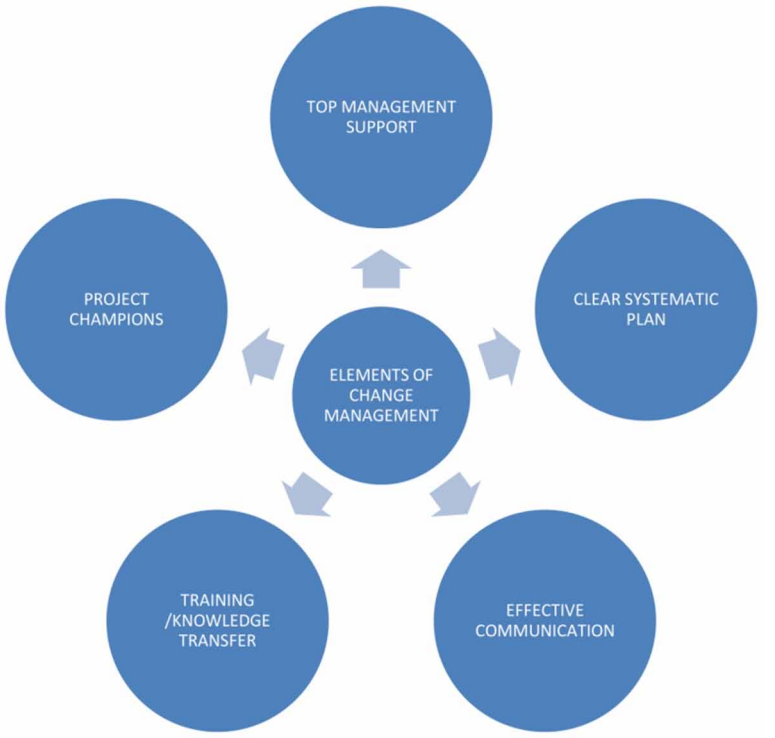
Figure 4.



He points out that increasing one set of forces without decreasing the other set of forces will lead to conflict in the organization.

Therefore, it is better to reduce the resisting force rather than increasing driving forces which may otherwise further lead to increase in resistance. Thus, particularly lowering the resistance will lead to increase in user satisfaction. Thus change management helps in balancing of forces in the favour of change over forces of resistance (Obeidat et al., 2016). People prefer status quo as change produces anxiety and uncertainty. People resist change because of several reasons like rationale for change not clear, non-participation of the users in the change process, modification in the working relationships between people, no proper communication with the users, threat of job, power or status and benefits not adequate for the effort involved in learning. Change management is one among the most factors that led to failure in ERP implementation (Al-Shamlan and Al-Mudimigh, 2011, Trieu and Kuzic, 2010). According to Trieu (2010) the elements of change management strategies is shown in figure 5. The employees usually do not resist technical change but it is the social change that accompanies it is resisted. Therefore at the outset it is very

Figure 5.



important for an organization to understand the nature of resistance, before adopting any strategy for minimizing this resistance.

Overcoming resistance to change: The organizations should implement the strategies for minimizing this risk and should be competent enough to facilitate a smooth implementation of the system. The most frequently used strategies to overcome resistance to change are communication, user participation, user involvement and training.

Communication

In the study by Andersson (2016) communication patterns were explored and analysed to describe communication as a barrier in an interorgainisational ERP. As the organizations move towards integration with the outside world proper communication is imperative amongst the users, top management, project management team and leader. Communication is required in every phase, before, during and after the implementation. Proper communication should ensure that the users understand

the need and the benefits associated with the adoption of the inter-organizational system. Communication should be two way as well as open where employees are free to express themselves and give their feedback .Communication will reduce the uncertainty with the adoption of the information system and would diminish the concern about the threat of job, power or status.

User Participation and Involvement

According to Briolat and Pogman (2000), "user participation is advocated in order to discover

Users' needs and point of view validate specifications, and hence build better IS for the Organization". The users who participate in the planning and implementation stage of the system are less likely to resist the change. The users should be asked to give their suggestions and feedback in the process of implementation which will improve user understanding of the system. Thus it is very important to keep the users and other stakeholders motivated and actively involved.

Top Management Support

Top management plays an important role in reducing resistance to change. Formal and honest communication from the top management leads to reduction in the resistance to change. Employees and the Management acting in tandem as a team can alleviate the resistance. The Management can facilitate team spirit by empowering the employees and also create a conducive environment for the employees to accept change. They can also develop informal leaders who can become effective agents of change and also can practice soft coercion tactics to reduce resistance. Top management should assign sufficient resources to the change management and should act as a leader and not boss. Top management should establish reward system which would further reduce the resistance.

Education and Training

The recent literature suggests that education and training are critical for competitive advantage (Ram *et al.*, 2014; Chien *et al.*, 2014; Sudhaman and Thangavel, 2015). Education and training should be provided to the user so that he becomes comfortable with the system. Due to lack of training, users are uncomfortable to input or retrieve data from the system (Peng & Nunes, 2010) .The user will be reluctant to use the system or will not posses sufficient skill unless and until relevant training is imparted to him. Low-skilled and ill-trained staff represents a crucial barrier to the use of ERP systems (Sherer & Alter, 2004). It is very important to give hands-on training to

the user so that he gets a feel of it. There must be development of a formal training program to meet the system users' requirements. Proper allocation of resources for the training should also be done. The training could be organized in-house or at the training centre where consultants could transfer knowledge to the technical personnel and end-users. Training is one of the most costly components of an ERP implementation project so the proper monitoring and evaluation should be done to ensure that the employees gain maximum knowledge and skillset.

CONCLUSION

The competition no longer exists between the companies, but it is between supply chains, this summarises the importance of supply chain in today's global competitive environment. The firm must be competitive enough to survive and technology is being used as a competitive tool in the form of implementation of SCMIS. The integration of supply chain is being embraced by the business firms in order to reduce cost and fulfil the market demand efficiently and effectively.

The implementation of highly integrated supply chain is a challenging task, as it requires huge amount of resources, cooperation from suppliers/partners, commitment from top management, organizational change, and technical infrastructure. There is a strong evidence in the literature that implementation of Inter organizational systems were either not completed on time or didn't bring about the planned effects and even exceeded their estimated costs.

This study aims to identify the impediments in the implementation of SCMIS. The impediments identified from the previous researches and discussions with the researchers, experts and practitioners in this field are organizational, technical, human, inter-organizational, project management and financial barriers. These six impediments were further divided into 40 dimensions and the severity score of each of the impediment was calculated. The highest severity factor is for the human barrier which is in line with the various previous researches (Khalifa, 2013, Fitzgerald & Russo, 2005; Hawking et al., 2004; Leon, 2008). Human barrier should be alleviated so as to have a successful implementation of the system. The major impediment is users' resistance to change which can be reduced by proper and formal communication, top management support for change, users participation and proper training. Thus these systems should not be viewed as an IT implementation only but more as an organizational revolution which would transform the organization processes into more efficient and effective one.

IMPLICATIONS OF THE STUDY

The contributions of the paper are important for industry practitioners, researchers and policy makers. The implementation requires huge investment and intensive research. With the clear understanding of the impediments the organizations can manage their resources in an efficient and effective way. Industry practitioners have not fully recognized the importance of such research due to a lack of understanding of technologies and their benefits. The impediments and their dimensions will provide a useful guide for industry practitioners who are planning to implement SCMIS in their organizations. The study can help them to improve decision making for successful implementation of SCMIS right from inception and subsequent realization of the enormous benefits like reduction of inventories, minimization of bull whip effect, cost saving, quality improvement, better coordination with the suppliers, more visibility of the information across the supply chain and greater competitive advantage that will accrue with right implementation.

Managers should streamline the business processes, manage the change carefully, understand the intrinsic complexities in the implementation of these systems, and increase the likelihood of implementing a successful system and achieve the desired results.

For the academic researchers the study form the basis of a more detailed examination of the subject related to the implementation of SCMIS. The proposed model can form the basis of deriving 'performance metrics' to give organizations a clearer picture of the benefits accruing from SCMIS. This study can encourage and enlighten policy makers to establish new training institutes and formulate policies in favour of SCMIS in the wider interest of the industries and improve the overall economy.

RECOMMENDATIONS

The recommendations for the managers to improve the success of SCMIS implementation in automotive industry are:

- For successful implementation, the focus should be on both product and process dimensions. Product dimension defines the efficiency of the system and process dimension provides the effectiveness of implementation process.
- Organization should effectively manage the change and all efforts should be made to make a smooth transition from the traditional to integrated systems across the organizations. For the smooth transition, the change should be managed at individual, workgroup and organizational levels.

- People form the biggest hindrance to the successful implementation, therefore the organization need to minimize the resistance to change. Companies should adopt strategies such as clear communication, user participation, user involvement, and proper training to overcome the resistance to change.
- Organization should ensure that the users understand the need and the benefits associated with the adoption of the inter-organizational system through clear and proper communication.
- The users and other stakeholders should be motivated and actively involved in the implementation process. User should be involved in defining SCMIS needs. The user involvement will be helpful to get user requirements, better quality of the system, and finally lead to the increase in system usage.
- Organizations must develop a formal training program to meet the requirements of the system users. The management should allocate proper resources for the user training to be imparted to the users so that the user becomes comfortable with the system. The training should be organized in-house or at the training center where consultants could transfer knowledge to the technical personnel and end-users.
- Support from the top management is very critical for successful implementation of SCMIS and they should not view it as a technological endeavor. Top management should assign sufficient resources and facilitate team spirit by empowering the employees, and create a positive environment for the employees to accept change.

LIMITATIONS OF THE STUDY AND FURTHER SCOPE OF RESEARCH

The major limitation of this study is its generalizability since the study was limited to two major players of the automotive sector, their suppliers and dealers of the NCR Region, India. The sample may not support the automobile industry of India in general. Secondly, the study does not include the views, opinions, and perceptions of software experts that are involved in the development of SCMIS from organizations like IBM, Oracle, and SAP. Thirdly, SCMIS implementation success was measured using perceptual measures because of difficulty in getting the factual data from the participating organizations. These limitations create ample scope of future research.

It is recommended that similar research studies should be conducted by taking a larger sample of organizations in automotive industry from other parts of India so as to include any other dimension whatsoever that might have been left out in

this study. Similar research should be undertaken for different sectors like retailing, pharmaceuticals, and petroleum as well for various organizational sizes like small, medium and large.

It would be beneficial if in future, research is conducted to find CFFs that are more industry-specific since certain CFFs like lack of top management support, inappropriate change management strategies, failure to redesign business process etc. are general failure factors for the implementation of any Information System. Further case studies can be undertaken in which longitudinal research should be done before and after the implementation of the system. This is to know the exact benefits the organization derives from the system. Future research can be undertaken where critical success and failure factors are linked to tangible benefits arising out of the system so that a clear ROI can be calculated for the system being implemented.

REFERENCES

Al-Mashari, M., Ghani, S. K., & Al-Rashid, W. (2006). A study of the critical success factors of ERP implementation in developing countries. *International Journal of Internet and Enterprise Management*, *4*(1), 68–95. doi:10.1504/IJIEM.2006.008866

Al-Shamlan, H., & Al-Mudimigh, A. (2011). The Change Management Strategies and Processes for Successful ERP Implementation: A Case Study of MADAR. *International Journal of Computer Science Issues*, *8*(2), 399–407.

Alballaa, H., & Al-Mudimigh, A. S. (2011). Change Management Strategies for Effective Enterprise Resource Planning Systems: A Case Study of a Saudi Company. *International Journal of Computers and Applications*, *17*(2), 14–19. doi:10.5120/2194-2785

Amid, A., Moalagh, M., & Ravasan, A. Z. (2012). Identification and classification of ERP critical failure factors in Iranian industries. *Information Systems*, *37*(3), 227–237. doi:10.1016/j.is.2011.10.010

Andersson, A. (2016). Communication barriers in an interorganizational ERP-project. *International Journal of Managing Projects in Business*, *9*(1), 214–233. doi:10.1108/IJMPB-06-2015-0047

Basu, R., & Biswas, D. (2013). An Approach to Identify Failure Factors of Enterprise Application Implementation in Indian Micro Enterprises. *International Journal of Managing Value and Supply Chains*, *4*(1), 37–47. doi:10.5121/ijmvsc.2013.4104

Bhatti, T. R. (2005, September). Critical success factors for the implementation of enterprise resource planning (ERP): empirical validation. In *The Second International Conference on Innovation in Information Technology* (p. 110). Academic Press.

Bingi, P., Sharma, M. K., & Godla, J. K. (1999). Critical issues affecting an ERP implementation. *Information Systems Management*, *16*(3), 7–14. doi:10.1201/1078/43197.16.3.19990601/31310.2

Briolat, D., & Pogman, J. (2000, April). User involvement influence on project productivity in a rad environment: A quasi-experiment. In *European Software Control and Metrics Conference*, Munich, Germany.

Chan, C. K., & Lee, H. W. J. (Eds.). (2005). *Successful strategies in supply chain management*. IGI Global. doi:10.4018/978-1-59140-303-6

Chaturvedi, A., & Goyal, S. (2012). Changing severity of impediments for entrepreneurs in India: An empirical analysis. *International Journal of Entrepreneurship and Small Business*, *16*(1), 1–32. doi:10.1504/IJESB.2012.046914

Chien, S., Lin, H., & Shih, C. (2014). A moderated mediation study: Cohesion linking centrifugal and centripetal forces to ERP implementation performance. *International Journal of Production Economics*, *158*(1), 1–8. doi:10.1016/j.ijpe.2014.06.001

Chopra, S., & Miendl, P. (2005). *Supply Chain Management* (3rd ed.). Pearson – Prentice Hall.

Davenport, T. H. (1998). Putting the enterprise into the enterprise system. *Harvard Business Review*, *76*(4). PMID:10181586

Dezdar, S., & Ainin, S. (2011). Critical success factors for ERP implementation: Insights from a Middle-Eastern country. *Middle East Journal of Scientific Research*, *10*(6), 798–808.

Fawcett, S. E., Fawcett, A. M., Watson, B. J., & Magnan, G. M. (2012). Peeking inside the black box: Toward an understanding of supply chain collaboration dynamics. *The Journal of Supply Chain Management*, *48*(1), 44–72. doi:10.1111/j.1745-493X.2011.03241.x

Finney, S., & Corbett, M. (2007). ERP implementation: A compilation and analysis of critical success factors. *Business Process Management Journal*, *13*(3), 329–347. doi:10.1108/14637150710752272

Fitzgerald, G., & Russo, N. L. (2005). The turnaround of the London ambulance service computer-aided despatch system (LASCAD). *European Journal of Information Systems*, *14*(3), 244–257. doi:10.1057/palgrave.ejis.3000541

Françoise, O., Bourgault, M., & Pellerin, R. (2009). ERP implementation through critical success factors' management. *Business Process Management Journal*, *15*(3), 371–394. doi:10.1108/14637150910960620

Ganesh, L., & Arpita, M. (2010). Critical failure factors in enterprise resource planning implementation at Indian SME. *Asian Journal of Management Research*, *1*(1).

Garg, P. (2010). Critical failure factors for enterprise resource planning implementations in Indian retail organizations: An exploratory study. *Journal of Information Technology Impact*, *10*(1), 35–44.

Gargeya, V. B., & Brady, C. (2005). Success and failure factors of adopting SAP in ERP system implementation. *Business Process Management Journal*, *11*(5), 501–516. doi:10.1108/14637150510619858

Hawking, P., Stein, A., & Foster, S. (2004, January). Revisiting ERP systems: benefit realization. In *System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on*. IEEE.

Hsu, P. F., Yen, H. R., & Chung, J. C. (2015). Assessing ERP post-implementation success at the individual level: Revisiting the role of service quality. *Information & Management*, *52*(8), 925–942. doi:10.1016/j.im.2015.06.009

Jagoda, K., & Samaranayake, P. (2017). An integrated framework for ERP system implementation. *International Journal of Accounting & Information Management*, *25*(1), 91–109. doi:10.1108/IJAIM-04-2016-0038

Kang, Y., O'Brien, W. J., & O'Connor, J. T. (2012). Analysis of information integration benefits drivers and implementation hindrances. *Automation in Construction*, *22*, 277–289. doi:10.1016/j.autcon.2011.09.003

Khalifa, M. (2013). Barriers to health information systems and electronic medical records implementation. A field study of Saudi Arabian hospitals. *Procedia Computer Science*, *21*, 335–342. doi:10.1016/j.procs.2013.09.044

Khaparde, V. M. (2012). Barriers of ERP while implementing ERP: A Literature Review. *Journal of Mechanical and Civil Engineering*, *3*(6), 49–91. doi:10.9790/1684-0364991

Khurana, M. K., Mishra, P. K., & Singh, A. R. (2011). Barriers to information sharing in supply chain of manufacturing industries. *International Journal of Manufacturing Systems*, *1*(1), 9–29. doi:10.3923/ijmsaj.2011.9.29

Kim, Y., Lee, Z., & Gosain, S. (2005). Impediments to successful ERP implementation process. *Business Process Management Journal*, *11*(2), 158–170. doi:10.1108/14637150510591156

Koh, S. C. L., Gunasekaran, A., & Rajkumar, D. (2008). ERP II: The involvement, benefits and impediments of collaborative information sharing. *International Journal of Production Economics*, *113*(1), 245–268. doi:10.1016/j.ijpe.2007.04.013

Koh, S. L., Gunasekaran, A., & Goodman, T. (2011). Drivers, barriers and critical success factors for ERPII implementation in supply chains: A critical analysis. *The Journal of Strategic Information Systems*, *20*(4), 385–402. doi:10.1016/j.jsis.2011.07.001

Kumar, V., Maheshwari, B., & Kumar, U. (2003). An investigation of critical management issues in ERP implementation: Empirical evidence from Canadian organizations. *Technovation*, *23*(10), 793–807. doi:10.1016/S0166-4972(02)00015-9

Leon, A. (2008). *Enterprise Resource Planning* (2nd ed.). New Delhi, India: MC-Graw-Hill.

Lewin, K. (1951). Field theory in social science: selected theoretical papers (D. Cartwright, Ed.). Academic Press.

Lindley, J. T., Topping, S., & Lindley, L. T. (2008). The hidden financial costs of ERP software. *Managerial Finance*, *34*(2), 78–90. doi:10.1108/03074350810841277

Marwah, A. K., Thakar, G., & Gupta, R. C. (2012). *Determinants of Supply Chain Performance in the Indian Manufacturing Organizations (Proposed Conceptual Model)*. Academic Press.

Mentzer, J. T., Min, S., & Zacharia, Z. G. (2000). The nature of interfirm partnering in supply chain management. *Journal of Retailing*, *76*(4), 549–568. doi:10.1016/S0022-4359(00)00040-3

Møller, C. (2005). ERP II: A conceptual framework for next-generation enterprise systems. *Journal of Enterprise Information Management*, *18*(4), 483–497. doi:10.1108/17410390510609626

Motwani, J., Akbulut, A. Y., Mohamed, Z. M., & Greene, C. L. (2008). Organisational factors for successful implementation of ERP systems. *International Journal of Business Information Systems*, *3*(2), 158–182. doi:10.1504/IJBIS.2008.016584

Ngai, E. W., Law, C. C., & Wat, F. K. (2008). Examining the critical success factors in the adoption of enterprise resource planning. *Computers in Industry*, *59*(6), 548–564. doi:10.1016/j.compind.2007.12.001

Obeidat, B. Y., Masa'deh, R., Al-Suradi, M., & Tarhini, A. (2016). The Impact of Knowledge Management on Innovation: An Empirical Study on Jordanian Consultancy Firms. *Management Research Review*, *39*(12), 25–40.

Peng, G. C., & Nunes, M. B. (2010). Barriers to the successful exploitation of ERP systems in Chinese state-owned enterprises. *International Journal of Business and Systems Research*, *4*(5), 596–620. doi:10.1504/IJBSR.2010.035077

Poonam, G., & Atul, G. (2013). An empirical study on critical failure factors for enterprise resource planning implementation in Indian retail sector. *Business Process Management Journal*, *19*(3), 496–514. doi:10.1108/14637151311319923

Ram, J., Wu, M., & Tagg, R. (2014). Competitive advantage from ERP projects: Examining the role of key implementation drivers. *International Journal of Project Management*, *32*(1), 663–675. doi:10.1016/j.ijproman.2013.08.004

Ranjan, S., Jha, V. K., & Pal, P. (2016). Literature review on ERP implementation challenges. *International Journal of Business Information Systems*, *21*(3), 388–402. doi:10.1504/IJBIS.2016.074766

Sarker, S., & Lee, A. S. (2003). Using a case study to test the role of three key social enablers in ERP implementation. *Information & Management*, *40*(8), 813–829. doi:10.1016/S0378-7206(02)00103-9

Schoorman, F. D., Mayer, R. C., & Davis, J. H. (2007). An integrative model of organizational trust: Past, present, and future. *Academy of Management Review*, *32*(2), 344–354. doi:10.5465/amr.2007.24348410

Shah, S. I. H., Khan, A. Z., Bokhari, R. H., & Raza, M. A. (2011). Exploring the Impediments of Successful ERP Implementation: A Case Study in a Public Organization. *International Journal of Business and Social Science*, *2*(22), 289–296.

Sherer, S. A., & Alter, S. (2004). Information system risks and risk factors: Are they mostly about information systems. *Communications of the Association for Information Systems*, *14*(2), 29–64.

Singh, L. P., Singh, S., & Pereira, N. M. (2010, July). Human risk factors in post-implementation phase of ERP in SMEs in India. In *Technology Management for Global Economic Growth (PICMET), 2010 Proceedings of PICMET'10* (pp. 1-11). IEEE.

Soja, P. (2006). Success factors in ERP systems implementations: Lessons from practice. *Journal of Enterprise Information Management*, *19*(4), 418–433. doi:10.1108/17410390610678331

Soja, P. (2008). Examining the conditions of ERP implementations: Lessons learnt from adopters. *Business Process Management Journal*, *14*(1), 105–123. doi:10.1108/14637150810849445

Somers, T. M., & Nelson, K. G. (2004). A taxonomy of players and activities across the ERP project life cycle. *Information & Management*, *41*(3), 257–278. doi:10.1016/S0378-7206(03)00023-5

Sudhaman, P., & Thangavel, C. (2015). Effciency analysis of ERP projects – software quality perspective. *International Journal of Project Management*, *33*(4), 961–970. doi:10.1016/j.ijproman.2014.10.011

Tapp, R., Hesseldenz, J., & Kelley, G. (2003). The role of project acceptance in the successful PeopleSoft human resources management system implementation for the Kentucky community and technical college system. *AMCIS 2003 Proceedings*, Paper 172.

Trieu, H., & Kuzic, J. (2010). Change Management Strategies for the Successful Implementation of Enterprise Resource Planning Systems. *Proceedings of the Second International Conference on Knowledge and Systems Engineering*, 178-182.

Umble, E. J., Haft, R. R., & Umble, M. M. (2003). Enterprise resource planning: Implementation procedures and critical success factors. *European Journal of Operational Research*, *146*(2), 241–257. doi:10.1016/S0377-2217(02)00547-7

Venkatraman, S., & Fahd, K. (2016). Challenges and Success Factors of ERP Systems in Australian SMEs. *Systems*, *4*(2), 20. doi:10.3390ystems4020020

Wei, C. C., & Chen, L. T. (2008). Developing Supply Chain Management System Evaluation Attributes Based on the Supply Chain Strategy. *Supply Chain, 95*.

Weston, E. C. T. Jr. (2003). ERPII: The extended enterprise system. *Business Horizons*, *46*, 49–55. doi:10.1016/S0007-6813(03)00088-0

Wong, A. C. P., Scarborough, H., Chau, P. Y. K., & Davison, R. M. (2005). Critical Failure Factors in ERP Implementation. *Proceedings of the 9th Pacific Asia Conference on Information Systems*.

Wu, J. H., Wang, Y. M., Chang-Chien, M. C., & Tai, W. C. (2002, January). An examination of ERP user satisfaction in Taiwan. In *System Sciences, 2002. Proceedings of the 35th Annual Hawaii International Conference on HICSS* (pp. 3072-3081). IEEE.

Young, D., Carr, H. H., & Rainer, R. K. Jr. (1999). Strategic implications of electronic linkages. *Information Systems Management*, *16*(1), 32–39. doi:10.1201/1078/43187.16.1.19990101/31159.5

Zhang, Z., Lee, M. K., Huang, P., Zhang, L., & Huang, X. (2005). A framework of ERP systems implementation success in China: An empirical study. *International Journal of Production Economics*, *98*(1), 56–80. doi:10.1016/j.ijpe.2004.09.004

Chapter 10
Critical Success Factors to Create 5G Networks in the Smart Cities of India From the Security and Privacy Perspectives

Sheshadri Chatterjee
https://orcid.org/0000-0003-1075-5549
Indian Institute of Technology, Delhi, India

ABSTRACT

Development of cities brings in overall economic growth of the country. As a result, cities are taking new shape with modern facilities to ensure development. In this perspective, Government of India (GOI) has announced to create 100 Smart Cities across different locations in India. In these Smart Cities, modern infrastructure would be created with introduction of modern 5G network systems. This network system is expected to bring in considerable improvements in the Smart Cities if the security and privacy issues involved in this system can be addressed. This chapter has taken an attempt to identify the critical success factors (CSFs) instrumental to improve this network system within the acceptable level of security and privacy vulnerabilities in Smart Cities of India. To identify the CSFs, different standard methods including questionnaire-oriented survey, brainstorming have been adopted. Interpretive structural modelling (ISM) methodology has been used to find out inter-relationships among the CSFs along with identification of driving forces.

DOI: 10.4018/978-1-7998-1786-4.ch010

INTRODUCTION

Urban setting has undergone radical change due to considerable development of Information and Communication Technology (ICT). As a result, cities are gradually assuming new shape with all modern and updated facilities including facilities of modern networking systems. These cities may be called Smart Cities where digitalized services are expected to be readily available. Naturally, in these cities, availabilities of strong and updated networking systems are to be ensured. India is also not lagging in this race of development. For this, Government of India (GOI) has already taken attempts to create 100 Smart Cities across different locations of India. However, complete creation of Smart Cities is in initial stage in India. For such creation, availabilities of all modern facilities including facilities concerning to networking systems are to be ensured (Lovehagen and Bondesson, 2013). The citizens of Smart Cities of India (SCI) would expect to enjoy robust, flawless, updated, quick networking facilities in this digitalized environment. Thus, to achieve this, the factors critical for improving the networking grid systems are to be identified and they are to be nursed properly. This work requires applications of modern techniques. Attempts are being taken to identify these Critical Success Factors (CSFs) instrumental to improve the networking systems with a focus on the security and privacy issues. It is pertinent to mention here that without ensuring proper protection to the security and privacy issues, desired results towards improvement of networking systems can hardly be achieved (Brown and Brudney, 2003). To identify the success factors critical to improve modern networking grid systems within the acceptable level of security and privacy issues, initially, attempts would be taken to detect relevant success factors (Nfuka and Rusu, 2010). To achieve this, several standard processes like questionnaire-based survey, brainstorming method and so on would be taken focusing due attention on security and privacy vulnerabilities within acceptable range. The procedural architecture for identifying CSFs in this context includes detection of success factors and then to filter those to detect CSFs. Once those are (CSFs) identified within the acceptable level of security and privacy issues, the inter-relations among those CSFs are to be identified for better understanding. After that the driving factors from these CSFs are to be identified so that additional attention may be devoted to nurse and nurture the driving forces for betterment of the latest networking systems expected to be used in SCI.

The success factors are identified through different standard methods as mentioned above and those are set into a Systematic Model (Warfield, 1974). To establish interrelationships among those so-identified SCFs and to identify the driving forces, Interpretative Structural Modelling methodology (Singh et al., 2003; Ravi et al., 2005; Raj et al., 2007) has been adopted. This ISM methodology is known to have brought in successful results in many places like Career Planning, Process Designing,

E-Commerce issues, Barrier Identifications and so on (Banwet and Arora, 1999; Rajesh et al., 2007).

In this background, this article has taken a holistic attempt to identify the CSFs for successfully establishing the latest 5G grid systems for the SCI with a focus on the security and privacy issues.

SMART CITIES AND SAFE DIGITAL SERVICES

It is expected that in the proposed SCI, the concerned authorities would continuously try to improve the modern digital systems by developing the smart grid networks. The authorities are scheduled to take sincere attempts to plug up any type of unexpected pilferage by tightening the security and privacy issues (Bartol et al., 2011). Digitalization of SCI mainly lies on the updated applications of modern networking systems like 5G. The authorities of SCI are to take sagacious as well as sincere attempts so that the citizens of SCI do not unnecessarily face any unwanted impediment to use new networking systems due to ominous threat of security and privacy issues (Tripathy and Mishra, 2000). In the proposed SCI, the citizens are expected to use online systems for purchasing items with the help of modern digital grid systems. In this process, naturally, some personal data of the purchasers would be disclosed to the vendors. The purchasers will be expecting that their personal data would be kept secret absolutely and those would be never used for purposes other than those purposes for which they were disclosed. This is needed to be ensured through efficient information security management (Eloff and Von Solms, 2000) to be exercised by the authorities of SCI. This issue is associated with the culture of the vendors and in that respect, the authorities of SCI should be vigilant to appropriately train the vendors and even the purchasers to develop their reasonable cultural perceptions (Hofsted et al., 2010). Appropriate regulatory control, by systemizing and updating the legal frameworks, should be executed with good governance to mitigate these ailments (Kally, 1994). These security and privacy issues associated with the network grid systems to be used in SCI are apprehended to retard the digital systems to be used in SCI (Rashad and Noor, 2010). In the digitalized environment, the citizens of SCI are expected to utilize cloud platforms in their daily financial transactional activities including activities concerning to banking transactions. It would save their time and it would be done with ease if they are able to use the systems appropriately. They will hesitate to use the systems if they apprehend that the security and privacy of their personal data in such activities would be at stake (Baraskar et al., 2010). For ensuring proper protection of their personal data while involved in online transactional activities, the citizens are to be trained to follow proper guidelines (Yasin et al., 2012). In the context of security

and privacy issues for managing personal data sharing associated with networking activities, confidentiality, non-repudiation and integrity are perceived to be principal essentialities (Los Huertos, 2010).

Applications of appropriate technologies, enforcement of appropriate regulations, development of clear perceptions of the users would help address privacy invasion of the personal data through collaborative digital governance (Dawes et al., 2002). These discussions highlight that CSFs are to be kept within controlling limit to ensure protection of security and privacy issues in modern networking systems to be operated in SCI. In such scenario, some researchers wondered if such type of Smart Cities can really be created in India where there will be no security and privacy vulnerabilities (Hollands, 2008; Cosgerove, 2011). To establish effective, flawless 5G network systems in SCI, it is required to use such bandwidth appropriate to address the needs of the citizens in the advanced digital environment (Norris, 2001; Odendaal, 2003). It is expected that security and privacy vulnerabilities will be there even for the cars plying in SCI with in-car wireless networks (Rouf et al., 2010). These are required to be addressed. Many researchers have discussed the technologies and mechanisms to be adopted for ensuring protection of security and privacy vulnerabilities and tried to identify the CSFs that require proper nursing to improve the developed networking systems in Smart Cities (Jeberson and Singh, 2011; Adel and Elmaghraby, 2013).

In this article, through questionnaire-based survey, brainstorming process (Isaksen et al., 2006) and through other processes, the CSFs have been identified and inter-relationship has been detected along with identifying the driving forces by the help of Interpretive Structural Modelling (ISM) methodology (Chidambaranathan et al., 2009).

METHODOLOGY

There are many methods to identify CSFs concerning to use of modern networking system through grids within the acceptable level of security and privacy issues. In this study, three processes have been perceived to be appropriate to identify the CSFs. The three processes are as follows:

1. Questionnaire-oriented survey
2. Brain Storming
3. Principal Component Analysis (PCA)

QUESTIONNAIRE-ORIENTED SURVEY

This method includes preparation of a set of questions (questionnaire). The questions are framed in the form of statements. These are also called items. In preparing the questionnaire, the scale development architecture has been adopted. This includes step-by-step approach where opinion of experts is taken, pre-test is conducted and so on (Carpenter, 2018). Due regards are emphasized so that the questions are not controversial, there should not be any leading question and the readabilities of these questions should not be difficult. After preparation of the set of questions, those are sent to some potential and selected respondents for their feedbacks. The feedbacks are quantified by applying 5-point Likert scale procedure. In this way eventually 22 questions have been prepared.

Towards selection of usable respondents (Sample), developers, enablers, thinkers and potential consumers have been targeted from different sectors. 28 firms from different parts of India have been chosen at random and 409 respondents have been initially targeted from those different sectors. The questionnaire was sent to them for their feedbacks in the usual way. They are to put one tick mark in one option out of five options in terms of 5-point Likert scale as already mentioned (Strongly Disagree (SD) has been marked as 1 to Strongly Agree (SA) has been marked as 5). The 409 respondents were given one-month time to respond. Within scheduled time, 226 responses have been obtained. Here response rate is 55%. Out of the 226 responses, 21 responses were found vague as opined by most of the experts. Here, either the respondents did not put tick mark in any option, or they put a tick mark in one particular option against all the questions. This is the reason for not considering those 21 responses. Eventually, number of usable responses was 205. The survey approach is within the acceptable range since the ratio between number of items and number of usable responses lie between 1:4 to 1:10 (Hinkin, 1996; Deb and David, 2014). The details of 205 usable respondents are given in Table 1.

In this way, it was possible to identify 22 success factors needed to be focused for betterment of 5G network systems in SCI. The mean, median, and standard division (SD) of all the success factors have been estimated and shown in Table 2.

BRAINSTORMING

With the help of brainstorming method, attempts are taken to develop ideas emerging spontaneously from the group members involved in this process. This process includes attempts to intend for reducing the social inhibitions among the participating group, for stimulating new ideas and for enhancing the creativity of the group. In the instant

Table 1. Descriptive statistics of the sample

Segmentation	Type of Sector	No of Firms	No of Respondents
Developers	Telecom Equipment Manufacturer	4	23
Developers	Mobile Operator	7	35
Developers	R&D Org	3	8
Developers	Academia	N/A	7
Enabler	Chip Manufacturer	1	3
Enabler	Handset manufacturer	2	6
Enabler	Sensor Device Manufacturer	2	6
Thinker	Forums	3	18
Thinker	Telecom Consultants	N/A	6
Thinker	Marketing Consultants	N/A	12
Consumer	The Individuals	N/A	20
Consumer	Digital Media Firms	2	7
Consumer	Random People	N/A	12
Consumer	Banks	4	42
Total		28	205

issue, 9 experts (5 from industry sectors and 4 from academia) were selected for the exercise of brainstorming. The experts gave ranking to each of the 22 success factors. Details are shown in Table 3.

However, the close relevance of the success factors and the subjective nature of the topic posed impediment to come to an unbiased conclusion through this process.

PRINCIPAL COMPONENT ANALYSIS (PCA)

This process is usually considered as a dimensionality reduction technique. The aim of this PCA is to realize the issue of interest. It also takes an attempt to discover new patterns among the relationship variables and to reduce the amplitude of focus by reduction of number of success factors in this context. The loading factors of all the success factors have been estimated. This process also estimated Eigen value, Variance along with Loading Factors. Those components possessing loading factors less than 0.707, which is the lowest acceptable value of loading factor, have not been considered (Borasso et al., 2010). By this way 16 Critical Success Factors (CSFs) out of 22 success factors have been selected. The results are shown in Table 4.

Table 2. Critical factors summarization

Sr. No.	Critical Factors	Mean	SD	Median
1	Security as a Service	3.910	0.765	4
2	Isolated as well as Integrated Secure Network Slices	4.045	0.830	4
3	Signaling security and user plane security	3.330	0.770	4
4	Cognitive, Embedded and Adaptive Privacy Protection Features	3.255	0.845	3
5	Identity, Authentication & Data Management	3.845	0.842	4
6	Energy Efficient Security	3.690	0.915	4
7	Evolving Standards for Open Systems	4.345	0.773	4
8	Differentiated Security Protection	4.155	0.821	4
9	Seamless and Non-Disruptive Security Models	3.745	0.829	3
10	Service Trust Models	3.855	1.018	4
11	Leakage, Pilferage resistant networks	3.405	0.880	4
12	Privacy Information Management	3.155	0.910	3
13	Secure Connected Ecosystem	3.655	0.820	4
14	CIA	3.230	0.738	3
15	Breadth of Service for Customers	3.445	1.075	4
16	Privacy Information Management	3.595	1.020	4
17	E2E Security in HetNets	3.395	0.840	4
18	Durable and tensile security models	3.955	0.781	4
19	Elastic and scalable security architecture	3.505	0.783	4
20	Privacy Protection	3.380	0.710	3
21	Security for trusted Non 3GPP access	4.205	0.660	4
22	Operator Monetization	3.655	1.032	4

EXPLANATION OF THE CRITICAL SUCCESS FACTORS (CSFs)

End to End (E2E) Security in Hetnets

The modern network system is vast. It possesses different complex architecture. The heterogeneity character of network is massive. As a result, the entire concept to secure the modern network has undergone a drastic change. The security of modern networking systems demands microscopic action at every vulnerable point. Continuous security layer is to be ensured through the networking systems. This discrete nature of security issues related with modern networking systems have made the designers tremendously flexible for optimizing the requirements of security. The end users are expected to possess huge information if the users use

Table 3. Ranking based on brainstorming

Sr. No.	Critical Factors	Ranking
1	Security as a Service	6
2	Isolated as well as Integrated Secure Network Slices	18
3	Signaling security and user plane security	7
4	Cognitive, Embedded and Adaptive Privacy Protection Features	13
5	Identity, Authentication & Data Management	8
6	Energy Efficient Security	20
7	Evolving Standards for Open Systems	10
8	Differentiated Security Protection	19
9	Seamless and Non-Disruptive Security Models	15
10	Service Trust Models	22
11	Leakage, Pilferage resistant networks	11
12	Privacy Information Management	21
13	Secure Connected Ecosystem	16
14	CIA	1
15	Breadth of Service for Customers	3
16	Privacy Information Management	17
17	E2E Security in HetNets	2
18	Durable and tensile security models	6
19	Elastic and scalable security architecture	4
20	Privacy Protection	5
21	Security for trusted Non 3GPP access	12
22	Operator Monetization	14

IoT enabled devices. Hence, that information is needed to be kept secret. Thus, end to end security of heterogeneous network is required to be ensured in the discrete areas to the entire areas.

Elastic and Scalable Security Architecture

In the 5G networking environment, it is perceived necessary to consider a more flexible, dynamic, elastic and scalable security architecture. Protection of synchronous aspects is to be ensured. To achieve this, cell reselection RAN signaling systems are required to be placed close to the access system ensuring higher degree of independence from asynchronous security aspects. This would enhance the security handling mechanisms and would mitigate infringement of privacy of data of the

Table 4. Survey through PCA

Critical Factors	Eigen Values	Variance (%)	Factor Loading
Security as a Service	6.232	12.990	0.825
Isolated as well as Integrated Secure Network Slices	5.435	11.329	0.817
Cloud Oriented Security	4.319	9.002	0.803
Cognitive, Embedded and Adaptive Privacy Protection Features	3.905	8.139	0.801
Identity, Authentication & Data Management	3.625	7.556	0.792
Evolving Standards for Open Systems	3.024	6.303	0.784
Differentiated Security Protection	2.863	5.967	0.775
Seamless and Non-Disruptive Security Models	1.765	3.679	0.775
Service Trust Models	1.543	3.216	0.765
Leakage, Pilferage resistant networks	1.436	2.993	0.752
Secure Connected Ecosystem	1.404	2.926	0.745
CIA	1.286	2.680	0.739
Breadth of Service for Customers	1.171	2.440	0.727
E2E Security in HetNets	1.012	2.190	0.718
Elastic and scalable security architecture	1.010	2.080	0.712
Privacy Protection	1.040	2.020	0.708

users of SCI. The security network should be elastic to ensure wide protection. In brief, for protecting data, extensive elastic and scalable security architecture is to be ensured.

Privacy Protection

Coverage of service layer with the access layer and ensuring privacy of identity and of location are perceived to be the two salient protective requirements in the context of 5G network systems expected to be used in SCI. Latency requirements and use of multi-layer architecture have aggravated the security and privacy issues. To ensure protection on these issues, new technologies including SDN oriented authentication handover can be used. This use of SDN oriented authentication architecture would help to signify the complex protection mechanisms in the context of use of 5G networking systems in SCI within the acceptable level of security and privacy issues.

Differentiated Security Protection

In SCI, the security demands would vary greatly for the service issues in the context of vertical industries. Light weight security would be needed to protect IoT enabled mobile devices (Chatterjee and Kar, 2018). Highly effective mobile security is needed to ensure protection to high-speed mobile services. The organizations would be able to establish virtual networks. It would be able to connect arbitrary end points. It would create multiple entry points along with creation of multiple backdoors. To ensure protection on all entry points, differentiated security protection architecture is to be ensured.

Evolving Standards for Open Systems

Higher degree of security arrangements is needed to be ensured for protections to the connected devices via HetNets. Provisions of open platforms for IoT and for 5G are to be provided. In these platforms, software and hardware of multi-vendors would exist. In the context of use of 5G in SCI, the users want to ensure end-to-end security. The 3GPP is already working with standardization of interfaces. The global bodies like SECAM, 3GPP, IEEE are needed to develop standard security frameworks for open systems.

Identity, Authentication and Data Management

IoT enabled devices are such devices which are embedded with many devices used for household activities, vehicular activities connected with Bluetooth and so on. In the 5G network operational systems, there are needs of identity management and of authentication management. These can be done by the appropriate use of Universal Integrated Circuit Card (UICC) and using Physical Unclonable Function (PUF) respectively. Data security is also needed to be ensured since using 5G network, there will be exchange of huge volume of data. In the era of environment of cloud infrastructure, security of data of the users in SCI is perceived to be another important issue.

Security as a Service

In SCI, security compromise can never be indulged at any level. Use of 5G networking systems in SCI involves use of IoT embedded devices. These devices are expected to be utilized by multifarious industries like healthcare industries, automobile industries and so on. If any security latches take place in these industries expected to function in SCI, the provider should instantly respond for treating the ailments. The service providers can ensure security of data by supplying SECaaS which can

address authentication issues, issues connected with anti-virus, and anti- malware. The service providers are needed to respond to address any case of security issue with zero delay.

Breadth of Service for Customers

Next Gen security arrangements offer an unprecedented protective mechanism for the customers. The service providers offer the customers all pervasive safety networks. However, the value of buck which is provided for protection of 5G is surprising. The scope of their security-related deliverables is expected to ensure security towards adoption of all modern devices in SCI including IoT enabled network devices. With discoveries of more secure IoT embedded devices, its use would be enhanced in SCI. If breadth of security devices is enhanced through use of 5G network, it would also provide security to the IoT embedded devices expected to be used in SCI.

Service Trust Models

Ultra-lean access design acts as an important ingredient of radio networking system to achieve higher efficiency. This mechanism acts to reduce all transmissions which are not directly concerned with the communication of users' data. This ultra-lean design is highly essential for ultra-dense deployments having large number of network nodes. This design is considered as a significant component for delivering high network energy performance. This design offered by the service providers of 5G networking systems would derive high benefits to the end users and would provide an effective input to grow trust on the service providers for using 5G networks.

Secure Connected Ecosystem

Users are always disturbed by the problems of latency, call drop, and security loopholes in the networking systems. But, the 5G network systems automatically remove these problems by the design itself. Moreover, this 5G network system expected to be used in SCI uses NFD and SDN which provide tight security architecture by rendering greater data protection technique. This 5G network consumes less energy ensuring secure connected ecosystem.

Confidentiality, Integrity, and Authenticity (CIA)

Preservation of confidentiality, integrity, and authenticity is considered as a secret of success in the Information Security Management. These attributes should be there in 5G network systems. In SCI, there should be appropriate infrastructural facilities

for the use of 5G networking systems with preservation of all the security aspects like confidentiality, integrity and authenticity that would help the citizens of SCI to fearlessly accept the 5G networks.

Isolated as Well as Integrated Secured Network Slices

For addressing issues of security of any shape in SCI, the service providers can use NETaaS. In this system, network slices can even be leased out on demand. This remedial measure is associated with the advanced concept of SDN and NDF. The authorities are required to put more sophisticated design of software of virtualization layer. This can ensure more secure isolated as well as integrated network devices.

Cloud Oriented Security

In SCI, it is expected that huge data will be generated using many modern devices. Management for providing security of these data needs help of Cloud Computing Infrastructure. Due to existence of many entry points, cloud is vulnerable, However, now, due to advancement of technology, many modern protective measures are being used to mitigate the threat in the context of security and privacy issues. Any abrupt attack on cloud infrastructure in SCI can bring in the SCI to stand still. Efficient programmability of SDN and cloud-friendly data encryption system should be used for ensuring cloud-oriented security.

Cognitive, Embedded and Adaptive Privacy Protection Features

Network sizes will lead to distributed, cognitive and programmable infrastructure that would provide efficient and flexible deployment of embedded and adaptive privacy protection solution. It would ensure protection of data in cloud storage. Embedded Universal Integrated Circuit Card (UICC) devices or use of Physical Unclonable Function (PUF) are expected to protect any untoward and unexpected privacy leakage. Homomorphic encryption may be used to ensure foolproof data protection in the environment of use of 5G networks in SCI.

Seamless and Non-Disruptive Security Models

5G network model can provide tremendous scope. Multifarious users' profile including individuals' profile to the profile of large business organizations functioning in SCI would be handled using the modern networking systems. This requires non-disruptive and seamless integration of security aspects in the service layer as well

as in the application layer. Appropriate programmable infrastructure would be the main building block to develop such seamless and non-disruptive security model.

Leakage, Pilferage Resistant Networks

It is a fact that radio access is very much vulnerable in cellular network in the context of security and privacy issues. Different encryption algorithms can ensue security of data. However, in-built pilferage resistant network can bring in full-proof protection. Signaling confidentiality and integrity can be addressed by the NAS layer security mechanisms, but its actions are sometimes delayed which are otherwise considered inimical for the interest of the citizens of SCI. 5G system networks are supposed to be free from all unwanted delays. For this, the protective systems should be enriched with application layer security acting in parallel to network security layer.

ISM Methodology

ISM methodology takes an attempt to draw a hierarchical structure establishing an inter-relationship among the 16 identified CSFs. The methodology consists of the following steps:

1. Construction of the Structural Self Iteration Matrix (SSIM)
2. Construction of Reachability Matrix (RM)
3. Carrying out level partitioning
4. Clustering of Factors and
5. Formation of the ISM

Now stepwise approach gives the results eventually.

Construction of the Structural Self Iteration Matrix (SSIM)

For expressing the inter-relationships among the 16 CSFs, 4 symbols have been used. These are V, A, X and O. These symbols provide different direction relating to the parameters i and j.

V is used for parameter i to lead to j
A is used for parameter j to lead to i
X is used for parameters i and j to lead to each other
O is used for parameters i and j when they are unrelated

Basing on these relationships, SSIM is developed and is shown in Table 5.

Table 5. Structural Self Iteration Matrix

Sr. No.	Critical Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	E2E Security in HetNets		V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
2	Elastic and scalable security architecture				V	V	O	V	V	V	O	V	O	V	O	V	V
3	Privacy Protection					V	V	O	O	V	V	V	V	V	V	V	V
4	Differentiated Security Protection							V	V	V	O	V	O	V	O	V	V
5	Evolving Standards for Open Systems									V	O	V	O	V	O	V	V
6	Identity, Authentication & Data Management										V	O	V	V	V	V	V
7	Security as a Service								X		O	V	O	V	O	V	V
8	Isolated as well as Integrated Secure Network Slices											V	O	V	O	V	V
9	Cloud Oriented Security											V	O	V	O	V	V
10	Cognitive, Embedded and Adaptive Privacy Protection Features												V	V	V	V	V
11	Seamless and Non-Disruptive Security Models													V	O	V	V
12	Leakage, Pilferage resistant networks													V	V	V	V
13	Breadth of Service for Customers														A	V	V
14	Service Trust Models															V	V
15	Secure Connected Ecosystem																V
16	Confidentiality, Integrity and Authenticity																

Construction of Reachability Matrix (RM)

SSIM is transformed to Binary Matrix which is termed as Reachability Matrix by the substitution of the symbols V, A, X, O with binaries 1 and 0. For this, the following mechanism is used.

- For each (i, j) pair in the SSIM is V, the (i, j) pair in the reachability matrix becomes 1 and the (j, i) pair becomes 0.

- For each (i, j) pair in the SSIM is A, the (i, j) pair in the reachability matrix becomes 0 and the (j, i) pair becomes 1.
- For each (i, j) pair in the SSIM is X, the (i, j) pair in the reachability matrix becomes 1 and the (j, i) pair also becomes 1.
- For each (i, j) pair in the SSIM is O, the (i, j) pair in the reachability matrix becomes 0 and the (j, i) pair also becomes 0.

Following the above rule, the Reachability Matrix (RM) is prepared and it is shown in Table 6.

Table 6. Reachability matrix

Sr. No.	Critical Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Driving Power
1	E2E Security in HetNets	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
2	Elastic and scalable security architecture	0	1	0	1	1	0	1	1	1	0	1	0	1	0	1	1	10
3	Privacy Protection	0	0	1	0	1	1	0	0	1	1	1	1	1	1	1	1	11
4	Differentiated Security Protection	0	0	0	1	0	0	1	1	1	0	1	0	1	0	1	1	8
5	Evolving Standards for Open Systems	0	0	0	0	1	0	0	0	1	0	1	0	1	0	1	1	6
6	Identity, Authentication & Data Management	0	0	0	0	0	1	0	0	0	1	0	1	1	1	1	1	7
7	Security as a Service	0	0	0	0	0	0	1	1	0	0	1	0	1	0	1	1	6
8	Isolated as well as Integrated Secure Network Slices	0	0	0	0	0	0	1	1	0	0	1	0	1	0	1	1	6
9	Cloud Oriented Security	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	1	5
10	Cognitive, Embedded and Adaptive Privacy Protection Features	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	6
11	Seamless and Non-Disruptive Security Models	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	4
12	Leakage, Pilferage resistant networks	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	5
13	Breadth of Service for Customers	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	3
14	Service Trust Models	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	4
15	Secure Connected Ecosystem	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
16	Confidentiality. Integrity and Authenticity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	Dependence	1	2	2	3	4	3	5	5	6	4	9	5	14	6	15	16	

Carrying Out Level Partitioning

From the Reachability Matrix as shown in Table 6, reachability set, and antecedent set have been derived. After this, the intersection of these sets is identified considering all the CSFs and levels of different factors are identified. Those factors would occupy top level in the ISM hierarchy for which the reachability and the intersection sets are the same. Once the top factor is identified, it is removed from consideration. Same process is repeated for identification of the factor/factors for the next levels. This process, known as iteration process, is continued till the level of each of the CSFs could be identified.

The process is lengthy. But, for conceptualization, the 1st iteration is shown only in Table 7.

It appears from this table, which is Iteration 1, serial number 16 as shown in Table 5(SSIM), that is, Confidentiality, Integrity and Authenticity (CIA) occupies in Level-1. In this way, by the help of different iterations, all the CSFs are given different levels. In this way, it has been assessed that there are 8 levels where the 8th level (lowest level) is occupied by E2E Security in HetNets.

Table 7. Iteration 1

Factor	Reachability Set	Antecedent Set	Intersection Set	Level
1	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1	1	
2	2,4,5,7,8,9,11,13,15,16	1,2	2	
3	3,5,6,9,10,11,12,13,14,15,16	1,3	3	
4	4,7,8,9,11,13,15,16	1,2,4	4	
5	5,9,11,13,15,16	1,2,3,5	5	
6	6,10,12,13,14,15,16	1,3,6	6	
7	7,8,11,13,15,16	1,2,4,8,7	7,8	
8	7,8,11,13,15,16	1,2,4,7,8	7,8	
9	9,11,13,15,16	1,2,3,4,5,9	9	
10	10,12,13,14,15,16	1,3,6,10	10	
11	11,13,15,16	1,2,3,4,5,7,8,9,11	11	
12	12,13,14,15,16	1,3,6,10,12	12	
13	13,15,16	1,2,3,4,5,6,7,8,9,10,11,12,14,13	13	
14	14,15,16	1,3,6,10,12,14	14	
15	15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	15	
16	16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	16	1

Clustering of Factors

The CSFs are compartmentalized into four clusters. It is shown in Figure 1.

Its implications are shown in the Table 8.

Formation of the ISM

With all the inputs derived from (i), (ii), (iii), and (iv), the final model could be structured. This is called Interpretive Structural Model (ISM) with reference to this study. This is shown in figure 2.

Besides, it appears that the CSFs occupy different levels in this model. The level-wise description of the CSFs is shown in Table 9.

DISCUSSION OF RESULTS

The ISM shows the blueprint in a hierarchical and sequential fashion distinctly highlighting the level of influence of each CSF. The ISM shows that the Confidentiality, Integrity and Authenticity (CIA) gets incremental benefits from the below seven levels. The practitioners would get food for their thinking regarding how full-proof security can be achieved by emphasizing the CSFs occupied in different levels in

Figure 1. Dependence and driving power diagram

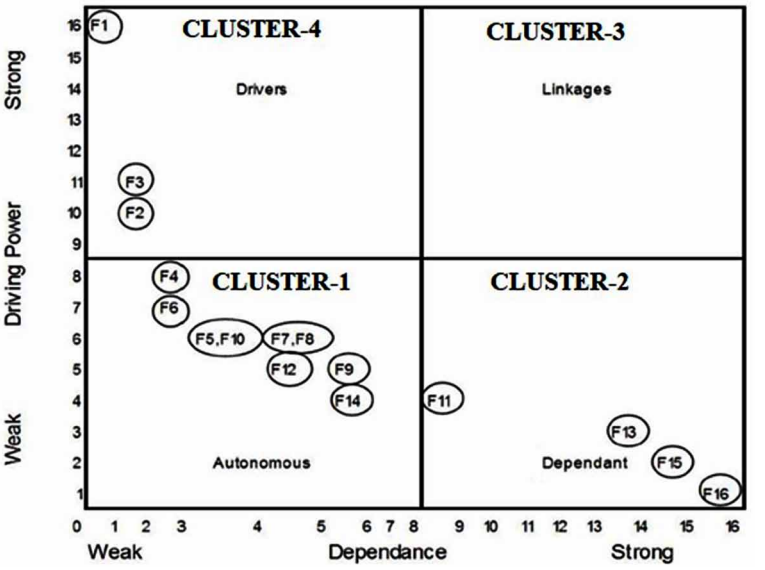


Table 8. Implications of clustering

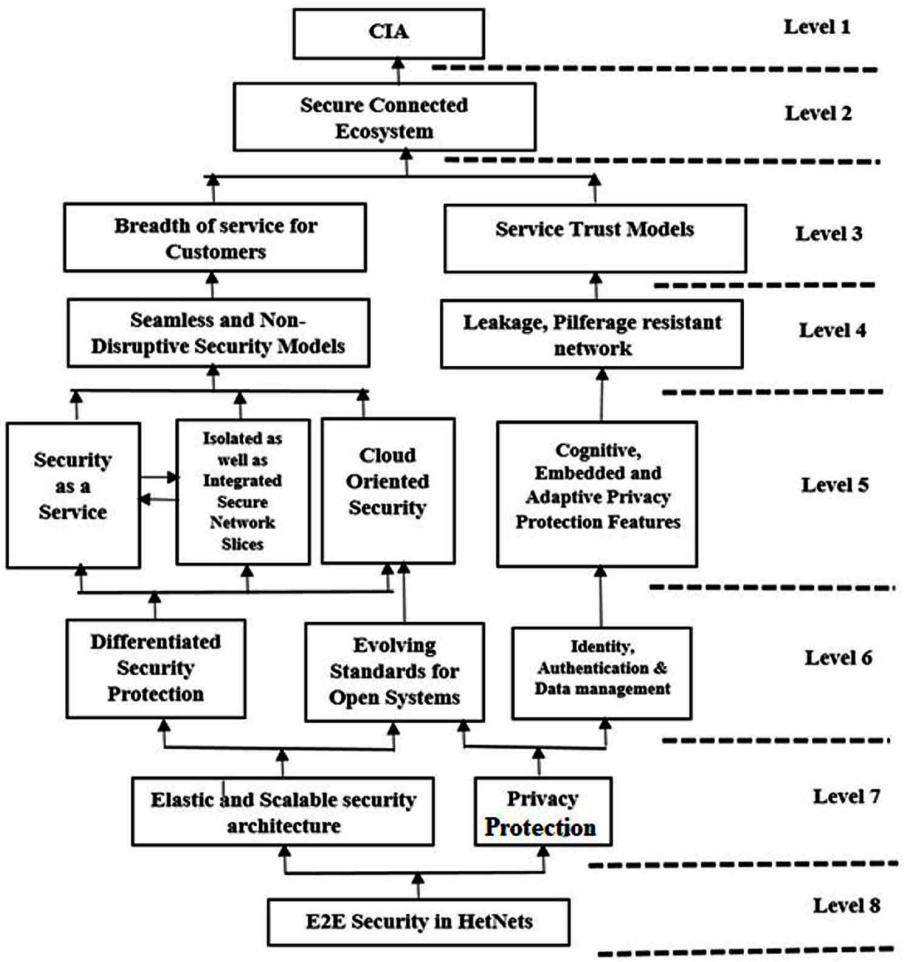
Cluster No.	Characteristics	Significance
Cluster 1	Autonomous Factors	These factors possess weak driving power with weak dependency. They are weakly linked with the system.
Cluster 2	Dependent Factors	These factors possess weak driving power with strong dependency.
Cluster 3	Linkage Factors	These factors possess strong driving power with stronger dependency (In this study, no factor is seen in this cluster)
Cluster 4	Independent Factors (Drivers)	These factors possess strong driving power with weak dependence.

Table 9. Level-wise description of CSFs

Level Number	Name (s) of the CSFs
1	CIA (Confidentiality, Integrity and Authenticity)
2	Secure Connected Eco System
3	Breadth of Service for Customers; Service Trust Models
4	Seamless and Non-Disruptive Security Models; Leakage, Pilferage resistant networks
5	Security as a Service; Isolated as well as Integrated Secured Network Slices; Cloud Oriented Security; Cognitive, Embedded and Adaptive Privacy Protection Features
6	Differentiated Security Protection; Evolving Standards for Open Systems; Identity, Authentication and Data Management
7	Elastic and Scalable Security Architecture; Privacy Protection
8	E2E Security in HetNets

the context of their weightage. This is a new type of research study. However, this study has given a lot of emphasis to identify the salient factors that would help to ameliorate the 5G network systems expected to be used in SCI within the acceptable level of security and privacy issues. The ISM shows that apart from E2E Security in HetNets, two other factors like Elastic and Scalable security architecture and Privacy Protection act as main driving powers for ensuring secure 5G networks in SCI. This also responds with the result of clustering in terms of 4th compartment of Figure 1 where these three CSFs are there. If these drivers (3 drivers) are made healthy and robust, it is expected that eventually it will be possible to ensure security in 5G network system expected to be used in SCI.

Figure 2. Interpretative Structural Modelling



LIMITATIONS OF THE STUDY

- For gathering feedbacks in the Questionnaire-based survey, 205 feedbacks have been considered and analyzed. This figure is meagre compared to the vastness of India.
- Inputs through feedbacks have been taken from Indian individuals. In India, Smart Cities have yet not been fully operational in the real sense of the term. Naturally, the feedbacks obtained from the respondents are the feedbacks obtained from the non-adopters. Hence, the feedbacks are predictive in nature. Generalization of this result might have invited some unwanted errors.

- Different Smart Cities may have their own special type of complexity and may possess different specific challenges in the context of security and privacy issues. These diversities have not been considered in this study.

CONCLUDING REMARKS

The aim of this study is to identify the Critical Success Factors which would impact to ensure security and privacy vulnerabilities in the SCI in the context of use of 5G network. The blueprint drawn in sequential style through ISM clearly has demarcated different levels of importance of the CSFs in hierarchical manner. The ISM has been able to stratify the relative additive power of each of the CSFs in terms of the 8 levels. The extent of independence as well as of convergence has been laid out in explicit manner. The study has highlighted an effective and meaningful incremental benefit over different 7 specific levels that eventually adds to a secure and CIA compliant SCI. Though it is a fact that most of the salient specifications for evolution of 5G connecting grids in SCI are yet to be finalized, it is important that each aspect concerning to network has been designed considering the security vulnerabilities. The CSFs so identified are expected to provide effective inputs to the designers and developers to nurse and to ease out the finer points and to weed out the latches which might crop up in terms of issues of security and privacy vulnerabilities towards use of 5G networking system when SCI would be fully operational.

REFERENCES

Banwet, D. K., & Arora, R. (1999). Enablers and inhibitors of E-Commerce Implementation in India- an imperative structural modeling (ISM) approach. In Operations management for global economy challengers and prospects, 332-341.

Barskar, R., Deen, A. J., Bharti, J., & Ahmed, G. F. (2010). The Algorithm Analysis of E-commerce security issue for on-line payment transaction system in Banking Technology. *Cryptography & Security*, *8*(1), 307–312.

Bartol, A., Harmandaze-Scrranoy, J. M., Soriano, M., Dohler, M. A., & Barthel, D. (2011). Security and Privacy in your Smart City. *Proceedings of Barcelona Smart Cities Congress*.

Borroso, C., Carrion, G. C., & Roldan, J. L. (2010). *Applying Maximum Likelihood and PLS on Different Sample Sizes: Studies on Seroquel Model and Employee Behavior Model. In Handbook of Partial Least Squares Concepts, Methods and Applications* (pp. 427–447). Heidelberg, Germany: Springer.

Brown, M. M., & Brudney, J. L. (2003). Learning organizations in the public sector? A study of police agencies employing information and technology to advance knowledge. *Public Administration Review*, *63*(1), 30–43. doi:10.1111/1540-6210.00262

Carpenter, S. (2018). Ten Steps in Scale Development and Reporting: A Guide for Researchers. *Communication Methods and Measures*, *12*(1), 25–44. doi:10.1080/19312458.2017.1396583

Chatterjee, S., Kar, A. K., & Gupta, M. P. (2018). Success of IoT in Smart Cities of India: An empirical analysis. *Government Information Quarterly*, *35*(3), 349–361. doi:10.1016/j.giq.2018.05.002

Chidambaranathan, Sk., Muralidharan, C., & Deshmukh, S. G. (2009). Analyzing the interaction of critical factors of supplier development wing, interpretive structural modeling (ISM)- an empirical study. *International Journal of Advanced Manufacturing Technology*, *138*(1-3), 243–249.

Cosgerove, V. (2011). *Smart Cities: Introducing the IBM city operations and management solutions*. IBM.

Dawes, S. S., & Pardo, T. A. (2002). Building collaborative digital government systems. In W. J. Melver & A. K. Elmagarmid (Eds.), *Advances in Digital Government: Technology, Human Factors and Policy*. Norwell, MA: Kluwer Academic Publishers. doi:10.1007/0-306-47374-7_16

Deb, M., & David, E. L. (2014). An empirical examination of customers' adoption of m-banking in India. *Journal of Marketing Intelligence & Planning*, *32*(4), 475–494. doi:10.1108/MIP-07-2013-0119

Elmaghraby. (2013). Security and Privacy in the Smart City. *6th Ajman International Urban Planning Conference, City and Security*, 1-7.

Eloff, M. W., & Von Solms, S. H. (2000). Information Security Management: An approach to combine process certification and product evolution. *Computers & Security*, *19*(8), 608–709. doi:10.1016/S0167-4048(00)08019-6

Hinkin, I. P. (1996). A review of scale development in the study of behavior in organizations. *Journal of Management*, *21*(5), 967–988. doi:10.1177/014920639502100509

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). *Cultures and organizations: Software of the mind. Revised and Expanded* (3rd ed.). New York: McGraw-Hill.

Hollands, R. G. (2008). Will the real smart city please stand up? *City*, *12*(3), 303–320. doi:10.1080/13604810802479126

Isaksen, S. G., & Ganlin, J. P. (2006). A reexamination of brainstorming research: Implication of research and practice. *Gifted Child Quarterly*, *49*(4), 315–329. doi:10.1177/001698620504900405

Jeberson, W., & Singh, G. (2011). Analysis of Security Measure Implemented on G 2 C on-line payment systems in India. *MIT International Journal of Computer Science and Information Technology, 1*(1).

Kally, F. P. (1994). On tariffs, Policing and Admission Control of Multi-Service Networks. *Operations Research Letters*, *15*(1), 1–9. doi:10.1016/0167-6377(94)90008-6

Los Huertos, G. (2010). *End of Privacy- Herding Friendship in Starbucks*. Academic Press.

Lövehagen, N., & Bondesson, A. (2013). Evaluating sustainability of using ICT solutions in smart cities – methodology requirements. *Proceedings for ICT for Sustainability conference*, 184-191.

Nfuka, E. N., & Rusu, L. (2010). Critical success factors for effective IT governance in the public sector organizations in a developing country: The case of Tanzania. *Proceedings of the 18th European Conference on Information Systems (ECIS)*, 7-9.

Norris, P. (2001). *Digital Divide: Civic Engagement, Information Poverty, and the Internet Worldwide*. New York: Cambridge University Press. doi:10.1017/CBO9781139164887

Odendaal, N. (2003). Information and Communication Technology and local Governance: Understanding the difference between cities in developed and emerging economies. *Computers, Environment and Urban Systems*, *27*(6), 585–607. doi:10.1016/S0198-9715(03)00016-4

Raj, T., Shankar, R., & Suhaib, M. (2007). An ISM approach for modeling the enablers of flexible manufacturing system: The case of India. *International Journal of Production Research, 46*(24), 1-30.

Rajesh, K. S., Suresh, K. G., & Deshmukh, S. G. (2007). Interpretive Structural Modeling (ISM) of factors for improving competitiveness of SMEs. *International Journal of Productivity and Quality Management*, *2*(4), 423–440. doi:10.1504/IJPQM.2007.013336

Rashad, Y., & Noor, A. E. (2010). Security and Privacy issues as a potential risk for further E-Commerce Development. *International Conference on Information, Communication and Management*, 16.

Ravi, V., Shankar, R., & Tewari, M. K. (2005). Productivity Improvement of a Computer Hardware Supply Chain. *International Journal of Productivity and Performance Management*, *54*(4), 239–255. doi:10.1108/17410400510593802

Rouf, I., Miller, R., Mustafa, H., Taylor, T., Oh, S., & Xu, W. (2010). Security and Privacy incredulities of in-car wireless networks: a tire pressure monitoring system case study. In *The 19th USENIX Conference on Security*. Berkeley, CA: USENIX Association.

Singh, M. D., Shankar, R., Narain, R., & Agarwal, A. (2003). An interpretive Structural Modeling of Knowledge Management in Engineering Industries. *Journal of Advanced Management Research*, *1*(1), 28–40. doi:10.1108/97279810380000356

Thripathy, B., & Mishra, J. (2000). Protective Measures in E-commerce to deal with security threats arising out of social issues – A framework. *International Journal of Computer Engineering and Technology*, *4*(1), 46–53.

Warfield, J. W. (1974). Developing Interconnected Matrices in Structural Modeling. *IEEE Transactions on Systems, Man, and Cybernetics*, *4*(1), 51–81.

Yasin, S., Haseeb, K., & Qureshi, R. J. (2012). Cryptography based E-Commerce Security: A review. *International Journal of Computational Science*, *9*(1-2), 132–137.

Chapter 11
A Novel Cooperative Divide-and-Conquer Neural Networks Algorithm

Pan Wang
Wuhan University of Technology, China

Yandi Zuo
Wuhan University of Technology, China

Jiasen Wang
Hithink RoyalFlush Information Network Co., Ltd., China

Jian Zhang
Wuhan University of Technology, China

ABSTRACT

Dynamic modularity is one of the fundamental characteristics of the human brain. Cooperative divide and conquer strategy is a basic problem solving approach. This chapter proposes a new subnet training method for modular neural networks with the inspiration of the principle of "an expert with other capabilities." The key point of this method is that a subnet learns the neighbor data sets while fulfilling its main task: learning the objective data set. Additionally, a relative distance measure is proposed to replace the absolute distance measure used in the classical method and its advantage is theoretically discussed. Both methodology and empirical study are presented. Two types of experiments respectively related with the approximation problem and the prediction problem in nonlinear dynamic systems are designed to verify the effectiveness of the proposed method. Compared with the classical learning method, the average testing error is dramatically decreased and more stable. The superiority of the relative distance measure is also corroborated. Finally, a mind-gut frame is proposed.

DOI: 10.4018/978-1-7998-1786-4.ch011

INTRODUCTION

In the system of nature and human society, the operation mode of physical and virtual worlds is dominated by some basic rules and patterns. For instance, the macroscopic world exists and evolves in a harmonious and orderly manner due to the internal effect of Newton's laws for the classical mechanics. The diversity and unity of the biology world have been determined by the principle of genetics in the life sciences and the determinism declared by Laplace has been terminated by the uncertainty in the microscopic world, etc.

Another important principle called "divide and conquer" has been confirmed by some discoveries in the brain-related sciences. Specifically, some researchers in neuroscience have found in human brain that there exist sparse connections between different neuronal groups where neurons are often densely connected and meanwhile that different response patterns are produced by the neuronal groups for different perceptual and cognitive tasks (Edelman, 1987; Fodor, 1983; Kandel, Schwartz, & Jessell,2000). These two phenomena are respectively called the structural and functional modularity. These modularity evidences suggesting that domain-specific modules are required by the specific tasks and that a variety of modules can be coordinated for more complex tasks have reflected the principle of "divide and conquer" and have motivated the development of modular neural network (MNN) (Farooq, 2000). Therefore, it can be deemed that the principle of "divide and conquer" has given birth to MNN.

With the social development and the progress in science and technology, an interesting phenomenon has been widely witnessed in various fields, such as talent cultivation, corporate development, and especially in biology. For instance, in the microscopic aspect, it has been found that a gene called Mesp1, the main controlling factor for the development of cardiovascular, can activate the transcription factors of the heart, guide the cardiac mesoderm formation, and prevent the stem cells from differentiating into other cell types. In addition, it plays an important role in the growth of the blood and skeletal muscle (Chan et al., 2013). In the macroscopic aspect, Rapamycin, which was previously a medicine for the treatment of immune rejection after transplantation, not only helps to prolong the life of yeast, worms, fruit flies and other invertebrates, but also can be used in the targeted therapy of tumor (Harrison et al., 2009; Ma et al., 2010).

In addition, this substance is even considered as the key factor in the evolution history of diverse species. Inspired by these discoveries, Wang et al. (2008) first proposed a principle called "an expert with other capabilities", based on which a subnet training method in MNNs is then proposed by Wang and Wang (2012). However, few experiments have been carried out to test its effectiveness due to space constraint. Therefore, this paper is devoted to further describe this method and to

testify its performance with more delicate experiments. In addition, the distance measure used in Wang and Wang (2012) is replaced by a new one, which proves theoretically and empirically more effective in general cases.

The chapter is arranged as follows. The principles respectively initiating the research in MNNs and motivating the work of the authors are briefly introduced. Next, the recent advances in MNNs, reflecting the active research on MNNs, are introduced. Then, the MNN is illustrated in detail and a classical subnet training method in MNNs is introduced. Next, the principle of "an expert with other capabilities" is described in depth and then a new subnet training method as well as a specific algorithm are proposed. In addition, a relative distance measure is advanced and its superiority is theoretically proved. Then the authors present the performance of the proposed subnet learning method in the experiments associated with the approximation problem and prediction problem in dynamic systems. The superiority of the relative distance measure is also illustrated with the experiment results. Finally, this paper is concluded with some directions for future research.

RECENT ADVANCES IN MNNS

MNNs have been widely applied in many fields such as image recognition, systems identification and time series prediction (Caelli, Guan, & Wen, 1999; Melin & Castillo, 2007; Melin, Mancilla, Lopez, & Mendoza, 2007). A recent example of MNN in pattern recognition is introduced in Melin et al (2011) where a modular neural network consisting of three monolithic feedforward neural networks is designed for the face recognition by using the Sugeno integral with interval type-2 fuzzy logic as the integration method and its outstanding performance has been verified in ORL (Samaria & Harter, 1994), Yale and FERET benchmark face databases. To the best of our knowledge, the recent work in the pattern recognition by using MNNs has been mainly led by a group of researchers from Tijuana Institute of Technology and their latest result was reported in (Sanchez, Melin, Castillo, & Valdez, 2013) where a modular neural network, combined with a granular approach and optimized by a new multi-objective hierarchical genetic algorithm in terms of several important parameters, is used in the human recognition based on the database of human Iris (Institute of Automation, Chinese Academy of Sciences, 2002).The effectiveness and the advantages of MNN in human recognition based on benchmark ear and face databases is verified by Sánchez et al. (2017) . A hybrid model using modular neural networks and fuzzy logic has been designed to provide the hypertension risk diagnosis of a person (Melin, Miramontes, & Prado-Arechiga,2018).

As an ensemble learning method, MNN has also been used in other problems. For instance, in Fernández-Navarro et al. (2013), neural networks are used as the base threshold methods in an ensemble approach based on negative correlation learning (NCL) (Wang, Tang, & Yao, 2009; Wang & Yao, 2010) to solve the ordinal regression problems. The diversity existing in different projections which are respectively generated by these threshold neural networks during training is promoted to ultimately improve the performance of ordinal regression classifiers. Additionally, a well-known problem within MNN has been studied in Coop et al. (2013). A feedforward neural network embedding an extra sparsely encoding hidden layer called fixed expansion layer (FEL) is designed to mitigate the catastrophic forgetting in parameterized supervised learning systems and a diverse set of FEL networks, which can effectively overcome the limitation of any single-FEL network, exhibited significantly higher accuracy in the presence of non-stationary inputs.

It is worth noting that MNN has been increasingly combined with machine learning methods. For instance, in Van and Wiering (2012), a structured multi-layer perceptron (MLP) is used as an evaluation function for the game Othello (Buro, 2003). The modularity lies in that the opening board is divided by the game program into regions which are then respectively evaluated by the corresponding subnets. Furthermore, by using a special sparse network structure and a weight sharing strategy, the number of learning parameters in a variant of temporal difference (TD) learning algorithm (Samuel, 1959) is largely reduced to accelerate the learning process and the resulting player is superior to that based on the linear networks or fully connected neural networks and to that based on the evaluation functions evolved with evolutionary algorithms (Rechenber, 1971).

Furthermore, since Hinton et al. (2006) made a breakthrough in deep neural network (DNN) learning by proposing a hybrid learning strategy which has given birth to a new machine learning area called deep learning (DL), the combination of MNNs and DNNs becomes a promising direction given the recent research results. In Gehring et al. (2013), a deep neural network composed by multiple stacked auto-encoders is applied to extract deep bottleneck features and then a deep belief networks (DBNs) (Hinton, Osindero, & Teh, 2006) is used to model successive windows of the bottleneck features by applying each neural network to the adjacent windows of features. The success of the modularity of these two tandem DNNs has proved the applicability of modularity to DNNs. Moreover, the catastrophic forgetting is also studied in modular DNNs. In Pape et al. (2011), by using a learning algorithm that adjusts the learning rate of each DBN module proportionally to the fraction of the best reconstructed samples, the proposed unsupervised modular DBN architecture is able to retain learned features even after they are removed from the training data, which shows that the modularity can enhance the adaptability of DNNs in complex situations.

Another evidence can be found in Gatys et al. (2015) where the content representation of an arbitrary image is learned by some parts of a deep convolutional neural network (CNN) and then a new image is produced by combining this content representation with the style representation of a piece of art extracted by other parts of the same CNN, giving this ordinary image a visually appealing style of well-known artists, e.g., Van Gogh. Since the content is the key of an ordinary picture while the style is the soul for an artistic one, the new artistic image can be viewed as a successful trial of the functional modularity in the DNN framework. Most importantly, AlphaGo (Silver et al., 2016), which is developed by Google DeepMind and has beaten the world champion Go Lee SeDol in 2016, is undoubtedly a highlighted example of such tendency. Three deep convolution neural networks are used in AlphaGo. The successive training of them respectively yields a supervised learning policy, a reinforcement learning policy and finally a predicted value.

With these obtained policies, AlphaGo is able to evaluate the board position and its local computation capability is significantly augmented, hence effectively reducing the width and depth of the search tree in Monte Carlo tree search (Coulom, 2006) and finding the quasi-optimal paths in an acceptable time.A generic training strategy that incorporates anatomical prior knowledge into CNNs through a new regularisation model in (Oktay et al.,2018). A unified deep neural network is helpful in car license-plate detection and recognition in natural scene images(Li,Wang,&Shen,2018).

MODULAR NEURAL NETWORKS

The modular neural network is one of the most important ensemble methods and tools (Seni & Elder, 2010; Wang et al., 2008; Wang, Xu, Zhou et al 2010; Wang, Zhang, Guo, Tao, & Liu, 2016). According to its definition in Wang et al. (2008): In the generalized sense, a modular neural network is a system composed by multiple neural networks which are relatively independent, mutually correlated and cooperative. These neural networks have individual specific tasks, relative independence and distinctive information processing patterns and styles. To be straightforward, the modular neural network is a system of neural networks connected in diverse manners, each of which is called a module and learns a part of the samples. Finally, the outputs of all the modules are integrated. This type of integrated neural networks can be cooperative or competitive. The so-called multi-neural network integration can be also unified in the above definition.

In fact, the information processing pattern of the modular neural networks is similar to the idea of problem solving adopted by the human teams, i.e., the task is first decomposed into several sub- tasks and they are then distributed to each team member who may be mutually cooperative and/ or competitive and finally the

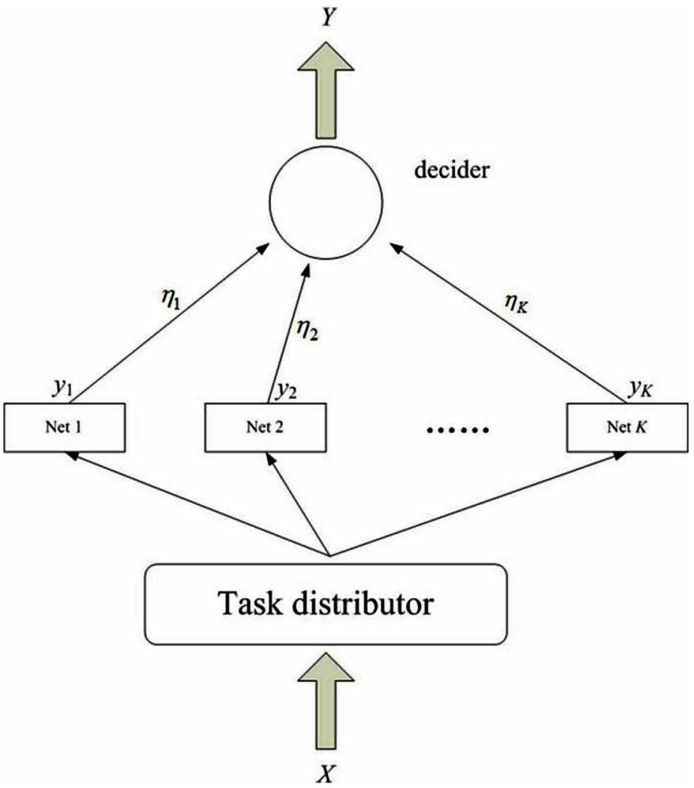
decision maker integrates the opinions of different members or the members decide collectively by reaching unanimity through consultation.

The structure of a modular neural network in Wang et al. (2008) is depicted in the Figure 1 and it is associated with a wide range of application problems. Task distributor represents a certain algorithm/ method, e.g., clustering algorithm, which divides the training task to reduce the problem complexity and to facilitate the network training. Then, the data X processed by the task distributor are respectively sent to each subnet (Net 1, Net 2, ..., Net K) for training and the outputs of all subnets respectively multiplied by the corresponding connection weights are given to the decision maker whose output is as follows:

$$Y = \sum_{i=1}^{K} \eta_i y_i \tag{1}$$

where y_i and η_i are respectively the output of subnet i and the connection weight between subnet i and the decision maker.

Figure 1. Structure of a modular neural network



Classical Subnet Training Method in MNN

The basic idea of training and testing algorithm used in (Wang et al., 2008; Wang, Shao, & Luo, 1998) for the MNN in Figure 1 is given as follows. First, the sample set is divided into the training set and the testing set. Then, the training set is clustered with fuzzy C-means Clustering method which functions as the task distributor and the center C_i, $i = i,...,K$ of each cluster is obtained. Then, K subnets are constructed to train every class of the training set. After the training, each member of the testing set, i.e., testing datum, is sent into all the subnets and the output of the *i*-th subnet is y_i. The membership degree of this test datum to the *i*-th subnet is denoted by β_i and let $\beta_i = \eta_i$. Then, the integrated output for each test datum is computed according to (1). Finally, the sum of the absolute errors between the network outputs based on the testing set and the corresponding targets is used to evaluate the network performance which is a measure of generalization capability. In this paper, this algorithm is called Algorithm 1 for the sake of brevity.

Note that with the objective to minimize $V = \sum_{i=1}^{K} \beta_i^2 d_i$, where

$$\sum_{i=1}^{K} \beta_i = 1, d_i = \left\| X - C_i \right\|^2$$

and $\|.\|$ stands for the Euclidean distance, the Lagrangian multiplier method is adopted to obtain β_i. Specifically:

$$\begin{cases} \beta_i = 1, \beta_{j \neq i} = 0 & if\ d_i = 0 \\ \beta_i = \dfrac{\dfrac{1}{d_i}}{\sum_{j=1}^{K} \dfrac{1}{d_j}} & otherwise \end{cases} \tag{2}$$

for $i, j = 1,...,K$ and $j \neq i$. Algorithm 1 shows the procedure.

This algorithm contains the procedures such as data clustering (Bi and Cochran 2014; Chen 2016; Duan et al 2009, 2012, 2015, 2017; Li et al 2009; Shen and Ye 2017), subnet training and error calculation and will be used as a reference algorithm for the comparison with the algorithm proposed in Wang and Wang (2012). It can be also seen that the connection weights differentiate with the distances between the testing sample and the cluster centers, so Algorithm 1 reflects the

idea of variable weight synthesis which has been firstly proposed in Wang (1985).

Algorithm 1.

Step 1: The sample set is divided into a training set named TrainSet and a testing set named TestSet. TrainSet is clustered with fuzzy C-means method, generating K clusters respectively denoted by S_i with the center C_i, $i = 1,...,K$.

Step 2: K subnets, respectively denoted by NN_i, $i = 1,...,K$, are constructed.

Step 3: The training performance index and training stopping criteria (such as certain value for performance index and maximum epoch) are set and then NN_i is trained by S_i.

Step 4: Using (1), the outputs based on the samples in TestSet are calculated and the absolute error between these outputs and the corresponding targets is used to evaluate the generalization capability of the MNN.

SUBNET TRAINING METHOD BASED ON "AN EXPERT WITH OTHER CAPABILITIES"

Principle of "an Expert With Other Capabilities"

Apart from the principle of "divide and conquer", another principle called "an expert with other capabilities" can be also used in the MNN. In this paper, this principle is defined as a strategy of being excellent in one aspect and meanwhile being capable in some other ones. For instance, this principle is very important for the survival and development of a variety of species. Specifically, according to the evolution theory proposed by Darwin, whether a creature can evolve microscopically in the positive direction depends on the extent of its adaptation to the environment, i.e., whether the creature can make the best of environment resources and eliminate its adverse factors and whether it can achieve a sustainable development in the co-system composed by the environment and itself. Therefore, its adaptation extent is an important factor determining its evolution direction. However, it has been proved in practice that it is rather complex to determine the adaptation extent of a specie to the environment. For instance, a population adapts well to the environment in the early stage while the characteristics which have helped them adapt to the environment gradually become the bottleneck hindering the maintenance of co-system when the environment has changed. For another example, a population develops in the early phase at the price of destroying the environment resources to promote its evolution while keeping the equilibrium of the co-system. However, once the destruction becomes excessive, the

adaptation was reversed, i.e., the former mutualism in the co-system became mutual antagonism, causing the population crisis. These two quintessential examples show that the adaptability has the following features:

- **Decisive Factors:** The adaptation extent determines the emergence of the characteristics for the positive evolution and the growth of a population;
- **Time-variation or Dynamic Property:** The adaptation of the same characteristic to the environment varies with time. In certain cases, it even results in an opposite result. In addition, when a characteristic causes the disequilibrium of the co-system, the adaptation is reversed;
- **Dependence on Environment:** The adaptation of certain characteristics of a population to different environment appears extraordinarily different. A population highly adaptable to a certain environment may be unable to survive when the environment changes.

It can be inferred that the principle of "an expert with other capabilities" is very promising to enhance the adaptability of one creature. The advantage of "an expert with other capabilities" is significant on account of its ability to resist the environment change. The adaptability of "an expert with other capabilities" is generally better than "an expert without other capabilities" and in some specific domains it outperforms "an ordinary person with no capability". Meanwhile, it should be noted that the strategy of "an expert with other capabilities" has more training complexity, e.g., a person who not only expects to be an expert but also pursues other capabilities must spend more time in learning and training in comparison with the others who are satisfied with being an expert in only one field. Therefore, the strategy of "an expert with other capabilities" sacrifices the training complexity for a better effect and a higher quality including the adaptability to a large-scale environment.

Subnet Training Method Based on "an Expert With Other Capabilities"

Inspired by the adaptation strategy of "an expert with other capabilities" in the real world, Wang and Wang (2012) has primarily proposed a subnet training algorithm in the MNN. Its general idea lies in that the training procedure of the i-th subnet is not only based on the corresponding training set S_i as its main training set, but also on some other geometrically adjacent training sets S_{iNEAR} as the auxiliary training sets to reinforce the training. Therefore, the performance index for training the i-th subnet is rewritten as follows:

$$F(w) = \sum_{x \in S_i} e^2 + \frac{1}{m} \sum_{x \in S_i NEAR} e^2 \tag{3}$$

where m depicts the importance of the auxiliary training set S_{iNEAR}. The closer to S_i it is, the more important S_{iNEAR} is (the closeness can be measured with the absolute/relative distance). In fact, m should be differentiated in the case of multiple auxiliary training sets. For instance, in the case of two auxiliary training sets, if the auxiliary training set closer to the main training set is assigned m, then the farther one should be assigned a value smaller than m. For the sake of simplicity, all the auxiliary training sets are treated equally and their importance is measured with the same value m .

The subnet training algorithm, based on "an expert with other capabilities" was proposed in Wang and Wang (2012) and shown in Algorithm 2.Wang and Wang (2012) has proposed the subnet training method based on "an expert with other capabilities" with few experiments to test its effectiveness. As its subsequent research, this paper illustrates its advantages with more experiment results.

Levenberg-Marquardt (LM) Training Algorithm

In this paper, it is necessary to describe the LM algorithm which has been introduced in the neural network training by Hagan and Menhaj (1994) since this algorithm or its variants have been involved in Algorithm 1 and 2 in this paper.

In LM algorithm, the performance criterion is:

$$I_w = \sum_{x \in S} e^2$$

which is the sum of quadratic errors e^2 between the network output based on the samples x in the training set S and the target output. A more specific expression is as follows:

Algorithm 2.

Step 1: The sample set is divided into a training set named TrainSet and a testing set named TestSet. TrainSet is clustered with fuzzy C-means method, generating K clusters respectively denoted by S_i with the center C_i , $i = 1,...,K$.

Step 2: The main training set and the auxiliary training sets of the *i*-th subnet are generated. Specifically, in the case of single auxiliary training set, S_i is the main training set and the nearest adjacent set to S_i is chosen in $\left\{S_j, j=1,...,K\right\}, j \neq i$, as the auxiliary training set S_{iNEAR} according to the absolute distances between the auxiliary training set and the major training set.

Step 3: Levenberg-Marquardt (LM) algorithm is used to train each subnet with performance index (3).

Step 4: The outputs of all subnets are integrated.

Step 5: After a certain operation period, the sample set is updated and then return to Step 1.

$$I\left(w\right)=\sum_{p=1}^{P}\sum_{k=1}^{K}\left(d_{kp}-o_{kp}\right)^2 \tag{4}$$

where $w=\left[w_1,w_2,...,w_N\right]^T$ is a vector containing all the weights and biases to be updated and they can be orderly organized. Here, they are described in a general form and N is the total number of all the weights and biases. d_{kp} is the target value of k-th output associated with the p-th sample, o_{kp} is the actual value of k-th output associated with the p-th sample. K represents the output dimension of the network and P denotes the number of training data. The vector form of (4) is shown as follows:

$$I\left(w\right)=E^TE \tag{5}$$

where

$$E=\left[e_{11},...,e_{K1},...,e_{1P},...,e_{KP}\right]^T$$

is an error vector and $e_{kp}=d_{kp}-o_{kp}$ for $k=1,...,K$ and $p=1,...,P$. The Jacob matrix J is defined as follows:

$$J = \begin{vmatrix} \frac{\partial e_{11}}{\partial w_1} & \frac{\partial e_{11}}{\partial w_2} & \cdots & \frac{\partial e_{11}}{\partial w_N} \\ \vdots & \vdots & & \vdots \\ \frac{\partial e_{K1}}{\partial w_1} & \frac{\partial e_{k1}}{\partial w_2} & \cdots & \frac{\partial e_{K1}}{\partial w_N} \\ \vdots & \vdots & & \vdots \\ \frac{\partial e_{1P}}{\partial w_1} & \frac{\partial e_{1P}}{\partial w_2} & \cdots & \frac{\partial e_{1P}}{\partial w_N} \\ \vdots & \vdots & & \vdots \\ \frac{\partial e_{KP}}{\partial w_1} & \frac{\partial e_{KP}}{\partial w_2} & \cdots & \frac{\partial e_{KP}}{\partial w_N} \end{vmatrix}$$

In neural networks, the derivative of the error with respect to the weight is calculated with a chain rule. The weights of the neural network is updated as follows:

$$w_{t+1} = w_t - \left(J_t^T J_t + \mu_t I\right)^{-1} J_t^T E_t \tag{6}$$

where w_t, J_t, E_t respectively represent the weights, Jacob matrix and error vector at the t-th step. I is a unit matrix and μ_t represents a learning rate. When $I_{(w)}$ increases, μ_t will be multiplied by a factor α while it will be divided by α when $I_{(w)}$ decreases. When μ_t is large, LM algorithm is approximately reduced to the gradient descent method and it is close to Gauss-Newton method when μ_t is small. The weights and biases are iteratively updated until the training objective function (4) falls below a threshold and then the training is terminated.

Subnet Training Method Based on "an Expert With Other Capabilities" and LM Algorithm

When the subnet training method based on "an expert with other capabilities" is used, LM algorithm should be modified. First, similar to (5), Equation (3) is written in the vector form:

$$I'\left(w\right) = \bar{E}^T \bar{E} \tag{7}$$

where:

$$\bar{E}=\left[e_{11}\cdots e_{K1}\cdots e_{1P'}\cdots e_{KP'}\frac{1}{\sqrt{m}}e_{1(P'+1)}\cdots\frac{1}{\sqrt{m}}e_{K(P'+1)}\cdots\frac{1}{\sqrt{m}}e_{1P}\cdots\frac{1}{\sqrt{m}}e_{KP}\right]$$

and $e_{kp}=d_{kp}-o_{kp}$ is the k-th output error of the p-th datum. By comparing the expression of $\bar{E}$ with (3), it can be seen that the number of samples in the main training set is P' and that in all the auxiliary training sets is $P-P'$. Then, the Jacob matrix is modified as:

$$\bar{J}=\begin{vmatrix}
\frac{\partial e_{11}}{\partial w_1} & \frac{\partial e_{11}}{\partial w_2} & \cdots & \frac{\partial e_{11}}{\partial w_N}\\
\vdots & \vdots & & \vdots\\
\frac{\partial e_{K1}}{\partial w_1} & \frac{\partial e_{k1}}{\partial w_2} & \cdots & \frac{\partial e_{K1}}{\partial w_N}\\
\vdots & \vdots & & \vdots\\
\frac{\partial e_{1P'}}{\partial w_1} & \frac{\partial e_{1P'}}{\partial w_2} & \cdots & \frac{\partial e_{1P'}}{\partial w_N}\\
\vdots & \vdots & & \vdots\\
\frac{\partial e_{KP'}}{\partial w_1} & \frac{\partial e_{KP'}}{\partial w_2} & \cdots & \frac{\partial e_{KP'}}{\partial w_N}\\
\frac{1}{\sqrt{m}}\frac{\partial e_{1\,P'+1}}{\partial w_1} & \frac{1}{\sqrt{m}}\frac{\partial e_{1\,P'+1}}{\partial w_2} & \cdots & \frac{1}{\sqrt{m}}\frac{\partial e_{1\,P'+1}}{\partial w_N}\\
\vdots & \vdots & & \vdots\\
\frac{1}{\sqrt{m}}\frac{\partial e_{K\,P'+1}}{\partial w_1} & \frac{1}{\sqrt{m}}\frac{\partial e_{K\,P'+1}}{\partial w_2} & \cdots & \frac{1}{\sqrt{m}}\frac{\partial e_{K\,P'+1}}{\partial w_N}\\
\vdots & \vdots & & \vdots\\
\frac{1}{\sqrt{m}}\frac{\partial e_{1P}}{\partial w_1} & \frac{1}{\sqrt{m}}\frac{\partial e_{1P}}{\partial w_2} & \cdots & \frac{1}{\sqrt{m}}\frac{\partial e_{1P}}{\partial w_N}\\
\vdots & \vdots & & \vdots\\
\frac{1}{\sqrt{m}}\frac{\partial e_{KP}}{\partial w_1} & \frac{1}{\sqrt{m}}\frac{\partial e_{KP}}{\partial w_2} & \cdots & \frac{1}{\sqrt{m}}\frac{\partial e_{KP}}{\partial w_N}
\end{vmatrix}$$

For the subnet training, the weights and biases are still updated according to (6), but J and E are respectively replaced by J and E. Note that the objective of the subnet training algorithm based on "an expert with other capabilities" is not restricted to the minimization of the sum of quadratic errors as is shown in (3). Other performance indexes such as algorithm speed, algorithm robustness, and structural complexity are also suitable major/auxiliary objectives for the future research. In this paper, the auxiliary objective is the minimization of the sum of quadratic errors with respect to auxiliary training sets. Furthermore, other proper training algorithms such as genetic algorithm (Jiang et al 2009; Li et al 2011a,b, 2012), simulated annealing algorithm, etc., can be also used in the proposed subnet training method.

Relative Distance Measure

In Algorithm 1, an absolute distance is adopted and is calculated as $d_i = \left\| X - C_i \right\|^2$ where X is a testing sample. This is effective and acceptable when the radii of the clusters are roughly equal. However, a relative distance measure is more rational when the radii of the clusters significantly differ. For instance, in Figure 2, the point X is considered to be closer to the class A if the absolute distance measure is used while the class B is geometrically closer. If a relative distance measure is used, this point is apt to belong to the class B. Therefore, it is considered that a better performance can be obtained with a relative distance measure, which is calculated as follows:

$$d_{i-relative} = {d_i}/{\gamma_i} \tag{8}$$

In the above equation:

$$\gamma_i = \frac{1}{\left|S_i\right|} \sum_{j-1}^{\left|S_i\right|} \left\| X_{ij} - C_i \right\|^2 \tag{9}$$

where C_i is the center of the cluster S_i and $\left|S_i\right|$ is the number of samples in the cluster S_i. X_{ij} is the j-th sample in the cluster $S_i \gamma_i$ is the radius of the cluster $S_i d_{i-relative}$ is the relative distance between X and the cluster S_i.

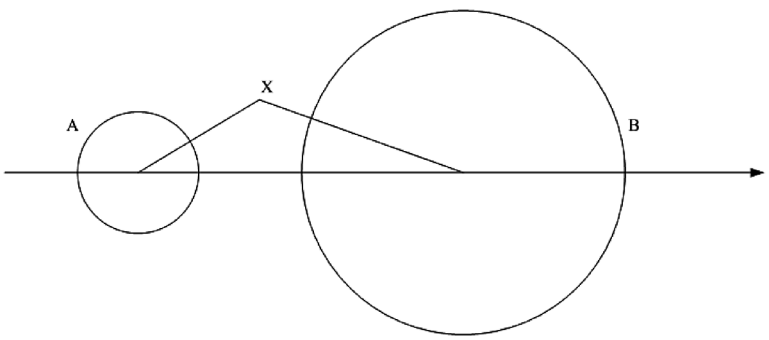
When the relative distance depicted by (8) is used, the membership degree $\hat{\beta}_i$ of a testing sample to the cluster S_i can be obtained by respectively replacing d_i and d_j in (2) with $d_{i-relative}$ and $d_{j-relative}$:

$$\begin{cases} \hat{\beta}_i = 1, \hat{\beta}_{j\neq i} = 0 & if\ d_i = 0 \\ \hat{\beta}_i = \dfrac{\dfrac{1}{d_i}}{\sum_{j=1}^{K}\left(\dfrac{\gamma_j}{\gamma_i}\times\dfrac{1}{d_j}\right)} & otherwise \end{cases} \tag{10}$$

It can be seen that including the relative distance in the membership $\hat{\beta}_i$ is equivalent to respectively multiplying the reciprocal of each d_j in the denominator of (2) with γ_j / γ_i when $d_i \neq 0$. If $\gamma_j > \gamma_i$ and $\gamma_k = \gamma_i$ for $k \neq i, j$ and $j \neq i$, then the influence of $1 / d_j$ is more significant and $\hat{\beta}_i < \beta_i$. If $\gamma_j = \gamma_i$ for $j \neq i$, then $\hat{\beta}_i = \beta_i$. If $\gamma_j = \gamma_i$ and $\gamma_k = \gamma_i$ for $k \neq i, j$ and $j \neq i$, then the influence of the *i*-th cluster is augmented and $\hat{\beta}_i > \beta_i$.

From the perspective of information utilization, the relative distance measure contains more information than the absolute distance since it considers the impact of cluster radius. Intuitively, a cluster with a larger radius has a higher probability of containing new samples as well as a better robustness to the same change. Therefore, this measure is preferable for calculating the membership degrees of the testing samples to different clusters. When their radii are comparative, the difference in the membership is not evident. However, when these radii are significantly different, it is expected that the performance associated with the relative distance measure will

Figure 2. Example for illustrating the rationality of relative distance measure



be superior to the one related to the absolute distance measure. Additionally, with the increase of new samples, it is necessary to re-cluster the samples periodically so that the radius of each cluster can be more exactly approximated.

EXPERIMENT RESULTS

Some simplified notations are made before presenting the experiment results. The aforementioned Algorithm 1 and 2 are respectively denoted by A1 and A2. This subnet training algorithm with *k* auxiliary training sets is named as A2-*k*. The maximum number of auxiliary training sets is 3 in terms of the computational time. The Algorithm 1, i.e., A1, adopting the relative distance measure is named as A1-R. Similarly, The Algorithm 2 adopting the relative distance measure with *k* auxiliary training sets is named as A2-*k*-R. The structure represented by *in-hidden1-hidden2-out* is composed by the input layer of *in* neurons, the first hidden layer of *hidden1* neurons, the second hidden layer of *hidden2* neurons and the output layer containing *out* neuron. Tan-sigmoid activation function is represented by "tansig" and the linear one is denoted by "purelin".

The error for evaluating the performance of the modular neural network is calculated as follows:

$$\hat{E} = \sum_{i=1}^{N} \sum_{i=1}^{N} \left| d_{ki} - o_{ki} \right| \tag{11}$$

where N is the number of samples contained in the testing set and K is the dimension of the network output. d_{ki} is the target value of the *k*-th output for the *i*-th testing sample and o_{ki} is the actual value of the *k*-th output for the *i*-th testing sample. In addition, an average performance index is used for repeated experiments. Specifically, for the same algorithm, $M = 10$ times of experiments are executed such that the training data and testing data from the same distribution are different at each time but the number of testing samples is fixed at $N = 500$, then the average performance is defined as:

$$\hat{E}_{avg} = \frac{1}{M} \sum_{j=1}^{M} \hat{E}_j \tag{12}$$

where $\hat{E}_j$ represents the error (11) in the j-th experiment.

Performance of Subnet Training Method Based on "an Expert With Other Capabilities" Approximation Problem

Experiment 1: The testing model is:

$$\begin{cases} y_1 = e^{x_1}\cos\left(x_2\right)x_3x_4x_5 \\ y_2 = x_1e^{x_2}\cos\left(x_3\right)x_4x_5 \\ y_3 = x_1x_2e^{x_3}\cos\left(x_4\right)x_5 \\ y_4 = x_1x_2x_3e^{x_4}\cos\left(x_5\right) \\ y_1 = \cos\left(x_1\right)x_2x_3x_4e^{x_5} \end{cases}$$

where $x_1, x_2, x_3, x_4, x_5 \in \left[0, 0.5\right]$. The structures of all the subnets are 5-9-19-5 of back propagation (BP) type. The activation functions in the hidden layers are tansig and the ones in the output layer are purelin.The training objective for each subnet is set to 10-6 and the maximum times of training repetition is 2500 and the number of cluster is 10.First, 1700 uniformly random numbers of x_1, x_2, x_3, x_4, x_5 are generated. Then, 1200 training samples and 500 testing samples are produced and used to train and to test A1, A2-1, A2-2, A2-3. 10 experiments are repeated in the same way for $m = 2, 3, 4, 5$ and the average performances of A1, A2-1, A2-2, A2-3 based on these 10 experiments are obtained according to (12) and shown in Figure 3. Figure 4 exhibits the respective performance calculated by (11) in each experiment for $m = 2, 3, 4, 5$

Experiment 2: The testing model is:

$$\begin{cases} y_1 = e^{x_1x_2}\cos\left(x_2x_3\right)x_4^2 + x_5x_6x_7x_8 + x_9\sin\left(x_{10}\right) \\ y_2 = x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} \end{cases}$$

where

$$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10} \in \left[0, 0.5\right].$$

The structures of all the subnets are 10-15-31-2 of BP type. The activation functions in the hidden layers are tansig and the ones in the output layer are purelin.The training objective for each subnet is set to 10^{-6} and the maximum times of training repetition is 2500 and the number of cluster is 8.First,1700 uniformly random numbers of

Figure 3. Average performance of A1, A2-1, A2-2, A2-3 for different m in Experiment 1

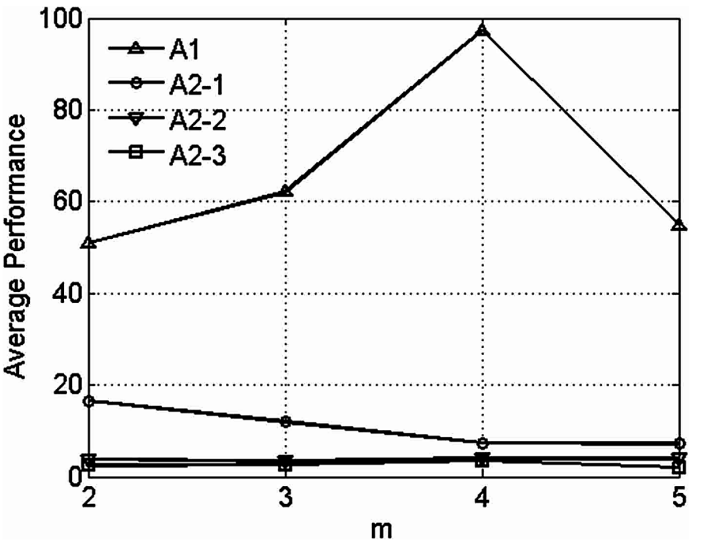
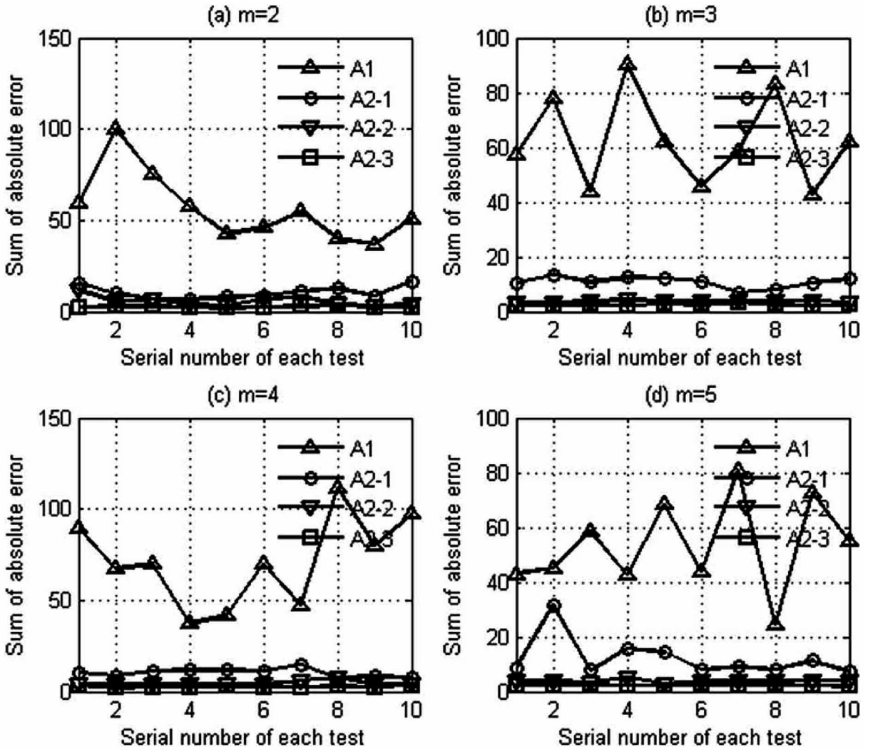


Figure 4. Respective performance of A1, A2-1, A2-2, A2-3 for different m in Experiment 1



$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}$

are generated. Then,1200 training samples and 500 testing samples are produced which are used to train and to test A1,A2-1, A2-2, A2-3. 10 experiments are repeated in the same way for $m = 2,3,4,5$ and the averageperformances of A1, A2-1, A2-2, A2-3 based on 10 these experiments are shown in Figure 5. Figure 6 exhibits the respective performance calculated by (11) in each experiment for $m = 2,3,4,5$.

Experiments 1 and 2 are both related with the approximation problem. According to the average performance in Figure 3 and Figure 5, these aforementioned algorithms are ordered in descending order as A2-3, A2-2, A2-1, A1 and this is not difficult to understand since within a certain range, "more capabilities" endows more advantages to the adaptation, i.e., the improvement in the testing performance in the paper.

Additionally, it can be seen from Figure 4 and Figure 6 that A2-3, A2-2,

A2-1 are more stable and significantly superior to A1 in terms of the performance with different *m* . Therefore, it can be concluded that the average performance of the subnet training algorithm based on "an expert with other capabilities" is better than that of A1 in the case of approximation problem. It can be also inferred that the increase in the number of auxiliary training sets in a certain range improves the average performance. In addition, the proposed algorithm has a more stable performance with few remarkable fluctuations.

Experiment on Dynamic Systems

Experiment 3: The testing model is:

$$y\left(k\right) = \frac{0.875y\left(k-1\right) + u\left(k-1\right)}{1 + y^2\left(k-1\right)}$$

This is a nonlinear dynamic problem where the input sequence is $u\left(k\right) \in U\left(-2,2\right)$ and $y\left(k\right)$ is a random number in the interval $\left(0,1\right)$. $y\left(k-1\right)$ and $u\left(k-1\right)$ are the inputs, $y\left(k\right)$ is the output. The structures of all the subnets are 2-6-13-1 of Elman type. The first and second hidden layers both contain a regression link, i.e., the network is a diagonal neural network. The activation functions in the hidden layers are tansig and the ones in the output layer are purelin. The training objective for each subnet is set to 10-6and the maximum times of training repetition is 2000 and the number of clusters is 8.

Figure 5. Average performance of A1, A2-1, A2-2, A2-3 for different m in Experiment 2

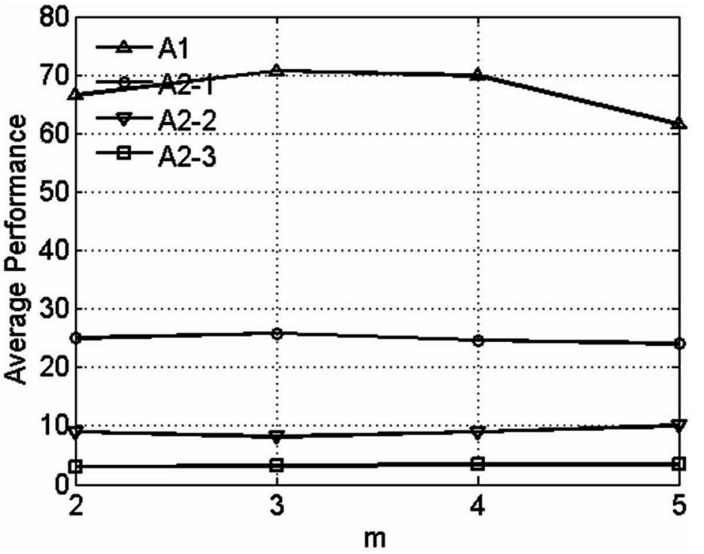
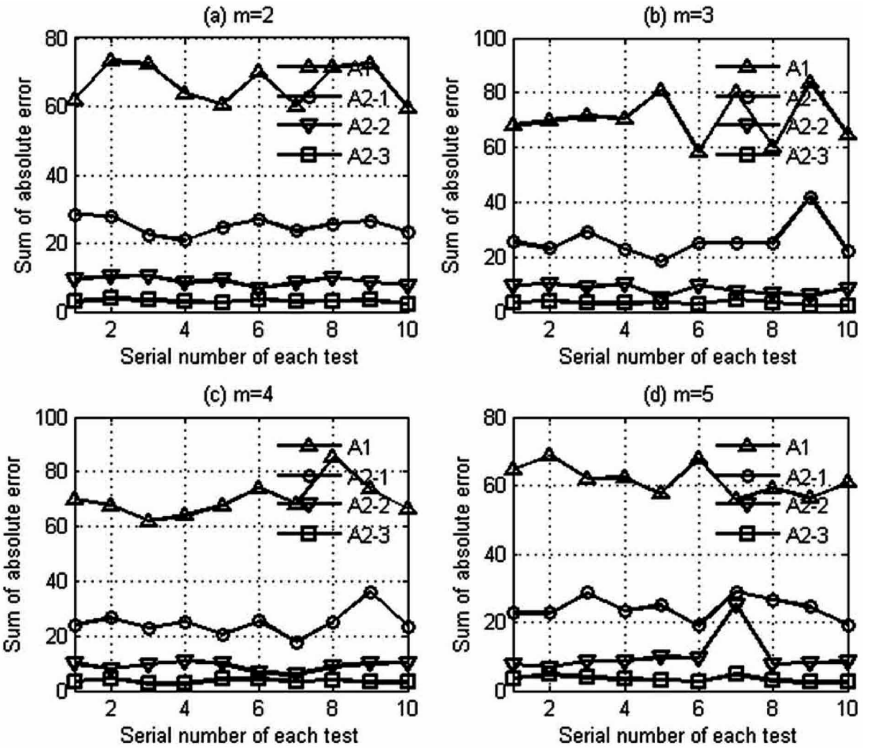


Figure 6. Respective performance of A1, A2-1, A2-2, A2-3 for different m in Experiment 2



First, a sequence containing 3500 random numbers $u(k) \in U(-2,2)$ are generated and the sequence of $y(k)$ is obtained according to $u(k)$ and the initial value of $y(k)$. Then, the first 3000 random numbers in the sequence are used as the training samples and the remaining samples are taken as the testing samples for A1, A2-1, A2-2, A2-3. The average performances of A1, A2-1, A2-2, A2-3 based on 10 repeated experiments for $m = 2,3,4,5$ are shown in Figure 7. Figure 8 exhibits the respective performance calculated by (11) in each experiment for $m = 2,3,4,5$. In addition, the average time for each subnet training algorithm is shown in Figure 9.

Experiment 4: The testing model is:

$$y(k+1) = 0.9722y(k) + 0.3578u(k) - 0.1295u(k-1) - 0.3103y(k)u(k)$$
$$-0.04228y^2(k-1) + 0.1663y(k-1)u(k-1) - 0.03259y^2(k)y(k-1)$$
$$-0.3513y^2(k)u(k-1) + 0.3804y(k)y(k-1)u(k-1) + 0.1087y(k-1)u(k)u(k-1)$$

This is a nonlinear dynamic problem where the input sequence is $u(k) \in U(-1,1)$ and the twoinitial values of $y(k)$ are random numbers in the interval $(0,1)$. $y(k)$, $y(k-1)$, $u(k)$ and $u(k-1)$ are the inputs, $y(k+1)$ is the output. The structures

Figure 7. Average performance of A1, A2-1, A2-2, A2-3 for different m in Experiment 3

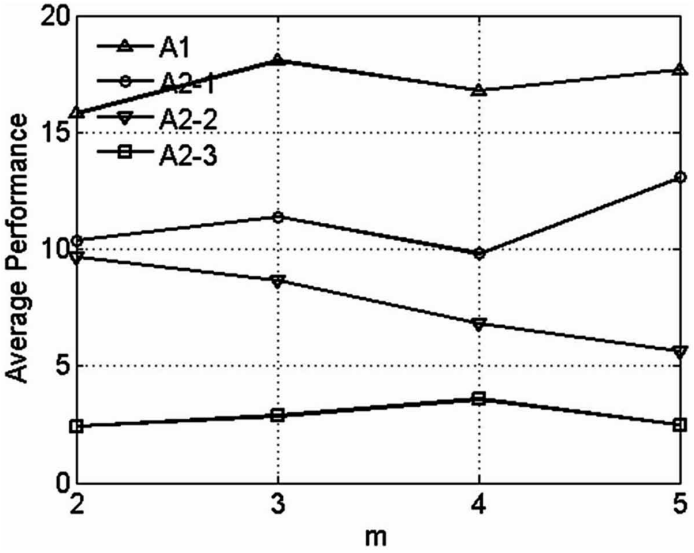
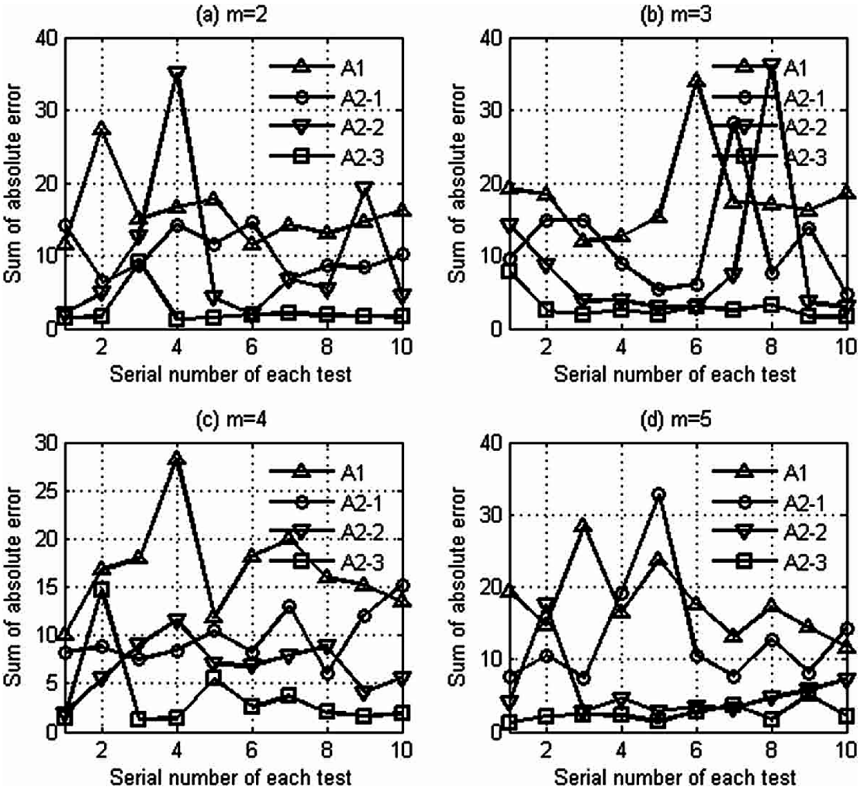


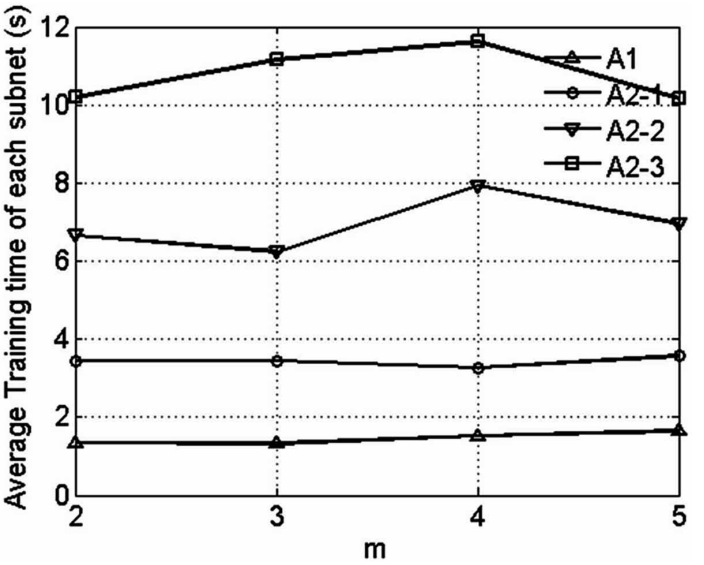
Figure 8. Respective performance of A1, A2-1, A2-2, A2-3 for different m in Experiment 3



of all the subnets are 4-6-13-1 of Elman type. The first and second hidden layers both contain a regression link. The activation functions in the hidden layers are tansig and the ones in the output layer are purelin. The training objective for each subnet is set to 10-6 and the maximum times of training repetition is 2000 and the number of clusters is 6.

First, a sequence containing 2500 random numbers $u(k) \in U(-1,1)$ are generated and the sequence of $y(k)$ is obtained according to $u(k)$ and the initial value of $y(k)$. Then, the first 2000 random numbers in the sequence are used as the training samples and the remaining samples are taken as the testing samples for A1, A2-1, A2-2, A2-3. The average performances of A1, A2-1, A2-2, A2-3 based on 10 repeated experiments for $m = 2,3,4,5$ are shown in Figure 10. Figure 11 exhibits the respective performance calculated by (11) in each experiment for $m = 2,3,4,5$. In addition, the average time for each subnet training algorithm is shown in Figure 12.

Figure 9. Average time for each subnet training algorithm based on 10 experiments with different m



The testing problems in Experiment 3 and 4 are respectively discussed in (Ahmed, 1994; Wang, 2006). According to the results, it can be also seen that the subnet training algorithm based on "an expert with other capabilities" performs better than the classical training method and its stability is also observed. According to the average time for each subnet training algorithm in these two experiments, the proposed algorithm consumes more training time as is predicted. Therefore, the tradeoff between improved performance and the learning complexity is an important issue.

Although the main and auxiliary objectives of the algorithms based on "an expert with other capabilities" in these experiments are both related with the error, they are not constrained to this criterion. Other performances indexes such as algorithm speed, algorithm robustness, and structure complexity can be also used.

Performance of Algorithm Including Relative Distance

A relative distance measure is proposed in the paper to eliminate the deviation induced by the large difference in the radii among different clusters. In order to highlight its effectiveness, Experiment 5 is designed and then the performance of the proposed algorithm with the relative distance measure is studied.

Figure 10. Average performance of A1, A2-1, A2-2, A2-3 for different m in Experiment 4

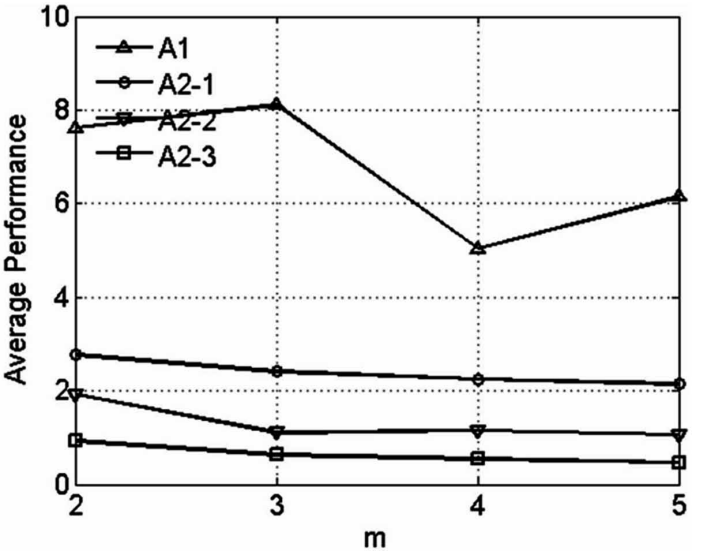


Figure 11. Respective performance of A1, A2-1, A2-2, A2-3 for different m (in comform with Figure 10) in Experiment 4

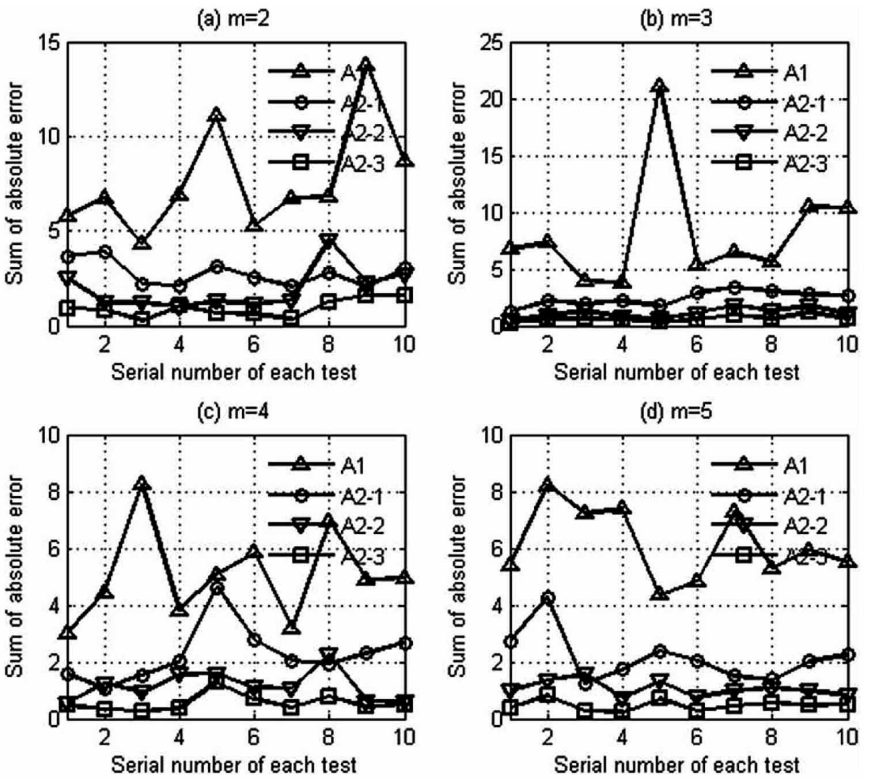
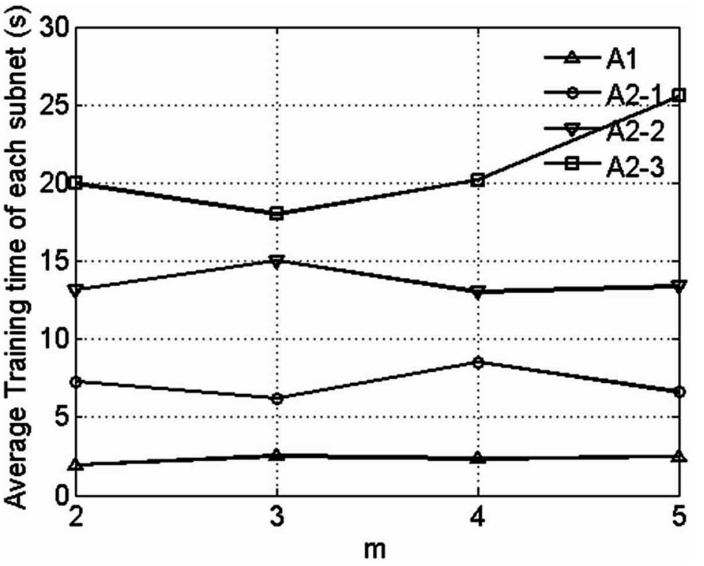


Figure 12. Average time for each subnet training algorithm based on 10 experiments with different m (in comform with Figure 10)



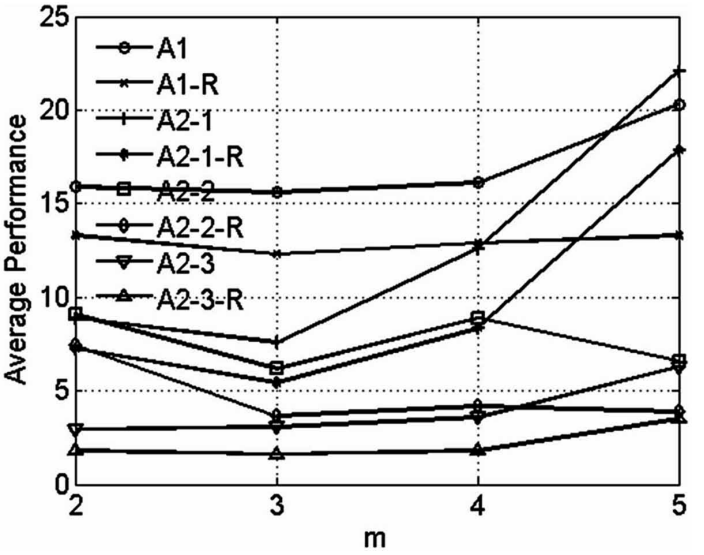
Experiment 5: All the conditions are the same with Experiment 3 except for the sampling range.First, a sequence containing 1000 random numbers $u(k) \in U(-2,0)$ and another sequence of 2500 random numbers $u(k) \in U(1,4)$ are generated. Then, all $y(k)$ are obtained according to these 3500 numbers and the initial value of $y(k)$, other manipulations are the same with Experiment 3 and the average performance of different algorithms is shown in Figure 13.

It can be seen that A1-R, A2-1-R, A2-2-R, A2-3-R have respectively outperformed A1, A2-1, A2-2, A2-3, which indicates that the relative distance measure is preferable in the case of a large difference in the radius.

DISCUSSION AND CONCLUSION

More recent researches have proven the solid fundation of modulality of human brain. In a literature of 2013, the authors claim "that the emergence of dynamic functional connectivity,from static structural connections, calls for formal (computational) approaches to neuronal information processing that may resolve the dialectic

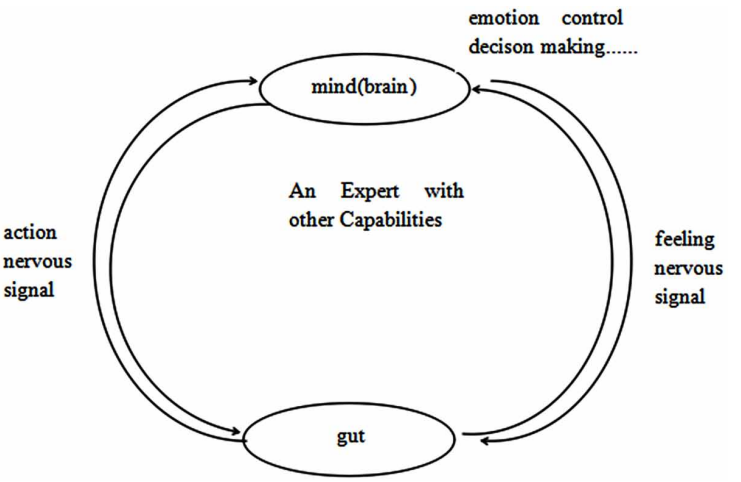
Figure 13. Average performance of various algorithms for different m in Experiment 5



between structure and function."(Park, 2013) . Moreover, the brain networks' small-world topology and the dynamic reorganization of its community structure lead the emergence of human's general intelligence (Barbey, 2018).

An exciting advance in neuroscience is the mind-gut connection (Mayer, 2016; Sangjune Kim et al., 2019; Nicholas WB et al., 2017). Based on the mind-gut connection, we propose the following mind-gut computational framework:

Figure 14. Mind-gut computational framework



This chapter is devoted to the further research on the proposed subnet training algorithm based on the principle of "an expert with other capabilities" – a paradigm of the cooperative divide and conquer strategy in the modular neural network. In the experiments related with the approximation problem and the prediction problem in nonlinear dynamic systems, the proposed subnet training algorithm has been verified to be better and more stable than the classical subnet training method. In addition, it has been theoretically and experimentally proved that the relative distance measure can bring up high stability and significant performance improvement when the radii of the clusters containing the training samples are very different. The further research of this paper includes:

1. The reduction in the training time and the improvement in the robustness as an auxiliary objective in the proposed training algorithm;
2. A further consideration of different MNN structures so that the advantage of integrating various typical ideas for the problem solving can be better highlighted;
3. The verification of effectiveness of the proposed method in some real- world problems.

ACKNOWLEDGMENT

This work is supported by the National Natural Science Foundation of China (71371148) and the Fundamental Research Funds for the Central Universities (WUT: 153111003).

REFERENCES

Ahmed, M. S. (1994). Block partial derivative and its application to neural-net-based direct model-reference adaptive control. *IEE Proceedings. Control Theory and Applications*, *141*(5), 305–314. doi:10.1049/ip-cta:19941395

Barbey, A. K. (2018). Network Neuroscience Theory of Human Intelligence. *Trends in Cognitive Sciences*, *22*(1), 8–20. doi:10.1016/j.tics.2017.10.001 PMID:29167088

Bellono, N. W., Bayrer, J. R., Leitch, D. B., Castro, J., Zhang, C., O'Donnell, T. A., ... Julius, D. (2017). Enterochromaffin Cells Are Gut Chemosensors that Couple to Sensory Neural Pathways. *Cell*, *170*(1), 185–198. doi:10.1016/j.cell.2017.05.034 PMID:28648659

Bi, Z., & Cochran, D. (2014). Big data analytics with applications. *Journal of Management Analytics*, *1*(4), 249–265. doi:10.1080/23270012.2014.992985

Buro, M. (2003). The evolution of strong Othello programs. In R. Nakatsu & J. Hoshino (Eds.), *Entertainment Computing* (Vol. 112, pp. 81–88). New York, NY: Springer US. doi:10.1007/978-0-387-35660-0_10

Caelli, T., Guan, L., & Wen, W. (1999). Modularity in neural computing. *Proceedings of the IEEE*, *87*(9), 1497–1518. doi:10.1109/5.784227

Chan, S. S.-K., Shi, X., Toyama, A., Arpke, R. W., Dandapat, A., Iacovino, M., ... Kyba, M. (2013). Mesp1 Patterns Mesoderm into Cardiac, Hematopoietic, or Skeletal Myogenic Progenitors in a Context-Dependent Manner. *Cell Stem Cell*, *12*(5), 587–601. doi:10.1016/j.stem.2013.03.004 PMID:23642367

Chen, Y. (2016). Industrial information integration-a literature review 2006-2015. *Journal of Industrial Information Integration*, *2*, 30–64. doi:10.1016/j.jii.2016.04.004

Coop, R., Mishtal, A., & Arel, I. (2013). Ensemble learning in fixed expansion layer networks for mitigating catastrophic forgetting. *IEEE Transactions on Neural Networks and Learning Systems*, *24*(10), 1623–1634. doi:10.1109/TNNLS.2013.2264952 PMID:24808599

Coulom, R. (2007). Efficient Selectivity and Backup Operators in Monte-Carlo Tree Search. *Lecture Notes in Computer Science*, *4630*, 72–83. doi:10.1007/978-3-540-75538-8_7

Duan, L., & Binbasioglu, M. (2017). An ensemble framework for community detection. *Journal of Industrial Information Integration*, *5*, 1–5. doi:10.1016/j.jii.2017.01.001

Duan, L., & Xiong, Y. (2015). Big data analytics and business analytics. *Journal of Management Analytics*, *2*(1), 1–21. doi:10.1080/23270012.2015.1020891

Duan, L., & Xu, L. (2012). Business Intelligence for Enterprise Systems: A Survey. *IEEE Transactions on Industrial Informatics*, *8*(3), 679–687. doi:10.1109/TII.2012.2188804

Duan, L., Xu, L., Liu, Y., & Lee, J. (2009). Cluster-based Outlier Detection. *Annals of Operations Research*, *168*(1), 151–168. doi:10.100710479-008-0371-9

Edelman, G. M. (1987). *Neural Darwinism: The theory of neuronal group selection*. New York, NY: Basic Books.

Farooq, A. (2000). *Biologically inspired modular neural networks* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.

Fernández-Navarro, F., Gutiérrez, P. A., Hervás-Martínez, C., & Yao, X. (2013). Negative correlation ensemble learning for ordinal regression. *IEEE Transactions on Neural Networks*, *24*(11), 1836–1849. doi:10.1109/TNNLS.2013.2268279 PMID:24808616

Fodor, J. A. (1983). *The modularity of mind*. Cambridge, MA: MIT Press. doi:10.7551/mitpress/4737.001.0001

Gatys, L. A., Ecker, A. S., & Bethge, M. (2015). *A neural algorithm of artistic style*. arXiv:1508.06576 [cs.CV]

Gehring, J., Lee, W., Kilgour, K., Lane, I. R., Miao, Y., Waibel, A., & Campus, S. V. (2013). *Modular combination of deep neural networks for acoustic modeling*. Paper presented at the 14th Annual Conference of the International Speech Communication Association, Lyon, France.

Hagan, M. T., & Menhaj, M. B. (1994). Training feedforward networks with the marquardt algorithm. *IEEE Transactions on Neural Networks*, *5*(6), 989–993. doi:10.1109/72.329697 PMID:18267874

Harrison, D. E., Strong, R., Sharp, Z. D., Nelson, J. F., Astle, C. M., Flurkey, K., ... Miller, R. A. (2009). Rapamycin fed late in life extends lifespan in genetically heterogeneous mice. *Nature*, *460*(7253), 392–395. doi:10.1038/nature08221 PMID:19587680

Hinton, G. E., Osindero, S., & Teh, Y. W. (2006). A fast learning algorithm for deep belief nets. *Neural Computation*, *18*(7), 1527–1554. doi:10.1162/neco.2006.18.7.1527 PMID:16764513

Institute of Automation, Chinese Academy of Sciences. (2002). *Database of human iris*. Retrieved from http:// www.cbsr.ia.ac.cn/english/IrisDatabase.asp

Jiang, Y., Xu, L., Wang, H., & Wang, H. (2009). Influencing Factors for Predicting Financial Performance based on Genetic Algorithms. *Systems Research and Behavioral Science*, *26*(6), 661–673. doi:10.1002res.967

Kandel, E. R., Schwartz, J. H., & Jessell, T. M. (2000). *Principles of neural science* (4th ed.). New York, NY: McGraw-Hill.

Kim, S., Kwon, S.-H., Kam, T.-I., Panicker, N., Karuppagounder, S. S., Lee, S., ... Ko, H. S. (2019). Transneuronal Propagation of Pathologic α-Synuclein from the Gut to the Brain Models Parkinson's Disease. *Neuron*, *103*(4), 1–15. doi:10.1016/j.neuron.2019.05.035 PMID:31255487

Li, F., Xu, L., Jin, C., & Wang, H. (2011a). Intelligent Bionic Genetic Algorithm (IB-GA) and Its Convergence. *Expert Systems with Applications*, *38*(7), 8804–8811. doi:10.1016/j.eswa.2011.01.091

Li, F., Xu, L., Jin, C., & Wang, H. (2011b). Structure of Multi-Stage Composite Genetic Algorithm (MSC-GA) and its Performance. *Expert Systems with Applications*, *38*(7), 8929–8937. doi:10.1016/j.eswa.2011.01.110

Li, F., Xu, L., Jin, C., & Wang, H. (2012). Random Assignment Method based on Genetic Algorithms and its Application in Resource Allocation. *Expert Systems with Applications*, *39*(15), 12213–12219. doi:10.1016/j.eswa.2012.04.055

Li, H., Wang, P., & Shen, C. (2018). Toward End-to-End Car License Plate Detection and Recognition With Deep Neural Networks. *IEEE Transactions on Intelligent Transportation Systems*, 1–11.

Li, J., Wang, K., & Xu, L. (2009). Chameleon based on Clustering Feature Tree and its Application in Customer Segmentation. *Annals of Operations Research*, *168*(1), 225–245. doi:10.100710479-008-0368-4

Ma, J., Meng, Y. D., Kwiatkowski, D. J., Chen, X., Peng, H., Sun, Q., ... Zhang, H. (2010). Mammalian target of rapamycin regulates murine and human cell differentiation through stat3/p63/jagged/notch cascade. *The Journal of Clinical Investigation*, *120*(1), 103–114. doi:10.1172/JCI37964 PMID:20038814

Mayer, E. (2016). *The Mind-Gut Connection: How the Hidden Conversation Within Our Bodies Impacts Our Mood, Our Choices, and Our Overall Health*. HarperCollins Publishers.

Melin, P., & Castillo, O. (2007). An intelligent hybrid approach for industrial quality control combining neural networks, fuzzy logic and fractal theory. *Information Sciences*, *177*(7), 1543–1557. doi:10.1016/j.ins.2006.07.022

Melin, P., Mancilla, A., Lopez, M., & Mendoza, O. (2007). A hybrid modular neural network architecture with fuzzy sugenointegration for timeseries forecasting. *Applied Soft Computing*, *7*(4), 1217–1226. doi:10.1016/j.asoc.2006.01.009

Melin, P., Mendoza, O., & Castillo, O. (2011). Face recognition with an improved interval type2 fuzzy logic sugeno integral and modular neural networks. *IEEE Transactions on Systems, Man, and Cybernetics. Part A, Systems and Humans*, *41*(5), 1001–1012. doi:10.1109/TSMCA.2010.2104318

Melin, P., Miramontes, I., & Prado-Arechiga, G. (2018). A hybrid model based on modular neural networks and fuzzy systems for classification of blood pressure and hypertension risk diagnosis. *Expert Systems with Applications*, *107*, 146–164. doi:10.1016/j.eswa.2018.04.023

Oktay, O., Ferrante, E., Kamnitsas, K., Heinrich, M., Bai, W., Caballero, J., ... Rueckert, D. (2018). Anatomically Constrained Neural Networks (ACNNs): Application to Cardiac Image Enhancement and Segmentation. *IEEE Transactions on Medical Imaging*, *37*(2), 384–395. doi:10.1109/TMI.2017.2743464 PMID:28961105

Pape, L., Gomez, F., Ring, M., & Schmidhuber, J. (2011). *Modular deep belief networks that do not forget*. Academic Press.

Park, H.-J., & Friston, K. (2013). Structural and Functional Brain Networks: From Connections to Cognition. *Science*, *342*(6158), 1238411–1238411. doi:10.1126cience.1238411 PMID:24179229

Rechenber, I. (1971). *Optimierung technischer systeme nach prinzipien der biologischen evolution*. New York, NY: Springer Verlag.

Samaria, F. S., & Harter, A. C. (1994). Parameterisation of a stochastic model for human face identification. In *Proceedings of the Second IEEE Workshop on Applications of Computer Vision* (Vol. 22, pp. 138-142). Los Alamitos, CA: IEEE Computer Society Press. 10.1109/ACV.1994.341300

Samuel, A. L. (1959). Some studies in machine learning using the game of checkers. *IBM Journal of Research and Development*, *3*(3), 210–229. doi:10.1147/rd.33.0210

Sánchez, D., Melin, P., & Castillo, O. (2017). Optimization of modular granular neural networks using a firefly algorithm for human recognition. *Engineering Applications of Artificial Intelligence*, *64*, 172–186. doi:10.1016/j.engappai.2017.06.007

Sanchez, D., Melin, P., Castillo, O., & Valdez, F. (2013). *Modular granular neural networks optimization with Multi-Objective Hierarchical Genetic Algorithm for human recognition based on iris biometric.* Paper presented at IEEE Congress on Evolutionary Computation, Cancun, Mexico. 10.1109/CEC.2013.6557646

Seni, G., & Elder, J. (2010). *Ensemble methods in data mining: Improving accuracy through combining predictions*. San Rafael, CA: Morgan & Claypool Publishers.

Shen, G., & Ye, D. (2017). A Distance-based Spectral Clustering Approach with Applications to Network Community Detection. *Journal of Industrial Information Integration*, *6*, 22–32. doi:10.1016/j.jii.2017.02.005

Silver, D., Huang, A., Maddison, C. J., Guez, A., Sifre, L., van den Driessche, G., ... Hassabis, D. (2016). Mastering the game of Go with deep neural networks and tree search. *Nature*, *529*(7587), 484–489. doi:10.1038/nature16961 PMID:26819042

Van, D. S., & Wiering, M. A. (2012). Neural-fitted td-leaf learning for playing othello with structured neural networks. *IEEE Transactions on Neural Networks and Learning Systems*, *23*(11), 1701–1713. doi:10.1109/TNNLS.2012.2210559 PMID:24808066

Wang, J., & Wang, P. (2012). *A new MNN's training method with empirical study.* Paper presented at the Third Global Congress on Intelligent Systems, Wuhan, China. 10.1109/GCIS.2012.35

Wang, P. (1985). *Fuzzy set and random set shadows*. Beijing, China: Beijing Normal University Press.

Wang, P., Li, Y., Fan, Z., & Feng, S. (2008). Methodological research for dynamic integration of modular neural networks sub-networks. *Journal of Systems Engineering and Electronics*, *30*(6), 1143–1147.

Wang, P., Xu, L., Zhou, S., Fan, Z., Li, Y., & Feng, S. (2010). A Novel Bayesian Learning Method for Information Aggregation in Modular Neural Networks. *Expert Systems with Applications*, *37*(2), 1071–1074. doi:10.1016/j.eswa.2009.06.104

Wang, P., Zhang, J., Guo, S., Tao, C., & Liu, X. (2016). *Methodological research on soft computing in optimization and control problems*. Wuhan, China: Hubei Science & Technology Press.

Wang, S., Tang, K., & Yao, X. (2009). *Diversity exploration and negative correlation learning on imbalanced data sets.* Paper presented at the International Joint Conference on Neural Networks, Atlanta, GA. 10.1109/IJCNN.2009.5178836

Wang, S., & Yao, X. (2010). *The Effectiveness of a New Negative Correlation Learning Algorithm for Classification Ensembles.* Paper presented at the 10th IEEE International Conference on Data Mining Workshops, Sydney, Australia. 10.1109/ICDMW.2010.196

Wang, X., Shao, H., & Luo, R. (1998). The distributed RBF neural network and its application in soft sensor. *Control Theory & Applications*, *15*(4), 558–563.

Wang, Y. (2006). *Intelligent control system. Changsha*. Hunan University Press.

Chapter 12
An Experimental Analysis of Modified EEECARP:
An Optimized Cluster-Based Adaptive Routing Protocol for Modern-Secure-Wireless Sensor Networks

Venkata Ramana Sarella
https://orcid.org/0000-0002-3448-7094
SRKR Engineering College, India

Deshai Nakka
https://orcid.org/0000-0002-4883-6224
SRKR Engineering College, India

Sekhar B. V. D. S.
SRKR Engineering College, India

Krishna Rao Sala
Sir C. R. Reddy College of Engineering, India

Sameer Chakravarthy V. V. S. S.
Raghu Institute of Technology, India

ABSTRACT

Designing various energy-saving routing protocols for real-time internet of things (IoT) applications in modern secure wireless sensor networks (MS-WSN) is a tough task. Many hierarchical protocols for WSNs were not well scalable to large-scale IoT applications. Low energy adaptive two-level-CH clustering hierarchy (LEATCH) is an optimized technique reduces the energy-utilization of few cluster heads, but

DOI: 10.4018/978-1-7998-1786-4.ch012

the LEATCH is not suitable for scalable and dynamic routing. For dynamic routing in MS-WSN, energy efficiency and event clustering adaptive routing protocol (EEECARP) with event-based dynamic clustering and relay communication by selecting intermediates nodes as relay-nodes is necessary. However, EEECARP cannot consider the hop-count, different magnitude ecological conditions, and energy wastage in cluster formation while collisions occur. So, the authors propose the modified EEECARP to address these issues for better dynamic event clustering adaptive routing to improve the lifetime of MS-WSNs. The experimental outcomes show that proposed protocol achieves better results than EEECARP and LEATCH.

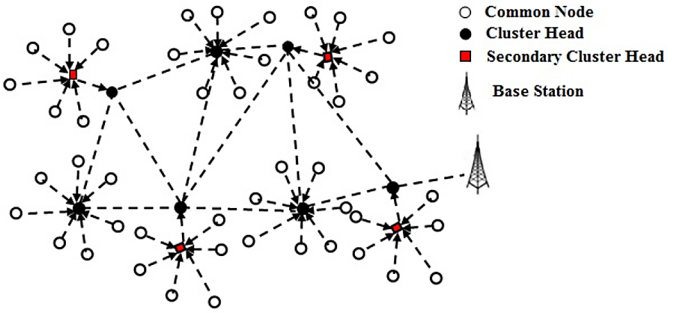
INTRODUCTION

The modern-secured-WSN is containing many sensor-nodes, tiny battery-powered gadgets. Their role intends observe, perceive and grasps the info from different ecological-objects and from environment and relay the sensed information securely (by security protocol) to a Base Station (BS) for further analysis (Visvanathan et al., 2005). MS-WSN systems can be deployed in underwater, underground, Terrestrial and can used in multimedia, mobile, Bioinformatics and IOT applications. Since modern-secure-WSNs contain many tiny sensor-nodes with minimal energy, so, a routing mechanism has to layout for retaining energy of sensor-nodes in modern-secure-WSN systems (Quang & Miyoshi, 2007). All the equipped sensors has to sense physical qualities like moisture, sound, luminosity, pressure, climate condition, humidity and transmit the possessed attributes to a central location called Base Station for further investigation(G.T. Shi and M.H. Liao,2005; Zheng et al., 2004).

Two-level-CH-LEACH method and LEATCH are the best hierarchical-routing method, which introduces aggregating the information; it's a turning point in grouping routing techniques. Most of hierarchical-routing methods have drafted working on the perception of LEACH (Fu.C et al., 2013). As per figure 1, Cluster Head (CH) analysis with sensor estimation achieves powerful data communication with server to CH analysis. LEATCH protocol reduces the energy-utilization of few CH's whose residual energy is low or is at a distant place from BS by setting Two-Level CH. Figure 1 represents the sample relay multi node communication of sensor network with routing.

Existing techniques use single hop transmission for which more energy consumption is observed. These transmission technologies work well on small-scale networks because each CH is within the reach of BS (Venkataramana et al., 2019). For large-scale networks, a CH is unable to transmit data to a BS due to the distance between them.

Figure 1. Representation of hierarchal clustering for WSNs with relay nodes



LEATCH is a revised technique based on LEACH technique; CH election and formation of cluster is similar to LEACH, but the average_energy of all nodes in the cluster is greater than the current-energy of elected Cluster-Head or the average-distance of all nodes to BS is lesser than the distance of CH to BS, then select the maximum energy node as the secondary Cluster-Head for same cluster (Venkataramana et al., 2016).

For large-scale WSNs, APREES (Quang & Miyoshi, 2007) and EEECARP (Venkataramana et al., 2017) are best dynamic event routing hierarchical methods, which introduce relay-node communication in an effective manner. However, EEECARP cannot consider the hop-count, different magnitude ecological conditions and energy wastage in cluster formation while collisions occur.

So, the authors propose the modified EEECARP to address these issues for better dynamic event clustering adaptive routing with load balancing of nodes for improving the lifetime of Modern Secure-WSNs (Venkataramana et al., 2017).

The rest of article summarizes as: later Section summarizes the related work. Next Section outlines the proposed system design and implementation process. In the next Section outlines the performance of proposed approach with LEATCH and EEECARP in computer simulation. In the final Section encapsulates the conclusions of the proposed protocol.

RELATED WORK

LEATCH (LEACH with Secondary/Additional Cluster-Head) is a revised technique build on LEACH Method (Venkataramana et al., 2016); the techniques of CH identification, construction of cluster are similar to LEACH method. Whenever the current energy of CH is less than the average-energy of all nodes in the cluster, that is

$$E_{cur} < E_{avr}, \text{ where } E_{avr} = \sum_{i=0}^{N} E\left(i\right)_{cur} \quad (1)$$

Or the distance between the CH and BS is greater than the average distance (average of all node's distances to BS), that is

$$d < d_{avr}, \text{ where } d_{avr} = \sum_{i=0}^{N} d_i \quad (2)$$

In this situation,

Case 1: the algorithm will selects highest energy node as a secondary Cluster-Head.
Case 2: If $E_{cur} \geq E_{avr}$ or $d \leq d_{avr}$, then no need to select another CH.

As per Case 1, additional CH duty is to collect and aggregate the information from the common nodes (Setup Phase) and transmit the fused information to primary Cluster-Head (Steady-state phase). Then the primary CH did the Steady-state phase (Venkataramana et al., 2016). As per Case 2, the Cluster without additional CH, the primary CH will take of Setup and Steady state phases.

In LEACH technique, all sensors are distributed randomly into 'n' clusters, if the number of clusters is very small, each CH suffers from heavy load so that the corresponding cluster will die soon due to energy drain; that will effects the network lifetime (Heinzelman et al., 2000). So, the scalability of LEATCH is very poor, i.e.; for large-scale wireless sensor networks LEATCH is not suitable.

For large-scale MS-WSN, the EEECARP is more suitable because it provides dynamic event handling, multi-hop transmitting in network. For multi-hop routing, EEECARP will choose the highest residual energy common node and nearest to the BS as Relay-node to deliver the fused information to the BS (Venkataramana et al., 2017).

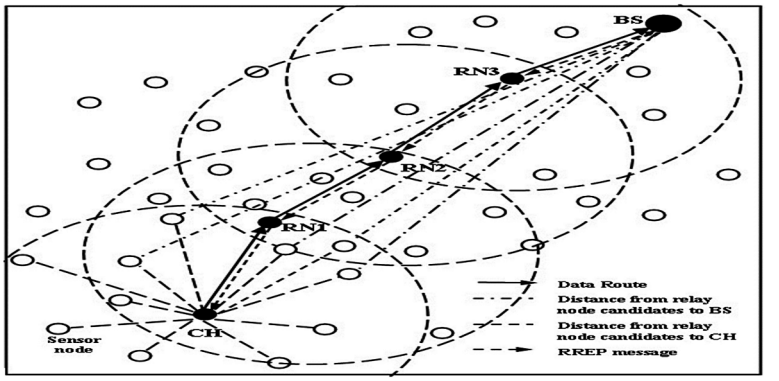
As per EEECAPR, the Figure 2 depicts the dynamic data routing path when an even occurs at every place in the network, considering RN1, RN2 and RN3 as relay nodes. The routing path is CH-RN1-RN2-RN3-BS almost equal to straight line.

SYSTEM DESIGN AND IMPLEMENTATION

Proposed Simulation Model

- Sensor-nodes are stationary. In our approach, authors have to maintain dynamic node event handling for WSN nodes. The BS is distant from the nodes and is fixed.

Figure 2. Data routing hierarchy implementation with route request and Relay-node selection in WSN.



- All the Sensor-nodes having same communication/processing capabilities & energy constrained since they are still not monitored after deployment. So charging of battery may not be possible.
- Every Sensor node equipped with stable levels of transmission power and will maintain their residual energy.
- All Sensors and the BS are not able to communicate directly. To know the distance between the sensor-node and the BS, authors assumed that the beacon messages are broadcasted to all Sensors from the BS. Every Sensor-node able to calculate the distance from the BS by using Received Signal Strength Indication (RSSI) (Bahl. P & Padmanabhan. V, 2002) when they received a beacon message from BS.

Implementation Process of Modified EEECARP

The process of modified EEECARP is classified as two stages for every round.

1. Clusters Formation and Cluster Head selection
2. Data Communication between CH to BS selecting Relay-nodes.

Clusters Formation and Cluster-Head Selection

Originally, every node is in sleep state to conserve the battery power in the entire network. Whenever any event occurs throughout the network, the neighboring nodes activated and sense the specific attributes. Based on the value of the sensed attribute value; some times its greater than or sometimes it is lesser than the threshold (pre-defined), then the particular nodes run a process to construct a cluster and elect a

CH. All nodes in the cluster broadcast *REQ_CLUSTER* message to their neighbors. That *REQ_CLUSTER* contains the Identification ($ID\left(i\right)$), Sensed attribute ($I\left(i\right)$) and the residual-energy ($E_{res}\left(i\right)$) of i^{th} node. (Assumed that one sensor node can sense only one type of information).

$$REQ\_CLUSTER\{ID\left(i\right), E_{res}\left(i\right), I\left(i\right)\} \tag{3}$$

During the time-period t_1, every sensor-node receive *REQ_CLUSTER* message from each node within the Cluster after setting their timer to t_1 and executes the function below:

$$F_{CH}\left(i\right) = E_{res}\left(i\right) \times I\left(i\right), \text{ such that } i \in \mathrm{X} \tag{4}$$

In case if a sensor node can sense more than one type of information, then *Cluster-Head* function as below:

$$F_{CH}\left(i\right) = E_{res}\left(i\right) \times \sum_{k=1}^{n} I_k\left(i\right), \text{ such that } i \in X \tag{5}$$

$$Max\, F_{CH}\left(i\right) \frac{\forall i \in X}{set\ as}\, Cluster\ Head \tag{6}$$

Where *X* - set of activated sensor-nodes by an event.

The Maximum $Max\, F_{CH}\left(i\right)$ sets itself as the CH, when the timer t_1 expires. The CH save all nodes IDs of activated nodes and generates the TDMA Schedule (P. Gupta & P.R.Kumar, 2000; Heinzelman.W et al., 2002) to set of all the nodes(*X*) to transmit perceived information to Cluster-Head. The TDMA schedule avoids the collisions in transmission of data and maintains the sync between the nodes in the same clusters. The other nodes wait for TDMA schedule from the corresponding CH and sets as non-CHs. Meanwhile, these nodes in sleep state to save their battery power for own data transmission. The flow chart of Stage-1 is depicted in Fig. 3. The algorithm ensures that the selected CH has the maximum residual energy and is nearest to the event.

But the *REQ_CLUSTER* is an asynchronous message, so collision will be there resulting in energy wastage. Here the EEECARP cannot consider the collisions when an event occurs, all the sensor nodes send *REQ_CLUSTER* message to other

nodes in the cluster. Modified EEECARP try to solve this problem by considering different cases.

Case 1: Authors assumed that among the activated sensors nodes at least two sensors will exchange *REQ_CLUSTER* message without collision, so that cluster will form.

Case 2: in the worst case, if the cluster is not formed means the number of collisions is Maximum. In this case, when the time period t_1 expires, the algorithm takes another time period t_1 to send *REQ_CLUSTER* message as the event lasts long.

In our simulation, retransmission of broadcast message is acceptable because broadcast packet size (25 bytes) is very much small compared to data packet size (500bytes).

Hence, later during transmission, TDMA was implemented to avoid collisions because retransmission of data packets consumes more energy.

Case 3: if energy efficiency has to be increased collisions must be avoided. Hence as an extension of the work researchers can implement Carrier Sense Multiple Access (CSMA) (can be 1-persistent, non-persistent or p- persistent) during the cluster formation stage.

If further energy efficiency has to be enhanced, researchers can implement Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA).

In this case, authors did not consider collisions during CH formation; later during transmission TDMA was implemented to avoid collisions.

When an event occurs, all the nearby nodes sense the same event with different values. Then these nodes start broadcasting *REQ_CLUSTER* and wait for the same from the remaining nodes until the time period t_1 expires. From the set of parameters in *REQ_CLUSTER* message, $ID(i)$ is the identity of the node which sensed the event. Hence, every node will receive different $ID(i)$ and aware of other nodes that sensed the same event. After time period expires, no node will wait to receive *REQ_CLUSTER* and algorithm starts selection of Cluster-Head.

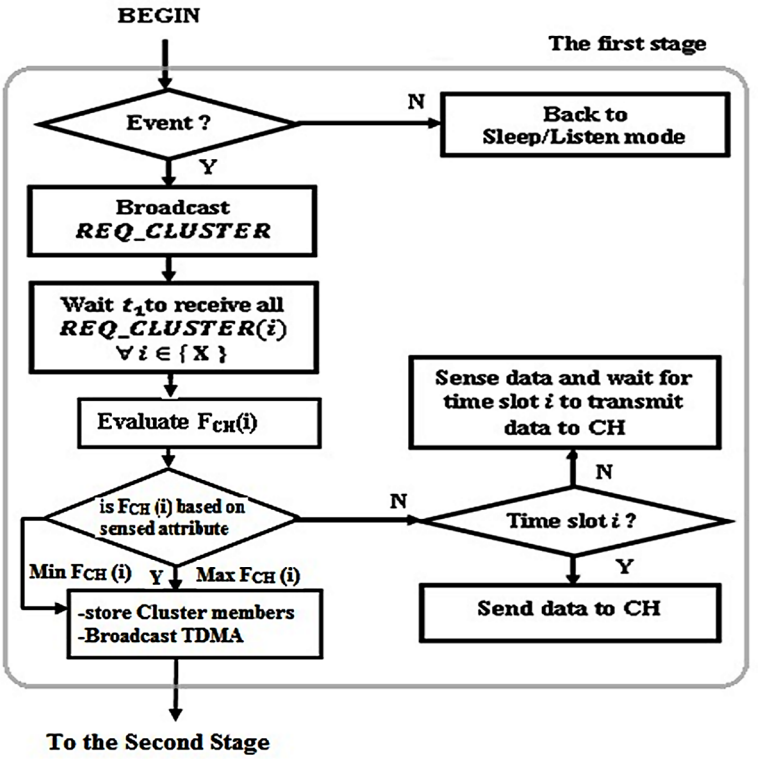
But when an event continuous, then non-CH nodes have to send information in its every TDM slot continuously. When another event occurs in the same activated area, it will restart the same process by sending *REQ_CLUSTER*. For this new event, the previous CH will not be selected as Cluster Head because the previous CH will consume some energy for Data communication (Aggregation and communication to BS). So, the previous Residual Energy (E_{res}) of previous CH will be low. Hence new CH will be selected.

Note: Our experimental work was carried on events where $I(i)$ is higher value because, in most of the applications, the sensed values must be highest magnitude value will be considered. In some applications the sensed value $I(i)$ has to be low, then modifications have to be done on lowering the Threshold value as well as a condition for cluster head selection given in as per Equations (5) and (7)

$$Min\ F_{CH}(i) \frac{\forall i \in X}{set\ as} Cluster\ Head \tag{7}$$

Furthermore, the Stage-1 used one type of message to form clusters and elect Cluster-Heads. By this lightweight modified-EEECARP, authors can minimize the overhead-messages and data-packets transported from nodes to CH. The Stage-2 will portray this.

Figure 3. Flow chart representing Stage-1



In our work, authors assumed that when an event occurs, the event lasts long for a period of time where the sensors no need to sense continuously and meanwhile, the sensor nodes can switch-off their radio signal except during their own transmission time slot. Slot is a TDMA time slot of node during data transmission phase. When event occurs, the sensed event attributes are few in number when compared to the number of sensor nodes deployed in the network. The CH should turn-on their radio device to receive sensed info forward by nodes within the cluster. The major point is that the nodes near the event are grouped as cluster and remaining nodes still in sleep state i.e. turn-off their radio receiver to preserve their energy. So, the broadcast phase should also consume less energy due to minimal distance between sensing nodes and CH.

Data Communication Between CH to BS Selecting Relay Nodes

Because of the large-scale MS-WSN, the CH cannot transfer the aggregated information to BS directly. So that some intermediate nodes to be act as relay nodes, which can receive the aggregated information from CH and forward to BS. Otherwise, the intermediate node to select another intermediate node as relay to depends upon the scalability of network. The data transmission phase composed as three activities.

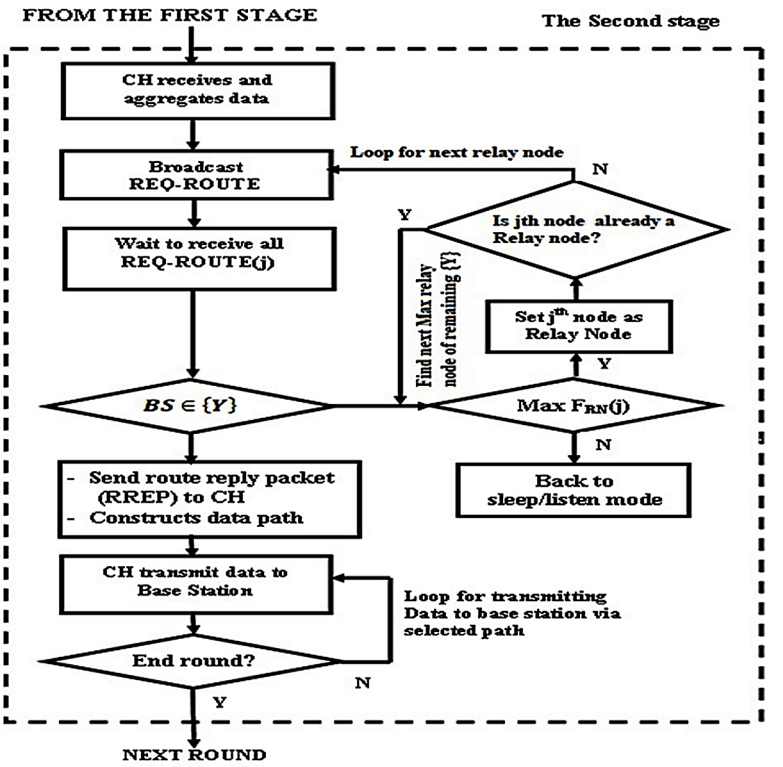
1. Collecting data within cluster
2. Performing data aggregation
3. Identifying optimal relay-nodes and constructing a route

Second Stage of modified EEECARP is similar to that of EEECARP (Venkataramana et al., 2017). The selection of Relay-node in EEECARP is not considering the hop count and overloading when more number of events occurs in same activation part in the network. Modified EEECARP is tried to address these issues by calculating hop count. When any Relay-node is overloaded, our modified EEECARP protocol select another node as Relay-node based on the below criteria.

1. The next highest residual energy and
2. Next nearest to BS

Our proposed protocol is an adaptive routing protocol. Hence, even though the events are happening in one part of the network only, the cluster formation, CH selection and route are different. When compared with static routing protocol or direct routing our protocol is energy efficient.

Figure 4. Flow chart representing Stage-2



When an event occurs in any activation area the number of hops always depends on the number of Relay nodes (r) only. Because the non-cluster-head initially communicates with its cluster head and thereafter hops are carried through relay nodes to the base station of the MS-WSN. So, the average number of hops required on a WSN with 'r' number of relay nodes is (r+2).

Table 1. Relation between No. of relay nodes and hops

Sl. No	No. of Relay Nodes	No. of hop(r+2)
1	0	2
2	2	4
3	4	6
4	10	12
5	15	17
6	20	22

SIMULATION EVALUATION

The proposed Modified EEECARP carried out using NS-2 platform (NS-2, 2008). LEATCH and EEECARP protocols are also implemented for comparing with modified protocol large-scale MS-WSN. Evaluation of all three protocols was done using QoPML process (Venkataramana et al., 2016, April).

The Parameters considered in the simulation as well as EEECARP protocol (Venkataramana et al., 2017). Authors change the network simulation area in our experiment depending on the nodes (He,T & Stankovic.J, 2003). Modified EEECARP protocol mainly concentrates for better dynamic event clustering adaptive routing with load balancing of nodes for improving the lifetime of Modern Secure-WSNs. Our main goal is to minimize the energy consumption of MS-WSN measuring number of living nodes present in network. The authors consider the every sensor node initial energy is 2 J after deployment. The rate of Data Frames is set to 30 in each round.

Experimental Results

The authors examine the recent contribution of efficient energy consumptions with efficient packet delivery ratio and collection of nodes with simple data transmission in MS-WSNs. For that, authors are taking 22 nodes sample network application as shown in following figures.

In the above figure 5 displays the formation of Network as per the proposed Network model. The main aim of modified protocol is to find perfect multi-path to transfer the fused information to the distant remote BS considering the overloading

Figure 5. Network simulation of stage-1

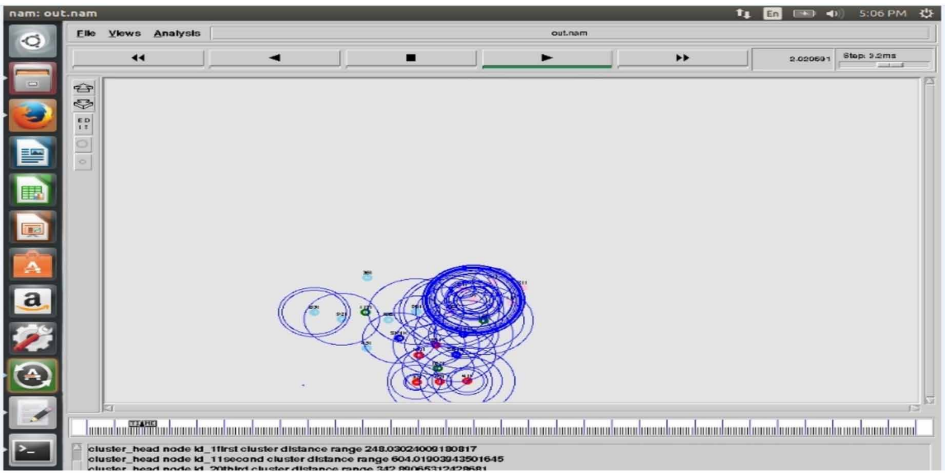
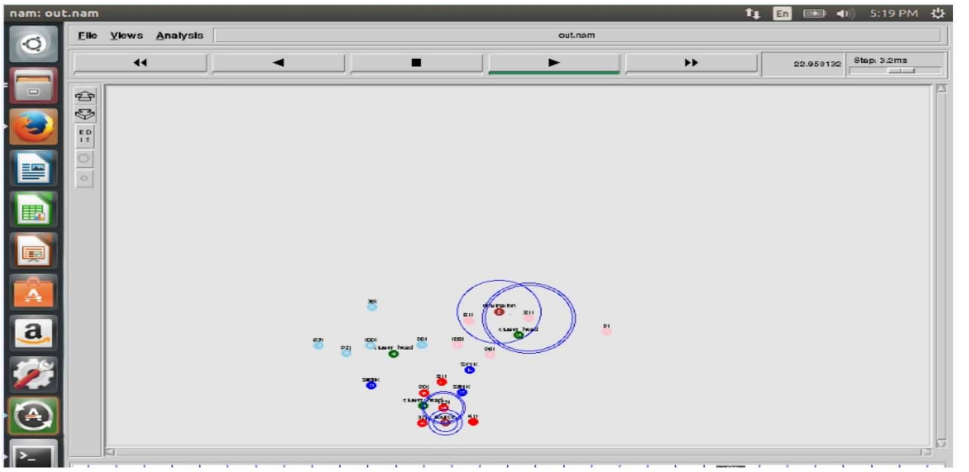


Figure 6. CH formation and cluster formation for efficient data transmission and communication between nodes



two criteria of Relay-nodes. Then authors need to select a Cluster-Head when an event is occurred in the network is called as activation part, the nodes surrounding the activation part are activated and sense the specific attributes. If value of specific attribute is more than the threshold (pre-defined), then those sensors execute Stage-1 process.

In the above figure 6 shows Cluster-Head formation and Cluster formation for efficient data Transmission and Communication between nodes.

In the figure 7 shows collecting data within the cluster, performing data aggregation and identifying relay-nodes and generating a route as per Stage-2. In Stage-2, the CH transmits the data packets by selecting the Relay-nodes intern pass these data packets to BS with a multiple hop route, rather than send the data packet directly to the BS.

To evaluate the parameters of the load balancing in terms of living nodes, efficient energy utilization in terms of total residual energy, authors used 22 nodes in our simulation process consistently spread over a 500m square region. The BS placed at [250, 600] co-ordinates, and 100m far away the nearby sensor node. According to our proposed approach, it has the dynamic simulation in topology maintenance, for that; initially, the energy of each node in the network is assumed as 10J. The energy consumption of each node in milliJoules (mJ) according to the number of packets transmitted.

Using LEATCH, the number of Cluster Heads (K) has to define because irrespective of occurrence of an event, clusters are formed. Where as in Modified EEECARP a cluster is formed at a place where an event occurs.

Figure 7. Relay node selection & data transmission with different Relay nod

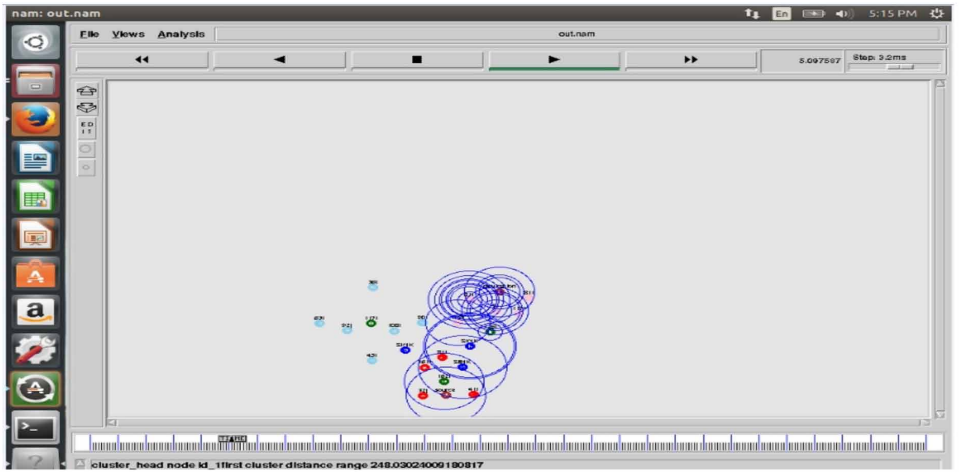
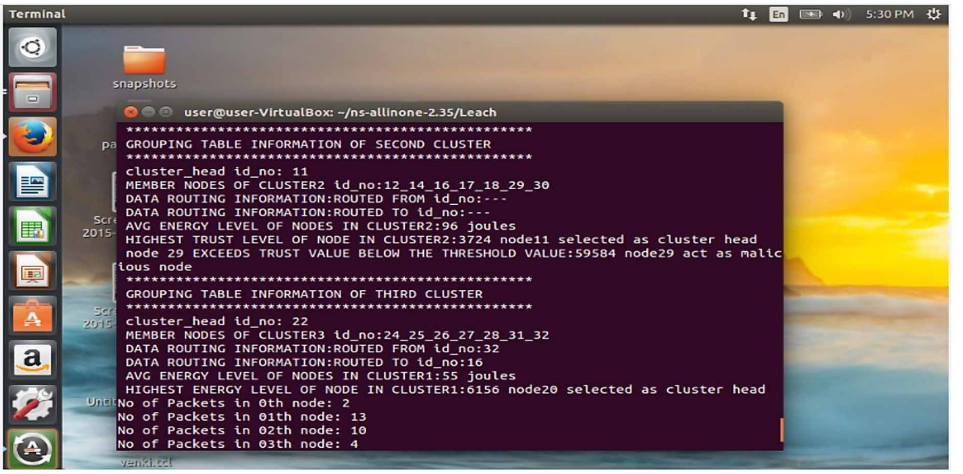


Figure 8. Cluster-Head formation in each node in data transmission



Hence the comparison between LEATCH, EEECARP and Modified EEECARP is only possible in terms of Energy Utilization and load balancing parameters as given in tables 2 and 3, with respect to K value the comparison is not possible.

The energy consumption of all three protocols for every 10 rounds is shown in table 2. As per the results, the LEATCH gradually increases the energy unitization of the network in every 10 rounds. EEECARP is also consumes slightly more energy compared with LEATCH. Whereas modified EEECARP outperforms steady energy utilization even for every 10 rounds till the end of the simulation. As per

Figure 9. Each node's energy consumption for data transmission in WSN

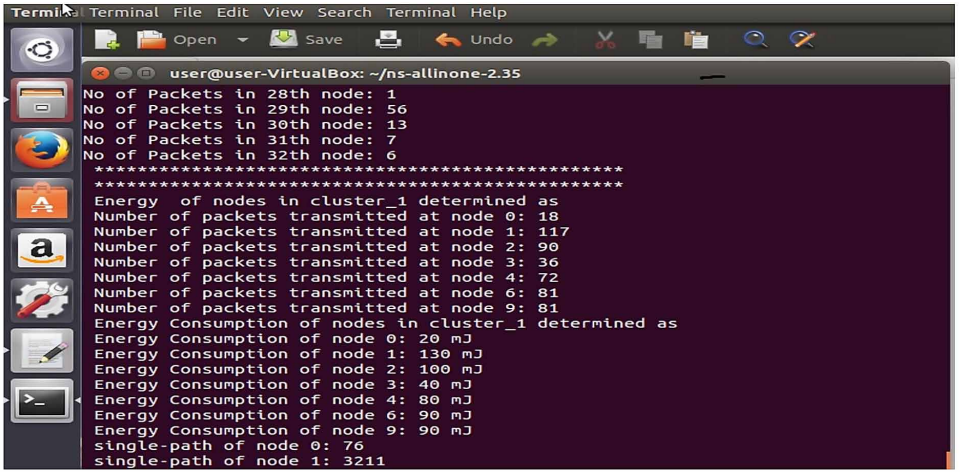


Table 2. Energy consumption analogy of LEATCH, EEECARP and Modified EEECARP

No. of Rounds	LEATCH	EEECARP	Modified EEECARP
10	5.82	4.35	3.82
20	4.81	4.45	3.73
30	6.5	4.2	3.63
40	7.3	4.7	3.49
50	8.3	4.9	3.51
60	7.8	5.4	3.64

the experiment, modified EEECARP consumes almost same energy compared with after 10 and 60 rounds; that's an indication of load balancing is done in the network excellently.

Load balancing is a major issue when evaluate performance of MS-WSN concerning of Stage-1 and Stage-2. In modified EEECARP, authors slightly modify the relay node selection in Stage-2 of EEECARP to improve load balancing all sensor nodes in network.

For Load Balancing (no. of alive nodes after fixed number of rounds), for every periodic intervals of time, the CH has to calculate

1. Read the residual energy and distance with respect to BS

Figure 10. The Energy Consumption results of three protocols plotted in the 500 meter network zone

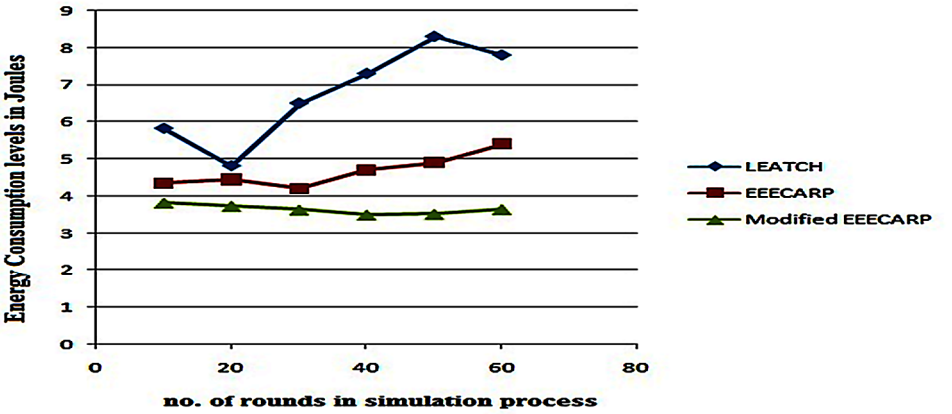
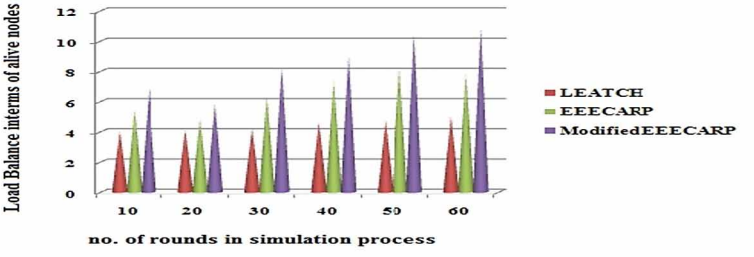


Table 3. Load Balance performance results of LEATCH, EEECARP and Modified EEECARP for 60 rounds

No. of Nodes	LEATCH	EEECARP	Modified EEECARP
10	4.0	5.4	6.82
20	4.1	4.8	5.78
30	4.2	6.3	8.18
40	4.6	7.3	8.97
50	4.7	8.2	10.41
60	5.0	7.8	10.83

Figure 11. Load Balance in terms of alive nodes for three techniques



2. Evaluate cos α_j for all Relay nodes in the cluster and based on which relay node will change.

Load balance performance evaluation of proposed method clearly shown that modified EEECARP outperformed in terms of percentage of alive nodes compared with LEATCH and EEECARP.

Undoubtedly, if more nodes were dead in the network or less number of alive nodes i.e., node density decreases, the network will be disconnected quickly. Our main aim is solve this problem. When more different events occurred at one place, some relay nodes will become as hot spots to relay the information to Base station which provokes the rapid death of those sensors because being overloaded (Venkataramana et al., 2016, December).

Table 4 clearly shows that the Modified EEECARP maintaining the load balancing compared with LEATCH and EEECARP. The 2nd column in the table 4 indicates the load balancing of modified EEECARP in terms of percentage of living nodes with respect to LEATCH is much more and 3rd column shows the same compared with EEECARP is more. Authors considered that a node consumes 90% of its energy as a dead node. So, the modified EEECARP improves the load balancing almost 60% and 30% respectively when compared with LEATCH and EEECARP, hence improves the network life time.

CONCLUSION

Our methodology is completely innovative correlates with the existing hierarchical approaches. In our methodology, authors never distribute all sensor nodes into clusters in the whole network, as and when an event occurs in the network (activation

Table 4. Load balance performance of modified EEECARP in terms of alive nodes comparing with existing LEATCH and EEECARP for 60 rounds

No. of Nodes	% of Alive Nodes w.r.t LEATCH	% of Alive Nodes w.r.t EEECARP
10	28.2%	14.2%
20	16.8%	9.8%
30	39.8%	18.3%
40	43.7%	16.7%
50	57.1%	22.1%
60	58.3%	30.3%

part), only the surrounding nodes in the activation part will form a cluster. The remaining nodes still in sleep state i.e. switch-off their radio receiver to preserve their energy. So, the estimation of Cluster-Heads and clusters are determined by the occurrence of events in the different parts of the network (Event-Clustering). By event clustering feature the data transmission will performs in activated part of the network whenever an event occurs. This avoids energy wastage by avoiding the transmission of messages in non-activated part of the entire network because in the non-activated parts of the network, the nodes are in sleep state and have nothing to transmit. Additionally, authors used the multi-hop strategy to relay the fused information for a long distance. The key feature of the modified protocol relies in relay node selection of Stage-2 of EEECARP to improve load balancing of all sensor-nodes in the network.

The simulation results illustrate that the modified routing protocol is able to reduce the energy utilization of each node and avoid the collisions when all sensor nodes transmit data to other nodes simultaneously. Most importantly the proposed protocol improves the load balancing of the network, therefore Modified EEECARP prolongs the whole network lifetime, especially in large-scale Wireless Sensor Networks. In the subsequent work, we will concentrate to apply the Modified EEECARP in the mobile wireless sensor networks where base station and mobile gadget nodes are not stationary.

REFERENCES

Bahl, P., & Padmanabhan, V. (2002, August 6). RADAR: An in-building RF-based user location and tracking system. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/document/832252/

Fu, C., Wei, W., & Jiang, Z. (2013, September 14). *An Energy Balanced Algorithm of LEACH Protocol in WSN.* Retrieved from http://ijcsi.org/papers/IJCSI-10-1-1-354-359.pdf

Gupta, P., & Kumar, P. R. (2000, March). The Capacity of Wireless Networks. *IEEE Transactions on Information Theory*, *IT-46*(2).

He, T., & Stankovic, J. (2003, June 11). SPEED: A stateless protocol for real-time communication in sensor networks. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/document/1203451/

Heinzelman, W. B., Chandrakasan, A. P., & Balakrishnan, H. (2000). *Energy-Efficient Communication Protocol for Wireless Microsensor Networks Processing of the Hawaii International Conference on System Science*. Retrieved from http://www.nhu.edu.tw/~cmwu/Lab/leach.pdf

Heinzelman, W. B., Chandrakasan, A. P., & Balakrishnan, H. (2002, October 7). *An Application-Specific Protocol Architecture for Wireless Microsensor Networks*. Retrieved from http://dl.acm.org/citation.cfm?id=2216028

NS-2. (n.d.). *A Network Simulator System Version 2*. Retrieved from https://www.isi.edu/nsnam/ns/

Quang, V. T., & Miyoshi, T. (2008, September 1). *Adaptive Routing Protocol with Energy Efficiency and Event Clustering for Wireless Sensor Networks*. Retrieved from http://search.ieice.org/bin/summary. php?id=e91-b92795

Tao, Shi, & Liao. (2006, April 3). A hierarchical architecture for energy-efficient information dissemination in sensor networks. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/ document/1609892/

Venkataramana, Rao, Sekhar, & Preethi. (2016, December). *ICR based Protocol Hierarchy to increase Lifetime of Wireless Sensor Networks*. Retrieved from https://sites.google.com/site/ijcsis/vol-14-no-12-dec-2016

Venkataramana, Sekhar, Desai, Chakravarthy, & Rao. (2019, January). *Efficient Time Reducing And Energy Saving Routing Algorithm for Wireless Sensor Networks*. Retrieved from https://iopscience.iop.org/article/10.1088/1742-6596/1228/1/012002/pdf

Venkataramana, S., Prasad Reddy, P. V. G. D., & Krishna Rao, S. (2016, February). *Energy Optimization via Cluster Based Hierarchy (LEACH) in WSNs*. Paper presented at IEEE Sponsored 3rd International Conference on Electronics and Communication Systems (ICECS 2016).

Venkataramana, Reddy, & Rao. (2016, April 5). *Secure Energy Tradeoffs with Low Power Consumption in Data Transmission in Wireless Sensor Networks*. Retrieved from http://www.arpnjournals. org/jeas/research_papers/rp_2016/ jeas_0416_3960.pdf

Venkataramana, Reddy, & Rao. (2017, October). *EEECARP: Efficient Energy Clustering Adaptive Routing Procedure for Wireless Sensor Networks*. Retrieved from https://www.igi-global.com/journal/journal-global-information-management/1070

Visvanathan, Youn, & Deogun. (2005, May 20). Hierarchical data dissemination scheme for large scale sensor networks. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/document/1494949/

Wei, Z. Z., & Hui, W. Z. (2003, September 3). Clustering routing algorithm using game-theoretic techniques for WSNs. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/document/1329151/

Compilation of References

Adams, C. A., & Frost, G. F. (2006). Accessibility and functionality of them corporate web site: Implications for sustainability reporting. *Business Strategy and the Environment*, *15*(4), 275–287. doi:10.1002/bse.531

Afshan, S., & Sharif, A. (2016). Acceptance of mobile banking framework in Pakistan. *Telematics and Informatics*, *33*(2), 370–387. doi:10.1016/j.tele.2015.09.005

Agarwal, A., Hosanagar, K., & Smith, M. D. (2011). Location, location, location: An analysis of profitability of position in online advertising markets. *JMR, Journal of Marketing Research*, *48*(6), 1057–1073. doi:10.1509/jmr.08.0468

Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *Management Information Systems Quarterly*, *24*(4), 665–694. doi:10.2307/3250951

Agarwal, R., & Prasad, J. (1999). Are individual differences germane to the acceptance of information technologies? *Decision Sciences*, *30*(2), 361–391. doi:10.1111/j.1540-5915.1999.tb01614.x

Ahmed, F., Capretz, L. F., Sandhu, M. A., & Raza, A. (2014). Analysis of risks faced by information technology offshore outsourcing service providers. *IET Software*, *8*(6), 279–284. doi:10.1049/iet-sen.2013.0204

Ahmed, M. S. (1994). Block partial derivative and its application to neural-net-based direct model-reference adaptive control. *IEE Proceedings. Control Theory and Applications*, *141*(5), 305–314. doi:10.1049/ip-cta:19941395

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. doi:10.1016/0749-5978(91)90020-T

Alalwan, A. A., Dwivedi, Y. K., & Rana, N. P. (2017). Factors influencing adoption of mobile banking by Jordanian bank customers: Extending UTAUT2 with trust. *International Journal of Information Management*, *37*(3), 99–110. doi:10.1016/j.ijinfomgt.2017.01.002

Alballaa, H., & Al-Mudimigh, A. S. (2011). Change Management Strategies for Effective Enterprise Resource Planning Systems: A Case Study of a Saudi Company. *International Journal of Computers and Applications*, *17*(2), 14–19. doi:10.5120/2194-2785

Alhawari, S., Karadsheh, L., Talet, A. N., & Mansour, E. (2012). Knowledge-based risk management framework for information technology project. *International Journal of Information Management*, *32*(1), 50–65. doi:10.1016/j.ijinfomgt.2011.07.002

Allen, T. J. (2007). Architecture and communication among product development engineers. *California Management Review*, *49*(2), 23–41. doi:10.2307/41166381

Al-Mashari, M., Ghani, S. K., & Al-Rashid, W. (2006). A study of the critical success factors of ERP implementation in developing countries. *International Journal of Internet and Enterprise Management*, *4*(1), 68–95. doi:10.1504/IJIEM.2006.008866

Aloini, D., Dulmin, R., & Mininno, V. (2012). Risk assessment in ERP projects. *Information Systems*, *37*(3), 183–199. doi:10.1016/j.is.2011.10.001

Alomaim, N., Tunca, M., & Zairi, M. (2003). Customer satisfaction @ virtual organizations. *Management Decision*, *41*(7), 666–670. doi:10.1108/00251740310495595

Al-Refaie, A. (2014). Examining factors affect supply chain collaboration in Jordanian organizations. *Journal of Management Analytics*, *1*(4), 317–337. doi:10.1080/23270012.2014.991357

Al-Shamlan, H., & Al-Mudimigh, A. (2011). The Change Management Strategies and Processes for Successful ERP Implementation: A Case Study of MADAR. *International Journal of Computer Science Issues*, *8*(2), 399–407.

AlSoufi, A., & Ali, H. (2014). Customer's perception of m-banking adoption in Kingdom of Bahrain: An empirical assessment of an extended TAM model. *International Journal of Managing Information Technology*, *6*(1), 1–13.

American Bankers Association. (2015). *ABA Survey: More Consumers Turning to Mobile Banking*. Retrieved January 27, 2016, from http://www.aba.com/Press/Pages/081115MobileBankingSurvey.aspx

Amid, A., Moalagh, M., & Ravasan, A. Z. (2012). Identification and classification of ERP critical failure factors in Iranian industries. *Information Systems*, *37*(3), 227–237. doi:10.1016/j.is.2011.10.010

Anantatmula, V., & Thomas, M. (2010). Managing global projects: A structured approach for better performance. *Project Management Journal*, *41*(2), 60–72. doi:10.1002/pmj.20168

Anderson, P., De Bruijn, A., Angus, K., Gordon, R., & Hastings, G. (2009). Impact of Alcohol Advertising and Media Exposure on Adolescent Alcohol Use: A Systematic Review of Longitudinal Studies. *Alcohol and Alcoholism (Oxford, Oxfordshire)*, 115. PMID:19144976

Andersson, A. (2016). Communication barriers in an interorganizational ERP-project. *International Journal of Managing Projects in Business*, *9*(1), 214–233. doi:10.1108/IJMPB-06-2015-0047

Andreassen, T. W. (1994). Satisfaction, loyalty and reputation as indicators of customer orientation in the public sector. *International Journal of Public Sector Management*, *7*(2), 16–34. doi:10.1108/09513559410055206

Andrews, R. (2004). *The Impact of Ict on Literacy Education*. Psychology Press.

Ao, J., & Liu, Z. (2014). What impact entrepreneurial intention? Cultural, environmental, and educational factors. *Journal of Management Analytics*, *1*(3), 224–239. doi:10.1080/23270012.2014.994232

Arnone, L., Ferauge, P., Geerts, A., & Pozniak, L. (2011). Corporate Social Responsibility: Internet as Communication Tool Towards Stakeholders. *Journal of Modern Accounting and Auditing*, *7*(7), 697–708.

Arora, B., & Puranik, R. (2004). A Review of Corporate Social Responsibility in India. *Society for International Development*, *47*(3), 93–100.

Arvidsson, S. (2010). Communication of corporate social responsibility: A study of the views of management teams in large companies. *Journal of Business Ethics*, *96*(3), 339–354. doi:10.100710551-010-0469-2

Aslam, A., Ahmad, N., Saba, T., Almazyad, A. S., Rehman, A., Anjum, A., & Khan, A. (2017). Decision support system for risk assessment and management strategies in distributed software development. *IEEE Access: Practical Innovations, Open Solutions*, *5*, 20349–20373. doi:10.1109/ACCESS.2017.2757605

Aslam, W., Ijaz, F., Lali, M. I. U., & Mehmood, W. (2017). Risk Aware and Quality Enriched Effort Estimation for Mobile Applications in Distributed Agile Software Development. *Journal of Information Science and Engineering*, *33*(6), 1481–1500. doi:10.6688/JISE.2017.33.6.6

Aundhe, M. D., & Mathew, S. K. (2009). Risks in offshore IT outsourcing: A service provider perspective. *European Management Journal*, *27*(6), 418–428. doi:10.1016/j.emj.2009.01.004

Avgerou, C. (2008). Information systems in developing countries: A critical research review. *Journal of Information Technology*, *23*(3), 133–146. doi:10.1057/palgrave.jit.2000136

Baabdullah, A. M., Alalwan, A. A., Rana, N. P., Kizgin, H., & Patil, P. (2019). Consumer use of mobile banking (M-Banking) in Saudi Arabia: Towards an integrated model. *International Journal of Information Management*, *44*, 38–52. doi:10.1016/j.ijinfomgt.2018.09.002

Baccarini, D., Salm, G., & Love, P. E. D. (2004). Management of risks in information technology projects. *Industrial Management & Data Systems*, *104*(4), 286–295. doi:10.1108/02635570410530702

Bagozzi, R. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the Association for Information Systems*, *8*(4), 244–254. doi:10.17705/1jais.00122

Bahl, P., & Padmanabhan, V. (2002, August 6). RADAR: An in-building RF-based user location and tracking system. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/document/832252/

Baker, E., Al-Gahtani, S., & Hubona, G. (2010). Cultural impacts on acceptance and adoption of information technology in a developing country. *Journal of Global Information Management*, *18*(3), 35–58. doi:10.4018/jgim.2010070102

Bakos, J. (1997). Reducing buyer search costs: Implications for electronic marketplace. *Management Science*, *43*(12), 1–27. doi:10.1287/mnsc.43.12.1676

Balasubramanian, S., & Raja, V. A. (2010). Assessment of CMM and its impact on software quality. *International Journal of Management*, *1*(1), 65–75.

Bank of Thailand. (2017). *Payment systems report 2017*. Retrieved July 15, 2019, from https://www.bot.or.th/English/PaymentSystems/Publication/PS_Annually_Report/Documents/Payment_2017_E.pdf

Banwet, D. K., & Arora, R. (1999). Enablers and inhibitors of E-Commerce Implementation in India- an imperative structural modeling (ISM) approach. In Operations management for global economy challengers and prospects, 332-341.

Baptista, G., & Oliveira, T. (2015). Understanding mobile banking: The unified theory of acceptance and use of technology combined with cultural moderators. *Computers in Human Behavior*, *50*, 418–430. doi:10.1016/j.chb.2015.04.024

Barbey, A. K. (2018). Network Neuroscience Theory of Human Intelligence. *Trends in Cognitive Sciences*, *22*(1), 8–20. doi:10.1016/j.tics.2017.10.001 PMID:29167088

Barney, J. B., & Hansen, M. H. (1994). Trustworthiness as a Source of Competitive Advantage. *Strategic Management Journal*, *15*(S1), 175–190. doi:10.1002mj.4250150912

Barskar, R., Deen, A. J., Bharti, J., & Ahmed, G. F. (2010). The Algorithm Analysis of E-commerce security issue for on-line payment transaction system in Banking Technology. *Cryptography & Security*, *8*(1), 307–312.

Bartol, A., Harmandaze-Scrranoy, J. M., Soriano, M., Dohler, M. A., & Barthel, D. (2011). Security and Privacy in your Smart City. *Proceedings of Barcelona Smart Cities Congress*.

Basu, D. D. (2002). *The essence of Hinduism*. PHI Learning Pvt. Ltd.

Basu, R., & Biswas, D. (2013). An Approach to Identify Failure Factors of Enterprise Application Implementation in Indian Micro Enterprises. *International Journal of Managing Value and Supply Chains*, *4*(1), 37–47. doi:10.5121/ijmvsc.2013.4104

Batra, R., Ramaswamy, V., Alden, D. L., Steenkamp, J.-B. E., & Ramachander, S. (2014). Effects of Brand Local and Non-Local Origin on Consumer Attitudes in Developing Countries. *Journal of Consumer Psychology*, *9*(2), 83-95.

Bauer, C., & Scharl, A. (2000). Quantitative Evaluation of Web Site Content and Structure. *Internet Research: Electronic Networking Applications and Policy*, *10*(1), 31–43. doi:10.1108/10662240010312138

Beatty, S. E., Kahle, L. R., Homer, P., & Misra, S. (1985). Alternative Measurement Approaches to Consumer Values: The List of Values and the Rokeach Value Survey. *Psychology & Marketing*, *2*(3), 181-200.

Beck, M., & Walgenbach, P. (2005). Technical Efficiency of Adaptation to Institutional Expectations? – The Adoption of ISO 9000 Standards in the German Mechanical Engineering Industry. *Organization Studies*, *26*(6), 841–866. doi:10.1177/0170840605054599

Belicove, M. E. (2013). *How to fix online mobile advertising*. Retrieved June 27, 2019, from http://www.forbes.com/sites/mikalbelicove/2013/09/04/how-to-fix-online-mobile-advertising

Bellono, N. W., Bayrer, J. R., Leitch, D. B., Castro, J., Zhang, C., O'Donnell, T. A., ... Julius, D. (2017). Enterochromaffin Cells Are Gut Chemosensors that Couple to Sensory Neural Pathways. *Cell*, *170*(1), 185–198. doi:10.1016/j.cell.2017.05.034 PMID:28648659

Benbunan-Fich, R. (2001). Using protocol analysis to evaluate the usability of a commercial web site. *Information & Management*, *39*(2), 151–163. doi:10.1016/S0378-7206(01)00085-4

Benbunan-Fich, R., & Benbuna, A. (2007). Understanding user behavior with new mobile applications. *The Journal of Strategic Information Systems*, *16*(4), 393–412. doi:10.1016/j.jsis.2007.08.002

Bhatiasevi, V. (2015). An extended UTAUT model to explain the adoption of mobile banking. *Information Development*, *32*(4), 799–814. doi:10.1177/0266666915570764

Bhatt, A. (2016). Factors affecting customer's adoption of mobile banking services. *Journal of Internet Banking and Commerce*, *21*(1).

Bhattacharya, A. (2018). The Number of Smartphone Users in India Will More Than Double in Four Years. *Quartz India.* Retrieved from: https://qz.com/india/1483368/indias-smartphone-internet-usage-will-surge-by-2022-cisco-says/

Bhatti, T. R. (2005, September). Critical success factors for the implementation of enterprise resource planning (ERP): empirical validation. In *The Second International Conference on Innovation in Information Technology* (p. 110). Academic Press.

Bingi, P., Sharma, M. K., & Godla, J. K. (1999). Critical issues affecting an ERP implementation. *Information Systems Management*, *16*(3), 7–14. doi:10.1201/1078/43197.16.3.19990601/31310.2

Bin, Q., Chen, S., & Sun, S. (2003). Cultural differences in E-commerce: A comparison between the U.S. and China. *Journal of Global Information Management*, *11*(2), 48–55. doi:10.4018/jgim.2003040103

Bishop, M. M., Brocato, E. D., & Vijayalakshmi, A. (2017). The role of medium content and ad format congruity in influencing advertising outcomes. *Journal of Marketing Communications*, *23*(4), 371–384. doi:10.1080/13527266.2015.1033442

Bi, Z., & Cochran, D. (2014). Big data analytics with applications. *Journal of Management Analytics*, *1*(4), 249–265. doi:10.1080/23270012.2014.992985

Black, S. E., & Lynch, L. M. (2001). How to Compete: The Impact of Workplace Practices and Information Technology on Productivity. *Review of Economics and Statistics*, *83*(3), 434-445.

Black, N., Lockett, A., Winklhofer, H., & Ennew, C. (2001). The adoption of internet financial services: A qualitative study. *International Journal of Retail & Distribution Management*, *29*(8), 390–398. doi:10.1108/09590550110397033

Blau, P. M. (1964). *Exchange and Power in Social Life*. New York: John Wiley and Sons.

Bock, G. W., & Kim, Y. G. (2002). Breaking the myths of rewards: An exploratory study of attitudes about knowledge sharing. *Information Resources Management Journal*, *15*(2), 14–21. doi:10.4018/irmj.2002040102

Bock, G. W., Zmud, R. W., Kim, Y. G., & Lee. (2005). Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *Management Information Systems Quarterly*, *29*(1), 87–111. doi:10.2307/25148669

Bolivar, P. M. R. (2009). Evaluating corporate social and environmental reporting on the internet: The utilities and resource industries in Spain. *Business & Society*, *48*(2), 179–205. doi:10.1177/0007650307305370

Bond, M.H. (1988). Finding universal dimensions of individual variation in multicultural studies of values: The Rokeach and Chinese value surveys. *Journal of Personality and Social Psychology*, *55*(6), 1009-1015.

Boonsiritomachai, W. & Pitchayadejanant, K. (2017). Determinants affecting mobile banking adoption by generation Y based on the Unified Theory of Acceptance and Use of Technology Model modifed by the Technology Acceptance Model concept. *Kasetsart Journal of Social Sciences.*

Borroso, C., Carrion, G. C., & Roldan, J. L. (2010). *Applying Maximum Likelihood and PLS on Different Sample Sizes: Studies on Seroquel Model and Employee Behavior Model. In Handbook of Partial Least Squares Concepts, Methods and Applications* (pp. 427–447). Heidelberg, Germany: Springer.

Bose, R. (2003). Knowledge management-enabled health care management systems: Capabilities, infrastructure, and decision-support. *Expert Systems with Applications*, *24*(1), 59–71. doi:10.1016/S0957-4174(02)00083-0

Braithwaite, V. A., & Law, H. (1985). Structure of Human Values: Testing the Adequacy of the Rokeach Value Survey. *Journal of Personality and Social Psychology*, *49*(1), 250.

Brenner, M. (2018). *Banner Ads Have 99 Problems and A Click Ain't One*. Retrieved June 27, 2019, from https://marketinginsidergroup.com/content-marketing/banners-99-problems/

Briolat, D., & Pogman, J. (2000, April). User involvement influence on project productivity in a rad environment: A quasi-experiment. In *European Software Control and Metrics Conference*, Munich, Germany.

Brookfield, D., Fischbacher-Smith, D., Mohd-Rahim, F., & Boussabaine, H. (2014). Conceptualising and responding to risk in IT projects. *Risk Management*, *16*(3), 195–230. doi:10.1057/rm.2014.10

Brown, I., Hoppe, R., Mugera, P., Newman, P., & Stander, A. (2004). The impact of national environment on the adoption of Internet banking: Comparing Singapore and South Africa. *Journal of Global Information Management*, *12*(2), 1–26. doi:10.4018/jgim.2004040101

Brown, J., Broderick, A. J., & Lee, N. (2007). Word of mouth communication within online communities. *Journal of Interactive Marketing*, *21*(3), 2–20. doi:10.1002/dir.20082

Brown, M. M., & Brudney, J. L. (2003). Learning organizations in the public sector? A study of police agencies employing information and technology to advance knowledge. *Public Administration Review*, *63*(1), 30–43. doi:10.1111/1540-6210.00262

Bunker, D., Hardy, C., Babar, A., & Stevens, K. (2015). *Exploring practitioner perspectives of sourcing risks: Towards the development of an integrated risk and control framework*. In *Australasian Conference on Information Systems*, Adelaide, South Australia.

Buro, M. (2003). The evolution of strong Othello programs. In R. Nakatsu & J. Hoshino (Eds.), *Entertainment Computing* (Vol. 112, pp. 81–88). New York, NY: Springer US. doi:10.1007/978-0-387-35660-0_10

Buttigieg, S., Schuetz, M., & Bezzina, F. (2016). Value Chains of Public and Private Health-Care Services in a Small EU Island State: A SWOT Analysis. *Frontiers in Public Health*, *4*, 201. doi:10.3389/fpubh.2016.00201 PMID:27683658

Caelli, T., Guan, L., & Wen, W. (1999). Modularity in neural computing. *Proceedings of the IEEE*, *87*(9), 1497–1518. doi:10.1109/5.784227

Capriotti, P., & Moreno, A. (2007). Corporate citizenship and public relations: The importance and interactivity of social responsibility issues on corporate websites. *Public Relations Review*, *33*(1), 84–91. doi:10.1016/j.pubrev.2006.11.012

Carlson, S. (1975). *How foreign is foreign trade: a problem in international business research*. Uppsala: Uppsala University Press.

Carmel, E. (1999). *Global software teams: collaborating across borders and time zones*. Prentice Hall PTR.

Carpenter, S. (2018). Ten Steps in Scale Development and Reporting: A Guide for Researchers. *Communication Methods and Measures*, *12*(1), 25–44. doi:10.1080/19312458.2017.1396583

Carroll, A. B. (1999). Corporate social responsibility: Evolution of a definitional construct. *Business & Society*, *38*(3), 268–292. doi:10.1177/000765039903800303

Chan, C. K., & Lee, H. W. J. (Eds.). (2005). *Successful strategies in supply chain management*. IGI Global. doi:10.4018/978-1-59140-303-6

Changchit, C. (2006). Consumer Perceptions of Online Shopping. *Issues in Information Systems*, *7*(2), 177–181.

Changchit, C. (2008). Data protection and privacy issue. *Journal of Information Privacy and Security*, *4*(3), 1–2. doi:10.1080/2333696X.2008.10855842

Changchit, C., Cutshall, R., & Tzong-Ru, L. (2014). Shopping preference: A comparative study of American and Taiwanese perceptions. *Journal of International Technology and Information Management*, *23*(1), 83–103.

Changchit, C., Lonkani, R., & Sampet, J. (2017). Mobile Banking: Exploring Determinants of Its Adoption. *Journal of Organizational Computing and Electronic Commerce*, *27*(3), 239–261. doi:10.1080/10919392.2017.1332145

Chang, Y. W., Hsu, P. Y., Shiau, W. L., & Tsai, C. C. (2015). Knowledge sharing intention in the United States and China: A cross-cultural study. *European Journal of Information Systems*, *24*(3), 262–277. doi:10.1057/ejis.2014.28

Chang, Y. W., Hsu, P. Y., Shiau, W. L., & Yi, R. (2015). The effect of customer power on enterprise internal knowledge sharing: An empirical study. *Aslib Journal of Information Management*, *67*(5), 505–525. doi:10.1108/AJIM-02-2015-0028

Chang, Y., Kim, H., Wong, S., & Park, M. (2015). A comparison of the digital divide across three countries with different development indices. *Journal of Global Information Management*, *23*(4), 55–76. doi:10.4018/JGIM.2015100103

Chan, S. S.-K., Shi, X., Toyama, A., Arpke, R. W., Dandapat, A., Iacovino, M., ... Kyba, M. (2013). Mesp1 Patterns Mesoderm into Cardiac, Hematopoietic, or Skeletal Myogenic Progenitors in a Context-Dependent Manner. *Cell Stem Cell*, *12*(5), 587–601. doi:10.1016/j.stem.2013.03.004 PMID:23642367

Chan, S., & Lu, M. (2004). Understanding Internet banking adoption and use behavior: A Hong Kong perspective. *Journal of Global Information Management*, *12*(3), 21–43. doi:10.4018/jgim.2004070102

Chatterjee, S., Kar, A. K., & Gupta, M. P. (2018). Success of IoT in Smart Cities of India: An empirical analysis. *Government Information Quarterly*, *35*(3), 349–361. doi:10.1016/j.giq.2018.05.002

Chaturvedi, A., & Goyal, S. (2012). Changing severity of impediments for entrepreneurs in India: An empirical analysis. *International Journal of Entrepreneurship and Small Business*, *16*(1), 1–32. doi:10.1504/IJESB.2012.046914

Chaundri, V., & Wang, J. (2007). Communicating corporate social responsibility on the internet: A case of the top 100 information technology companies in India. *Management Communication Quarterly*, *21*(2), 232–247. doi:10.1177/0893318907308746

Chau, P., & Hu, P. (2001). Information technology acceptance by individual professionals: A model comparison approach. *Decision Sciences*, *32*(4), 699–719. doi:10.1111/j.1540-5915.2001.tb00978.x

Chau, P., & Lai, V. (2003). An empirical investigation of the determinants of user acceptance of internet banking. *Journal of Organizational Computing and Electronic Commerce*, *13*(2), 123–145. doi:10.1207/S15327744JOCE1302_3

Chen, C.-N., Lai, M., & Tarn, D. D. (1999). Feminism Orientation, Product Attributes and Husband-Wife Decision Dominance: A Taiwan-Japan Cross-Cultural Study. *Journal of Global Marketing*, *12*(3), 23-39.

Chen, C. C., Cameron, M. F., & George, F. F. (1999). Do rewards benefit the organization? The effects of reward types and the perceptions of diverse R&D professionals. *IEEE Transactions on Engineering Management*, *46*(1), 47–55. doi:10.1109/17.740037

Chen, Q., Griffith, D. A., & Shen, F. (2005). The Effects of Interactivity on Cross-Channel Communication Effectiveness. *Journal of Interactive Advertising*, *5*(2), 19–28. doi:10.1080/15252019.2005.10722098

Chen, S. C., & Dhillon, G. S. (2003). Interpreting Dimensions of Consumer Trust in E-Commerce. *Information Technology Management*, *4*(2/3), 303–318. doi:10.1023/A:1022962631249

Chen, S. S., Chuang, Y. W., & Chen, P. Y. (2012). Behavioral intention formation in knowledge sharing: Examining the roles of KMS quality, KMS self-efficacy, and organizational climate. *Knowledge-Based Systems*, *31*, 106–188. doi:10.1016/j.knosys.2012.02.001

Chen, Y. (2016). Industrial information integration-a literature review 2006-2015. *Journal of Industrial Information Integration*, *2*, 30–64. doi:10.1016/j.jii.2016.04.004

Chevers, D. A., & Duggan, E. W. (2010). *A preliminary study of the use of software process improvement initiatives in Jamaica.* Paper presented at the 3rd International Conference on Information Resources Management (Conf-IRM), Montego Bay, Jamaica.

Chevers, D. A., Moore, S., Duggan, E. W., & Mills, A. M. (2008). *Identifying key software development practices in the English-speaking Caribbean using the nominal group technique.* Paper presented at the 19th Australasian Conference on Information Systems (ACIS), Christchurch, New Zealand.

Chevers, D. A., & Duggan, E. W. (2007). A Modified Capability Framework for Improving Software Production Processes in Jamaican Organizations. *The Electronic Journal on Information Systems in Developing Countries*, *30*(4), 1–18. doi:10.1002/j.1681-4835.2007.tb00207.x

Chevers, D. A., Mills, A. M., Duggan, E. W., & Moore, S. (2017). Towards a simplified software process improvement framework for small software development organizations. *Journal of Global Information Management*, *20*(2), 110–130. doi:10.1080/1097198X.2017.1321356

Chidambaranathan, Sk., Muralidharan, C., & Deshmukh, S. G. (2009). Analyzing the interaction of critical factors of supplier development wing, interpretive structural modeling (ISM)- an empirical study. *International Journal of Advanced Manufacturing Technology*, *138*(1-3), 243–249.

Chien, S., Lin, H., & Shih, C. (2014). A moderated mediation study: Cohesion linking centrifugal and centripetal forces to ERP implementation performance. *International Journal of Production Economics*, *158*(1), 1–8. doi:10.1016/j.ijpe.2014.06.001

Chiesa, V. (1995). Globalizing R & D around centers of excellence. *Long Range Planning*, *28*(6), 19–28. doi:10.1016/0024-6301(95)00048-N

Chiesa, V. (2000). Global R&D project management and organization: A taxonomy. *Journal of Product Innovation Management*, *17*(5), 341–359. doi:10.1111/1540-5885.1750341

Chi, J., & Sun, L. (2015). IT and competitive advantage: A study from micro perspective. *Modern Economy*, *6*(03), 404–410. doi:10.4236/me.2015.63038

Chin, W. W. (1998). The partial least squares approach for structural equation modelling. In G. A. Marcoulides (Ed.), *Modern Methods for Business Research* (pp. 295–336). London: Lawrence Erlbaum.

Chin, W. W. (2010). *How to write-up and report PLS analysis*. Berlin: Springer - Verlag.

Chiu, C. K., Lin, C. P., Tsai, Y. H., & Teh, S. F. (2018). Enhancing knowledge sharing in high-tech firms: The moderating role of collectivism and power distance. *Cross Cultural & Strategic Management*, *25*(3), 468–491. doi:10.1108/CCSM-03-2017-0034

Cho, C. H. (2003). Factors influencing clicking of banner ads on the WWW. *Cyberpsychology & Behavior*, *6*(2), 201–215. doi:10.1089/109493103321640400 PMID:12804033

Choi, B., Lee, I., & Kim, J. (2006). Culturability in Mobile Data Services: A Qualitative Study of the Relationship between Cultural Characteristics and User-Experience Attributes. *International Journal of Human-Computer Interaction*, *20*(3), 171–203. doi:10.120715327590ijhc2003_2

Choi, J., & Geistfeld, L. V. (2004). A cross-cultural investigation of consumer e-shopping adoption. *Journal of Economic Psychology*, *25*(6), 821–838. doi:10.1016/j.joep.2003.08.006

Chopra, S., & Miendl, P. (2005). *Supply Chain Management* (3rd ed.). Pearson – Prentice Hall.

Chou, J., & Yang, J. (2012). Project management knowledge and effects on construction project outcomes: An empirical study. *Project Management Journal*, *43*(5), 47–67. doi:10.1002/pmj.21293

Chow, C. W., Deng, J., & Ho, J. L. (2000). The openness of knowledge sharing within organizations: A comparative study of the United States and the people's republic of china. *Journal of Management Accounting Research*, *12*(1), 65–95. doi:10.2308/jmar.2000.12.1.65

Clark, T. (1990). International marketing and national character: A review and proposal for an integrative theory. *Journal of Marketing*, *54*(4), 66–79. doi:10.1177/002224299005400406

Cockburn, A., & Highsmith, J. (2001). Agile Software Development: The People Factor. *Computer*, *34*(11), 131–133. doi:10.1109/2.963450

Collins, S. (2010). Corporate social responsibility and the future health care manager. *The Health Care Manager*, *29*(4), 339–345. doi:10.1097/HCM.0b013e3181fa050e PMID:21045586

Committee of Sponsoring Organizations of the Treadway Commission (COSO). (2007). *Gerenciamento de risco corporativo – estrutura integrada*. Recovered on January 26, 2011 from http://www.coso.org/documents/COSO_ERM_ExecutiveSummary_Portuguese.pdf

Connolly, T., & Thorn, B. K. (1999). Discretionary databases: Theory, data, and implications. In J. Fulk & C. Steinfield (Eds.), *Organizations and Communication Technology*. Newbury Park, CA: Sage Publications.

Consolandi, C., Phadke, H., Hawley, J. P., & Eccles, R. G. (2018). *Material ESG Outcomes and SDG Externalities: Evaluating the Health Care Sector's Contribution to the SDGs*. Available at SSRN 3277421.

Constant, D., Kiesler, S., & Sproull, L. (1994). What's mine is ours, or is it? A study of attitudes about information sharing. *Information Systems Research*, *5*(4), 400–421. doi:10.1287/isre.5.4.400

Constant, D., Sproull, L., & Kiesler, S. (1996). The kindness of strangers: The usefulness of electronic weak ties for technical advice. *Organization Science*, *7*(2), 119–135. doi:10.1287/orsc.7.2.119

Conte, F., Vitale, P., Vollero, A., & Siano, A. (2018). Designing a Data Visualization Dashboard for Managing the Sustainability Communication of Healthcare Organizations on Facebook. *Sustainability*, *10*(12), 4447. doi:10.3390u10124447

Conway, A. R., Cowan, N., & Bunting, M. F. (2001). The cocktail party phenomenon revisited: The importance of working memory capacity. *Psychonomic Bulletin & Review*, *8*(2), 608–611. doi:10.3758/BF03196169 PMID:11495122

Cook, M. P. (2006). Visual representations in science education: The influence of prior knowledge and cognitive load theory on instructional design principles. *Science Education*, *90*(6), 1073–1091. doi:10.1002ce.20164

Coop, R., Mishtal, A., & Arel, I. (2013). Ensemble learning in fixed expansion layer networks for mitigating catastrophic forgetting. *IEEE Transactions on Neural Networks and Learning Systems*, *24*(10), 1623–1634. doi:10.1109/TNNLS.2013.2264952 PMID:24808599

Corbitt, B. J., Thanasankit, T., & Yi, H. (2003). Trust and E-Commerce: A Study of Consumer Perception. *Electronic Commerce Research and Applications*, *2*(3), 203–215. doi:10.1016/S1567-4223(03)00024-3

Correa-Garcia, J. A., Garcia-Benau, M. A., & Garcia-Meca, E. (2018). CSR communication strategies of colombian business groups: An analysis of corporate reports. *Sustainability*, *10*(5), 1602. doi:10.3390u10051602

Corritore, C. L., Kracher, B., & Wiedenbeck, S. (2003). On-line trust: Concepts, evolving themes, a model. *International Journal of Human-Computer Studies*, *58*(6), 737–758. doi:10.1016/S1071-5819(03)00041-7

Cosgerove, V. (2011). *Smart Cities: Introducing the IBM city operations and management solutions*. IBM.

Coulom, R. (2007). Efficient Selectivity and Backup Operators in Monte-Carlo Tree Search. *Lecture Notes in Computer Science*, *4630*, 72–83. doi:10.1007/978-3-540-75538-8_7

Coupe, R. T., & Onodu, N. M. (1996). An empirical evaluation of the impact of CASE on developer productivity and software quality. *Journal of Information Technology*, *11*(2), 173–181. doi:10.1177/026839629601100207

Dalton, J. (2016). A guide to Scrum and CMMI: Improving agile performance with CMMI. CMMI Institute, 1-130.

Dapp, T. F., Slomka, L., & Hoffman, R. (2015). *Fintech reload-traditional banks as digital ecosystems*. Frankfurt am Main, Germany: Deutsche Bank Research.

Darus, F., Artini, E., Hamzah, C. K., & Yusoff, H. (2013). CSR web reporting: The influence of ownership structure and mimetic isomorphism. Procedia Economics and Finance, 7, 236-242.

Dasgupta, S., Paul, R., & Fuloria, S. (2011). Factors affecting behavioral intentions towards mobile banking usage: Empirical evidence from India. Romanian. *Journal of Marketing*, *6*(1), 6–28.

Davenport, T. H. (1998). Putting the enterprise into the enterprise system. *Harvard Business Review*, *76*(4). PMID:10181586

Davenport, T. H., & Prusak, L. (1998). *Working Knowledge: How Organizations Manage What They Know*. Boston: Harvard Business School Press.

Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly*, *13*(3), 319–340. doi:10.2307/249008

Davis, F., Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(3), 982–1003. doi:10.1287/mnsc.35.8.982

Davis, J. J. (1992). Ethic and Environmental Marketing. *Journal of Business Ethics*, *11*(2), 81–87. doi:10.1007/BF00872314

Dawes, S. S., & Pardo, T. A. (2002). Building collaborative digital government systems. In W. J. Melver & A. K. Elmagarmid (Eds.), *Advances in Digital Government: Technology, Human Factors and Policy*. Norwell, MA: Kluwer Academic Publishers. doi:10.1007/0-306-47374-7_16

Dawkins, J. (2004). Corporate responsibility: The communication challenge. *Journal of Communication Management*, *1*, 20–25.

Day, B., Ke-Zun, S. C., & Lovelock, L. (2009). *Climbing the ladder: CMMI level 3.* Paper presented at the IEEE International Enterprise Distributed Object Computing Conference, Auckland, New Zealand. 10.1109/EDOC.2009.29

de Fockert, J. W., Rees, G., Frith, C. D., & Lavie, N. (2001). The role of working memory in visual selective attention. *Science*, *291*(2), 1803–1806. doi:10.1126cience.1056496 PMID:11230699

Deb, M., & David, E. L. (2014). An empirical examination of customers' adoption of m-banking in India. *Journal of Marketing Intelligence & Planning*, *32*(4), 475–494. doi:10.1108/MIP-07-2013-0119

Deci, E. L., & Ryan, R. M. (1980). The empirical exploration of intrinsic motivational processes. *Advances in Experimental Social Psychology*, *13*, 39–80. doi:10.1016/S0065-2601(08)60130-6

Dellarocas, C. (2003). The digitization of word of mouth: Promise and challenges of online feedback mechanisms. *Management Science*, *49*(10), 1407–1424. doi:10.1287/mnsc.49.10.1407.17308

Detmer, D. E. (2003). Building the national health information infrastructure for personal health, health care services, public health, and research. *BMC Medical Informatics and Decision Making*, *3*(1), 1. doi:10.1186/1472-6947-3-1 PMID:12525262

Dezdar, S., & Ainin, S. (2011). Critical success factors for ERP implementation: Insights from a Middle-Eastern country. *Middle East Journal of Scientific Research*, *10*(6), 798–808.

Diamantopoulos, A., Riefler, P., & Roth, K. (2008). Advancing formative measurement models. *Journal of Business Research*, *58*(12), 1203–1218. doi:10.1016/j.jbusres.2008.01.009

DiehardIndian.com. (2012). Retrieved From: Http://Www.Diehardindian.Com/Entertain/Media.Php

Dinev, T., Bellotto, M., Hart, P., Russo, V., Serra, I., & Colautti, C. (2006). Internet users' privacy concerns and beliefs about government surveillance: An exploratory study of differences between Italy and the United States. *Journal of Global Information Management*, *14*(4), 57–93. doi:10.4018/jgim.2006100103

Dogtiev, A. (2019a). *App Revenues (2017).* Retrieved June 28, 2019, from https://www.businessofapps.com/data/app-revenues/

Dogtiev, A. (2019b). *Mobile App Advertising Rates (2018).* Retrieved June 28, 2019, from https://www.businessofapps.com/ads/research/mobile-app-advertising-cpm-rates/

Dong, H. S. (2009). A cross-national study of mobile internet services: A comparison of U.S. and Korean mobile internet users. *Journal of Global Information Management*, *17*(4), 29–54. doi:10.4018/jgim.2009070902

Donney, P. M., & Cannon, J. P. (1997). An Examination of the Nature of Trust in Buyer-Seller Relationships. *Journal of Marketing*, *61*, 35–51.

Dooley, K., Subra, A., & Anderson, J. (2001). Maturity and its impact on new product development project performance. *Research in Engineering Design*, *13*(1), 23–29. doi:10.1007001630100003

Doolin, B., Dillon, S., Thompson, F., & Corner, J. (2005). Perceived risk, the Internet shopping experience and online purchasing behavior: A New Zealand perspective. *Journal of Global Information Management*, *13*(2), 66–88. doi:10.4018/jgim.2005040104

Duan, L., & Binbasioglu, M. (2017). An ensemble framework for community detection. *Journal of Industrial Information Integration*, *5*, 1–5. doi:10.1016/j.jii.2017.01.001

Duan, L., & Xiong, Y. (2015). Big data analytics and business analytics. *Journal of Management Analytics*, *2*(1), 1–21. doi:10.1080/23270012.2015.1020891

Duan, L., & Xu, L. (2012). Business Intelligence for Enterprise Systems: A Survey. *IEEE Transactions on Industrial Informatics*, *8*(3), 679–687. doi:10.1109/TII.2012.2188804

Duan, L., Xu, L., Liu, Y., & Lee, J. (2009). Cluster-based Outlier Detection. *Annals of Operations Research*, *168*(1), 151–168. doi:10.100710479-008-0371-9

Duggan & Reichgelt. (2006). The Panorama of Information Systems Quality. In *Measuring Information Systems Delivery Quality* (pp. 1-27). Hershey, PA: Ideal Group Inc.

Du, S., Bhattacharya, C. B., & Sen, S. (2010). Maximizing Business Returns to Corporate Social Responsibility (CSR): The Role of CSR Communication International. *Journal of Management Reviews*, *12*(1), 8–19.

Dwivedi, Y. K., Wastell, D., Laumer, S., Henriksen, H. Z., Myers, M. D., Bunker, D., & Srivastava, S. C. (2015). Research on information systems failures and successes: Status update and future directions. *Information Systems Frontiers*, *17*(1), 143–157. doi:10.100710796-014-9500-y

Ebert, C., Murthy, B. K., & Jha, N. N. (2008). Managing risks in global software engineering: principles and practices. *Global Software Engineering, 2008. ICGSE 2008. IEEE International Conference on. IEEE, 2008*, 131-140. 10.1109/ICGSE.2008.12

Ebert, C. (2011). *Global software and IT: A guide to distributed development, projects, and outsourcing*. Wiley-IEEE Computer Society Press; doi:10.1002/9781118135105

Economic Times. (2013). India to Have 348 Million Internet Users by 2017: Cisco. *Economic Times.* Retrieved from: http://articles.economictimes.indiatimes.com/2013-06-04/news/39740674_1_traffic-internet-access-indian-mobile-data)

Edelman, G. M. (1987). *Neural Darwinism: The theory of neuronal group selection*. New York, NY: Basic Books.

Edwards, S. M., Li, H., & Lee, J. H. (2002). Forced exposure and psychological reactance: Antecedents and consequences of the perceived intrusiveness of pop-up ads. *Journal of Advertising*, *31*(3), 83–95. doi:10.1080/00913367.2002.10673678

Ein-Dor, P., Segev, E., & Orgad, M. (1993). The Effect of National Culture on IS: Implications for International Information Systems. *Journal of Global Information Management*, *1*(1), 33–44. doi:10.4018/jgim.1993010103

Einwiller, S., & Will, M. (2001). The role of reputation to engender trust in electronic markets. *Proceedings of the Fifth International Conference on Corporate Reputation, Identity, and Competitiveness*.

Elbeltagi, I., McBride, N., & Hardaker, G. (2005). Evaluating the factors affecting DSS usage by senior managers in local authorities in Egypt. *Journal of Global Information Management*, *13*(2), 42–65. doi:10.4018/jgim.2005040103

Elmaghraby. (2013). Security and Privacy in the Smart City. *6th Ajman International Urban Planning Conference, City and Security*, 1-7.

Eloff, M. W., & Von Solms, S. H. (2000). Information Security Management: An approach to combine process certification and product evolution. *Computers & Security*, *19*(8), 608–709. doi:10.1016/S0167-4048(00)08019-6

Elzamly, A., Hussin, B., & Salleh, N. (2016). Top Fifty Software Risk Factors and the Best Thirty Risk Management Techniques in Software Development Lifecycle for Successful Software Projects. *International Journal of Hybrid Information Technology*, *9*(6), 11–32. doi:10.14257/ijhit.2016.9.6.02

Eng, T.-Y., & Bogaert, J. (2010). Psychological and Cultural Insights into Consumption of Luxury Western Brands in India. *Journal of Customer Behaviour*, *9*(1), 55-75.

Esichaikul, V., & Janecek, P. (2009). A survey of e-banking performance in Thailand. *International Journal of Electronic Finance*, *3*(4), 354–373. doi:10.1504/IJEF.2009.028976

Esmer, Y. (2006). Globalization, Mcdonaldization and Values: Quo Vadis? *Comparative Sociology*, *5*(2), 183-202.

Espinosa-Curiel, I. E., Rodriguez-Jacobo, J., & Fernandez-Zepeda, J. A. (2013). A framework for evaluation and control of the factors that influence the software process improvement in small organizations. *Journal of Software: Evolution and Process*, *25*, 393–406.

Esrock, S. L., & Leichty, G. B. (1999). Corporate world-wide pages: Serving the news media and other publics. *Journalism & Mass Communication Quarterly*, *76*(3), 456–467. doi:10.1177/107769909907600304

Ester, P., Halman, L., de Moor, R., & de Moor, R. (1994). *The Individualizing Society: Value Change in Europe and North America*. Tilburg University Press Tilburg.

Estrin, D. & Sim, I. (2010). Open mHealth Architecture: An Engine for Health Care Innovation. *Science*, *330*(6005), 759-760.

Etter, M. (2013). Reasons for low levels of interactivity (non-) interactive CSR communication in twitter. *Public Relations Review*, *39*(5), 606–608. doi:10.1016/j.pubrev.2013.06.003

Etzioni, A. (2019). Cyber Trust. *Journal of Business Ethics*, *156*(1), 1–13. doi:10.100710551-017-3627-y

Europa.eu.Malta. (2016). Available from: https://europa.eu/european-union/about-eu/countries/member-countries/malta_en

European Commission. (2005). The new SME definition: User guide and model declaration. Enterprise and Industry Publications, 1-51.

European Commission. (2011). A renewed EU strategy 2011-14 for Corporate Social Responsibility. *European Commission*. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0681

Eurostat. (2019). Available from: http://ec.europa.eu/eurostat/statistics-explained/index.php/Unemployment_statistics

Everard, A., & Galletta, D. F. (2005). How presentation flaws affect perceived site quality, trust, and intention to purchase from an online store. *Journal of Management Information Systems*, *22*(3), 56–95. doi:10.2753/MIS0742-1222220303

Eysenbach, G. (2001). What is e-health? *Journal of Medical Internet Research*, *3*(2), e20. doi:10.2196/jmir.3.2.e20 PMID:11720962

Farooq, A. (2000). *Biologically inspired modular neural networks* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.

Fawcett, S. E., Fawcett, A. M., Watson, B. J., & Magnan, G. M. (2012). Peeking inside the black box: Toward an understanding of supply chain collaboration dynamics. *The Journal of Supply Chain Management*, *48*(1), 44–72. doi:10.1111/j.1745-493X.2011.03241.x

Fernández-Navarro, F., Gutiérrez, P. A., Hervás-Martínez, C., & Yao, X. (2013). Negative correlation ensemble learning for ordinal regression. *IEEE Transactions on Neural Networks*, *24*(11), 1836–1849. doi:10.1109/TNNLS.2013.2268279 PMID:24808616

Fiestas, I. (2011). Constraints to private investment in the poorest developing countries - A review of the literature. *Nathan*, 1-34.

Finney, S., & Corbett, M. (2007). ERP implementation: A compilation and analysis of critical success factors. *Business Process Management Journal*, *13*(3), 329–347. doi:10.1108/14637150710752272

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Fitzgerald, G., & Russo, N. L. (2005). The turnaround of the London ambulance service computer-aided despatch system (LASCAD). *European Journal of Information Systems*, *14*(3), 244–257. doi:10.1057/palgrave.ejis.3000541

Flavia'n, C., & Guinalı'u, M. (2006). Consumer trust, perceived security and privacy policy: Three basic elements of loyalty to a web site. *Industrial Management & Data Systems*, *106*(5), 601–620. doi:10.1108/02635570610666403

Flavian, C., Guinaliu, M., & Gurrea, R. (2006). The role played by perceived usability, satisfaction and consumer trust on website loyalty. *Information & Management*, *43*(1), 1–14. doi:10.1016/j.im.2005.01.002

Fodor, J. A. (1983). *The modularity of mind*. Cambridge, MA: MIT Press. doi:10.7551/mitpress/4737.001.0001

Fombrum, C., & Riel, C. V. (1997). The reputational landscape. *Corporate Reputation Review*, *1*(1), 5–14. doi:10.1057/palgrave.crr.1540008

Forcht, K. (1994). *Computer security management*. Boston, MA: Boyd & Fraser.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equations with unobservable variables and measurement error. *JMR, Journal of Marketing Research*, *18*(1), 39–50. doi:10.1177/002224378101800104

Fottler, M. D., & Blair, J. D. (2002). Introduction: new concepts in health care stakeholder management theory and practice. Health Care Management Review, 27(2).

Françoise, O., Bourgault, M., & Pellerin, R. (2009). ERP implementation through critical success factors' management. *Business Process Management Journal*, *15*(3), 371–394. doi:10.1108/14637150910960620

Friedman, T. L. (2005). *The World Is flat: A Brief History of the Twenty-first Century*. New York: Farrar, Straus and Giroux.

Fu, C., Wei, W., & Jiang, Z. (2013, September 14). *An Energy Balanced Algorithm of LEACH Protocol in WSN.* Retrieved from http://ijcsi.org/papers/IJCSI-10-1-1-354-359.pdf

Fukuyama, F. (1995). *Trust: The Social Virtues and the Creation of Prosperity*. New York: Free Press.

Ganesan, S. (1994). Determinants of long-term orientation in buyer-seller relationship. *Journal of Marketing*, *58*(2), 1–19. doi:10.1177/002224299405800201

Ganesh, L., & Arpita, M. (2010). Critical failure factors in enterprise resource planning implementation at Indian SME. *Asian Journal of Management Research*, *1*(1).

Gargeya, V. B., & Brady, C. (2005). Success and failure factors of adopting SAP in ERP system implementation. *Business Process Management Journal*, *11*(5), 501–516. doi:10.1108/14637150510619858

Garg, P. (2010). Critical failure factors for enterprise resource planning implementations in Indian retail organizations: An exploratory study. *Journal of Information Technology Impact*, *10*(1), 35–44.

Gatys, L. A., Ecker, A. S., & Bethge, M. (2015). *A neural algorithm of artistic style*. arXiv:1508.06576 [cs.CV]

Gefen, D. (2002). Reflections on the Dimensions of Trust and Trustworthiness among Online Consumers. *ACM SIGMIS Database*, *33*(3), 38–53. doi:10.1145/569905.569910

Gefen, D., & Heart, T. (2006). On the need to include national culture as a central issue in E-commerce trust beliefs. *Journal of Global Information Management*, *14*(4), 1–30. doi:10.4018/jgim.2006100101

Gefen, D., Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: An integrated model. *Management Information Systems Quarterly*, *27*(1), 51–90. doi:10.2307/30036519

Gefen, D., Straub, D. W., & Boudreau, M. C. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems*, *4*(7), 1–70.

Gehring, J., Lee, W., Kilgour, K., Lane, I. R., Miao, Y., Waibel, A., & Campus, S. V. (2013). *Modular combination of deep neural networks for acoustic modeling.* Paper presented at the 14th Annual Conference of the International Speech Communication Association, Lyon, France.

Gerpott, T., Thomas, S., & Weichert, M. (2013). Characteristics and mobile Internet use intensity of consumers with different types of advanced handsets: An exploratory empirical study of iPhone, Android and other web-enabled mobile users in Germany. *Telecommunications Policy*, *37*(4-5), 357–371. doi:10.1016/j.telpol.2012.04.009

Gerrard, P., & Cunningham, J. (2003). The diffusion of Internet banking among Singapore consumers. *International Journal of Bank Marketing*, *21*(1), 16–28. doi:10.1108/02652320310457776

Ghafoor, F., Shah, I. A., & Rashid, N. (2017). Issues in adopting agile methodologies in global and local software development: A systematic literature review protocol with preliminary results. *International Journal of Computers and Applications*, *160*(7), 37–41. doi:10.5120/ijca2017913092

Ghemawat, P., & Reiche, S. (2011). *National Cultural Differences and Multinational Business*. Retrieved from https://pdfs.semanticscholar.org/dbb7/0b0e14146d1a5a6c4c85bb815c25557849fa.pdf

Gheni, A. Y., Yusmadi, Y. J., Marzanah, A. J., & Norhayati, M. A. (2016). Factors affecting global virtual teams' performance in software projects. *Journal of Theoretical and Applied Information Technology*, *92*(1), 90–97.

Ghobadi, S., & Mathiassen, L. (2017). Risks to effective knowledge sharing in agile software teams: A model for assessing and mitigating risks. *Information Systems Journal*, *27*(6), 699–731. doi:10.1111/isj.12117

Ghose, A., Goldfarb, A., & Han, S. P. (2013). How is the mobile internet different? Search costs and local activities. *Information Systems Research*, *24*(3), 1–19. doi:10.1287/isre.1120.0453

Ghose, A., & Han, S. P. (2014). Estimating demand for mobile applications in the new economy. *Management Science*, *60*(6), 1470–1488. doi:10.1287/mnsc.2014.1945

Ghose, A., & Yang, S. (2009). An empirical analysis of search engine advertising: Sponsored search in electronic markets. *Management Science*, *55*(10), 1605–1622. doi:10.1287/mnsc.1090.1054

Gigler, B.-S. (2011). *Informational Capabilities - the Missing Link for the Impact of Ict on Development.* Available at SSRN: http://ssrn.com/abstract=2191594

Good, D. (1988). Individual, interpersonal relations and trust. In D. G. Gambetta (Ed.), *Trust* (pp. 131–185). New York: Blackwell.

Gorla, N., & Lin, S. (2010). Determinants of software quality: A survey of information systems project managers. *Information and Software Technology*, *52*(6), 602–610. doi:10.1016/j.infsof.2009.11.012

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, *91*(3), 481–510. doi:10.1086/228311

Grech, K., Podesta, M., Calleja, A., & Calleja, N. (2015). *Report on the Performance of the Maltese Health System*. Valletta, Malta: Ministry for Health and Energy.

Greenberg, R., Wong-On-Wing, B., & Lui, G. (2008). Culture and consumer trust in online businesses. *Journal of Global Information Management*, *16*(3), 26–44. doi:10.4018/jgim.2008070102

Grewal, D., Bart, Y., Spann, M., & Zubcsek, P. P. (2016). Mobile Advertising: A Framework and Research Agenda. *Journal of Interactive Marketing*, *34*, 3–14. doi:10.1016/j.intmar.2016.03.003

Griffith, D. A., Myers, M. B., & Harvey, M. G. (2006). An investigation of national culture's influence on relationship and knowledge resources in interorganizational relationships between Japan and the united states. *Journal of International Marketing*, *14*(3), 1–32. doi:10.1509/jimk.14.3.1

Gu, J., Lee, S., & Suh, Y. (2009). Determinants of behavioral intention to mobile banking. *Expert Systems with Applications*, *36*(9), 11605–11616. doi:10.1016/j.eswa.2009.03.024

Guo, G., Zhang, J., Thalmann, D., & Yorke-Smith, N. (2014). *ETAF: An extended trust antecedents framework for trust prediction.* Paper presented at the 2014 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2014), Beijing, China. 10.1109/ASONAM.2014.6921639

Guo, X., & Zhang, N. (2010). User attitude towards mandatory use of information systems: A Chinese cultural perspective. *Journal of Global Information Management*, *18*(4), 1–18. doi:10.4018/jgim.2010100101

Gupta, N. (2011). Globalization Does Lead to Change in Consumer Behavior: An Empirical Evidence of Impact of Globalization on Changing Materialistic Values in Indian Consumers and Its Aftereffects. *Asia Pacific Journal of Marketing and Logistics*, *23*(3), 251-269.

Gupta, P., & Kumar, P. R. (2000, March). The Capacity of Wireless Networks. *IEEE Transactions on Information Theory*, *IT-46*(2).

Gürhan-Canli, Z., & Maheswaran, D. (2000). Cultural Variations in Country of Origin Effects. *JMR, Journal of Marketing Research*, *37*(3), 309–317. doi:10.1509/jmkr.37.3.309.18778

Hagan, M. T., & Menhaj, M. B. (1994). Training feedforward networks with the marquardt algorithm. *IEEE Transactions on Neural Networks*, *5*(6), 989–993. doi:10.1109/72.329697 PMID:18267874

Hair, J. F. Jr, Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

Hair, J., Black, W., Babin, B., & Anderson, R. (2009). *Multivariate Data Analysis: A Global Perspective* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Halkias, G., & Kokkinaki, F. (2017). Schema strength, processing opportunity, and the rewarding nature of incongruity resolution in advertising. *International Journal of Advertising*, *36*(3), 415–438. doi:10.1080/02650487.2016.1169579

Ham, C. D., Lee, J., Hayes, J. L., & Bae, Y. H. (2019). Exploring sharing behaviors across social media platforms. *International Journal of Market Research*, *61*(2), 157–177. doi:10.1177/1470785318782790

Hammond, A. L. (2007). *The Next 4 Billion: Market Size and Business Strategy at the Base of the Pyramid*. Washington, DC: World Resources Institute, International Finance Corp.

Hampton-Sosa, W., & Koufaris, M. (2005). The Effect of Website Perceptions on Initial Trust in the Owner Company. *International Journal of Electronic Commerce*, *10*(1), 55–81. doi:10.1080/10864415.2005.11043965

Hanafizadeh, P., Keating, B., & Khedmatgozar, H. (2014). A systematic review of Internet banking adoption. *Telematics and Informatics*, *31*(3), 492–510. doi:10.1016/j.tele.2013.04.003

Han, W. M. (2014). Validating differential relationships between risk categories and project performance as perceived by managers. *Empirical Software Engineering*, *19*(6), 1956–1966. doi:10.100710664-013-9270-z

Harman, H. H. (1976). *Modern Factor Analysis*. New York: University of Chicago Press.

Harmoni, A. (2012). *Official website as a means of stakeholder dialogue on corporate social responsibility*. The International Conference on Eurasian Economies, Almaty, Kazakhstan.

Harrison, D. E., Strong, R., Sharp, Z. D., Nelson, J. F., Astle, C. M., Flurkey, K., ... Miller, R. A. (2009). Rapamycin fed late in life extends lifespan in genetically heterogeneous mice. *Nature*, *460*(7253), 392–395. doi:10.1038/nature08221 PMID:19587680

Harter, D. E., Slaughter, S. A., & Krishnan, M. S. (2000). Effects of process maturity on quality, cycle time, and effort in software product development. *Management*, *46*(4), 451–466.

Hart, S. L. (1997). *Beyond Greening: Strategies for Sustainable World*. Boston: Harvard Business Review.

Harvey, F. (1999). National Cultural Differences in Theory and Practice: Evaluating Hofstede's National Cultural Framework. *Information Technology & People*, *10*(2), 132–146. doi:10.1108/09593849710174986

Harwood, M. (2006). *Corporate Responsibility in Small States Like Malta: A Luxury Companies Can Ill Affords?* Msida, Malta: University of Malta, European Studies.

Hasan, H., & Ditsa, G. (1999). The impact of culture on the adoption of it: An interpretive study. *Journal of Global Information Management*, *7*(1), 5–15. doi:10.4018/jgim.1999010101

Hawking, P., Stein, A., & Foster, S. (2004, January). Revisiting ERP systems: benefit realization. In *System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on*. IEEE.

Hawkins, D., & Mothersbaugh, D. (2010). *Consumer Behavior: Building Marketing Strategy* (11th ed.). New York: McGraw-Hill/Irwin.

He, T., & Stankovic, J. (2003, June 11). SPEED: A stateless protocol for real-time communication in sensor networks. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/document/1203451/

Heinzelman, W. B., Chandrakasan, A. P., & Balakrishnan, H. (2000). *Energy-Efficient Communication Protocol for Wireless Microsensor Networks Processing of the Hawaii International Conference on System Science*. Retrieved from http://www.nhu.edu.tw/~cmwu/Lab/leach.pdf

Heinzelman, W. B., Chandrakasan, A. P., & Balakrishnan, H. (2002, October 7). *An Application-Specific Protocol Architecture for Wireless Microsensor Networks*. Retrieved from http://dl.acm.org/citation.cfm?id=2216028

Hendriks, P. (1999). Why Share Knowledge? The Influence of Ict on the Motivation for Knowledge Sharing. *Knowledge and Process Management*, *6*(2), 91-100.

Herbsleb, J. D., & Mockus, A. (2003). An empirical study of speed and communication in globally distributed software development. *Software Engineering. IEEE Transactions on Software Engineering*, *29*(6), 481–494. doi:10.1109/TSE.2003.1205177

Hernandez, J., & Mazzon, J. (2007). Adoption of internet banking: Proposition and implementation of an integrated methodology approach. *International Journal of Bank Marketing*, *25*(2), 72–88. doi:10.1108/02652320710728410

Higuera, R., & Haimes, Y. (1996). *Software risk management*. Pittsburgh, PA: Carnegie Mellon, Software Engineering Institute.

Hijazi, H., Alqrainy, S., & Muaidi, H., & KhdourIdentifyin, T. (2014). Causality relation between software projects Risk Factors. *International Journal of Software Engineering and Its Applications*, *8*(2), 51–58.

Hinkin, I. P. (1996). A review of scale development in the study of behavior in organizations. *Journal of Management*, *21*(5), 967–988. doi:10.1177/014920639502100509

Hinton, G. E., Osindero, S., & Teh, Y. W. (2006). A fast learning algorithm for deep belief nets. *Neural Computation*, *18*(7), 1527–1554. doi:10.1162/neco.2006.18.7.1527 PMID:16764513

Hofstede, G. (2015/2019). *What About India*. The Hofstede Center. Retrieved from: http://geert-hofstede.com/india.html

Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-related Values*. Beverly Hills, CA: Sage Publications.

Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-Related Values*. Beverly Hills, CA: Sage.

Hofstede, G. (1984). *Culture's consequences: international differences in work-related values*. Beverly Hills, CA: Sage Publications.

Hofstede, G. (2001). *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations across Nations* (2nd ed.). Thousand Oaks, CA: Sage.

Hofstede, G. H., & Hofstede, G. (2001). Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations across Nations. *Sage (Atlanta, Ga.)*.

Hofstede, G., & Bond, M. H. (1988). The Confucius connection from cultural roots to economic growth. *Organizational Dynamics*, *16*(4), 5–21. doi:10.1016/0090-2616(88)90009-5

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). *Cultures and organizations: Software of the mind. Revised and Expanded* (3rd ed.). New York: McGraw-Hill.

Hollands, R. G. (2008). Will the real smart city please stand up? *City*, *12*(3), 303–320. doi:10.1080/13604810802479126

Holmström, H., Conchúir, Ó. E., Ågerfalk, P. J., & Fitzgerald, B. (2006). *Global software development challenges: A case study on temporal, geographical and socio-cultural distance*. In International Conference on Global Software Engineering (ICGSE2006), Costão do Santinho, Florianópolis, Brazil. 10.1109/ICGSE.2006.261210

Hong, I. B. (2015). Understanding the consumer's online merchant selection process: The roles of product involvement, perceived risk, and trust expectation. *International Journal of Information Management*, *35*(3), 322–336. doi:10.1016/j.ijinfomgt.2015.01.003

Hong, I. B. (2018). Building Initial Trust in an Intermediary in B2C Online Marketplaces: The Korean Evidence from Interpark.com. *Journal of Global Information Management*, *26*(2), 27–47. doi:10.4018/JGIM.2018040102

Hong, I. B. (2019). Understanding and Predicting Behavioral Intention to Adopt Mobile Banking: The Korean Experience. *Journal of Global Information Management*, *27*(3), 182–202. doi:10.4018/JGIM.2019070110

Hong, I. B., & Cho, H. (2011). The impact of consumer trust on attitudinal loyalty and purchase intentions in B2C e-marketplaces: Intermediary trust vs. seller trust. *International Journal of Information Management*, *31*(5), 469–479. doi:10.1016/j.ijinfomgt.2011.02.001

Hong, W., Thong, J. Y. L., & Tam, K. Y. (2004). Does animation attract online users' attention? The effects of flash on information search performance and perceptions. *Information Systems Research*, *15*(1), 60–86. doi:10.1287/isre.1040.0017

Hong, W., Thong, J., Wong, W., & Tam, K. (2001). Determinants of user acceptance of digital libraries: An empirical examination of individual differences and system characteristics. *Journal of Management Information Systems*, *18*(3), 97–124. doi:10.1080/07421222.2002.11045692

Hooghiemstra, R. (2000). Corporate communication and impression management – New perspectives why companies engage in corporate social reporting. *Journal of Business Ethics*, *27*(1/2), 55–68. doi:10.1023/A:1006400707757

Hoque, A., & Lohse, G. L. (1999). An information search cost perspective for designing interfaces for electronic commerce. *JMR, Journal of Marketing Research*, *36*(3), 387–394. doi:10.1177/002224379903600307

Hossain, M. S., Yahya, S. B., Rahman, S., Sobhani, F. A., & Rahman, R. (2019). Corporate Social Responsibility in Healthcare: A case of Islamic Banks (IBs) in Bangladesh. *Bangladesh Journal of Medical Science*, *18*(3), 567–573. doi:10.3329/bjms.v18i3.41627

Hsu, C. L., & Lin, J. C. C. (2008). Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & Management*, *45*(1), 65–74. doi:10.1016/j.im.2007.11.001

Hsu, P. F., Yen, H. R., & Chung, J. C. (2015). Assessing ERP post-implementation success at the individual level: Revisiting the role of service quality. *Information & Management*, *52*(8), 925–942. doi:10.1016/j.im.2015.06.009

Huang, Q., Davison, R. M., & Gu, J. (2008). Impact of personal and cultural factors on knowledge sharing in China. *Asia Pacific Journal of Management*, *25*(3), 451–471. doi:10.100710490-008-9095-2

Humphrey, W. (1989). *Managing the Software Process*. Reading, MA: Addison-Wesley.

Hung, S. Y., Durcikova, A., Lai, H. M., & Lin, W. M. (2011). The influence of intrinsic and extrinsic motivation on individuals' knowledge sharing behaviour. *Journal of Human-Computer Studies*, *69*(6), 415–427. doi:10.1016/j.ijhcs.2011.02.004

Hung, S. Y., Lai, H. M., & Chang, W. W. (2011). Knowledge-sharing motivations affecting R&D employees' acceptance of electronic knowledge repository. *Behaviour & Information Technology*, *30*(2), 213–230. doi:10.1080/0144929X.2010.545146

Hung, S., Kang, T., Yen, D., Huang, A., & Chen, K. (2012). A cross-cultural analysis of communication tools and communication outcomes. *Journal of Global Information Management*, *20*(3), 55–83. doi:10.4018/jgim.2012070103

Husted, K., & Michailova, S. (2002). Diagnosing and fighting knowledge-sharing hostility. *Organizational Dynamics*, *31*(1), 60–73. doi:10.1016/S0090-2616(02)00072-4

Hwang, C., Hsiao, B. H. G., & Chern, C. C. (2016). Multiphase assessment of project risk interdependencies: Evidence from a university ISD Project in Taiwan. *Project Management Journal*, *47*(1), 59–75. doi:10.1002/pmj.21563

Ibef.org. (2016). Available from: http://www.ibef.org/industry/healthcare-india.aspx

ICC Center (IC3). (2018). *2018 Internet Crime Report*. Retrieved from https://www.ic3.gov/media/annualreport/2018_IC3Report.pdf

IMF. (2014). *Gross Domestic Product Based on Purchasing-Power-Parity Share of World Total*. International Monetary Fund.

IMF. (2018). *Report for Selected Country Groups and Subjects (PPP valuation of country GDP).* IMF.

Independent. (2011). Flashy Fasion Grows as India's Rich Flaunt Wealth. *The Independent.* Retrieved from: http://www.independent.co.uk/life-style/flashy-fashion-grows-as-indias-rich-flaunt-wealth-2287713.html

Inglehart, R. (1997). *Modernization and Postmodernization: Cultural, Economic, and Political Change in 43 Societies*. Cambridge Univ Press.

Inkeles, A. (1998). *One World Emerging?: Convergence and Divergence in Industrial Societies*. Westview Press.

Institute of Automation, Chinese Academy of Sciences. (2002). *Database of human iris*. Retrieved from http:// www.cbsr.ia.ac.cn/english/IrisDatabase.asp

Intana, M., Chansa-ngavej, C., Changchit, C., & Satjawathee, T. (2013). Factors Encouraging the Internet Banking Adoption in Thailand. *International Journal of Electronic Finance*, *7*(3/4), 196–212. doi:10.1504/IJEF.2013.058602

Internet Live Statistics. (2019). Retrieved from http://www.internetlivestats.com/internet-users/india/

Internet World Stats. (2019). Retrieved from https://www.internetworldstats.com/asia/in.htm

Iqbal, J., Ahmad, R. B., Nasir, M. H. N., Niazi, M., Shamshirband, S., & Asim Noor, M. A. (2016). Software SMEs' unofficial readiness for CMMI_-based software process improvement. *Software Quality Journal*, *24*(4), 997–1023. doi:10.100711219-015-9277-3

Isaksen, S. G., & Ganlin, J. P. (2006). A reexamination of brainstorming research: Implication of research and practice. *Gifted Child Quarterly*, *49*(4), 315–329. doi:10.1177/001698620504900405

Islam, S. (2014). Systematic literature review: Security challenges of mobile banking and payments system. *International Journal of u- and e- Service. Science and Technology*, *7*(6), 107–116.

ISO/IEC. (2014). ISO/IEC 25000:2014. *International Standard*, 1-7.

Iversen, J., & Ngwenyama, O. (2005). Problems in measuring effectiveness in software process improvement: A longitudinal study of organizational change at Danske Data. *International Journal of Information Management*, *26*(1), 30–43. doi:10.1016/j.ijinfomgt.2005.10.006

Jagoda, K., & Samaranayake, P. (2017). An integrated framework for ERP system implementation. *International Journal of Accounting & Information Management*, *25*(1), 91–109. doi:10.1108/IJAIM-04-2016-0038

Jalali, S., & Wohlin, C. (2010, August). Agile practices in global software engineering-A systematic map. In *2010 5th IEEE International Conference on Global Software Engineering* (pp. 45-54). IEEE. 10.1109/ICGSE.2010.14

Jaruwachirathanakul, B., & Fink, D. (2005). Internet banking adoption strategies for a developing country: The case of Thailand. *Internet Research*, *15*(3), 295–311. doi:10.1108/10662240510602708

Jarvenpaa, S. L., Tractinsky, N., & Vitale, M. (2000). Consumer trust in an Internet store. *Information Technology Management*, *1*(1), 45–71. doi:10.1023/A:1019104520776

Jarvenpaa, S., & Todd, P. (1996). Consumer reaction to electronic shopping on the World Wide Web. *International Journal of Electronic Commerce*, *1*(2), 59–88. doi:10.1080/10864415.1996.11518283

Jeberson, W., & Singh, G. (2011). Analysis of Security Measure Implemented on G 2 C on-line payment systems in India. *MIT International Journal of Computer Science and Information Technology, 1*(1).

Jiacheng, W., Lu, L., & Francesco, C. A. (2010). A cognitive model of intra-organizational knowledge-sharing motivations in the view of cross-culture. *International Journal of Information Management*, *30*(3), 220–230. doi:10.1016/j.ijinfomgt.2009.08.007

Jiang, J. J., & Klein, G. (2000). Software development risks to project effectiveness. *Journal of Systems and Software*, *52*(1), 3–10. doi:10.1016/S0164-1212(99)00128-4

Jiang, Y., Xu, L., Wang, H., & Wang, H. (2009). Influencing Factors for Predicting Financial Performance based on Genetic Algorithms. *Systems Research and Behavioral Science*, *26*(6), 661–673. doi:10.1002res.967

Jin, C. H. (2017). The effect of psychological capital on start-up intention among young start-up entrepreneurs: A cross-cultural comparison. *Chinese Management Studies*, *11*(4), 707–729. doi:10.1108/CMS-06-2017-0162

Johansen, F., Loorbach, D., & Stoopendaal, A. (2018). Exploring a transition in Dutch healthcare. *Journal of Health Organization and Management*, *32*(7), 875–890. doi:10.1108/JHOM-07-2018-0185 PMID:30465486

Johnson, C. (2014). What Would Jesus Buy? New Website Helps Consumers Make Decisions Based on Biblical Values. *Desert News National.* Retrieved from http://national.deseretnews.com/article/1937/what-would-jesus-buy-new-website-helps-consumers-make-decisions-based-on-biblical-values.html

Joines, J., Scherer, C., & Scheufele, D. (2003). Exploring motivations for consumer Web use and their implications for e-commerce. *Journal of Consumer Marketing*, *20*(2), 90–108. doi:10.1108/07363760310464578

Jones, M., Marsden, G., Mohd-Nasir, N., Boones, K., & Buchanan, G. (1999). Improving web interaction on small displays. *Computer Networks*, *31*(11-16), 1129–1137. doi:10.1016/S1389-1286(99)00013-4

Jonides, J., Schumacher, E. H., Smith, E. E., Lauber, E. J., Awh, E., Minoshima, S., & Koeppe, R. (1997). Verbal working memory load affects regional brain activation as measured by PET. *Journal of Cognitive Neuroscience*, *9*(4), 462–475. doi:10.1162/jocn.1997.9.4.462 PMID:23968211

Kakabadse, N. K., & Rozuel, C. (2006). Meaning of corporate social responsibility in a local French hospital: A case study. *Society and Business Review*, *1*(1), 77–96.

Kally, F. P. (1994). On tariffs, Policing and Admission Control of Multi-Service Networks. *Operations Research Letters*, *15*(1), 1–9. doi:10.1016/0167-6377(94)90008-6

Kaltio, T., & Kinnula, A. (2000). Deploying the defined SW process. *Software Process Improvement and Practice*, *5*(1), 65–83. doi:10.1002/(SICI)1099-1670(200003)5:1<65::AID-SPIP112>3.0.CO;2-R

Kamal, M., Hackney, R., & Sarwar, K. (2013). Investigating factors inhibiting e-government adoption in developing countries: The context of Pakistan. *Journal of Global Information Management*, *21*(4), 77–102. doi:10.4018/jgim.2013100105

Kandel, E. R., Schwartz, J. H., & Jessell, T. M. (2000). *Principles of neural science* (4th ed.). New York, NY: McGraw-Hill.

Kane, M. J., & Engle, R. W. (2003). Working-memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to Stroop Interface. *Journal of Experimental Psychology. General*, *132*(1), 47–70. doi:10.1037/0096-3445.132.1.47 PMID:12656297

Kang, H., Lee, M., & Lee, J. (2012). Are you still with us? A study of the post-adoption determinants of sustained use of mobile-banking services. *Journal of Organizational Computing and Electronic Commerce*, *22*(2), 132–159. doi:10.1080/10919392.2012.667710

Kang, Y., O'Brien, W. J., & O'Connor, J. T. (2012). Analysis of information integration benefits drivers and implementation hindrances. *Automation in Construction*, *22*, 277–289. doi:10.1016/j.autcon.2011.09.003

Kankanhalli, A., Tan, B. C. Y., & Wei, K. K. (2005). Contributing knowledge to electronic knowledge repositories: An empirical investigation. *Management Information Systems Quarterly*, *29*(1), 113–143. doi:10.2307/25148670

Karahanna, E., Evaristo, J. R., & Srite, M. (2005). Levels of culture and individual behavior: An integrative perspective. *Journal of Global Information Management*, *13*(2), 1–20. doi:10.4018/jgim.2005040101

Karake-Shalhoub, Z., & Westport, C. T. (2002). *Trust and Loyalty in Electronic Commerce: An Agency Theory Perspective*. Quorum Books.

Kazi, A. K., & Mannan, M. A. (2013). Factors affecting adoption of mobile banking in Pakistan: Empirical evidence. *International Journal of Research in Business and Social Science*, *2*(3), 54–61.

Kelman, H. C. (1958). Compliance, identification, and internalization: Three processes of attitude change. *The Journal of Conflict Resolution*, *2*(1), 51–60. doi:10.1177/002200275800200106

Ketchen, D. J. Jr, & Shook, C. L. (1996). The application of cluster analysis in strategic management research: An analysis and critique. *Strategic Management Journal*, *17*(6), 441–458. doi:10.1002/(SICI)1097-0266(199606)17:6<441::AID-SMJ819>3.0.CO;2-G

Khalifa, M. (2013). Barriers to health information systems and electronic medical records implementation. A field study of Saudi Arabian hospitals. *Procedia Computer Science*, *21*, 335–342. doi:10.1016/j.procs.2013.09.044

Khaparde, V. M. (2012). Barriers of ERP while implementing ERP: A Literature Review. *Journal of Mechanical and Civil Engineering*, *3*(6), 49–91. doi:10.9790/1684-0364991

Kharagpur, I. I. T. (2008). Lesson 37: Basic ideas on CASE tools. Indian Institute of Technology, 1-6.

Khurana, M. K., Mishra, P. K., & Singh, A. R. (2011). Barriers to information sharing in supply chain of manufacturing industries. *International Journal of Manufacturing Systems*, *1*(1), 9–29. doi:10.3923/ijmsaj.2011.9.29

Kim, R. (2012). *What's working in mobile advertising and what might work in the future*. Retrieved June 27, 2019, from http://gigaom.com/2012/11/15/whats-working-in-mobile-advertising-and-what-might-work-in-the-future

Kim, D. J., Ferrin, D. L., & Rao, H. R. (2008). A trust-based consumer decision-making model in electronic commerce: The role of trust, perceived risk, and their antecedents. *Decision Support Systems*, *44*(2), 544–564. doi:10.1016/j.dss.2007.07.001

Kim, H., Gupta, S., & Jeon, Y. (2013). User Continuance intention towards mobile Internet service: The case of WIMAX in Korea. *Journal of Global Information Management*, *21*(4), 121–142. doi:10.4018/jgim.2013100107

Kim, J., Yuan, X., Kim, S., & Lee, Y. (2014). How perceived quality works in new technology adoption process: A cross-national comparison among China, Korea and Japan. *Journal of Global Information Management*, *22*(2), 23–47. doi:10.4018/jgim.2014040102

Kim, M. S., & Ahn, J. H. (2007). Management of trust in the e-marketplace: The role of the buyer's experience in building trust. *Journal of Information Technology*, *22*(2), 119–132. doi:10.1057/palgrave.jit.2000095

Kim, S., & Ferguson, M. A. T. (2018). Dimensions of effective CSR communication based on public expectations. *Journal of Marketing Communications*, *24*(6), 549–567. doi:10.1080/13527266.2015.1118143

Kim, S., Kwon, S.-H., Kam, T.-I., Panicker, N., Karuppagounder, S. S., Lee, S., ... Ko, H. S. (2019). Transneuronal Propagation of Pathologic α-Synuclein from the Gut to the Brain Models Parkinson's Disease. *Neuron*, *103*(4), 1–15. doi:10.1016/j.neuron.2019.05.035 PMID:31255487

Kim, Y., Lee, Z., & Gosain, S. (2005). Impediments to successful ERP implementation process. *Business Process Management Journal*, *11*(2), 158–170. doi:10.1108/14637150510591156

Kinra, N. (2006). The Effect of Country-of-Origin on Foreign Brand Names in the Indian Market. *Marketing Intelligence & Planning*, *24*(1), 15-30.

Kivrak, S., Arslan, G., Tuncan, M., & Birgonul, M. T. (2014). Impact of national culture on knowledge sharing in international construction projects. *Canadian Journal of Civil Engineering*, *41*(7), 642–649. doi:10.1139/cjce-2013-0408

Kjeldsko, J., & Paay, J. A. (2012). Longitudinal review of Mobile HCI research methods. In *the 15th international conference on Human-computer interaction with mobile devices and services*. ACM.

Kliem, R. (2004). Managing the risks of offshore IT development projects. *Information Systems Management*, *21*(3), 22–27. doi:10.1201/1078/44432.21.3.20040601/82473.4

Kluckhohn, C. (1951). *The Study of Culture*. Stanford, CA: Stanford University Press.

Ko, D., Kirsch, L. J., & King, W. R. (2005). Antecedents of knowledge transfer from consultants to clients in enterprise system implementations. *Management Information Systems Quarterly*, *29*(1), 59–85. doi:10.2307/25148668

Koenig-Lewis, N., Palmer, A., & Moll, A. (2010). Predicting young consumers' take up of mobile banking services. *International Journal of Bank Marketing*, *28*(5), 410–432. doi:10.1108/02652321011064917

Koh, S. C. L., Gunasekaran, A., & Rajkumar, D. (2008). ERP II: The involvement, benefits and impediments of collaborative information sharing. *International Journal of Production Economics*, *113*(1), 245–268. doi:10.1016/j.ijpe.2007.04.013

Koh, S. L., Gunasekaran, A., & Goodman, T. (2011). Drivers, barriers and critical success factors for ERPII implementation in supply chains: A critical analysis. *The Journal of Strategic Information Systems*, *20*(4), 385–402. doi:10.1016/j.jsis.2011.07.001

Koivumäki, T. (2001). Customer Satisfaction and Purchasing Behavior in a Web-based Shopping Environment. *Electronic Markets*, *11*(3), 186–192. doi:10.1080/101967801681008022

Kommeren, R., & Paiviainen, P. (2007). Philips experiences in global distributed software development. *Empirical Software Engineering*, *12*(6), 647–660. doi:10.100710664-007-9047-3

Koufaris, M., & Hampton-Sosa, W. (2004). The development of initial trust in an online company by new customers. *Information & Management*, *41*(3), 377–397. doi:10.1016/j.im.2003.08.004

Koyuncu, C., & Lien, D. (2003). E-commerce and consumer's purchasing behavior. *Applied Economics*, *35*(6), 721–725. doi:10.1080/0003684022000020850

Kraidy, M. (2002). Globalization of culture through the media. In J. R. Schement (Ed.), *Encyclopedia of Communication and Information* (Vol. 2, pp. 359–363). New York, NY: Macmillan.

Kroeber, A. L., & Parsons, T. (1958). The concept of culture and of social system. *American Sociological Review*, *23*(5), 582–583.

Kumar, V., Maheshwari, B., & Kumar, U. (2003). An investigation of critical management issues in ERP implementation: Empirical evidence from Canadian organizations. *Technovation*, *23*(10), 793–807. doi:10.1016/S0166-4972(02)00015-9

Kutsch, E., Denyer, D., Hall, M., & Lee-Kelley, E. (2013). Does risk matter? Disengagement from risk management practices in information systems projects. *European Journal of Information Systems*, *22*(6), 637–649. doi:10.1057/ejis.2012.6

Lane V., Khuntia J., Parthasarathy M., Hazarika B. (2017). The Impact of the Internet on Values: Shifts in Self-Enhancement and Self-Transcendence amongst Indian Youth. *Journal of Global Information Managemen*, *25*(3), 98-120.

Larrucea, X., O'Connor, R. V., Colomo-Palacios, R., & Laporte, C. Y. (2016). Software Process Improvement in Very Small Organizations. *IEEE Software*, *33*(2), 85–89. doi:10.1109/MS.2016.42

Lavie, N. (1995). Perceptual load as a necessary condition for selective attention. *Journal of Experimental Psychology. Human Perception and Performance*, *21*(3), 451–468. doi:10.1037/0096-1523.21.3.451 PMID:7790827

Lavie, N., Hirst, A., de Fockert, J. W., & Viding, E. (2004). Load theory of selective attention and cognitive control. *Journal of Experimental Psychology. General*, *133*(3), 339–354. doi:10.1037/0096-3445.133.3.339 PMID:15355143

Lavie, N., & Tsai, Y. (1994). Perceptual load as a major determinant of the locus of selection in visual attention. *Perception & Psychology*, *65*(2), 202–212. doi:10.3758/BF03194795 PMID:7971119

Lee, A. B. S., Chan, F. T. S., & Pu, X. (2018). Impact of supplier development on supplier's performance. *Industrial Management & Data Systems*, *118*(6), 1192–1208. doi:10.1108/IMDS-05-2017-0229

Lee, G., & Xia, W. (2005). The ability of information systems development project teams to respond to business and technology changes: A study of flexibility measures. *European Journal of Information Systems*, *14*(1), 75–92. doi:10.1057/palgrave.ejis.3000523

Lee, H., Zhang, Y., & Chen, K. (2013). An investigation of features and security in mobile banking strategy. *Journal of International Technology and Information Management*, *22*(4), 23–45.

Lee, I., Choi, B., Kim, J., & Hong, S. J. (2007). Culture-technology fit effects of cultural characteristics on the post-adoption beliefs of mobile Internet users. *International Journal of Electronic Commerce*, *11*(4), 11–51. doi:10.2753/JEC1086-4415110401

Lee, J., Shiue, Y., & Chen, C. (2016). Examining the impacts of organizational culture and top management support of knowledge sharing on the success of software process improvement. *Computers in Human Behavior*, *54*, 462–474. doi:10.1016/j.chb.2015.08.030

Lee, K., Tsai, M., & Lanting, M. (2011). From marketplace to marketspace: Investigating the customer switch to online banking. *Electronic Commerce Research and Applications*, *10*(1), 115–125. doi:10.1016/j.elerap.2010.08.005

Lee-Kelley, L., & Sankey, T. (2008). Global virtual teams for value creation and project success: A case study. *International Journal of Project Management*, *26*(1), 51–62. doi:10.1016/j.ijproman.2007.08.010

Lee, M., & Faber, R. J. (2007). Effects of product placement in online-games on brand memory: A Perspective of the limited-capacity model of attention. *Journal of Advertising*, *36*(4), 75–90. doi:10.2753/JOA0091-3367360406

Lee, O. K., & Baby, D. V. (2013). Managing dynamic risks in global it projects: Agile risk-management using the principles of service-oriented architecture. *International Journal of Information Technology & Decision Making*, *12*(6), 1121–1150. doi:10.1142/S0219622013400117

Lee, Y., Kozar, K., & Larsen, K. (2003). The technology acceptance model: Past, present, and future. *Communications of the Association for Information Systems*, *12*, 752–780. doi:10.17705/1CAIS.01250

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, *40*(3), 191–204. doi:10.1016/S0378-7206(01)00143-4

Leon, A. (2008). *Enterprise Resource Planning* (2nd ed.). New Delhi, India: MC-Graw-Hill.

Levitt, T. (1984, Summer). The Globalization of Markets. *The McKinsey Quarterly*, 1–20.

Lewin, K. (1951). Field theory in social science: selected theoretical papers (D. Cartwright, Ed.). Academic Press.

Lewis, C. C., & George, J. F. (2008). Cross-cultural deception in social networking sites and face-to-face communication. *Computers in Human Behavior*, *24*(6), 2945–2964. doi:10.1016/j.chb.2008.05.002

Lewis, J. R. (1995). IBM Computer Usability Satisfaction Questionnaire: Psychometric Evaluation and Instructions for Use. *International Journal of Human-Computer Interaction*, *7*(1), 57–78. doi:10.1080/10447319509526110

Liao, C., Chen, J. L., & Yen, D. C. (2007). Theory of planned behavior(TPB) and customer satisfaction in the continued use of e-service: An integrated model. *Computers in Human Behavior*, *23*(6), 2804–2822. doi:10.1016/j.chb.2006.05.006

Liao, L. F. (2008). Knowledge-sharing in R&D departments: A social power and social exchange theory perspective. *International Journal of Human Resource Management*, *19*(10), 1881–1895. doi:10.1080/09585190802324072

Liébana-Cabanillas, F., Alonso-Dos-Santos, M., Soto-Fuentes, Y., & Valderrama-Palma, V. A. (2016). Unobserved heterogeneity and the importance of customer loyalty in mobile banking. *Technology Analysis and Strategic Management*, *29*(9), 1015–1032. doi:10.1080/09537325.2016.1262021

Lientz, B. P., & Rea, K. P. (2003). *International project management*. San Diego, CA: Academic Press.

Li, F., Xu, L., Jin, C., & Wang, H. (2011a). Intelligent Bionic Genetic Algorithm (IB-GA) and Its Convergence. *Expert Systems with Applications*, *38*(7), 8804–8811. doi:10.1016/j.eswa.2011.01.091

Li, F., Xu, L., Jin, C., & Wang, H. (2011b). Structure of Multi-Stage Composite Genetic Algorithm (MSC-GA) and its Performance. *Expert Systems with Applications*, *38*(7), 8929–8937. doi:10.1016/j.eswa.2011.01.110

Li, F., Xu, L., Jin, C., & Wang, H. (2012). Random Assignment Method based on Genetic Algorithms and its Application in Resource Allocation. *Expert Systems with Applications*, *39*(15), 12213–12219. doi:10.1016/j.eswa.2012.04.055

Li, H., Wang, P., & Shen, C. (2018). Toward End-to-End Car License Plate Detection and Recognition With Deep Neural Networks. *IEEE Transactions on Intelligent Transportation Systems*, 1–11.

Li, J., Wang, K., & Xu, L. (2009). Chameleon based on Clustering Feature Tree and its Application in Customer Segmentation. *Annals of Operations Research*, *168*(1), 225–245. doi:10.100710479-008-0368-4

Lin, C. (2003). A critical appraisal of customer satisfaction and e-commerce. *Managerial Auditing Journal*, *18*(3), 202–212. doi:10.1108/02686900310469952

Lindley, J. T., Topping, S., & Lindley, L. T. (2008). The hidden financial costs of ERP software. *Managerial Finance*, *34*(2), 78–90. doi:10.1108/03074350810841277

Lindsay, S., Bellaby, P., Smith, S., & Baker, R. (2008). Enabling Healthy Choices: Is Ict the Highway to Health Improvement? *Health, 12*(3), 313-331.

Lin, H. (2011). An empirical investigation of mobile banking adoption - The effect of innovation attributes and knowledge-based trust. *International Journal of Information Management*, *31*(3), 252–260. doi:10.1016/j.ijinfomgt.2010.07.006

Lin, H. F. (2007). Effects of extrinsic and intrinsic motivation on employee knowledge sharing intentions. *Journal of Information Science*, *33*(2), 135–149. doi:10.1177/0165551506068174

Lin, T. C., Lai, M. C., & Yang, S. W. (2015). Factors influencing physicians' knowledge sharing on web medical forums. *Health Informatics Journal*. PMID:25888432

Lippert, S., & Volkmar, J. (2007). Cultural effects on technology performance and utilization: A comparison of U.S. and Canadian users. *Journal of Global Information Management*, *15*(2), 5–10. doi:10.4018/jgim.2007040103

Liu, C., Marchewka, J., Lu, J., & Yu, C. (2004). Beyond concern: A privacy–trust– behavioral intention model of electronic commerce. *Information & Management*, *42*(1), 127–142. doi:10.1016/j.im.2004.01.002

Liu, S., & Wang, L. (2014). Understanding the impact of risks on performance in internal and outsourced information technology projects: The role of strategic importance. *International Journal of Project Management*, *32*(8), 1494–1510. doi:10.1016/j.ijproman.2014.01.012

Liu, S., Zhang, J., Keil, M., & Chen, T. (2010). Comparing senior executive and project manager perceptions of IT project risk: A Chinese Delphi study. *Information Systems Journal*, *20*(4), 319–355. doi:10.1111/j.1365-2575.2009.00333.x

Liu, Y., & Shrum, L. (2002). What Is Interactivity and Is It Always Such a Good Thing? Implications of Definition, Person, and Situation for the Influence of Interactivity on Advertising Effectiveness. *Journal of Advertising*, *31*(4), 53–64. doi:10.1080/00913367.2002.10673685

Liu, Y., Tan, C.-H., & Sutanto, J. (2016). Selective Attention to Commercial Information Displays in Globally Available Mobile Application. *Journal of Global Information Management*, *24*(2), 18–38. doi:10.4018/JGIM.2016040102

Li, X., Hess, T. J., Mcnab, A. L., & Yu, Y. (2009). Culture and acceptance of global web sites: A cross-country study of the effects of national cultural values on acceptance of a personal web portal. *The Data Base for Advances in Information Systems*, *40*(4), 62–87. doi:10.1145/1644953.1644959

Logan, K. (2015). How uses and gratifications of smartphone apps affect attitudes toward in-app advertising. *Proceedings of the American Academy of Advertising Conference*, 168.

López, C., & Salmeron, J. L. (2012). Risks response strategies for supporting practitioners decision-making in software projects. *Procedia Technology*, *5*, 437–444. doi:10.1016/j.protcy.2012.09.048

Los Huertos, G. (2010). *End of Privacy- Herding Friendship in Starbucks*. Academic Press.

Lövehagen, N., & Bondesson, A. (2013). Evaluating sustainability of using ICT solutions in smart cities – methodology requirements. *Proceedings for ICT for Sustainability conference*, 184-191.

Luarn, P., & Lin, H. (2005). Toward an understanding of the behavioral intention to use mobile banking. *Computers in Human Behavior*, *21*(6), 873–891. doi:10.1016/j.chb.2004.03.003

Lu, B., Zhang, T., Wang, L., & Keller, L. R. (2016). Trust antecedents, trust and online microsourcing adoption: An empirical study from the resource perspective. *Decision Support Systems*, *85*, 104–114. doi:10.1016/j.dss.2016.03.004

Luo, L., He, Q., Xie, J., Yang, D., & Wu, G. (2017). Investigating the relationship between project complexity and success in complex construction projects. *Journal of Management Engineering*, *33*(2), 1–13.

Luo, X., Li, H., Zhang, J., & Shim, J. P. (2010). Examining multi-dimensional trust and multi-faceted risk in initial acceptance of emerging technologies: An empirical study of mobile banking services. *Decision Support Systems*, *49*(2), 222–234. doi:10.1016/j.dss.2010.02.008

Lu, S. T., Yu, S. H., Chang, D. S., & Su, S. C. (2013). Using the Fuzzy Linguistic Preference relation approach for assessing the importance of risk factors in a software development project. *Mathematical Problems in Engineering*. doi:10.1155/2013/376375

Ma, J., Meng, Y. D., Kwiatkowski, D. J., Chen, X., Peng, H., Sun, Q., ... Zhang, H. (2010). Mammalian target of rapamycin regulates murine and human cell differentiation through stat3/p63/jagged/notch cascade. *The Journal of Clinical Investigation*, *120*(1), 103–114. doi:10.1172/JCI37964 PMID:20038814

Malaquias, F. F., & Hwang, Y. (2016). Trust in mobile banking under conditions of information asymmetry: Empirical evidence from Brazil. *Information Development*, *32*(5), 1600–1612. doi:10.1177/0266666915616164

Malaquias, R. F., & Hwang, Y. (2019). Mobile banking use: A comparative study with Brazilian and U.S. participants. *International Journal of Information Management*, *44*, 132–140. doi:10.1016/j.ijinfomgt.2018.10.004

Mandler, G. (1982). The structure of value: Accounting for taste. In *Affect and Cognition: The 17th Annual Carnegie Symposium* (pp. 203-230). Hillsdale, NJ: Lawrence Erlbaum Associates.

Markus, M., & Soh, C. (2002). Structural influences on global E-commerce activity. *Journal of Global Information Management*, *10*(1), 5–12. doi:10.4018/jgim.2002010101

Martinsons, M. G., & Davison, R. (2007). Strategic decision making and support systems: Comparing American, Japanese and Chinese management. *Decision Support Systems*, *43*(1), 284–300. doi:10.1016/j.dss.2006.10.005

Marwah, A. K., Thakar, G., & Gupta, R. C. (2012). *Determinants of Supply Chain Performance in the Indian Manufacturing Organizations (Proposed Conceptual Model)*. Academic Press.

Masrek, M. N., Mohamed, I. S., Daud, N. M., & Omar, N. (2013). Technology trust and mobile banking satisfaction: A case of Malaysian consumers. *Procedia: Social and Behavioral Sciences*, *129*, 53–58. doi:10.1016/j.sbspro.2014.03.647

Mathwick, C., Malhotra, N., & Rigdon, E. (2001). Experiential value: Conceptualization, measurement and application in the catalog and Internet shopping environment. *Journal of Retailing*, *77*(1), 39–56. doi:10.1016/S0022-4359(00)00045-2

Matsumoto, D. (1994). *Psychology from a Cultural Perspective*. Brookes/Cole.

Mattila, A. S., & Enz, C. A. (2002). The role of emotions in service encounters. *Journal of Service Research*, *4*(4), 268–277. doi:10.1177/1094670502004004004

Mayer, E. (2016). *The Mind-Gut Connection: How the Hidden Conversation Within Our Bodies Impacts Our Mood, Our Choices, and Our Overall Health*. HarperCollins Publishers.

Mayer, R. C., & Davis, J. H. (1999). The effect of the performance appraisal system on trust for management: A field quasi-experiment. *The Journal of Applied Psychology*, *84*(1), 123–136. doi:10.1037/0021-9010.84.1.123

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of Management Review*, *20*(3), 709–734. doi:10.5465/amr.1995.9508080335

Mazrui, A. (1996). *Perspectives: The Muse of Modernity and the Quest for Development*. Academic Press.

McCoy, S., Everard, A., Polak, P., & Galletta, D. F. (2007). The effects of online advertising. *Communications of the ACM*, *50*(3), 84–88. doi:10.1145/1226736.1226740

McCoy, S., Loiacono, E., & Abitia, G. (2004). Cross Cultural Information Systems Research. *Journal of Global Information Technology Management*, *7*(4), 1–2. doi:10.1080/109719 8X.2004.10856381

McKnight, D. H., Cummings, L. L., & Chervany, N. L. (1998). Initial trust formation in new organizational relationships. *Academy of Management Review, 23*(3), 473-490.

McKnight, D. H., & Chervany, N. L. (2002). What Trust Means in E-Commerce Customer Relationships: An Interdisciplinary Conceptual Typology. *International Journal of Electronic Commerce*, *6*(2), 35–59. doi:10.1080/10864415.2001.11044235

McKnight, D. H., Choudhur, V., & Kacmar, C. (2002). Developing and validating trust measures for e-commerce: An Integrative Typology. *Information Systems Research*, *13*(3), 334–359. doi:10.1287/isre.13.3.334.81

McKnight, D. H., Choudhury, V., & Kacmar, C. (2002). The impact of initial consumer trust on intentions to transact with a Web site: A trust building model. *The Journal of Strategic Information Systems*, *11*(3-4), 297–323. doi:10.1016/S0963-8687(02)00020-3

McLuhan, M. (1962). *The Glutenberg Galaxy: The Making of the Typographic Man*. University of Toronto Press.

Melin, P., & Castillo, O. (2007). An intelligent hybrid approach for industrial quality control combining neural networks, fuzzy logic and fractal theory. *Information Sciences*, *177*(7), 1543–1557. doi:10.1016/j.ins.2006.07.022

Melin, P., Mancilla, A., Lopez, M., & Mendoza, O. (2007). A hybrid modular neural network architecture with fuzzy sugenointegration for timeseries forecasting. *Applied Soft Computing*, *7*(4), 1217–1226. doi:10.1016/j.asoc.2006.01.009

Melin, P., Mendoza, O., & Castillo, O. (2011). Face recognition with an improved interval type2 fuzzy logic sugeno integral and modular neural networks. *IEEE Transactions on Systems, Man, and Cybernetics. Part A, Systems and Humans*, *41*(5), 1001–1012. doi:10.1109/TSMCA.2010.2104318

Melin, P., Miramontes, I., & Prado-Arechiga, G. (2018). A hybrid model based on modular neural networks and fuzzy systems for classification of blood pressure and hypertension risk diagnosis. *Expert Systems with Applications*, *107*, 146–164. doi:10.1016/j.eswa.2018.04.023

Mentzer, J. T., Min, S., & Zacharia, Z. G. (2000). The nature of interfirm partnering in supply chain management. *Journal of Retailing*, *76*(4), 549–568. doi:10.1016/S0022-4359(00)00040-3

Merrilees, B., & Fry, M. (2003). E-trust: the influence of perceived interactivity on e-retailing users. *Marketing Intelligence & Planning, 21*(2), 123-128.

Middlemiss, N. (2003). Authentic not cosmetic: CSR as brand enhancement. *Journal of Brand Management*, *10*(4), 353–361. doi:10.1057/palgrave.bm.2540130

Mifsud, D. (2009). *The adoption of CSR reporting by Maltese enterprises: a survey*. Msida, Malta: University of Malta, Faculty of Economics, Management and Accountancy.

Mishra, A. K. (1996). Organizational responses to crisis: The centrality of trust. In R. M. K. T. R. Tyler (Ed.), *Trust in Organizations: Frontiers of Theory and Research* (pp. 261–287). Thousand Oaks, CA: Sage. doi:10.4135/9781452243610.n13

Mohan, A. (2001). *Corporate Citizenship: Perspectives from India. Journal of Corporate Citizenship*. doi:10.9774/GLEAF.4700.2001.su.00012

Møller, C. (2005). ERP II: A conceptual framework for next-generation enterprise systems. *Journal of Enterprise Information Management*, *18*(4), 483–497. doi:10.1108/17410390510609626

Molm, L. D. (1997). *Coercive power in social exchange*. Cambridge University Press. doi:10.1017/CBO9780511570919

Money, R. B., Gilly, M. C., & Graham, J. L. (1998). Explorations of National Culture and Word-of-Mouth Referral Behavior in the Purchase of Industrial Services in the United States and Japan. *Journal of Marketing*, *62*(4), 76–87. doi:10.1177/002224299806200406

Moon, J. W., & Kim, Y. G. (2001). Extending the TAM for a world-wide-web context. *Information & Management*, *38*(4), 217–230. doi:10.1016/S0378-7206(00)00061-6

Moore, R., Stammerjohan, C. A., & Coulter, R. R. (2005). Banner advertiser-web site context congruity and color effects on attention and attitudes. *Journal of Advertising*, *34*(2), 71–84. doi:10.1080/00913367.2005.10639189

Morsing, M., & Spence, L. J. (2019). Corporate social responsibility (CSR) communication and small and medium sized enterprises: The governmentality dilemma of explicit and implicit CSR communication. *Human Relations*.

Motwani, J., Akbulut, A. Y., Mohamed, Z. M., & Greene, C. L. (2008). Organisational factors for successful implementation of ERP systems. *International Journal of Business Information Systems*, *3*(2), 158–182. doi:10.1504/IJBIS.2008.016584

Muller, R., Geraldi, J., & Turner, J. (2011). Relationships between leadership and success in different types of project complexities. *IEEE Transactions on Engineering Management*, *59*(1), 77–90. doi:10.1109/TEM.2011.2114350

Muñoz-Leiva, F., Climent-Climent, S., & Liébana-Cabanillas, F. (2017). Determinants of intention to use the mobile banking apps: An extension of the classic TAM model. *Spanish Journal of Marketing-ESIC*, *21*(1), 25–38. doi:10.1016/j.sjme.2016.12.001

Nakatsu, R. T., & Iacovou, C. L. (2009). A comparative study of important risk factors involved in offshore and domestic outsourcing of software development projects: A two-panel Delphi study. *Information & Management*, *46*(1), 57–68. doi:10.1016/j.im.2008.11.005

Namahoot, K. S., & Laohavichien, T. (2015). An analysis of behavioral intention to use Thai internet banking with quality management and trust. *Journal of Internet Banking and Commerce*, *20*(3), 1–15.

Nasri, W., & Charfeddine, L. (2012). Factors affecting the adoption of Internet banking in Tunisia: An integration theory of acceptance model and theory of planned behavior. *The Journal of High Technology Management Research*, *23*(1), 1–14. doi:10.1016/j.hitech.2012.03.001

National Statistical Office. (2014). *The 2014 Household Survey on the Use of Information and Communication Technology*. Retrieved December 26, 2015, from http://web.nso.go.th/en/survey/ict/ data_ict/2014_Full%20Report.pdf

Nel, J., & Boshoff, C. (2014). An invariance analysis of online-mobile cross-channel evaluations in the banking industry. In *Proceeding of 13th International Conference WWW/Internet 2014* (pp. 307-314). Lisbon: IADIS Press.

Neves, S. M., da Silva, C. E. S., Salomon, V. A. P., da Silva, A. F., & Sotomonte, B. E. P. (2014). Risk management in software projects through Knowledge Management techniques: Cases in Brazilian Incubated Technology-Based Firms. *International Journal of Project Management*, *32*(1), 125–138. doi:10.1016/j.ijproman.2013.02.007

Newman, E. J., Stem, D. E. Jr, & Sprott, D. E. (2004). Banner advertisement and web site congruity effects on consumer web site perceptions. *Industrial Management & Data Systems*, *104*(3), 273–281. doi:10.1108/02635570410525816

Nfuka, E. N., & Rusu, L. (2010). Critical success factors for effective IT governance in the public sector organizations in a developing country: The case of Tanzania. *Proceedings of the 18th European Conference on Information Systems (ECIS)*, 7-9.

Ngai, E. W., Law, C. C., & Wat, F. K. (2008). Examining the critical success factors in the adoption of enterprise resource planning. *Computers in Industry*, *59*(6), 548–564. doi:10.1016/j.compind.2007.12.001

NGT. (2008). Global Youth Panel. *NGT*. Retrieved from www.nextgreatthing.com

Niazi, M., & Babar, M. A. (2009). Identifying high perceived value practices of CMMI level 2: An empirical study. *Information and Software Technology*, *51*(8), 1231–1243. doi:10.1016/j.infsof.2009.03.001

Niazi, M., Babar, M. A., & Verner, J. M. (2010). Software process improvement barriers: A cross-cultural comparison. *Information and Software Technology*, *52*(11), 1204–1216. doi:10.1016/j.infsof.2010.06.005

Nicolás, J., De Gea, J. M. C., Nicolás, B., Fernández-Alemán, J. L., & Toval, A. (2018). On the risks and safeguards for requirements engineering in global software development: Systematic literature review and quantitative assessment. *IEEE Access: Practical Innovations, Open Solutions*, *6*, 59628–59656. doi:10.1109/ACCESS.2018.2874096

Niederman, F., Alhorr, H., Park, Y., & Tolmie, C. (2012). Global information management research: What have we learned in the past decade? *Journal of Global Information Management*, *20*(1), 18–56. doi:10.4018/jgim.2012010102

Nielsen, J. (1999). *Trust or Bust: Communicating Trustworthiness in Web Design*. Academic Press.

Nisha, N., Iqbal, M., & Rifat, A. (2019). The Changing Paradigm of Health and Mobile Phones: An Innovation in the Health Care System. *Journal of Global Information Management*, *27*(1), 19–46. doi:10.4018/JGIM.2019010102

Noll, J., Beecham, S., & Richardson, I. (2010). Global software development and collaboration: Barriers and solutions. *ACM Inroads*, *1*(3), 66–78. doi:10.1145/1835428.1835445

Norris, P. (2001). *Digital Divide: Civic Engagement, Information Poverty, and the Internet Worldwide*. New York: Cambridge University Press. doi:10.1017/CBO9781139164887

NS-2. (n.d.). *A Network Simulator System Version 2*. Retrieved from https://www.isi.edu/nsnam/ns/

Nunnally, J., & Bernstein, I. (1994). *Psychometric Theory* (3rd ed.). New York: McGraw-Hill.

Nurdiani, I., Jabangwe, R., Smite, D., & Damian, D. (2011, August). Risk identification and risk mitigation instruments for global software development: Systematic review and survey results. In *Global Software Engineering Workshop (ICGSEW), 2011 Sixth IEEE International Conference on* (pp. 36-41). IEEE. 10.1109/ICGSE-W.2011.16

Obeidat, B. Y., Masa'deh, R., Al-Suradi, M., & Tarhini, A. (2016). The Impact of Knowledge Management on Innovation: An Empirical Study on Jordanian Consultancy Firms. *Management Research Review*, *39*(12), 25–40.

Odendaal, N. (2003). Information and Communication Technology and local Governance: Understanding the difference between cities in developed and emerging economies. *Computers, Environment and Urban Systems*, *27*(6), 585–607. doi:10.1016/S0198-9715(03)00016-4

Odzaly, E. E., Greer, D., & Stewart, D. (2018). Agile risk management using software agents. *Journal of Ambient Intelligence and Humanized Computing*, *9*(3), 823–841. doi:10.100712652-017-0488-2

Office of Government Commerce (OGC). (2005). *Managing successful projects with Prince2* (4th ed.). London: The Stationery Office.

Oktay, O., Ferrante, E., Kamnitsas, K., Heinrich, M., Bai, W., Caballero, J., ... Rueckert, D. (2018). Anatomically Constrained Neural Networks (ACNNs): Application to Cardiac Image Enhancement and Segmentation. *IEEE Transactions on Medical Imaging*, *37*(2), 384–395. doi:10.1109/TMI.2017.2743464 PMID:28961105

Oliveira, T., Faria, M., Thomas, M. A., & Popovič, A. (2014). Extending the understanding of mobile banking adoption: When UTAUT meets TTF and ITM. *International Journal of Information Management*, *34*(5), 689–703. doi:10.1016/j.ijinfomgt.2014.06.004

O'Mahony, M., & Vecchi, M. (2005). Quantifying the Impact of Ict Capital on Output Growth: A Heterogeneous Dynamic Panel Approach. *Economica*, *72*(288), 615-633.

O'Mahony, M., Robinson, C., & Vecchi, M. (2008). The Impact of ICT on the Demand for Skilled Labour: A Cross-Country Comparison. *Labour Economics*, *15*(6), 1435-1450.

Ongkasuwan, M., & Tantichattanon, W. (2002). A comparative study of internet banking in Thailand. *Proceedings of The First National Conference on Electronic Business*.

Organ, D. W., & Konovsky, M. (1989). Cognitive versus affective determinants of organizational citizenship behavior. *The Journal of Applied Psychology*, *74*(1), 157–164. doi:10.1037/0021-9010.74.1.157

Ou, C. X., Pavlou, P. A., & Davison, R. M. (2014). Swift Guanxi in online marketplaces: The role of computer-mediated communication technologies. *Management Information Systems Quarterly*, *38*(1), 209–230. doi:10.25300/MISQ/2014/38.1.10

Padmanabhan, M. (2012). Walmart's Struggles in India: How Institutional Contexts Can Limit Foreign Entry. *Journal of Communication, Culture & Technology*, *13*, 1.

Palvia, P. (2009). The role of trust in e-commerce relational exchange: A unified model. *Information and Management, 46*(4), 213-220.

Palvia, P. (1998). Research issues in global information technology management. *Information Resources Management Journal*, *11*(2), 27–36. doi:10.4018/irmj.1998040103

Pane, E. S., & Sarnob, R. (2015). Capability Maturity Model Integration (CMMI) for Optimizing Object-Oriented Analysis and Design (OOAD). *Procedia Computer Science*, *72*, 40–48. doi:10.1016/j.procs.2015.12.103

Pape, L., Gomez, F., Ring, M., & Schmidhuber, J. (2011). *Modular deep belief networks that do not forget*. Academic Press.

Parasuraman, A., & Zinkhan, G. (2002). Marketing to and serving customers through the Internet: An overview and research agenda. *Journal of the Academy of Marketing Science*, *30*(4), 286–295. doi:10.1177/009207002236906

Park, H.-J., & Friston, K. (2013). Structural and Functional Brain Networks: From Connections to Cognition. *Science*, *342*(6158), 1238411–1238411. doi:10.1126cience.1238411 PMID:24179229

Park, T., Shenoy, R., & Salvendy, G. (2008). Effective advertising on mobile phones: A literature review and presentation of results from 53 case studies. *Behaviour & Information Technology*, *27*(5), 355–373. doi:10.1080/01449290600958882

Parthasarathy, M., Lane, V., & Stansifer, M. (2015). A Time-Based Analysis of Changing Consumer Values in India. *Journal of Indian Business Research*, *7*(3), 271–291. doi:10.1108/JIBR-12-2014-0091

Pasha, M., Qaiser, G., & Pasha, U. (2018). A critical analysis of software risk management techniques in large scale systems. *IEEE Access: Practical Innovations, Open Solutions*, *6*, 12412–12424. doi:10.1109/ACCESS.2018.2805862

Passey, D., & Goodison, R. (2004). *The Motivational Effect of Ict on Pupils*. DfES Publications.

Pavlou, P. A., & Gefen, D. (2004). Building Effective Online Marketplaces with Institution-Based Trust. *Information Systems Research*, *15*(1), 37–59. doi:10.1287/isre.1040.0015

Payne, J. W. (1994). Think aloud: Insights into information processing. *Psychological Science*, *5*(5), 241–247. doi:10.1111/j.1467-9280.1994.tb00620.x

Pee, L. G., Kankanhalli, A., Ong, L. L., & Vu, M. K. (2010) Antecedents, and impact of knowledge management capability in public organizations. *2010 Pacific Asia Conference on Information Systems*, 713-724.

Peng, G. C., & Nunes, M. B. (2010). Barriers to the successful exploitation of ERP systems in Chinese state-owned enterprises. *International Journal of Business and Systems Research*, *4*(5), 596–620. doi:10.1504/IJBSR.2010.035077

Peng, J., Xiao, W., Peng, L., & Quan, J. (2014). An explorative study of the effectiveness of mobile advertising. *Proceedings of the 2014 Wuhan International Conference on e-Business*, 213–220.

Persson, J. S., Mathiassen, L., Boeg, J., Madsen, T. S., & Steinson, F. (2009). Managing risks in distributed software projects: An integrative framework. *IEEE Transactions on Engineering Management*, *56*(3), 508–532. doi:10.1109/TEM.2009.2013827

Petticrew, M., & Roberts, H. (2008). *Systematic reviews in the social sciences: A practical guide*. John Wiley & Sons.

Pikkarainen, T., Pikkarainen, K., Karjaluoto, H., & Pahnila, S. (2004). Consumer acceptance of online banking: An extension of the technology acceptance model. *Internet Research*, *14*(3), 224–235. doi:10.1108/10662240410542652

Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management*, *12*(4), 531–544. doi:10.1177/014920638601200408

Poonam, G., & Atul, G. (2013). An empirical study on critical failure factors for enterprise resource planning implementation in Indian retail sector. *Business Process Management Journal*, *19*(3), 496–514. doi:10.1108/14637151311319923

Pornpitakpan, C., & Francis, J. N. (2000). The Effect of Cultural Differences, Source Expertise, and Argument Strength on Persuasion: An Experiment with Canadians and Thais. *Journal of International Consumer Marketing*, *13*(1), 77–101. doi:10.1300/J046v13n01_06

Posey, C., Lowry, P. B., Roberts, T. L., & Ellis, T. S. (2010). Proposing the online community self-disclosure model: The case of working professionals in France and the U.K. who use online. *European Journal of Information Systems*, *19*(2), 181–19. doi:10.1057/ejis.2010.15

Posnock, S. (2004). Customer satisfaction up online. *American Demographics*, *26*(3), 16.

Prikladnicki, R., & Yamaguti, M. (2004). Risk management in global software development: a position paper. In *Third International Workshop on Global Software Development (GSD 2004) - 26th IEEE - International Conference on Software Engineering*, (pp. 18 – 20). Stevenage, UK: IEEE. 10.1049/ic:20040306

Pritchard, J. (1998). *Codes of ethics*. Elsevier Inc.

Project Management Institute (PMI). (2009). *Practice Standard for Project Risk Management*. Newton Square: PMI.

Project Management Institute (PMI). (2017). *PMBOK Guide – A guide to the Project Management Body of Knowledge* (6th ed). Newton Square: PMI.

Puncheva-Michelotti, P., Hudson, S., & Jin, G. (2018). Employer branding and CSR communication in online recruitment advertising. *Business Horizons*, *61*(4), 643–651. doi:10.1016/j.bushor.2018.04.003

Püschel, J., Mazzon, J. A., & Hernandez, J. M. C. (2010). Mobile banking: Proposition of an integrated adoption intention framework. *International Journal of Bank Marketing*, *28*(5), 389–409. doi:10.1108/02652321011064908

Putam, R. D. (1995). Tuning in, tuning out: The strange disappearance of social capital in America. *PS, Political Science & Politics*, *28*(4), 664–683. doi:10.1017/S1049096500058856

Quang, V. T., & Miyoshi, T. (2008, September 1). *Adaptive Routing Protocol with Energy Efficiency and Event Clustering for Wireless Sensor Networks*. Retrieved from http://search.ieice.org/bin/summary. php?id=e91-b92795

Radford, M. H., Mann, L., Ohta, Y., & Nakane, Y. (1991). Differences between Australian and Japanese students in reported use of decision processes. *International Journal of Psychology*, *26*(1), 35–52. doi:10.1080/00207599108246848

Raj, T., Shankar, R., & Suhaib, M. (2007). An ISM approach for modeling the enablers of flexible manufacturing system: The case of India. *International Journal of Production Research, 46*(24), 1-30.

Rajesh, K. S., Suresh, K. G., & Deshmukh, S. G. (2007). Interpretive Structural Modeling (ISM) of factors for improving competitiveness of SMEs. *International Journal of Productivity and Quality Management*, *2*(4), 423–440. doi:10.1504/IJPQM.2007.013336

Ram, J., Wu, M., & Tagg, R. (2014). Competitive advantage from ERP projects: Examining the role of key implementation drivers. *International Journal of Project Management*, *32*(1), 663–675. doi:10.1016/j.ijproman.2013.08.004

Ranjan, S., Jha, V. K., & Pal, P. (2016). Literature review on ERP implementation challenges. *International Journal of Business Information Systems*, *21*(3), 388–402. doi:10.1504/IJBIS.2016.074766

Rao, S. (2000). India's Rapidly Changing Consumer Markets. *Economic and Political Weekly*, 3570–3572.

Rashad, Y., & Noor, A. E. (2010). Security and Privacy issues as a potential risk for further E-Commerce Development. *International Conference on Information, Communication and Management*, 16.

Ravi, V., Shankar, R., & Tewari, M. K. (2005). Productivity Improvement of a Computer Hardware Supply Chain. *International Journal of Productivity and Performance Management*, *54*(4), 239–255. doi:10.1108/17410400510593802

Rechenber, I. (1971). *Optimierung technischer systeme nach prinzipien der biologischen evolution*. New York, NY: Springer Verlag.

Remington, K., Zolin, R., & Turner, R. (2009). A model of project complexity: Distinguishing dimensions of complexity from severity. *Proceedings of the 9th International Research Network of Project Management Conference*.

Remus, W. (1986). Graduate students as surrogates for managers in experiments on business decision making. *Journal of Business Research*, *14*(1), 19–25. doi:10.1016/0148-2963(86)90053-6

Richardson, I., & von Wangenheim, C. G. (2007). Why are small software organizations different? *IEEE Software*, *24*(1), 18–22. doi:10.1109/MS.2007.12

Richins, M. L. (1987). Media, Materialism, and Human Happiness. *Advances in Consumer Research*, *14*(1), 352-356.

Ring, P. S., & Van de Ven, A. H. (1994). Developing processes of cooperative inter-organizational relationships. *Academy of Management Review*, *19*(1), 90–118. doi:10.5465/amr.1994.9410122009

Robey, D., Farrow, D., & Franz, C. (1989). Group process and conflict in system development. *Management Science*, *35*(10), 1172–1189. doi:10.1287/mnsc.35.10.1172

Robinson, S. L. (1996). Trust and breach of the psychological contract. *Administrative Science Quarterly*, *41*(4), 574–599. doi:10.2307/2393868

Roca, J., Garcia, J., & De la Vega, J. (2009). The importance of perceived trust, security and privacy in online trading systems. *Information Management & Computer Security*, *17*(2), 96–113. doi:10.1108/09685220910963983

Rodríguez, A., Ortega, F., & Concepción, R. (2016). A method for the evaluation of risk in IT projects. *Expert Systems with Applications*, *45*, 273–285. doi:10.1016/j.eswa.2015.09.056

Rogers, E. M. (2010). *Diffusion of Innovations*. Simon and Schuster.

Rokeach, M. (1968). The Role of Values in Public Opinion Research. *Public Opinion Quarterly*, *32*(4), 547-559.

Rolim, C. O., Koch, F. L., Westphall, C. B., Werner, J., Fracalossi, A., & Salvador, G. S. (2010, February). A cloud computing solution for patient's data collection in health care institutions. In *eHealth, Telemedicine, and Social Medicine, 2010. ETELEMED'10. Second International Conference on* (pp. 95-99). IEEE. 10.1109/eTELEMED.2010.19

Rotchanakitumnuai, S., & Speece, M. (2003). Barriers to internet banking adoption: A qualitative study among corporate customers in Thailand. *International Journal of Bank Marketing*, *21*(6/7), 312–323. doi:10.1108/02652320310498465

Rouet, J. F., Voros, Z., & Pleh, C. (2012). Incidental learning of links during navigation: The role of visuo-spatial capacity. *Behaviour & Information Technology*, *31*(1), 71–81. doi:10.1080/0144929X.2011.604103

Rouf, I., Miller, R., Mustafa, H., Taylor, T., Oh, S., & Xu, W. (2010). Security and Privacy incredulities of in-car wireless networks: a tire pressure monitoring system case study. In *The 19th USENIX Conference on Security*. Berkeley, CA: USENIX Association.

Rouibah, K., & Hamdy, H. (2009). Factors affecting information communication technologies usage and satisfaction: Perspective from instant messaging in Kuwait. *Journal of Global Information Management*, *17*(2), 1–29. doi:10.4018/jgim.2009040101

Russo, R. D. F. S. M., Sbragia, R., & Abraham, S. O. Y. (2017). Unknown Unknowns in Innovative Projects: Early Signs Sensemaking. *BAR - Brazilian Administration Review*, *14*(3), 1–24. doi:10.1590/1807-7692bar2017170060

Ryan, R. M., & Deci, E. L. (2000). Self-Determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American Psychologist*, *55*(1), 68–78. doi:10.1037/0003-066X.55.1.68 PMID:11392867

Ryu, G., Lim, E. A. C., Tan, L. T. L., & Han, Y. J. (2007). Preattentive processing of banner advertisements: The role of modality, location and interface. *Electronic Commerce Research and Applications*, *6*(1), 6–18. doi:10.1016/j.elerap.2005.11.001

Sacconi, L. (2002). Impresa non profit: Efficienza, ideologia e codice etico. Modelli di Governo, Riforma del Welfare e Organizzazioni Non Profit. il Mulino.

Salehi, M., & Alipour, M. (2010). E-banking in emerging economy: Empirical evidence of Iran. *International Journal of Economic and Finance*, *2*(1), 201–209. doi:10.5539/ijef.v2n1p201

Samantra, C., Datta, S., Mahapatra, S. S., & Debata, B. R. (2016). Interpretive structural modelling of critical risk factors in software engineering project. *Benchmarking: An International Journal*, *23*(1), 2–24. doi:10.1108/BIJ-07-2013-0071

Samaria, F. S., & Harter, A. C. (1994). Parameterisation of a stochastic model for human face identification. In *Proceedings of the Second IEEE Workshop on Applications of Computer Vision* (Vol. 22, pp. 138-142). Los Alamitos, CA: IEEE Computer Society Press. 10.1109/ACV.1994.341300

Samuel, A. L. (1959). Some studies in machine learning using the game of checkers. *IBM Journal of Research and Development*, *3*(3), 210–229. doi:10.1147/rd.33.0210

Sanchez, D., Melin, P., Castillo, O., & Valdez, F. (2013). *Modular granular neural networks optimization with Multi-Objective Hierarchical Genetic Algorithm for human recognition based on iris biometric.* Paper presented at IEEE Congress on Evolutionary Computation, Cancun, Mexico. 10.1109/CEC.2013.6557646

Sánchez, D., Melin, P., & Castillo, O. (2017). Optimization of modular granular neural networks using a firefly algorithm for human recognition. *Engineering Applications of Artificial Intelligence*, *64*, 172–186. doi:10.1016/j.engappai.2017.06.007

Sarigiannidis, L., & Chatzoglou, P. D. (2014). Quality vs risk: An investigation of their relationship in software development projects. *International Journal of Project Management*, *32*(6), 1073–1082. doi:10.1016/j.ijproman.2013.11.001

Sarker, S., & Lee, A. S. (2003). Using a case study to test the role of three key social enablers in ERP implementation. *Information & Management*, *40*(8), 813–829. doi:10.1016/S0378-7206(02)00103-9

Satpathi, S., & Roy, O. (2011, June). The Impact of the Electronic Media on the Modern Indian Voter: A Study of the Post Liberalization Era. Global Media Journal, 1-29.

Sauser, B. J., Reilly, R. R., & Shenhar, A. J. (2009). Why projects fail? How contingency theory can provide new insights – A comparative analysis of NASA's Mars Climate Orbiter loss. *International Journal of Project Management*, *27*(7), 665–679. doi:10.1016/j.ijproman.2009.01.004

Scerri, S., Garg, L., Garg, R., Scerri, C., Xuereb, P., & Tomaselli, G. (2015). Understanding Human-Device Interaction patterns within the context of mobile nutrition. *The 2nd International Conference on Recent Advances in Engineering & Computational Sciences (RAECS 2015)*. 10.1109/RAECS.2015.7453410

Schaar, A. K., Calero Valdez, A., & Ziefle, M. (2012). *Social media for the ehealth context.* In V. Duffy (Ed.), *Advances in Human Aspects of Healthcare* (pp. 1928–1937). Communications, Systems Support and Healthcare Informatics.

Schmidt, R., Lyytinen, K., Keil, M., & Cule, P. (2001). Identifying software project risks: An international Delphi study. *Journal of Management Information Systems*, *17*(4), 5–36. doi:10.1080/07421222.2001.11045662

Schoorman, F. D., Mayer, R. C., & Davis, J. H. (2007). An integrative model of organizational trust: Past, present, and future. *Academy of Management Review*, *32*(2), 344–354. doi:10.5465/amr.2007.24348410

Schwartz, S. H. (1992). Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries. Advances in Experimental Social Psychology, 25(1), 1-65.

Schwartz, S. H., Melech, G., Lehmann, A., Burgess, S., Harris, M., & Owens, V. (2001). Extending the Cross-Cultural Validity of the Theory of Basic Human Values with a Different Method of Measurement. *Journal of Cross-Cultural Psychology*, *32*(5), 519-542.

Scott, W. A. (1965). *Values and organizations: A study of fraternities and sororities*. Chicago: Rank McNally.

Scuotto, V., Giudice, M. D., Holden, N., & Mattiacci, A. (2017). Entrepreneurial settings within global family firms: Research perspectives from cross-cultural knowledge management studies. *European Journal of International Management*, *11*(4), 469–489. doi:10.1504/EJIM.2017.085586

Sedighi, M., van Splunter, S., Brazier, F., van Beers, C., & Lukosch, S. (2016). Exploration of multi-layered knowledge sharing participation: The roles of perceived benefits and costs. *Journal of Knowledge Management*, *20*(6), 1247–1267. doi:10.1108/JKM-01-2016-0044

SEI. (2010). *CMMI for Development, Version 1.3*. Carnegie Mellon University, Software Engineering Institute, CMU/SEI-2010-TR-033.

Seni, G., & Elder, J. (2010). *Ensemble methods in data mining: Improving accuracy through combining predictions*. San Rafael, CA: Morgan & Claypool Publishers.

Serra, R. (1997). I codici etici nelle aziende. *De Qualitate*.

Shah, S. I. H., Khan, A. Z., Bokhari, R. H., & Raza, M. A. (2011). Exploring the Impediments of Successful ERP Implementation: A Case Study in a Public Organization. *International Journal of Business and Social Science*, *2*(22), 289–296.

Shameem, M., Kumar, R. R., Kumar, C., Chandra, B., & Khan, A. A. (2018). Prioritizing challenges of agile process in distributed software development environment using analytic hierarchy process. *Journal of Software: Evolution and Process*, *30*(11), e1979. doi:10.1002mr.1979

Shamir, R. (2005). Mind the gap: The commodification of corporate social responsibility. *Symbolic Interaction*, *28*(2), 229–253. doi:10.1525i.2005.28.2.229

Sharma, A. (2013). Even Animals Don't Behave Like That: India's Gang Rape Victim's Friends Recalls the Apathy of Police, Public after Deadly Attack. *The National Post.* Retrieved from: http://news.nationalpost.com/2013/01/04/even-animals-dont-behave-like-that-india-gang-rape-victims-friend-recalls-apathy-of-police-public-after-deadly-attack/

Sharma, A., Sengupta, S., & Gupta, A. (2011). Exploring risk dimensions in the Indian software industry. *Project Management Journal*, *42*(5), 78–91. doi:10.1002/pmj.20258

Sharma, S. K., & Sharma, M. (2019). Examining the role of trust and quality dimensions in the actual usage of mobile banking services: An empirical investigation. *International Journal of Information Management*, *44*, 65–75. doi:10.1016/j.ijinfomgt.2018.09.013

Shehzad, B., Awan, K. M., Lali, M. I. U., & Aslam, W. (2017). Identification of Patterns in Failure of Software Projects. *Journal of Information Science and Engineering*, *33*(6), 1465–1479. doi:10.6688/JISE.2017.33.6.5

Shen, G., & Ye, D. (2017). A Distance-based Spectral Clustering Approach with Applications to Network Community Detection. *Journal of Industrial Information Integration*, *6*, 22–32. doi:10.1016/j.jii.2017.02.005

Sherer, S. A., & Alter, S. (2004). Information system risks and risk factors: Are they mostly about information systems. *Communications of the Association for Information Systems*, *14*(2), 29–64.

Shim, S., Eastlick, M., Lotz, S., & Warrington, P. (2001). An online prepurchase intentions model: The role of intention to search. *Journal of Retailing*, *77*(3), 397–216. doi:10.1016/S0022-4359(01)00051-3

Shin, D. H., & Choo, H. (2012). Exploring cross-cultural value structures with smartphones. *Journal of Global Information Management*, *20*(2), 67–93. doi:10.4018/jgim.2012040104

Shokouhyar, S., Panahifar, F., Karimisefat, A., & Nezafatbakhsh, M. (2018). An information system risk assessment model: A case study in online banking system. *International Journal of Electronic Security and Digital Forensics*, *10*(1), 39–60. doi:10.1504/IJESDF.2018.089205

Shrivastava, S. V., & Rathod, U. (2015). Categorization of risk factors for distributed agile projects. *Information and Software Technology*, *58*, 373–387. doi:10.1016/j.infsof.2014.07.007

Siegel, S., & Castellan, N. J. Jr. (1988). *Nonparametric Statistics for the Behavioral Sciences*. New York: McGraw-HiU Book Company.

Silver, D., Huang, A., Maddison, C. J., Guez, A., Sifre, L., van den Driessche, G., ... Hassabis, D. (2016). Mastering the game of Go with deep neural networks and tree search. *Nature*, *529*(7587), 484–489. doi:10.1038/nature16961 PMID:26819042

Singh, L. P., Singh, S., & Pereira, N. M. (2010, July). Human risk factors in post-implementation phase of ERP in SMEs in India. In *Technology Management for Global Economic Growth (PICMET), 2010 Proceedings of PICMET'10* (pp. 1-11). IEEE.

Singh, M. D., Shankar, R., Narain, R., & Agarwal, A. (2003). An interpretive Structural Modeling of Knowledge Management in Engineering Industries. *Journal of Advanced Management Research*, *1*(1), 28–40. doi:10.1108/97279810380000356

Singh, N., Zhao, H., & Hu, X. (2003). Cultural adaptation on the web: A study of American companies' domestic and Chinese websites. *Journal of Global Information Management*, *11*(3), 63–80. doi:10.4018/jgim.2003070104

Singh, S., Srivastava, V., & Srivastava, R. (2010). Customer acceptance of mobile banking: A conceptual framework. SIES. *Journal of Management*, *7*(1), 55–64.

Sinha, K. (2014). Why Indian Billionaires Are So Bad at Charity. *The Times of India.*

Sirgy, M. J., Gurel-Atay, E., Webb, D., Cicic, M., Husic, M., Ekici, A., Herrmann, A., Hegazy, I., Lee, D.-J., & Johar, J. (2012). Linking Advertising, Materialism, and Life Satisfaction. *Social Indicators Research*, *107*(1), 79-101.

Šmite, D. (2006). Global software development projects in one of the biggest companies in Latvia: Is geographical distribution a problem? *Software Process Improvement and Practice*, *11*(1), 61–76. doi:10.1002pip.252

Smith, P. B., & Schwartz, S. H. (1997). Article. In W. Berry, C. Kagitcibasi, & M. H. Segall (Eds.), Handbook of Cross-Cultural Psychology: Vol. J. Values. Boston: Allyn & Bacon.

Soja, P. (2006). Success factors in ERP systems implementations: Lessons from practice. *Journal of Enterprise Information Management*, *19*(4), 418–433. doi:10.1108/17410390610678331

Soja, P. (2008). Examining the conditions of ERP implementations: Lessons learnt from adopters. *Business Process Management Journal*, *14*(1), 105–123. doi:10.1108/14637150810849445

Somers, T. M., & Nelson, K. G. (2004). A taxonomy of players and activities across the ERP project life cycle. *Information & Management*, *41*(3), 257–278. doi:10.1016/S0378-7206(03)00023-5

Sommerville, I. (2015). *Software Engineering*. Pearson Education.

Sonchan, P., & Ramingwong, S. (2014, May). Top twenty risks in software projects: A content analysis and Delphi study. In *Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), 2014 11th International Conference on* (pp. 1-6). IEEE. 10.1109/ECTICon.2014.6839820

Song, H. (2015). Customer adoption of mobile banking: An integration of TAM with trust and social influence. *Applied Mechanics and Materials*, (701-702), 1323–1327. doi:10.4028/www.scientific.net/AMM.738-739.1323

Sprott, D., Spangenberg, E., & Fisher, R. (2003). The importance of normative beliefs to the self-prophecy effect. *The Journal of Applied Psychology*, *88*(3), 423–431. doi:10.1037/0021-9010.88.3.423 PMID:12814292

Sripalawat, J., Thongmak, M., & Ngramyarn, A. (2011). M-banking in metropolitan Bangkok and a comparison with other countries. *Journal of Computer Information Systems*, *51*(3), 67–76.

Srite, M., & Karahanna, E. (2006). The role of espoused national cultural values in technology acceptance. *Management Information Systems Quarterly*, *30*(3), 679–704. doi:10.2307/25148745

Srite, M., Thatcher, J., & Galy, E. (2008). Does within-culture variation matter? An empirical study of computer usage. *Journal of Global Information Management*, *16*(1), 1–25. doi:10.4018/jgim.2008010101

Staff, J. (2013, Nov. 1). ABA survey: Popularity of mobile banking continues to climb. *Banking & Wealth Management, The Central New York Business Journal*.

Stancati, M., & Rana, P. (2014). Culture of Apathy Haunts India. *Wall Street Journal.* Retrieved From: http://blogs.wsj.com/indiarealtime/2013/04/16/culture-of-apathy-haunts-india/

Standish Group. (2015). *Chaos Report 2015*. Author.

Staples, M., & Niazi, M. (2008). Systematic review of organizational motivations for adopting CMM-based SPI. *Information and Software Technology*, *50*(7-8), 605–620. doi:10.1016/j.infsof.2007.07.003

Statista. (2015). *Usage of mobile banking apps worldwide in 2014*. Retrieved January 27, 2016, from http://www.statista.com/statistics/468943/usage-of-mobile-banking-apps-worldwide-by-country/

Statistica. (2019). Retrieved From: https://www.statista.com/statistics/268136/top-15-countries based-on-number-of-Facebook-users/

Steenkamp, J. B. E., Hofstede, F. T., & Wedel, M. (1999). A cross-national investigation into the individual and national cultural antecedents of consumer innovativeness. *Journal of Marketing*, *63*(2), 55–69. doi:10.1177/002224299906300204

Stone, A. A., Shiffman, S., Atienza, A. A., & Nebeling, L. (2007). *The science of real-time data capture: self-reports in health research*. Oxford, UK: Oxford University Press.

Straub, D., Keil, M., & Brenner, W. (1997). Testing the technology acceptance model across cultures: A three country study. *Information & Management*, *33*(1), 1–11. doi:10.1016/S0378-7206(97)00026-8

Straub, D., Loch, W., Aristo, R., Karahanna, E., & Strite, M. (2002). Toward a theory-based measurement of culture. *Journal of Global Information Management*, *10*(1), 13–23. doi:10.4018/jgim.2002010102

Strauss, A. L., & Corbin, J. M. (1998). *Basics of Qualitative Research* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Suanmali, S. (2015). Factors influencing the adoption of using mobile banking on smartphone: An empirical case study in Bangkok, Thailand. In L. Wang, S. Uesugi, I. H. Ting, K. Okuhara, & K. Wang (Eds.), *Multidisciplinary Social Networks Research, MISNC 2015. Communications in Computer and Information Science* (pp. 415–424). Berlin: Springer. doi:10.1007/978-3-662-48319-0_34

Subramanian, G. H., Jiang, J. J., Klein, G., Huang, S., & Bramanian, G. H. (2007). Software quality and IS project performance improvements from software development process maturity and IS implementation strategies. *Journal of Systems and Software*, *80*(4), 616–627. doi:10.1016/j.jss.2006.06.014

Sudhaman, P., & Thangavel, C. (2015). Effciency analysis of ERP projects – software quality perspective. *International Journal of Project Management*, *33*(4), 961–970. doi:10.1016/j.ijproman.2014.10.011

Sumner, M. (2000). Risk factors in enterprise-wide/ERP projects. *Journal of Information Technology*, *15*(4), 317–327. doi:10.1177/026839620001500407

Susanto, A., Lee, H., Zo, H., & Ciganek, A. (2013). Factors affecting Internet banking success: A comparative investigation between Indonesia and South Korea. *Journal of Global Information Management*, *21*(2), 72–95. doi:10.4018/jgim.2013040104

Su, W., Xu, X., Li, Y., Martínez-López, F. J., & Li, L. (2018). Technological Innovation: A Case Study of Mobile Internet Information Technology Applications in Community Management. *Journal of Global Information Management*, *26*(2), 193–203. doi:10.4018/JGIM.2018040109

Svilar, A., & Zupančič, J. (2016). User experience with security elements in Internet and mobile banking. *Organizacija*, *49*(4), 251–260. doi:10.1515/orga-2016-0022

Syed Ali Fathima, S. J., & Shankar, S. (2018). AR Using NUI Based Physical Therapy Rehabilitation Framework with Mobile Decision Support System: A Global Solution for Remote Assistance. *Journal of Global Information Management*, *26*(4), 36–51. doi:10.4018/JGIM.2018100103

TAM. (2015). *Tam Report 2015*. Retrieved From: Http://Www.Tamindia.Com/Webview.Php?Web=Ref_Pdf/Overview_Universe_Update_2015.Pdf

Tan, M. (1996). Software quality practice in Singapore: Is it adequate for today's global information systems? *Journal of Global Information Management*, *4*(4), 23–32. doi:10.4018/jgim.1996100103

Tao, Shi, & Liao. (2006, April 3). A hierarchical architecture for energy-efficient information dissemination in sensor networks. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/ document/1609892/

Tapp, R., Hesseldenz, J., & Kelley, G. (2003). The role of project acceptance in the successful PeopleSoft human resources management system implementation for the Kentucky community and technical college system. *AMCIS 2003 Proceedings*, Paper 172.

Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*, *6*(2), 144–176. doi:10.1287/isre.6.2.144

Techatassanasoontorn, A. A., Huang, H., Trauth, E., & Juntiwasarakij, S. (2011). Analyzing ICT and development: Thailand's path to the information economy. *Journal of Global Information Management*, *19*(1), 1–29. doi:10.4018/jgim.2011010101

Thailand Chapter of Internet Society. (2015). *History of the Internet in Thailand*. Retrieved December 26, 2015, from http://www.isoc-th.org/History_ITH.htm

Thamhain, H. (2013). Managing risks in complex projects. *Project Management Journal*, *44*(2), 20–35. doi:10.1002/pmj.21325

The World Bank. (2019a). Available from: http://data.worldbank.org/indicator/NY.GDP.MKTP.CD

The World Bank. (2019b). *Health Expenditure, Total (% of GDP).* Available from: http://data.worldbank.org/indicator/SH.XPD.TOTL.ZS

Thibaut, J. W., & Kelley, H. H. (1959). *The social psychology of groups*. New York: John Wiley.

Thripathy, B., & Mishra, J. (2000). Protective Measures in E-commerce to deal with security threats arising out of social issues – A framework. *International Journal of Computer Engineering and Technology*, *4*(1), 46–53.

Thussu, D. K. (2007). Themurdochization'of News? The Case of Star Tv in India. *Media, Culture & Society*, *29*(4), 593-611.

Tippins, M., & Sohi, R. (2003). IT competency and firm performance: Is organizational learning a missing link? *Strategic Management Journal*, *24*(8), 745–761. doi:10.1002mj.337

Tomaselli, G., Garg, L., Gupta, V., Xuereb, P. A., & Buttigieg, S. C. (2018). Corporate Social Responsibility Communication Research: State of the Art and Recent Advances. In Advances in Data Communications and Networking for Digital Business Transformation (pp. 272-305). IGI Global.

Tomaselli, G., Garg, L., Gupta, V., Xuereb, P., Buttigieg, S., & Vassallo, P. (2015). *Traditional Vs Interactive Technologies for Corporate Social Responsibility Communication in Health Care: A Study in Malta and India*. The 22nd EurOMA International Annual Conference (EurOMA 2015), Neuchâtel, Switzerland.

Tomaselli, G., Garg, L., Gupta, V., Xuereb, P. A., Buttigieg, S. C., & Vassallo, P. (2018). Healthcare Systems and Corporate Social Responsibility Communication: A Comparative Analysis Between Malta and India. *Journal of Global Information Management*, *26*(4), 52–66. doi:10.4018/JGIM.2018100104

Tomaselli, G., & Melia, M. (2014). The role of interactive technologies for CSR communication. *Journal of International Scientific Publications: Economy & Business*, *8*, 324–340.

Tomaselli, G., Melia, M., Garg, L., Gupta, V., Xuereb, P., & Buttigieg, S. (2016). Digital and traditional tools for communicating corporate social responsibility: A literature review. *International Journal of Business Data Communications and Networking*, *12*(2), 1–15. doi:10.4018/IJBDCN.2016070101

Torrecilla-Salinasa, C. J., Sedeñoa, J., Escalonaa, M. J., & Mejíasa, M. (2016). Agile,Web Engineering and Capability Maturity Model Integration: Asystematic literature review. *Information and Software Technology*, *71*, 92–107. doi:10.1016/j.infsof.2015.11.002

TRAI. (2013). *Highlights of Telecom Subscription Data*. New Delhi, India: Telecom Regulatory Authority of India.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence informed management knowledge by means of systematic review. *British Journal of Management*, *14*(3), 207–222. doi:10.1111/1467-8551.00375

Trauth, E., Quesenberry, J., & Huang, H. (2008). A multicultural analysis of factors influencing career choice for women in the information technology workforce. *Journal of Global Information Management*, *16*(4), 1–23. doi:10.4018/jgim.2008100101

Treasury, H. M. S. (2004). *The Orange Book: management of risk–principles and concepts*. London: HM Treasury.

Triandis, H. C. (1995). *Individualism and collectivism*. Boulder.

Trieu, H., & Kuzic, J. (2010). Change Management Strategies for the Successful Implementation of Enterprise Resource Planning Systems. *Proceedings of the Second International Conference on Knowledge and Systems Engineering*, 178-182.

Trochim, W. M. K. (2006). *Convergent and Discriminant Validity for Social Research Methods*. Retrieved from http://www.socialresearchmethods.net

Tsai, J. Y., Egelman, S., Cranor, L., & Acquisti, A. (2011). The effect of online privacy information on purchasing behavior: An experimental study. *Information Systems Research*, *22*(2), 254–268. doi:10.1287/isre.1090.0260

Twocircles.net. (2015). *Print Media Grows by 6.25%; Urdu at No. 3*. Retrieved From: Http://Twocircles.Net/2011dec30/Print_Media_Grows_625_Urdu_No_3.Html#.Vqtiubdf-Ja

Tyler, T. R., Lind, E. H., & Huo, Y. J. (2000). Cultural values and authority relations: The psychology of conflict resolution across cultures. *Psychology, Public Policy, and Law*, *6*(4), 1138–1163. doi:10.1037/1076-8971.6.4.1138

Umble, E. J., Haft, R. R., & Umble, M. M. (2003). Enterprise resource planning: Implementation procedures and critical success factors. *European Journal of Operational Research*, *146*(2), 241–257. doi:10.1016/S0377-2217(02)00547-7

Valentine, S., & Barnett, T. (2003). Ethics code, awareness, perceived ethical values, and organizational commitment. *Journal of Personal Selling & Sales Management*, *23*, 359–367.

Valvi, A. C., & West, D. C. (2015). Mobile applications (apps) in advertising: A grounded theory of effective uses and practices. In K. Kubacki (Ed.), *Ideas in marketing: Finding the new and polishing the old* (pp. 349–352). New York, NY: Springer International Publishing. doi:10.1007/978-3-319-10951-0_132

Van Noort, G., Antheunis, M. L., & Van Reijmersdal, E. A. (2012). Social Connections and the Persuasiveness of Viral Campaigns in Social Network Sites: Persuasive Intent as the Underlying Mechanism. *Journal of Marketing Communications*, *18*(1), 39–53. doi:10.1080/13527266.2011.620764

Van Someren, M. W., Barnard, Y. F., & Barnard, J. A. C. (1994). *The think aloud method: A practical guide to modelling cognitive process*. London, UK: Academic Press.

Van, D. S., & Wiering, M. A. (2012). Neural-fitted td-leaf learning for playing othello with structured neural networks. *IEEE Transactions on Neural Networks and Learning Systems*, *23*(11), 1701–1713. doi:10.1109/TNNLS.2012.2210559 PMID:24808066

Vasconcellos, F. J. S., Landre, G. B., Cunha, J. O. G., Oliveira, J. L., Ferreira, R., & Vincenzi, A. M. R. (2017). Approaches to strategic alignment of software process improvement: A systematic literature review. *Journal of Systems and Software*, *123*, 45–63. doi:10.1016/j.jss.2016.09.030

Vashisht, D., & Pillai, S. S. (2016). Are they really persuaded with the brand embedded in the game? Analyzing the effects of nature of game, brand prominence and game-product congruence. *Journal of Research in Interactive Marketing*, *10*(3), 249–264. doi:10.1108/JRIM-04-2015-0026

Vasisht, P., & Guiterrez, J. A. (2004). An investigation of revenue streams of New Zealand online content providers. *Journal of Global Information Management*, *12*(4), 75–88. doi:10.4018/jgim.2004100104

Venkataramana, Rao, Sekhar, & Preethi. (2016, December). *ICR based Protocol Hierarchy to increase Lifetime of Wireless Sensor Networks*. Retrieved from https://sites.google.com/site/ijcsis/vol-14-no-12-dec-2016

Venkataramana, Reddy, & Rao. (2016, April 5). *Secure Energy Tradeoffs with Low Power Consumption in Data Transmission in Wireless Sensor Networks*. Retrieved from http://www.arpnjournals. org/jeas/research_papers/rp_2016/ jeas_0416_3960.pdf

Venkataramana, Reddy, & Rao. (2017, October). *EEECARP: Efficient Energy Clustering Adaptive Routing Procedure for Wireless Sensor Networks*. Retrieved from https://www.igi-global.com/journal/journal-global-information-management/1070

Venkataramana, S., Prasad Reddy, P. V. G. D., & Krishna Rao, S. (2016, February). *Energy Optimization via Cluster Based Hierarchy (LEACH) in WSNs*. Paper presented at IEEE Sponsored 3rd International Conference on Electronics and Communication Systems (ICECS 2016).

Venkataramana, Sekhar, Desai, Chakravarthy, & Rao. (2019, January). *Efficient Time Reducing And Energy Saving Routing Algorithm for Wireless Sensor Networks*. Retrieved from https://iopscience.iop.org/article/10.1088/1742-6596/1228/1/012002/pdf

Venkatesh, V., & Davis, F. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204. doi:10.1287/mnsc.46.2.186.11926

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *Management Information Systems Quarterly*, *27*(3), 425–478. doi:10.2307/30036540

Venkatraman, S., & Fahd, K. (2016). Challenges and Success Factors of ERP Systems in Australian SMEs. *Systems*, *4*(2), 20. doi:10.3390ystems4020020

Verk, N., Golob, U., & Podnar, K. (2019). A Dynamic Review of the Emergence of Corporate Social Responsibility Communication. *Journal of Business Ethics*, 1–25.

Vermeren, I. (2013). *How Social Media is Changing the World.* Retrieved from https://www.brandwatch.com/2013/08/how-social-media-is-changing-our-world-infographic/

Verner, J. M., Brereton, O. P., Kitchenham, B. A., Turner, M., & Niazi, M. (2014). Risks and risk mitigation in global software development: A tertiary study. *Information and Software Technology*, *56*(1), 54–78. doi:10.1016/j.infsof.2013.06.005

Vijayasarathy, L. (2004). Predicting consumer intentions to use on-line shopping: The case for an augmented technology acceptance model. *Information & Management*, *41*(6), 747–762. doi:10.1016/j.im.2003.08.011

Vijayasarathy, L. R., & Butler, C. W. (2017). Choice of software development methodologies: Do organizational, project and team characteristics matter? *IEEE Software*, 86–94.

Villani, S. (2001). Impact of Media on Children and Adolescents: A 10-Year Review of the Research. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*(4), 392-401.

Visvanathan, Youn, & Deogun. (2005, May 20). Hierarchical data dissemination scheme for large scale sensor networks. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/document/1494949/

Vrhovec, S. L., Hovelja, T., Vavpotič, D., & Krisper, M. (2015). Diagnosing organizational risks in software projects: Stakeholder resistance. *International Journal of Project Management*, *33*(6), 1262–1273. doi:10.1016/j.ijproman.2015.03.007

Walford, G., Tucker, E., & Viswanathan, M. (2010). *The SAGE Handbook of Measurement*. London: SAGE Publications Ltd.

Walgenbach, P. (2001). The production of distrust by means of producing trust. *Organization Studies*, *22*(4), 693–714. doi:10.1177/0170840601224006

Walker, C. (2008). Six Seismic Shifts in Global Teen Culture. *Chief Marketer*. Retrieved from www.chiefmarketer.com

Wallace, L., Keil, M., & Rai, A. (2004). How software project risk affects project performance: An investigation of the dimensions of risk and an exploratory model. *Decision Sciences*, *35*(2), 289–321. doi:10.1111/j.00117315.2004.02059.x

Wang, J., & Wang, P. (2012). *A new MNN's training method with empirical study.* Paper presented at the Third Global Congress on Intelligent Systems, Wuhan, China. 10.1109/GCIS.2012.35

Wang, S., & Yao, X. (2010). *The Effectiveness of a New Negative Correlation Learning Algorithm for Classification Ensembles.* Paper presented at the 10th IEEE International Conference on Data Mining Workshops, Sydney, Australia. 10.1109/ICDMW.2010.196

Wang, S., Tang, K., & Yao, X. (2009). *Diversity exploration and negative correlation learning on imbalanced data sets.* Paper presented at the International Joint Conference on Neural Networks, Atlanta, GA. 10.1109/IJCNN.2009.5178836

Wang, P. (1985). *Fuzzy set and random set shadows*. Beijing, China: Beijing Normal University Press.

Wang, P., Li, Y., Fan, Z., & Feng, S. (2008). Methodological research for dynamic integration of modular neural networks sub-networks. *Journal of Systems Engineering and Electronics*, *30*(6), 1143–1147.

Wang, P., Xu, L., Zhou, S., Fan, Z., Li, Y., & Feng, S. (2010). A Novel Bayesian Learning Method for Information Aggregation in Modular Neural Networks. *Expert Systems with Applications*, *37*(2), 1071–1074. doi:10.1016/j.eswa.2009.06.104

Wang, P., Zhang, J., Guo, S., Tao, C., & Liu, X. (2016). *Methodological research on soft computing in optimization and control problems*. Wuhan, China: Hubei Science & Technology Press.

Wang, S. S., & Chou, H.-Y. (2019). Effects of game-product congruity on in-app interstitial advertising and the moderation of media-context factors. *Psychology and Marketing*, *36*(3), 229–246. doi:10.1002/mar.21174

Wang, S. W., Ngamsiriudom, W., & Hsieh, C.-H. (2015). Trust disposition, trust antecedents, trust, and behavioral intention. *Service Industries Journal*, *35*(10), 555–572. doi:10.1080/0264 2069.2015.1047827

Wang, X., Shao, H., & Luo, R. (1998). The distributed RBF neural network and its application in soft sensor. *Control Theory & Applications*, *15*(4), 558–563.

Wang, Y. (2006). *Intelligent control system. Changsha*. Hunan University Press.

Wansink, B. (2000). New Techniques to Generate Key Marketing Insights. *Marketing Research*, *12*(2), 28-36.

Warfield, J. W. (1974). Developing Interconnected Matrices in Structural Modeling. *IEEE Transactions on Systems, Man, and Cybernetics*, *4*(1), 51–81.

Wasko, M. M., & Farjaj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *Management Information Systems Quarterly*, *29*(1), 35–57. doi:10.2307/25148667

Watts, P., & Holme, R. (1999). *Corporate Social Responsibility: Meeting Changing Expectations*. Geneva: World Business Council for Sustainable Development.

Wei, C. C., & Chen, L. T. (2008). Developing Supply Chain Management System Evaluation Attributes Based on the Supply Chain Strategy. *Supply Chain, 95*.

Wei, Z. Z., & Hui, W. Z. (2003, September 3). Clustering routing algorithm using game-theoretic techniques for WSNs. *IEEE Xplore Document*. Retrieved from http://ieeexplore.ieee.org/document/1329151/

West, J., & Mace, M. (2010). Browsing as the killer app: Explaining the rapid success of Apple's iPhone. *Telecommunications Policy*, *34*(4–5), 270–286. doi:10.1016/j.telpol.2009.12.002

Weston, E. C. T. Jr. (2003). ERPII: The extended enterprise system. *Business Horizons*, *46*, 49–55. doi:10.1016/S0007-6813(03)00088-0

Wheeler, D., & Elkington, J. (2001). The end of the corporate social and environmental report? Or the advent of cybernetic sustainability reporting and communication. *Business Strategy and the Environment*, *10*(1), 1–14. doi:10.1002/1099-0836(200101/02)10:1<1::AID-BSE274>3.0.CO;2-0

Wilson, K. (2007). *What's new in Microsoft Project 2007? Advantages and benefits of upgrading from Microsoft Project 2000/2003 to Microsoft Project 2007*. Accessed on September 22, 2009. http://www.epmconnect.com/Project%20Professional%20Documents/What's%20New%20In%20Project%202007.pdf, 1-5.

Wong, B. (2006). The Different Views of Software Quality. In Measuring Information Systems Delivery Quality (pp. 55-88). Hershey, PA: Idea Group Inc. doi:10.4018/978-1-59140-857-4.ch003

Wong, A. C. P., Scarborough, H., Chau, P. Y. K., & Davison, R. M. (2005). Critical Failure Factors in ERP Implementation. *Proceedings of the 9th Pacific Asia Conference on Information Systems*.

Wong, Y., & Hsu, C. (2008). A confidence-based framework for business to consumer (B2C) mobile commerce adoption. *Personal and Ubiquitous Computing*, *12*(1), 77–84. doi:10.100700779-006-0120-5

Wu, J. H., Wang, Y. M., Chang-Chien, M. C., & Tai, W. C. (2002, January). An examination of ERP user satisfaction in Taiwan. In *System Sciences, 2002. Proceedings of the 35th Annual Hawaii International Conference on HICSS* (pp. 3072-3081). IEEE.

Wu, G., Hu, X., & Wu, Y. (2010). Effects of Perceived Interactivity, Perceived Web Assurance and Disposition to Trust on Initial Online Trust. *Journal of Computer-Mediated Communication*, *16*(1), 1–26. doi:10.1111/j.1083-6101.2010.01528.x

Yadav, A. (2016). Factors influencing the usage of mobile banking among customers. The IUP. *Journal of Brand Management*, *15*(4), 7–18.

Yadav, V., Adya, M., Sridhar, V., & Nath, D. (2009). Flexible global software development (GSD) antecedents of success in requirements analysis. *Journal of Global Information Management*, *17*(1), 1–31. doi:10.4018/jgim.2009010101

Yaghoubi, N., & Bahmani, E. (2010). Factors Affecting the Adoption of Online Banking an Integration of Technology Acceptance Model and Theory of Planned Behavior. *International Journal of Business and Management*, *5*(9), 159–165. doi:10.5539/ijbm.v5n9p159

Yan, G., He, W., Shi, H., & Rawat, D. B. (2014). Applying a bilingual model to mine e-commerce satisfaction sentiment. *Journal of Management Analysis*, *1*(4), 285–300.

Yang, K. (2010). The effects of technology self-efficacy and innovativeness on consumer mobile data service adoption between American and Korean consumers. *Journal of International Consumer Marketing*, *22*(2), 117–127. doi:10.1080/08961530903476147

Yan, Z., Wang, T., Chen, Y., & Zhang, H. (2016). Knowledge sharing in online health communities: A social exchange theory perspective. *Information & Management*, *53*(5), 643–653. doi:10.1016/j.im.2016.02.001

Yasin, S., Haseeb, K., & Qureshi, R. J. (2012). Cryptography based E-Commerce Security: A review. *International Journal of Computational Science*, *9*(1-2), 132–137.

Yenisey, M., Ozok, A., & Salvendy, G. (2005). Perceived security determinants in e-commerce among Turkish university students. *Behaviour & Information Technology*, *24*(4), 259–274. doi:10.1080/01449290420003209 92

Yoon, C. (2009). The effects of national culture values on consumer acceptance of e-commerce: Online shoppers in China. *Information & Management*, *46*(5), 294–301. doi:10.1016/j.im.2009.06.001

Young, D., Carr, H. H., & Rainer, R. K. Jr. (1999). Strategic implications of electronic linkages. *Information Systems Management*, *16*(1), 32–39. doi:10.1201/1078/43187.16.1.19990101/31159.5

Yu, C. S. (2014). Consumer switching behavior from online banking to mobile banking. *International Journal of Cyber Society and Education*, *7*(1), 1–28. doi:10.7903/ijcse.1108

Yu, C., & Chantatub, W. (2015). Consumers' resistance to using mobile banking: Evidence from Thailand and Taiwan. *International Journal of Electronic Commerce Studies*, *7*(1), 21–38. doi:10.7903/ijecs.1375

Yu, M. (2014). Examining the effect of individualism and collectivism on knowledge sharing intention. *Chinese Management Studies*, *8*(1), 149–166. doi:10.1108/CMS-06-2011-0037

Zanjani, S., Diamond, W., & Chan, K. (2011). Does ad context congruity help surfers and information seekers remember ads in cluttered e-magazines. *Journal of Advertising*, *40*(4), 67–83. doi:10.2753/JOA0091-3367400405

Zazelenchuk, T. W., & Boling, E. (2003). Considering User Satisfaction in Designing Web-based Portals. *EDUCAUSE Quarterly*, *1*, 35–40.

Zhang, X., Pablos, P. O. d., & Xu, Q. (2014). Culture effects on the knowledge sharing in multi-national virtual classes: A mixed method. Elsevier Science Publishers B. V.

Zhang, W., Yang, X., Wang, Q., Zheng, C., & Sia, C. (2015). Investigation on the factors determining consumers' use of online intermediated shopping (OIS): A behavioral intention perspective. *Journal of Organizational and End User Computing*, *27*(1), 77–97. doi:10.4018/joeuc.2015010104

Zhang, X., Liu, S., Chen, X., & Gong, Y. (2017). Social capital, motivations, and knowledge sharing intention in health Q&A communities. *Management Decision*, *55*(7), 1536–1557. doi:10.1108/MD-10-2016-0739

Zhang, Z., & Jasimuddin, S. M. (2015). A model-based analysis for mobile knowledge management in organizations. *Journal of Management Analytics*, *2*(1), 35–52. doi:10.1080/23270012.2015.1012232

Zhang, Z., Lee, M. K., Huang, P., Zhang, L., & Huang, X. (2005). A framework of ERP systems implementation success in China: An empirical study. *International Journal of Production Economics*, *98*(1), 56–80. doi:10.1016/j.ijpe.2004.09.004

Zhou, T. (2012). Understanding users' initial trust in mobile banking: An elaboration likelihood perspective. *Computers in Human Behavior*, *28*(4), 1518–1525. doi:10.1016/j.chb.2012.03.021

Zhou, T. (2018). Understanding online knowledge community user continuance: A social cognitive theory perspective. *Data Technologies and Applications*, *52*(3), 445–458. doi:10.1108/DTA-10-2017-0077

Zhou, T., Lu, Y., & Wang, B. (2010). Integrating TTF and UTAUT to explain mobile banking user adoption. *Computers in Human Behavior*, *26*(4), 760–767. doi:10.1016/j.chb.2010.01.013

Zorotheos, A., & Kafeza, E. (2009). Users' perceptions on privacy and their intention to transact online: A study on Greek internet users. *Direct Marketing: An International Journal*, *3*(2), 139–153. doi:10.1108/17505930910964795

Zubrow, D., Hayes, W., Siegel, J., & Goldenson, D. (1994). *Maturity Questionnaire*. Accessed on January 1, 2006. www.sei.cmu.edu/publications/documents/94.reports/94.sr.007.html

About the Contributors

Justin Zhang is a faculty member in the Department of Management at Coggin College of Business in University of North Florida. He received his Ph.D. in Business Administration with a concentration on Management Science and Information Systems from Pennsylvania State University, University Park. His research interests include economics of information systems, knowledge management, electronic business, business process management, information security, and social networking. He has published research articles in various scholarly journals, books, and conference proceedings. He is the editor-in-chief of the Journal of Global Information Management. He also serves as an associate editor and an editorial board member for several other journals.

* * *

Sandra C. Buttigieg is Head of Department of Health Services Management, Faculty of Health Sciences, University of Malta, and Honorary Senior Research Fellow, Health Services Management Centre, University of Birmingham, UK. She is Consultant Public Health Medicine at Mater Dei Hospital, Malta. She is currently Global Representative-at-Large of HCM Division of the American Academy of Management and member of European Health Management Association Council. Sandra Buttigieg strongly advocates inter-/trans-disciplinarity within HSM in practice/research. She is on the Editorial Boards of PLOS ONE, International Journal of Human Resources Management, Health Services Management Research, Journal of Health Organization and Management, and Frontiers in Public Health. She is currently also Guest Associate Editor for Frontiers Veterinary Science. Professor Buttigieg participates in the EU-funded programmes: Horizon2020 - To REACH; COST Actions: CA 15222 – cost containment and quality of care (leader-WG 1); TD 1404 – NEOH (co-leader-WG 3); IS 1402 – Ageism (co-leader-WG 1); and IS 1103 – Adapting European Health Systems to Diversity (country-coordinator).

Yu-Wei Chang is an assistant professor at the Department of Business Management of National Taichung University of Science and Technology. He holds a Ph.D. degree in business administration from the National Central University. He also serves an e-Business consultant to provide counseling services for SMEs. His research areas are e-commerce, tourism management, business intelligence, enterprise resource planning, and knowledge management. He has published more than 30 Journal and conference articles.

Chuleeporn Changchit is a Professor of Management Information Systems at Texas A&M University – Corpus Christi. She holds a Ph.D. in Decision Sciences and Information Systems from the University of Kentucky. Dr. Changchit is actively engaged in the scholarly activities. She has published articles in many journals such as Decision Support Systems, Information Systems Journal, Expert Systems with Applications, the Journal of Computer Information Systems, and International Journal of Intelligent Systems in Accounting, Finance, and Management. She also serves as an ex-Editor-in-Chief for the Journal of Information Privacy and Security (JIPS), serves as an Associate Editor for the Journal of Electronic Commerce in Organization (JECO) and the Journal of Organizational Computing and Electronic Commerce (JOCEC), and serves on editorial review board for several journals.

Sheshadri Chatterjee has completed PhD from Indian Institute of Technology Delhi, India. He is having work experience in different multinational organizations such as Microsoft Corporation, Hewlett Packard Company, IBM and so on. Sheshadri has published research articles in several reputed journals such as Government Information Quarterly, Information Technology & People, Journal of Digital Policy, Regulation and Governance and so on. Sheshadri is also a certified project management professional, PMP from Project Management Institute (PMI), USA and completed PRINCE2, OGC, UK and ITIL v3 UK.

Delroy Chevers is a lecturer of Operations Management and Information Systems at the University of the West Indies. He holds a PhD in Information Systems from the University of the West Indies. His research interests are information systems quality and success, IT adoption and project management. He is actively conducting research on a simplified process improvement framework for developing countries and the adoption of software process improvement initiatives in the English-speaking Caribbean.

Evan Duggan was the Dean in the Faculty of Social Sciences at the University of the West Indies, Mona and Professor of Management Information Systems. He obtained the Ph.D. and MBA degrees from Georgia State University with concen-

trations in Decision Sciences and Computer Information Systems and the B.Sc. from the University of the West Indies, Mona. His research interests involve the management of information systems (IS) in corporations, with particular reference to IS success factors and quality and systems delivery methodologies. He has published extensively in refereed information systems (IS) and allied journals such as Information Technology & Management, Journal of End User Computing, Information Resources Management Journal, Human-Computer Interactions, Information & Management, and Communications of the Association of Information Systems, Electronic Journal of Information Systems in Developing Countries. Professor Duggan has also written papers for edited books, and major conference proceedings as well as other scholarly outlets.

Lalit Garg has more than 18 years of teaching and research experience. He has a PhD in Computing and Information Engineering from the University of Ulster, UK. He has published more than 90 papers in refereed journals, international conferences and books. Areas of his research interest include machine learning, knowledge discovery, data mining stochastic modelling and simulation, health informatics, health service management science, biomedical computing and Neuroimaging, missing data handling and forecasting, cloud computing and pervasive computing.

D. P. Goyal is at present Director, IIM Shillong. Before taking up the prestigious position at IIM Shillong he was a Professor of Information Systems at Management Development Institute, Gurgaon, India. He has more than 30 years of teaching, research and Corporate experience. Prof Goyal has already supervised more than a dozen PhD Scholars, published several books, and has published more than 100 research articles in national/ International journals/conference proceedings. His current research interest areas are Management Information Systems; eGovernance; IS Strategy and Business Process Management.

Vipul Gupta is working as an Associate Professor at LM Thapar School of Management, Thapar University, India. He has earned a Ph.D. from Indian Institute of Information Technology and Management (IIITM), Gwalior with fellowship from Ministry of HRD, India in the area of Industrial Engineering and Operations Management. He holds a B.E. (Mechanical Engineering) and a Masters in Business Administration (MBA) from IIITM, Gwalior. He has more than 14 years of academic and professional experience. He has published papers in International journals and conferences. His areas of interest include Operations Research, Lean Manufacturing Systems, and System Dynamics with focused academic research as well as imparting training to SMEs.

Ilyoo Barry Hong is presently a full professor of management information systems in College of Business and Economics at Chung-Ang University, Seoul, Korea. He earned his PhD degree in MIS from the University of Arizona, his MS in Business from the University of Illinois at Urbana-Champaign, and his BS in Management from Indiana University. He was a visiting scholar at the UCLA Anderson School of Management. Ilyoo Hong has published in such journals as Decision Sciences, Information & Management, International Journal of Electronic Commerce, and International Journal of Information Management, among others. He also presented academic papers at numerous international conferences, including HICSS. His research interests include building online consumer trust, consumer's e-WOM assessment, and determinants of transaction intent in a sharing economy. He presently serves as a member of the International Editorial Review Board for International Journal of Information Management.

Ping-Yu Hsu is a professor in the Business Administration department of National Central University in Taiwan and the secretary-in-chief of the Chinese ERP association. He graduated from the CSIE department of National Taiwan University in 1987, got his master degree from the Computer Science Department of New York University in 1991, and Ph.D. degree from the Computer Science Department of UCLA in 1995. His research interest focuses in the business data related applications, including Data mining, Business Intelligence, Data Warehousing, and Enterprise System implementation. He has published more than 100 Journal and conference articles.

Jiban Khuntia is an assistant professor of information systems in the business school at the University of Colorado, Denver. He received his Ph.D. from the Robert H. Smith School of Business, University of Maryland. Dr. Khuntia's research is in the areas of digital service innovation and health IT. His work has appeared in journals including Journal of Management Information Systems, Production and Operations Management, Decision Support Systems, Communications of the AIS, and others. Earlier, he had a decade of professional and consulting experience in supercomputing, the IT industry, and government organizations.

Ravi Kiran is PhD in Industrial Management. She is presently Professor and head of the School of Humanities and Social Sciences, and Former Professor In-charge Alumni relations at Thapar University, Patiala. Her research areas are: Industrial Management, Business & Behavioral Economics, Finance, E-Business and Intellectual Property Rights. She has published 137 papers in refereed Journals.

She has published eighty papers in National/ International Conferences and fifteen book chapters. She has guided 27 PhD scholars. She has completed eight research projects including one on IPRs in Pharmaceutical Sector of India. Currently working on DST funded research project on Designing a model for enhancing Entrepreneurial skills in Technology Business Incubators. She is on the editorial board of International journals and referee of many journals listed in SSCI and Thomson Reuters. She has visited widely in many countries including Bangkok, Australia, Singapore, Dubai and Dublin (Ireland), Geneva (Switzerland), and Paris (France) for academic collaborations and for presenting papers and to chair a session and present keynote Address.

Yi Liu is an Associate Professor at Rennes School of Business, France. He got his PhD from ETH Zurich, Switzerland. His research focuses on Human-Computer Interaction, social media, and e-commerce.

Ravi Lonkani is an Associate Professor of Finance at Chiang Mai University, Thailand. He received a Ph.D. in Finance from Chulalongkorn University. Dr. Ravi has been very active scholar in Finance. He is well recognized in the Thai academic community as an outstanding researcher and lecturer, with a strong tie to the Business Sector. He worked as a SET(Stock Exchange of Thailand) fellowship in 2006 and was also a Fulbright Scholar in 2010-2011. Dr. Ravi is also a senior researcher and continuously published many academic articles every year. Dr. Ravi participates in many academic conferences and serves as a reviewer for many journals. He also published many text books in Finance such as Investment, Derivatives and Feasibility Study text books.

Annette Mills is an Associate Professor in Information Systems at the University of Canterbury (New Zealand). She has published in a number of journals including MIS Quarterly, Information and Management, Journal of Knowledge Management, Information Systems Frontiers, Journal of Travel & Tourism Marketing, and Communications of the AIS. She currently serves as a Senior Editor for DATA BASE and as Associate Editor for the Journal of Global Information Management. Her research interests include behavioral, social, and organizational aspects of IS/IT use, user satisfaction and information privacy.

Stanford Moore is the Deputy Dean in the Faculty of Social Sciences at the University of the West Indies, Mona. He holds a BSc in Mechanical Engineering from the University of the West Indies, a masters in Petroleum Engineering from Heriot Watt University and masters in Manufacturing Management from North-

western University. His research interests are in software process improvement and project management.

Deshai Nakka is currently working as Assistant professor in the Department of Information Technology at S.R.K.R. Engineering College, Bhimavaram, and Andhra Pradesh (INDIA). His research interests are in the field of Big Data, Cloud Computing, Internet of things, Artificial Intelligence. He published papers in national and international journals and also in international conferences including Springer. He has successfully guided a good number of the undergraduate and postgraduate thesis.

Krishna Rao S. obtained his B.Tech from Bangalore University in the year 1995 and M.Tech in Computer Science & Technology, in 2000, and Ph.D, in Computer Science & Technology in the year 2011 from Andhra University. Prof. Krishna Rao has more than 22 years of teaching experience which includes around 9 years of administrative experience with Sir CRR Engineering College. Prof. Krishna Rao's Research areas include Mobile Information Systems, Software Architectures, Wireless Sensor Networks, Image Processing & e-Commerce. He guided one Ph.D student and presently guiding 2 PhD's in Computer Science Engineering, and has to his credit, more than 23 Research papers. Prof. Krishna Rao is presently the Head of Information technology department, Board of Studies Member, Dept. of CS&SE, Andhra University and Board of Studies Member, Dept. of IT, ANITS, Visakhapatnam.

Rosaria Russo has her PhD Degree (FEA/USP, major: Administration, 2012), MA Degree (FEA/USP, major: Administration, 2007), MBA (FIA, major: Project Management, 2004), BA Degree (FATEC, major: technologist in Data Processing, 1983), PMP (Project Management Professional Certification – PMI, 2004). She worked in TI Project Management for 25 years, worked mainly in banks, govern companies, software houses. Professor in the course of professional master in Uninove and for the MBA in Business Management and Projects such as the FDC. Researcher in the group "Decide" on Decision Theory at FEA / USP.

Chakravarthy Sameer is Working as Associate Professor in Department of Electronics and Communication Engineering, Raghu Institute of Technology, Visakhapatnam. His research interests are in the field of Image Processing, Antennas, Optimization, Soft computing. He is EC member of IEEE Vizag bay subsection. He is an editor for renowned journals and conferences. He successfully completed a number of funded projects. He has guided more than 28 bachelors and master thesis.

Jomjai Sampet is an Assistant Professor of Accounting. She received a Doctoral of Social and Economic Sciences from Vienna University of Economics and Business in 2009. She is currently a lecturer at the Department of Accounting, Faculty of Business Administration, Chiang Mai University, Thailand.

Sarella Venkataramana has more than 19 years of teaching experience. Presently author is working as Associate Professor in department of Information Technology at S.R.K.R. Engineering College, Bhimavaram, and Andhra Pradesh (India). His research interests are in the field of Wireless Sensor Networks, Cloud Computing and Internet of things. He published various papers in national and international journals and also in international conferences. He is serving as editorial board member and reviewer for various Scopus indexed journals.

B. V. D. S. Sekhar holds a Ph.D in Computer Science & Systems Engineering Department of Andhra University- Visakhapatnam, Andhra Pradesh (INDIA). He is working as a Associate Professor in Department of Information Technology, S.R.K.R. Engineering College Bhimavaram. His research interests are in the field of Image Processing, Internet of things, Computer networks and network security, cloud computing. He published papers in national and international journals and also in international conferences. He is serving as an editorial member and reviewer for various Scopus indexed journals.

Manisha Seth is an engineering graduate with postgraduate in Management and a Ph.D from Thapar University, Patiala. She is a gold medalist both in BTech and Master of business administration. She has 17 years of experience in teaching, research, consultancy and administrative activities. She has contributed to the body of knowledge in management discipline in the domains of Operations Management, Supply Chain Management, Information system, Investment Management and Financial Management. Prof Seth has published research papers in various international /national journals and conferences.

Wen-Lung Shiau received the MS in Computer Science from Polytechnic University, New York, U.S. in 1995 and the PhD degree from the Department of Business Administration, National Central University, Chung-Li, Taiwan in 2006. He is a professor in the Department of Business Administration of Zhejiang University of Technology, Hangzhou City, Zhejiang, China. He was a certified instructor of Cisco (CCSI), Novell (CNI), and Microsoft (MCT) and trained innumerable certified engineers. He wrote more than 60 books and published the first IPv6 book in traditional Chinese. His current research interests include Cloud Computing Ser-

vice, Marketing, Networking, and E-Business. His research has been published or accepted more than 50 journal papers.

Franciane Freitas Silveira is an Adjunct Professor of Business Management in the Center for Engineering, Modeling and Applied Social Sciences (CECS) at the Federal University of ABC (UFABC) in São Paulo, Brazil. Professor Silveira holds masters and PhD degrees in Business Administration from the Faculty of Economics, Business and Accountancy (FEA) at the University of São Paulo (USP), with emphasis on Technology Innovation. Dr. Silveira worked as an Innovation Project Manager for 8 years mainly in the Telecommunications Industry. Mrs. Silveira is an author, consultant, and professor in the fields of technology management and Social and Sustainable Innovation management.

Gianpaolo Tomaselli is a Research Support Officer at the University of Malta within the Department of Health Services Management (Faculty of Health Sciences). He currently works as Project Administrator of EU-funded projects within the Ministry for Health in Malta. He is on the Editorial Boards of Frontiers in Public Health (Guest Associate Editor of Research Topic "Patient Safety: Delivering Cost-Contained, High Quality, Person-Centered, and Safe Healthcare") and Quaderni FMV (Italian research magazine of Marco Vigorelli Foundation). Dr Tomaselli participates in the EU-funded programmes: Horizon2020 - To REACH; COST Actions: CA 15222 – cost containment and quality of care (member of WG 1); Erasmus+ Jean Monnet Network (SMSHealth.eu). He holds a Ph.D. in Economics and Management in Health Care from University Magna Græcia of Catanzaro, Italy. His main research interests involve Corporate Social Responsibility Communication, Health Services Management & Policy and Health Innovation.

Jiasen Wang received his BS degree in automation from Wuhan University of Technology (WHUT), Wuhan, China, in 2011 and received his MS degree in control theory and control engineering from Zhejiang University (ZJU), Hangzhou, China, in 2014. He is now working in a financial data service company called Tonghuashun in Hangzhou as an algorithm engineer. Meanwhile, he is an adjunct research fellow of WHUT. His research interests include machine learning and learning control.

Pan Wang received the bachelor degree in Industrial Automation from Wuhan University of Technology (WHUT), Wuhan, China, MS and PhD degree in systems engineering from Huazhong University of Science and Technology (HUST), Wuhan, China in 1994, 1998, and 2003, respectively. He is with the School of Automation

and Institute of Systems Science and Engineering (ISSE), WHUT, where he is currently a professor and vice director of ISSE. His research interests are in the fields of intelligent control and optimization, decision analysis, and biomedical intelligent information systems. He has published 3 monographs, over 60 journals (such as IEEE Trans. on Industrial Electronics, IEEE Systems Journal, Chaos, Solitons and Fractals, Expert Systems with Applications, Int. J. Distributed Sensor Networks, Systems Research and Behavioral Science, Expert Systems, J. Systems Engineering and Electronics) papers and 30 conference papers. Professor Wang is an IEEE Senior Member, a member of TC EIS of the IEEE Systems, Man, and Cybernetics Society and WG8.9 of the IFIP. He is an associate editor of the Journal of Industrial Information Integration (published by Elsevier). He is also a Fellow of China Creative Studies Institute and a founding member of the WUT-RAE International Joint Institute.

Peter Xuereb received his primary and secondary education in Malta. He graduated with First Class Honours in Computer Science from Imperial College London in 1986. In 1997 Peter obtained an MPhil in Management at the University of Cambridge, and in late 1999 commenced his PhD in Information Systems, again at the University of Cambridge. During these periods Peter was the recipient of the Foreign and Commonwealth Office Scholarship, the British Chevening Scholarship, the Cambridge Commonwealth Trust (CCT) and the Overseas Research Students (ORS) Awards. Peter's professional career found him working in Computer Aided Design, IT Consultancy, Software Quality Management, and Voice Recognition; in positions as diverse as R&D Engineer, IT Projects Manager, EMEA Sales Manager, and Technical Director; and for organisations that included the United Nations International Computing Centre (UNICC), Geneva; Hewlett Packard (HP), Stuttgart; Management Systems Unit (MSU), Malta; Netdecisions, Cambridge; and DS Spatial GmbH, Saarbrueken. In 2012, Peter began as Lecturer in the Faculty of ICT at the University of Malta, and has since been promoted to Senior Lecturer. He has taught Logic Programming, ERP, e-Business, Cloud Computing, and Computer Ethics. His research interests include Augmented Reality, CAD, Intelligent Transport Systems, Voice Recognition, Business Intelligence, and the application of computer technologies to the medical field.

Jian Zhang received the BS degree in automatic engineering and the MS degree in pattern recognition and intelligent systems from North China Electric Power University (NCEPU), Beijing, China, in 2007 and 2010. He received the PhD degree

in system optimization and dependability from University of Technology of Troyes (UTT), Troyes, France, in 2014. He is currently a lecturer in the School of Automation and a member of the Institute of Systems Science and Engineering (ISSE) in Wuhan University of Technology (WHUT), Wuhan, China. His research interests include reliable and real-time transmission in wireless sensor networks, statistical decision theory, and intelligent information systems.

Yandi Zuo received her BS degree in automation from Zhengzhou University of Light Industry, Zhengzhou, China, in 2011 and received her MS degree in testing and measurement technology and instrument from Zhengzhou University of Light Industry, Zhengzhou, China, in 2014. She is now studying for her doctorate at wuhan university of technology. Her research interests include machine learning and evolutionary computation.

Index

K

L

M

N

O

P

Q

R

S

T

U

V