Understanding the individual performance of m-banking

Carlos Tam Chuem Vai, MSc

A dissertation submitted in partial fulfillment
of the requirements for the degree of

Doctor of Philosophy in
Information Management

NOVA IMS
Information Management School

Universidade Nova de Lisboa
2016

Understanding the individual performance of m-banking

Professor Doutor Tiago André Gonçalves Félix de Oliveira,
Supervisor

2016

Abstract

Fast advances in mobile technologies and devices have made m-banking increasingly important in mobile commerce and financial services. Although much research has been developed in this field, most of the academic literature until now has focused on m-banking adoption rather than on assessing the impact on individual performance in the post-adoption phase. This dissertation fills this gap in the literature through the analysis of the individual performance. The task-technology fit (TTF) theory and the DeLone & McLean IS Success model ground the current research's conceptual model for assessing the m-banking individual performance at individual level. With this dissertation we contribute to a better understanding of the m-banking and individual performance in the post-adoption stage. To this end we developed four empirical studies.

In Chapter 2 is a review of literature of m-banking and individual performance. This chapter assembles this diverse body of knowledge into a coherent whole. The present review indicates that the topics of m-banking adoption and behavioural intention dominate the majority of research, but finds no studies on post-adoption and use stage. Moreover, the two most significant drivers of intentions to adopt m-banking are perceived ease of use and perceived usefulness. Considering several m-banking definitions and the technological changes over time, we propose a new, broader definition.

In Chapter 3 we empirically tested in Portugal the task-technology fit (TTF) model to study the determinants of m-banking for individual performance and to discover if there are any age or gender differences. The results reveal that TTF and use

are important precedents of individual performance. We found statistically significant differences in path TTF and use to performance impact for the age subsample, and not statistically significant differences for the gender subsample.

In Chapter 4 we propose a model combining the TTF model and DeLone & McLean IS success model to evaluate the impact of m-banking on individual performance. The empirical approach is based on an online survey questionnaire of 233 individuals. The results reveal that usage and user satisfaction are important precedents of individual performance, and the importance of the moderate effects of TTF over usage to individual performance. The system quality, information quality, and service quality positively affect user satisfaction.

In Chapter 5 we show the relevance of the relationship between culture and individual performance in the m-banking context. The individual performance (efficiency and effectiveness of performing banking tasks) becomes a source of retention and attraction of potential adopters of m-banking service. We apply the DeLone & McLean IS success model and two of Hall's cross-cultural dimension scales of high-low context and monochromic-polychronic time perception. Understanding the importance of the culture effects on individual performance can positively influence service providers, so as to develop strategies that lead to continued use and user satisfaction of the service. We find that system quality, information quality, and service quality play important roles in user satisfaction, and influence its use and individual performance. Additionally, we test the relevance of the moderating effect of time perception over the use and user satisfaction to individual performance.

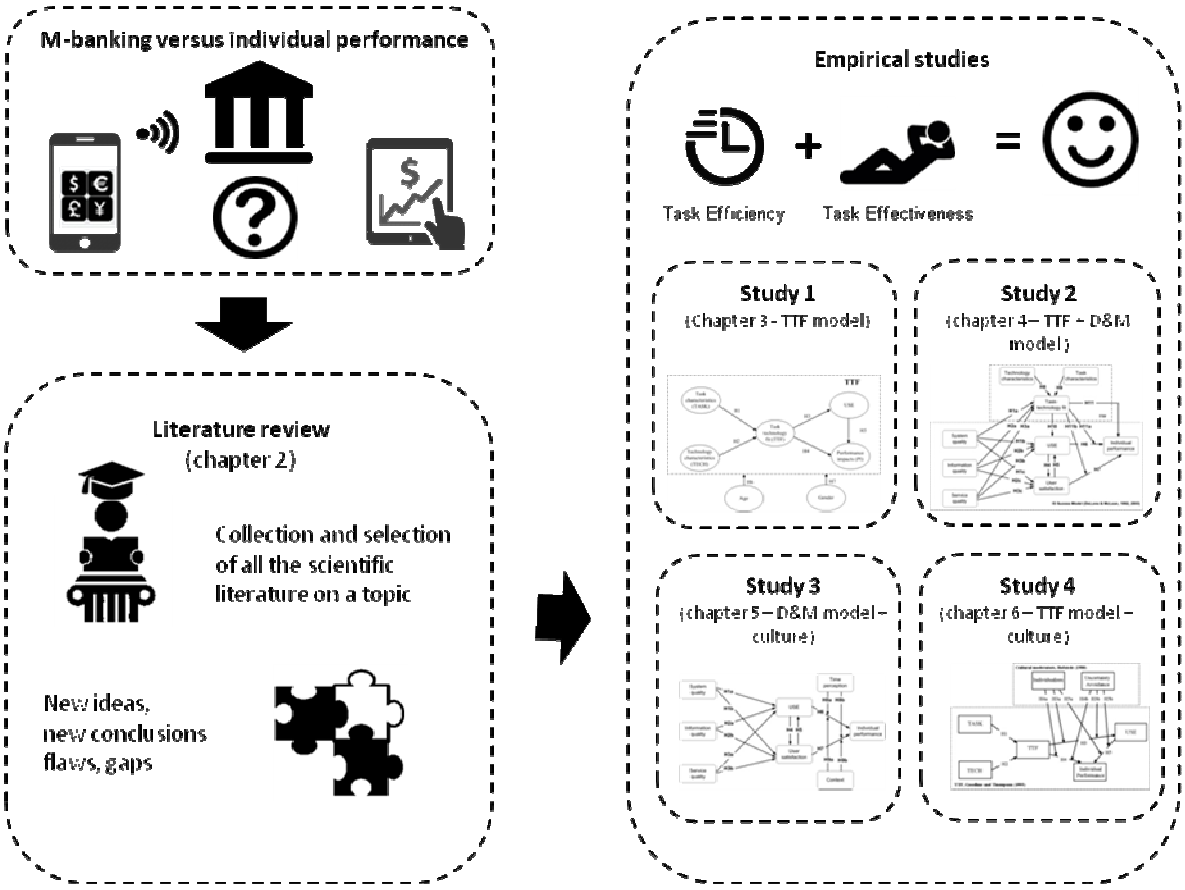
In Chapter 6 we show evidence on the influence of culture on m-banking use and individual performance, using a combination of the task-technology fit model and

two of Hofstede's cross-cultural dimension scales: uncertainty avoidance and individualism. Based on a sample of 204 m-banking users, we show that individualism moderates the relationship between TTF and use, and uncertainty avoidance moderates the relationship between TTF and individual performance. The remaining constructs, which represent the core of the TTF model, can still empirically explain the TTF, use, and individual performance of m-banking. Strategies grounded in these factors are suggested for m-banking service providers to better attract and retain users.

In this dissertation, in epistemological terms, we adopted a posture characteristic of positivism. With regard to research methodologies we used the deductive method. The contextualist theory was applied to organize our proposed research model.

Keywords: Mobile banking (m-banking), task-technology fit (TTF), information systems success model, use, individual performance

Graphical Abstract



Resumo

Os avanços significativos em tecnologias e dispositivos móveis tornaram o m-banking importante para o comércio móvel e serviços financeiros. Apesar de ter sido desenvolvida muita investigação neste campo, a maior parte da literatura académica existente centra-se na adoção de m-banking, em vez de avaliar o seu impacto sobre o desempenho individual (eficiência e eficácia da execução de tarefas bancárias) na fase da pós-adoção. Esta dissertação preenche esta lacuna na literatura através da análise do desempenho individual. O modelo conceptual é suportado pela teoria do alinhamento da tecnologia e tarefa (TTF) e o modelo de sucesso em sistemas de informação de DeLone e McLean para avaliar o desempenho individual no m-banking ao nível do contexto individual. A dissertação pretende contribuir para uma melhor compreensão do m-banking e do desemprenho individual na fase da pós-adoção. Para atingir esse objetivo foram desenvolvidos 4 estudos empíricos.

No 2º capítulo apresentamos a revisão da literatura do m-banking e performance individual. Este capítulo abarca um conjunto de conhecimento alargado e relevante que servirá para apresentar o que foi analisado e quais as lacunas identificadas. A revisão da literatura indica que os temas de adoção do m-banking e intenção comportamental dominam a maioria dos estudos realizados, não tendo sido encontrado nenhum estudo sobre a pós-adoção e uso. Para além disso, os dois fatores mais significativos de intenções para adotar m-banking são: a facilidade de uso percebido e a utilidade percecionada. Considerando as várias definições m-banking e as mudanças tecnológicas ao longo do tempo, propomos uma nova e mais ampla definição.

No 3º capítulo testou-se empiricamente, em Portugal, o modelo do TTF para estudar os fatores determinantes do m-banking para o desempenho individual com o objetivo de avaliar se existem diferenças de idade ou gênero. Os resultados revelam que TTF e uso são precedentes importantes do desempenho individual. Encontramos diferenças estatisticamente significativas no percurso TTF e uso para o impacto no desempenho para a subamostra de idade, e diferenças estatisticamente não significativas na subamostra de gênero.

No 4º capítulo combinamos a teoria do TTF e o modelo de sucesso em sistemas de informação de DeLone e McLean para avaliar o desempenho individual no m-banking. O estudo empírico foi desenvolvido com base numa amostra de 233 observações. Os resultados revelam que o uso e satisfação são vetores importantes do desempenho individual. A qualidade do sistema, a qualidade da informação e a qualidade de serviço afetam a satisfação dos utilizadores do m-banking.

No 5º capítulo, demonstramos empiricamente a importância de incluir variáveis culturais na análise da relação com o desempenho individual. O desempenho individual pode tornar-se uma fonte de retenção e captação de potenciais utilizadores do serviço de m-banking. Neste capítulo aplicamos o modelo de DeLone e McLean e duas dimensões de cultura de Hall, alto-baixo contexto e perceção do tempo monocromático e policromático. Compreendendo o efeito da cultura no desempenho individual, poderemos fornecer contributos importantes para os fornecedores de serviço de m-banking, no âmbito do desenvolvimento de estratégias que levem os utilizadores a continuar satisfeitos com o serviço bem como fomentar a utilização continuada do serviço. Neste estudo empírico, concluímos que a qualidade do sistema, a qualidade da informação e a qualidade de serviço afetam a satisfação dos utilizadores de m-banking,

que por sua vez determina a utilização continuada e o desempenho individual do serviço. Demonstramos a importância da perceção do tempo na execução de tarefas bancárias no âmbito do uso e satisfação e a sua influência no desempenho individual.

No 6º capítulo, investigamos a influência da cultura no uso e desempenho individual, combinando o modelo TTF com duas dimensões culturais de Hofstede: aversão à incerteza e o individualismo. O estudo empírico foi desenvolvido com base numa amostra de 204 observações. Os resultados do estudo revelam que o individualismo modera a relação entre o TTF e o uso, e a aversão à incerteza modera a relação entre o TTF e o desempenho individual. Os outros construtos que representam o núcleo do modelo de TTF continuam a explicar empiricamente o TTF, o uso e o desempenho individual. São sugeridas estratégias baseadas nestes fatores aos gestores de m-banking com vista a captação e retenção de utilizadores.

Em termos epistemológicos, nesta dissertação, adotámos uma postura característica do positivismo. No que diz respeito às metodologias de investigação utilizamos o método dedutivo. A teoria do contextualismo esteve assente no modelo de investigação proposto.

Palavras-chave: Mobile banking (m-banking), alinhamento tarefa-tecnologia (TTF), modelo sucesso de sistemas de informação, uso, desempenho individual.

Publications

List of publications resulting from this dissertation

Papers:

Tam, Carlos; Oliveira, Tiago, (2016) "Literature review of mobile banking and individual performance", *submitted to a journal of quartile two of Scimago index*

Tam, Carlos; Oliveira, Tiago, (2016) "Performance impact of mobile banking: Using the task-technology fit (TTF) approach", *International Journal of Bank Marketing, Vol. 34 Issue: 4, (in press)*

Tam, Carlos; Oliveira, Tiago, (2016) "Understanding the impact of m-banking on individual performance: DeLone & McLean and TTF perspective", *Computers in Human Behavior*, Vol. 61, pp. 233–244.

Tam, Carlos; Oliveira, Tiago, (2016) "Understanding m-banking individual performance: The DeLone & McLean Model and the moderating effects of individual cultural", *submitted to a journal of quartile one of Scimago index*

Tam, Carlos; Oliveira, Tiago, (2016) "Does culture influence m-banking use and individual performance?", *submitted to a journal of quartile one of Scimago index*

“Life is a succession of lessons which must be lived to be understood”

(Helen Keller)

To Ana, Margarida, and Matilde

To my Mother, in memory, and my Father

Acknowledgments

I dedicate this work to my family for their unconditional love and moral support throughout my life. Without them nothing of this would ever be possible. To my wife, Ana, for all her love and support. You have always been so understanding and patient with my impatience - *every day you gave me the strength to move forward*. And to my daughters Margarida and Matilde for their loving support - *follow your dreams, believe in yourself and don't give up*. I would like to acknowledge the expert guidance I received from my supervisor, Professor Tiago Oliveira. I am very grateful to him for the time and effort he has invested in helping me to achieve my goals. He has been constantly encouraging me to progress in this research. I am extremely grateful to Professor John Huffstot for all the comments and revisions, especially to improve my English. I am also grateful to Professor Miguel Neto for his encouragement and understanding on my academic path. I would like to thank my CAT committee members: Professor Ramiro Gonçalves and Professor Fernando Bação for their time, interest, and helpful comments. I would like also to thank Ana Maria Lampreia for her support and guidance. Thanks to José Coelho, for his encouraging support - *do it now, sometimes 'later' becomes 'never'*. Thanks to my colleagues, especially Manuela Aparicio, and Professor Marco Painho during seminar classes, for their critical support, suggestions, and recommendations. Finally, to Florinda, Maria Ernesta, and Adelino for their friendship and support.

Index

List of Tables

List of Figures

Abbreviations

ATM	Automated Teller Machines
AVE	Average Variance Extracted
CA	Cronbach's Alpha
CFA	Confirmatory Factor Analyses
CR	Composite Reliability
D&M	DeLone & McLean
DTPB	Decomposed Theory of Planned Behaviour
ERP	Enterprise Resource Planning
EU	European Union
ICT	Information and Communications Technology(ies)
IDT	Innovation Diffusion Theory
IS	Information Systems
IT	Information Technology(ies)
ITM	Initial Trust Model
ITU	International Telecommunication Union
KMS	Knowledge Management Systems
K-S	Kolmogorov-Smirnov
LMS	Learning Management Systems
MPCU	Model of PC Utilization
PDA	Personal Digital Assistant
PLS	Partial Least Squares
SCT	Social Cognitive Theory
SEM	Structural Equation Modeling

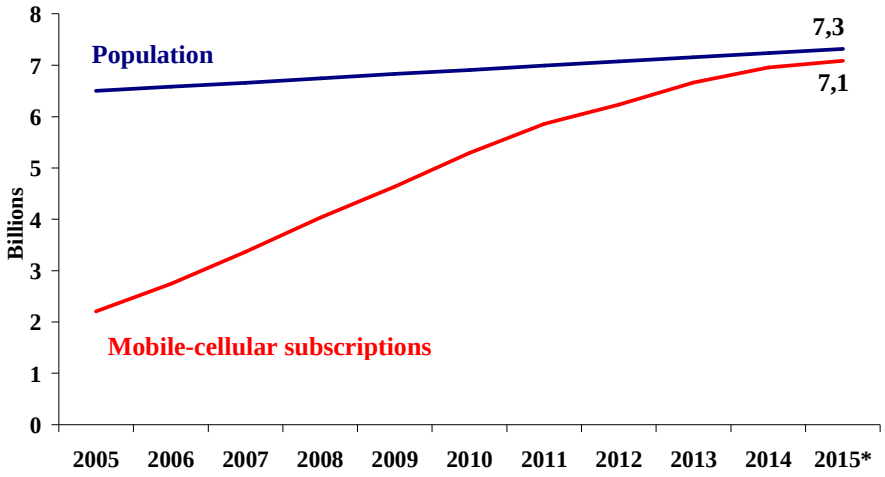
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TTF	Task-Technology Fit
UTAUT	Unified Theory of Acceptance and Use of Technology

Chapter 1 - Introduction

With this dissertation we contribute to a better understanding of the determinants of individual performance in mobile banking (m-banking) at the individual level. In order to accomplish this aim, this study follows a series of steps documented below.

1.1 Research context and motivation

In the last decade there has been an increase in the number of mobile devices. Over 7.1 billion user subscriptions are recorded for the second quarter of 2015 (Figure 1.1), and there are almost as many mobile-cellular subscriptions as people in the world (International Telecommunication Union, 2015).



Source: ITU World Telecomunication ICT Indicators database
Note: * Estimate

Figure 1.1 Evolution of number of mobile devices

Despite the growth of the number of mobile devices, the use of m-banking has remained limited. For Zwass (2003) there are challenges associated with m-banking services in terms of the customer's experience with the user interface of the corresponding device, such as small screen, uncooperative keypad, communication

bandwidth, and other constraints. Some studies have established the importance of the appearance of display, graphics, and colours and how these factors affect customer satisfaction (e.g. Jarvenpaa and Todd, 1996). However, not only technical challenges but also social influence, age (Morris and Venkatesh, 2000), and gender (Riquelme and Rios, 2010) differences may affect (initial) trust in m-banking and its adoption (Kim *et al.*, 2009). M-banking enables users to conduct financial services in a more efficient and effective way and thus offers many advantages for individuals such as time savings and ease in performing banking transactions. The main goal of this dissertation is to enhance knowledge and understanding of m-banking post-adoption, especially to understand the use and individual performance. In this dissertation there are five main motivating research questions (RQ):

RQ1 – What are the factors that drive the majority m-banking studies?

RQ2 – What are the differences in age and gender to individual performance?

RQ3 – Could task characteristics, technology characteristics, system quality, information quality, and service quality impact m-banking use and user satisfaction to achieve better individual performance?

RQ4 – How does culture influence m-banking use and user satisfaction that lead to individual performance?

RQ5 – How does culture influence task-technology fit (TTF) and use that lead to individual performance?

In order to answer these research questions we developed the literature review (Chapter 2) and four empirical studies (Chapters 3 through 6) based on two main theories: TTF model and DeLone & McLean (D&M) IS Success model. RQ1 will be

answered in Chapter 2, which focuses on literature review of m-banking and individual performance. The literature review gives an overview of m-banking research and identifies potential gaps and future directions. RQ2 will be answered in Chapter 3, which focuses on performance impact of m-banking using the TTF approach. RQ3 will be answered in Chapter 4, which focuses on understanding the impact of m-banking on individual performance applying the D&M and TTF perspectives. RQ4 will be answered in Chapter 5, which focuses on understanding m-banking individual performance applying the D&M model and the moderating effects of individual cultural. In order to understand the cultural moderating effects, we joined Hall's cross-cultural dimension scales of high-low context and monochromic-polychronic time perception to discover if culture moderates the effect of use and user satisfaction to individual performance. Finally, to answer RQ5, in Chapter 6 we developed a fourth empirical study that combines the TTF model and two of Hofstede's cross-cultural dimension scales, uncertainty avoidance and individualism, to discover if culture moderates the effect of TTF and use to individual performance.

1.2 Theoretical framework

There are several models for technology acceptance, including the technology acceptance model (TAM) (Davis, 1989, Venkatesh and Davis, 2000), the innovation diffusion theory (IDT) (Rogers, 1995), and more recently the unified theory of acceptance and use of technology (UTAUT) (Venkatesh *et al.*, 2003, Venkatesh *et al.*, 2012). These theories have examined the factors affecting user acceptance of new technology from different angles and bolstered technology acceptance research considerably. Goodhue and Thompson (1995) proposed the TTF model, which extends the TAM by considering how task affects the use of technology and individual

performance. TTF refers to the matching of the capabilities of the technology to the requirements of the task, that is, the ability of technology to support a task. The model theorizes that the fit between task characteristics and technology characteristics influences the use and performance impact (Goodhue and Thompson, 1995).

Another theory that explains the individual performance as a dependent construct in a post-adoption context (i.e., by using an IS/IT) is D&M's IS Success model (DeLone and McLean, 1992). The original version of the D&M model revised IS success measures and conceived a model of the interrelationships between six information systems' success factors: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. Later, in the updated version DeLone and McLean (2003) added the "service quality" measure. For D&M, to measure the success of a single system, information quality or system quality may be the most significant quality component. For measuring the overall success of the IS department, as opposed to individual systems, 'service quality' may become the most important variable".

Both the TTF model and the D&M model have strengths and weaknesses, and these are offset and complemented by combining the various models. In this dissertation we test several combinations of the TTF and D&M models for understanding the m-banking individual performance.

1.3 Research focus

The research focus of this dissertation is on understanding the determinants of m-banking for individual performance (Figure 1.2). While most empirical studies of m-banking seek to understand the factors and motivations that influence the adoption or behaviour intention, this dissertation focuses on post-adoption, i.e., on use of m-banking

and individual performance in the m-banking context. The importance of use and individual performance has long been recognized by academics and practitioners in a variety of functional disciplines.

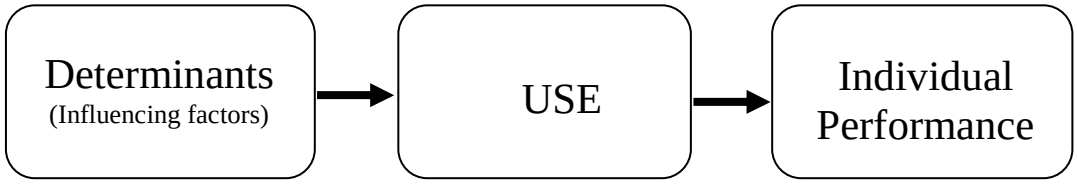


Figure 1.2 Understanding the individual performance of m-banking

To understand the individual performance at a post-adoption stage, it is important to study these stages in different contexts. We expect that this dissertation will contribute to a better understanding of individual performance. We developed four empirical studies (Figure 1.3) in the Portuguese context: in the first study we applied the TTF model; in the second we applied TTF model and D&M IS Success model; in the third we applied D&M IS Success model combined with Hall's cross-cultural dimension scales, and in the fourth study we applied the TTF model combined with two Hofstede's culture dimension.

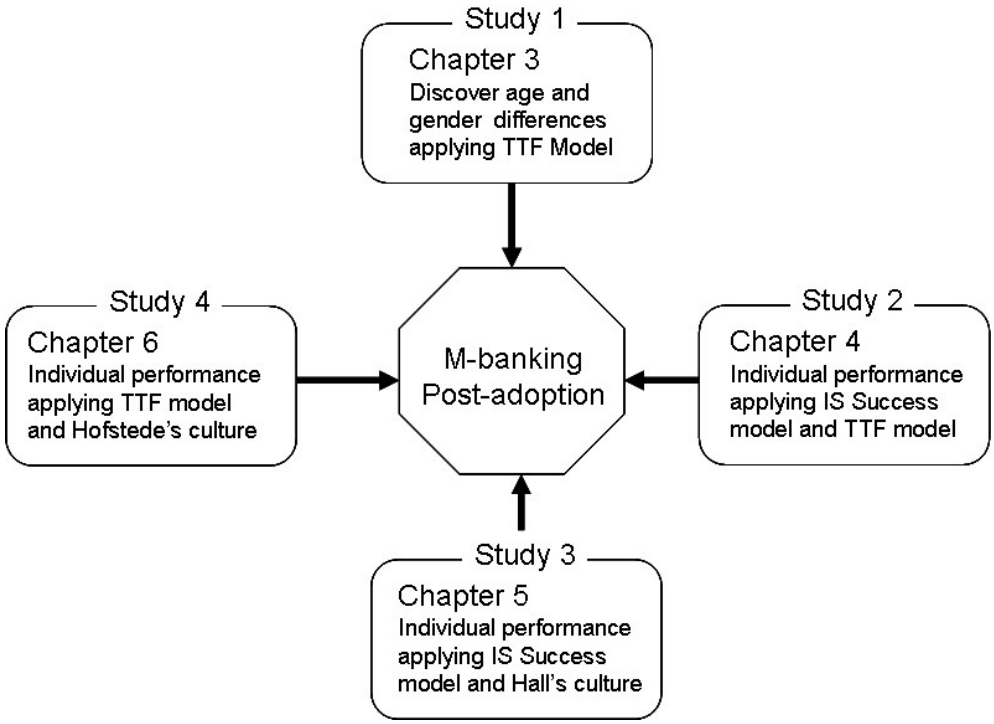


Figure 1.3 Empirical studies covered in this dissertation to understand the individual performance of m-banking

1.4 Research methodology

The conceptual background of this dissertation applies a combination of several methodological approaches. We consider that this work presents characteristics fully consistent with the positivist approach, as we apply various quantitative approaches. The present work develops a research model and a set of hypotheses from the existing literature and theories, which are then empirically tested. We then examine the measurement model by assessing the indicator reliability, construct reliability, convergent validity, and discriminant validity (further detailed in the following chapters). In subsequent studies we will use the same methodology of data collection. Although earlier research suggests that students represent typical consumers (Remus,

1986), in order to enhance generalization and external validity, we also include non-student m-banking users.

1.5 Research structure

This research is organized as follows: Chapter 2 is dedicated to a review of the literature in terms of m-banking and individual performance, through the comparison of different theories and models applied to the m-banking adoption, and how they fit in the individual performance. In Chapter 3 we empirically tested in Portugal the TTF model to study the determinants of m-banking for individual performance to discover if there are any age or gender differences. In Chapter 4 we empirically test in Portugal individual performance using the combination TTF model and D&M IS Success model. In Chapter 5 we empirically test the individual performance using the D&M model and Hall's cross-cultural dimension scales in order to evaluate if there are any cultural influences. In Chapter 6 we empirically test use and individual performance using the TTF model and Hofstede's cultural dimension scales in order to evaluate if there are any cultural influences. The last chapter is devoted to the discussion of findings and conclusions derived, in addition to reporting research contributions, limitations, and future work.

1.6 Path of research

In the first year (September-2012) of the Doctoral Programme under the supervision of Professor Miguel Neto, we presented our work entitled "How knowledge sharing leads to firm performance". At the beginning of the second year of the programme, due of the

fact that Professor Miguel Neto assumed the Secretary of State of Spatial Planning and Nature Conservation in the Portuguese Government, it was agreed to change the supervision and the dissertation topic. I am very grateful to Professor Miguel Neto for all the support and valuable knowledge I received during the first year, which eased the change of the topic.

At the same time, I am extremely grateful to Professor Tiago Oliveira, who agreed to serve as my advisor in the second year (November, 2013) of the Doctoral Programme. Due to the fact that one of Professor Oliveira's research areas is technology adoption, especially regarding electronic banking, and the fact that he had already collected data that was still unstudied, I immediately accepted his kind offer and re-focused on the subject of m-banking. I began my research with the literature review of m-banking, and realized that the majority of the studies were about adoption, and that there were no studies on the post-adoption stage. Professor Oliveira agreed with me that my doctoral research could address this gap. Since the earlier collected data and the constructs fit well with the TTF model, I began to develop the first empirical study (Chapter 3), which was published in the *International Journal of Bank Marketing* in April, 2015 (Tam and Oliveira, 2016a).

Continuing with the post-adoption subjects, more specifically with the individual performance, and based on my 20 years plus of banking experience, 15 years of which were in a mobile and internet division, I realized that there are several factors leading to continued customer use in the m-banking service, one of which is the overall quality of the systems. This overall quality leads us to the D&M IS success model, which considers several constructs of quality, and we decided to combine the TTF and D&M models. In the summer of 2014 we began to collect data for our second empirical work

(Chapter 4), which was published in *Computers in Human Behavior* in March, 2016 (Tam and Oliveira, 2016b).

Meanwhile, during the third year of Doctoral Programme (spring of 2015), due to the fact that several publications had appeared in the literature regarding the influence of culture on technology adoption (the majority of which applying Hofstede's dimension), we decided to use Hall's dimension, which is less applied. Having in mind that cultural characteristics going far beyond country differences could exist within a single country (Baskerville, 2003), and that two people might have different cultural characteristics even though living in the same country, we decided to collect data only for Portugal. We developed the third empirical work (Chapter 5) combining the D&M model, which was submitted to a journal of quartile one of the Scimago index.

Nevertheless, even though there are several empirical works applying Hofstede's dimensions, we decided to test some of these dimensions in the post-adoption context, which leads to the fourth empirical work (Chapter 6) combining the TTF model, which was submitted to a journal of quartile one of the Scimago index.

At the end of year 2015, during the development of the four empirical works, having already collected several m-banking studies, we ended the literature review (Chapter 2) and submitted it to a journal of quartile two of the Scimago index.

During the third and fourth year of the Doctoral Programme, I had the opportunity and good fortune to serve as reviewer of many papers for several top journals of the IS field. This opportunity gave me the knowledge and experience in preparing articles.

Finally, after two empirical works published, I received the agreement to present the dissertation which begins with the Introduction Chapter, which covers the research

motivations, theoretical frameworks, methodology, and structure of the dissertation. In the Conclusion Chapter it is presented a summary of the conclusions stated in Chapters 2 to 6.

Chapter 2 - Literature review of mobile banking and individual performance

2.1 Introduction

Mobile banking (m-banking) is one of the most important strategic changes to occur in retail banking in more than a decade. Changes in technological interfaces have made it possible for the financial industry to delight its customers with instant solutions to their problems through the use of self-service technologies. Today, the financial industry offers a wide range of channel services to its customers, such as branch service for traditional use, self-service devices such as automated teller machines (ATM), telephone banking, internet banking, and m-banking. Internet banking allows customers to conduct financial transactions, such as account transfers, paying bills, stock exchange transactions, and other financial services on a secure website offered by the financial institution (Lee and Chung, 2009, Martins et al., 2014), usually accessed via a laptop device or desktop PC (Shaikh and Karjaluoto, 2015). M-banking users can perform almost the same transactions of internet banking by using a mobile device (mobile phone, smartphone, or tablet) (Shaikh and Karjaluoto, 2015). M-banking and internet banking are commonly perceived as two similar alternative self-service channels for banks to deliver products and services for their customers (Thakur, 2014). Many banks are encouraging theirs customers to adopt self-service technology, which allows additional benefits such as cost savings and cross-selling activity (Hoehle and Huff, 2012, Sharma and Govindaluri, 2014, Sharma *et al.*, 2015, Al-Somali *et al.*, 2009). At the same time, offering different multi-channel services and products enhances the relationship between banks and their customers (Laukkanen, 2007). For these reasons,

the e-commerce literature is vast and the research streams continue to grow, as does their impact on the financial industry.

Most studies investigating the youngest channel in the financial industry – m-banking, focus on adoption. Most empirical studies of m-banking seek to understand the factors and motivations that influence the adoption or behaviour intention. However, there is a paucity of studies on the post-adoption phase, retention, or even continuance of using m-banking. This study focuses on understanding the use of m-banking as a benefit for the user, especially on the individual performance. Although several authors relate "performance" to effectiveness and productivity (e.g. Manzoor, 2012, Adler and Benbunan-Fich, 2012, Mahdi *et al.*, 2014), we associate individual performance in the m-banking context with efficiency and effectiveness in the performance of m-banking tasks as a benefit for user.

Our contribution with this paper is threefold. Firstly, we identify several m-banking definitions and propose a new one. Considering several "front-office" technologies' evolution over time, including portable technologies, which make it possible for the banking industry to offer a portfolio of products and services on several platforms. The definition of m-banking has changed along with the evolving technologies, and we propose a new, more inclusive definition. Secondly, we review, analyse, and synthesize the body of literature reporting empirical studies of m-banking over the last decade. Extensive research has been undertaken to understand the determinants of m-banking and the focus of m-banking studies (adoption and behavioural intention). This helps us to characterize the development of this research stream and show where it is today. Based on that, and motivated by the research gap mentioned, we provide further insights on individual performance at the post-adoption

phase. Thirdly, and, most importantly, we provide recommendations regarding where the focus of effort of m-banking studies should be in the future and outline future research avenues. Understanding m-banking's future trends may help researchers and service providers to develop strategies in order to attract potential adopters and retain users.

The structure of the paper is as follows. In the next section we describe how we collected our data. We then examine m-banking definitions and present an overview of empirical studies published in the last 15 years, and set the boundaries of our work. We then present the individual performance and associated main theories. Finally, the conclusions and recommendations for future research are made.

2.2 Research methodology

To determine the state-of-the-art and future directions in m-banking research we conducted an extensive literature review based on the research methodology proposed by Orlando *et al*. (2013). Firstly, we conducted a systematic literature search based on the descriptors, "mobile banking" and "m-banking" using Google Scholar and Ebsco. The search scope was performed for the 15-year period from 2002 to 2016. Our search terms help to determine the scope of our definition of m-banking since many of the terms include the word "m-commerce", "e-commerce", and "m-payments". Although this search was not exhaustive, it serves as a comprehensive base for an understanding of m-banking research. Secondly, we identified published articles pertaining to m-banking, refining the search by reading the abstract and excluding papers not strictly focused on our research objective. In addition, we selected seminal handbooks and other articles whose objective(s) and

results were consistent with the scope of our research. The first extraction indicated 103 papers, but more than half were excluded and the final selection included 50 contributions, among seminal articles and conceptual and/or empirical research papers. We have adopted the following criteria for including or excluding an article from the review:

- Publication date after 2002 (inclusive) to present is considered.
- The research must be empirically investigating m-banking.
- The research must have reported correlation coefficients, or other values that could be converted to correlation coefficients.
- Studies from any geographical location are considered.
- We selected articles by reading the abstract. Articles that apparently do not focus on our research objective were excluded manually from the list.
- Goals and result of the studies must be within the scope of our research.
- Only articles published in scholarly journals were considered.
- Non-English language studies were excluded.

At the end of this selection stage, the number of studies was 50. Figure 1 summarizes the works by year of publication.

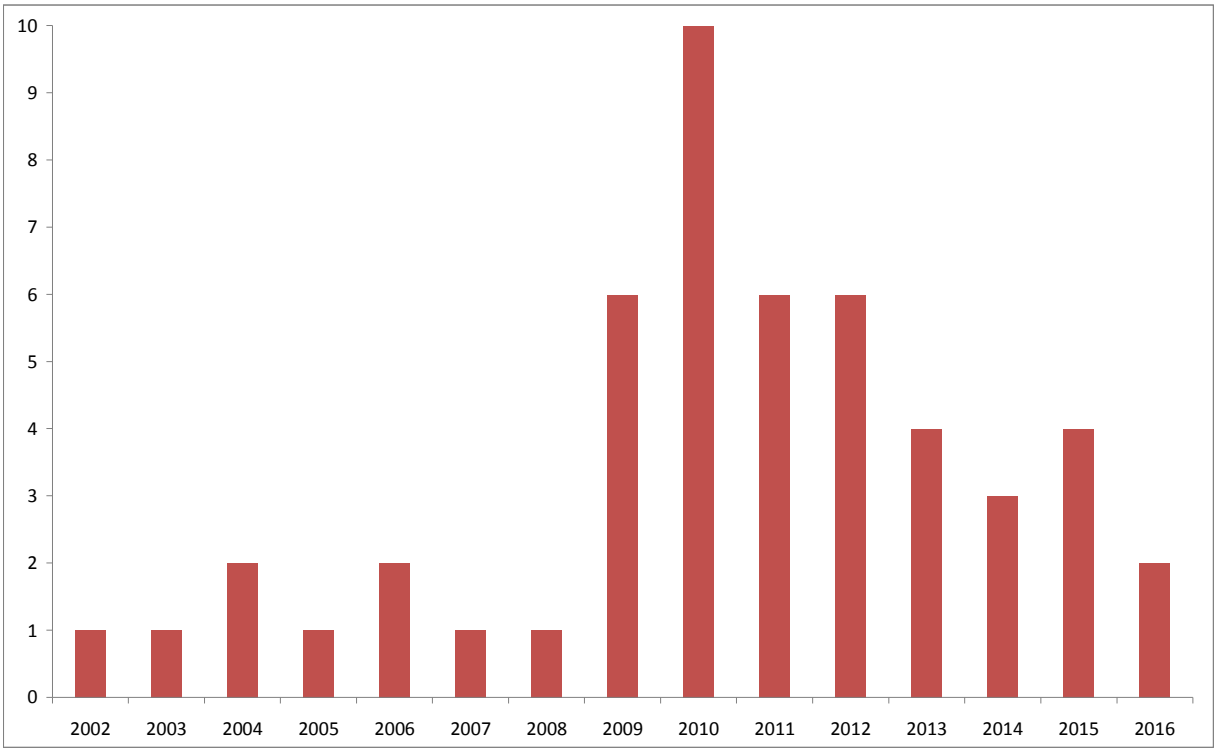


Figure 2.1 M-banking articles included in the review (January 2002–January 2016)

2.3 Mobile banking

Customers interact with their banks today through multiple channels. Branches, automated teller machines (ATM), telephone banking, internet banking, and m-banking are all efficient ways of selling products and services to banking customers (Hoehle and Huff, 2012). The evolution from a focus on local-centric (branches and ATM) to place-centric (internet banking) and then to equipment-centric (accessible anywhere, 24 hours per day and 7 days a week) has yielded benefits in the form of time savings and shorter customer queues. Equipment-centric vision brings the customer closer to the bank since (s)he needs only a mobile device to carry out a financial-service activity. In local-centric banking customers need to go to a physical place (a branch or an ATM), which may not be close to them. In place-centric banking, customers can conveniently carry out the

vast majority of banking transactions remotely, provided that they have a computer with internet access. Consumers favour specific banking channels for specific product categories. Hoehle and Huff (2012) noted that branches are used for complex products categories (for example, mortgages and loans) while more simple operations such as bill payments or other domestic transactions can be done through self-service technology. Many banks charge a fee for domestic transactions made at branches to encourage customers to adopt self-service technology.

The composite services and products offered on the mobile platform range from simple accounting balance inquiries to payment of services, funds transfers, and more complex products, such as stock exchange transactions (Suoranta and Mattila, 2004). Complex transactions are quite difficult to perform on mobile devices due to their hardware limitations, such as small screens and clumsy input mechanisms. Consequently, consumers tend to use mobile devices for simple banking transactions, in situations in which they need instant access to their accounts, and their other banking channels are not in reach (for example, checking their account balance before purchasing goods at a point of sale) (Hoehle and Huff, 2012).

The huge explosion of mobile device usage and the initiatives in e-commerce have drawn the attention of researchers to m-banking. Various management information system researchers have provided different definitions of m-banking. M-banking is often considered to be a subset of m-commerce, and m-commerce a subset of e-commerce (Coursaris and Hassanein, 2002). Some studies explicitly qualify device type for use under m-banking (e.g. Barnes and Corbitt (2003), Lee and Chung (2009), Shaikh and Karjaluoto (2015)), while many others do not (e.g. Suoranta and Mattila (2004), Oliveira *et al.* (2014)), the reasoniong being that accessing banking services from a

laptop should not be considered as m-banking, since the interface is similar to a desktop PC, which is not a mobile device (Shaikh and Karjaluoto, 2015). Table 2.1 presents several definitions of m-banking. It can be seen that the evolution of the several definitions has changed throughout the last decade.

Table 2.1 M-banking definitions

(Barnes and Corbitt, 2003)	…can be defined as a channel whereby the customer interacts with a bank via a mobile device, such as a mobile phone or personal digital assistant (PDA).
(Suoranta and Mattila, 2004)	…is among the newest electronic delivery channels to be offered by banks. In using the term 'electronic banking' the authors refer to a definition that explains it as the provision of information and services by a bank to its customers via electronic wired or wireless channels, for example the internet, telephone, mobile phone, or interactive television.
(Pousttchi and Schurig, 2004)	... a type of execution of financial services in the course of which - within an electronic procedure - the customer uses mobile communication techniques in conjunction with mobile devices.
(Porteous, 2006)	Mobile payments (m-payments) are financial transactions undertaken using mobile device such as a mobile phone. Mobile banking (m-banking) includes m-payments but involves access by mobile device to the broader range of banking services, such as account-based savings or transactions products offered by banks.
(Laukkanen, 2007)	… has emerged as a wireless service delivery channel providing increased value for customers' banking transactions.
(Clarke III, 2008)	… can be considered as a subset of e-banking or online-banking and refers to the shift of conducting financial transactions from wired networks to

	wireless networks.
(Morawczynski and Miscione, 2008)	… a platform for the delivery of financial services via the mobile phone.
(Lee and Chung, 2009)	… is defined as banking transactions using mobile devices such as cellphones, PDAs (Personal Digital Assistants), smart phones and other devices (except for laptops).
(Riquelme and Rios, 2010)	… is used in this paper to mean electronic banking that uses mobile phone technology (or other wireless devices) to deliver electronic financial services to consumers.
(Luo *et al.*, 2010)	… an innovative method for accessing banking services via a channel whereby the customer interacts with a bank via a mobile device (e.g., mobile phone or personal digital assistant).
(Laukkanen and Kiviniemi, 2010)	… an interaction in which a customer is connected to a bank via a mobile device such as cell phone, smartphone or personal digital assistant (PDA).
(Oliveira *et al.*, 2014)	… an instance of a mobile commerce (mCommerce) application in which financial institutions enable their customer to carry out banking activities via mobile device.
(Shaikh and Karjaluoto, 2015)	… is a product or service offered by a bank or a microfinance institute (bank-led model) or MNO (non-bank-led model) for conducting financial and non-financial transactions using a mobile device, namely a mobile phone, smartphone, or tablet.

Considering these many definitions and the technological changes over time, we propose the following definition since it is more broadly inclusive:

"M-banking is a service or product offered by financial institutions that makes use of portable technologies."

The improvement of mobile platform technologies enables m-banking users to carry out banking services anytime from anywhere. The new paradigms of banking services in the last decade have changed the face of retail banking, with new services and products and new points of interaction with their customers (Ensor and Wannemacher, 2015). The mobility offers banks the opportunity to tailor products and services to their customers' exact needs - or exact location, in order to preserve them (Floh and Treiblmaier, 2006). Additional benefits arising from the m-banking technologies:

- For the consumers, m-banking reduces time and expenses by allowing users to review transactions, transfer funds, pay bills, check balances, and perform other financial services, without relatively expensive phone calls to a bank's customer service call centre or or by visiting a branch (Kim *et al.*, 2009, Hoehle *et al.*, 2012).
- For the financial industry, m-banking affords banks additional benefits such as cost savings, attracting new customers, and retaining old ones (Hoehle and Huff, 2012). This channel allows the bank to cross-sell and up-sell their other complex banking products and services such as vehicle loans, credit cards, etc. In addition, the m-banking channel helps banks to improve service operational efficiency, customer satisfaction, and cost effectiveness.

An extensive body of research has been developed to understand the factors that influence m-banking user adoption. These factors include perceived usefulness (e.g.

Hanafizadeha *et al.*, 2014), perceived ease of use (e.g. Hanafizadeha *et al.*, 2014), trust (e.g. Hanafizadeha *et al.*, 2014), social influence (e.g. Aboelmaged and Gebba, 2013), perceived risk (e.g. Chitungo and Munongo, 2013), self-efficacy (e.g. Amin *et al.*, 2012), facilitating conditions (e.g. Yu, 2012), demographic factors (e.g. Laukkanen *et al.*, 2007, Amin *et al.*, 2006, Alafeef *et al.*, 2011), and many others. The main targets of the dependent variable are antecedent of attitude (e.g. Püschel *et al.*, 2010), behavioural intention (e.g. Luo *et al.*, 2010), and usage (e.g. Crabbe *et al.*, 2009). Table 2.2 shows a chronology of relevant empirical research published from January 2005 to January 2016. No empirical study was published in 2008.

Table 2.2 M-banking empirical studies

Model/Theory	Dependent Variable	Source	Constructs																						
			Attitude	Behavioural control	Culture	Effort expectancy	Facilitating conditions	Habit	Hedonic motivation	Information quality	Interface quality	Perceived compatibility	Perceived credibility	Perceived ease of use	Perceived relative advantage	Perceived risk	Perceived self-efficacy	Perceived usefulness	Performance expectancy	Price value	Social influence	Subjective norm	System quality	Task characteristics	Technology characteristics	Task technology fit	Trust
Extend TAM	Behaviour intention	(Luarn and Lin, 2005)											X	X			X	X		X						
IDT	Adoption	(Amin *et al.*, 2006)	X																							
Mean-end theory	Adoption	(Laukkanen, 2007)													X											
D&M	Satisfaction	(Lee and Chung, 2009)								X	X												X			X
IDT – Trust	Behaviour intention	(Kim *et al.*, 2009)													X											X
Extend TAM	Behaviour	(Gu *et al.*, 2009)					X							X			X	X					X			X

Model/Theory	Dependent Variable	Source	Constructs																						
			Attitude	Behavioural control	Culture	Effort expectancy	Facilitating conditions	Habit	Hedonic motivation	Information quality	Interface quality	Perceived compatibility	Perceived credibility	Perceived ease of use	Perceived relative advantage	Perceived risk	Perceived self-etticacy	Perceived usefulness	Performance expectancy	Price value	Social intluence	Subjective norm	System quality	Task characteristics	Technology characteristics	Task technology fit	Trust
	intention																									
TAM	Behaviour intention	(Crabbe *et al.*, 2009)	X				X						X	X				X								
D&M	Satisfaction	(Chung and Kwon, 2009)								X													X			X
TTF, UTAUT	Adoption	(Zhou *et al.*, 2010)				X	X												X		X			X	X	X
TAM, TPB, IDT	Adoption	(Riquelme and Rios, 2010)												X	X	X		X				X				
IDT, DTPB	Adoption	(Püschel *et al.*, 2010)	X	X								X		X	X							X				
TAM	Behaviour intention	(Schierz *et al.*, 2010)	X									X		X				X				X				
Trust and Risk	Adoption	(Luo *et al.*, 2010)														X	X		X							X
TAM, IDT	Adoption	(Koenig-Lewis *et al.*, 2010)										X	X	X		X		X		X						X
TAM	Behaviour intention	(Shen *et al.*, 2010)															X									X
TAM, TRA, DOI	Adoption	(Cruz *et al.*, 2010)								X				X	X	X		X								
TAM, TPB, D&M	Satisfaction	(Saleem and Rashid, 2011)												X		X		X								X
IDT	Behaviour intention	(Lin, 2011)										X		X	X											
IDT	Adoption	(Khraim *et al.*, 2011)										X			X	X	X									
TAM, TPB	Behaviour intention	(Sripalawat *et al.*, 2011)						X						X		X	X	X				X				
TAM	Behaviour intention	(Cheah *et al.*, 2011)												X	X	X		X								
UTAUT	Behaviour	(Yu, 2012)				X	X						X				X		X	X	X					

Model/Theory	Dependent Variable	Source	Constructs																						
			Attitude	Behavioural control	Culture	Effort expectancy	Facilitating conditions	Habit	Hedonic motivation	Information quality	Interface quality	Perceived compatibility	Perceived credibility	Perceived ease of use	Perceived relative advantage	Perceived risk	Perceived self-efficacy	Perceived usefulness	Performance expectancy	Price value	Social influence	Subjective norm	System quality	Task characteristics	Technology characteristics	Task technology fit	Trust
	intention																									
TAM	Behaviour intention	(Amin *et al.*, 2012)											X	X			X	X								
Trust	Trust	(Zhou, 2012b)							X								X					X				
Trust	Behaviour intention	(Zhou, 2012a)												X												
TAM, TPB	Adoption	(Aboelmaged and Gebba, 2013)	X	X										X				X				X				
TAM	Behaviour intention	(Jeong and Yoon, 2013)											X	X			X	X								
TTF, UTAUT, ITM	Adoption	(Oliveira *et al.*, 2014)					X	X											X		X			X	X	X	X
TAM	Behaviour intention	(Hanafizadeha *et al.*, 2014)												X		X		X		X						X
TAM	Intention to use	(Mortimer *et al.*, 2015)				X								X		X		X				X				
UTAUT2	Use Behaviour	(Baptista and Oliveira, 2015)				X	X	X	X	X									X	X	X					
UTAUT, TTF, ITM.	Behaviour intention	(Afshan and Sharif, 2016)					X	X											X		X			X	X	X	X
Trust	Adoption	(Malaquias and Hwang, 2016)														X					X			X			

Notes: TAM - Technology Acceptance Model; TPB - Theory of Planned Behaviour; TTF - Task Technology Fit; UTAUT - Unified Theory of Acceptance and Usage of Technology; ITM - Initial Trust Model; IDT - Innovation Diffusion Theory; DTPB - Decomposed Theory of Planned Behaviour; D&M – DeLone and McLean

The dependent variables of the majority of the 33 empirical studies in Table 2.2 are behaviour intention and adoption. Of 33 studies, 15 (45%) are behaviour intention, and

12 (36%) are adoption. The results of these various studies suggest that there are no studies on post-adoption and use stage, and none has studied the individual performance using m-banking as a benefit for the consumer.

2.4 Individual performance

M-banking is the most important strategic change in retail banking in more than a decade, and has quickly moved beyond being simply online banking using a smartphone. It is at the hub of the customer relationship and is quickly becoming a point of differentiation and a potential source of revenue for progressive banks (Ensor and Wannemacher, 2015). Attracting potential users and retaining existing users is crucial to the long-term business success of m-banking firms (Gu *et al.*, 2009).

Several authors relate "performance" to effectiveness and productivity (e.g. Manzoor, 2012, Adler and Benbunan-Fich, 2012, Mahdi *et al.*, 2014). Despite the fact that performance measurement has received considerable attention, the focus of the majority of m-banking studies is the adoption field, to attract potential users. In this research we adopt the term "performance" at the individual level to express the idea of users' efficiency and effectiveness in performing m-banking tasks. There is no single accepted view about these terms, however. Effectiveness is usually described as "doing the right things", while efficiency means "doing things right" (Sink and Tuttle, 1989). The following table summarizes the meaning of task effectiveness and task efficiency.

Performance indicators	Elements
Task effectiveness The degree to which a given banking task undertaken by a user improves well-being.	- Reducing number of errors and delays.
Task efficiency The degree to which a given banking task undertaken by a user leads to a more efficient workflow.	- Enable doing transactions more quickly. - Skip queues and avoids long waiting times.

Performing banking tasks at a high level could enhance time saving and reduce effort, and can be a source of individual performance. DeLone and McLean (1992) reported 39 studies associated with different aspects of individual performance, including improved time efficiency of task accomplishment, increased job performance, enhanced decision-making effectiveness, individual productivity, and improved efficiency of effort. For Hou (2012), individual performance impact of IS refers to the actual performance of an individual using an IS. Sonnentag and Frese (2002) link the research on individual performance to the research on work-related well-being. For them "accomplishing tasks and performing at a high level can be a source of satisfaction, with feelings of mastery and pride. Low performance and not achieving the goals might be experienced as dissatisfying or even as a personal failure". They also discuss if and how well-being and performance are empirically related, and argue, especially, that self-regulation might account for such a relationship.

The nature of the specific banking operation drives the customer to the specific channel. Several examples related to the task time criticality and task importance in performing financial transactions, such as stock market operations, are highly sensitive

due to market volatility and to their *just-in-time* nature. Examples include checking an account balance and verifying a salary deposit or urgent-payments processing. These are m-banking transactions that aim to meet market and customer demands of high level of individual performance (Kim *et al.*, 2009, Tan and Teo, 2000). An empirical study based on a focus group discussion reported the relationship between the use of certain banking channels and the nature of banking tasks (Hoehle and Huff, 2012). The urgency of the banking task was determined in their investigation to be the driver in the selection of banking channel.

The main theories that explain the individual performance as a dependent construct in a post-adoption context (i.e., by using an IS/IT) are: IS Success model (DeLone and McLean, 1992) and Task technology Fit (TTF) model (Goodhue and Thompson, 1995). The individual performance refers to the consequences or a result of using IS/IT. For example, a student using a calculator to do a homework assignment will probably have a better result than another student who does not use it. Or imagine a bank customer using a self-service channel for payments; this customer will enjoy the availability of service anytime, unlike another customer using only a traditional channel, such as a branch facility, which is open only during certain hours of the day.

However, there are other models that apply the terminology “performance expectancy”, “outcome expectation”, and “perceived usefulness” as main independent construct(s)/factor(s) or predictor variable to explain behaviour intention to use or adopt IS/IT. These include Perceived usefulness in the technology acceptance model (TAM) (Davis, 1989), job fit in the Model of PC Utilization (MPCU) (Thompson *et al.*, 1991), outcome expectations in the Social Cognitive Theory (SCT) (Compeau and Higgins, 1995), and performance expectancy in the unified theory of acceptance and use of

technology (UTAUT) (Venkatesh *et al.*, 2003). The subsequent section shows the IS Success model and the TTF model and how they were used in the m-banking context.

2.4.1 IS Success model

A major contribution to the individual performance area was DeLone and McLean's (D&M) study, which proposed a comprehensive framework for the IS Success model (original and updated version) (DeLone and McLean, 1992, DeLone and McLean, 2003).

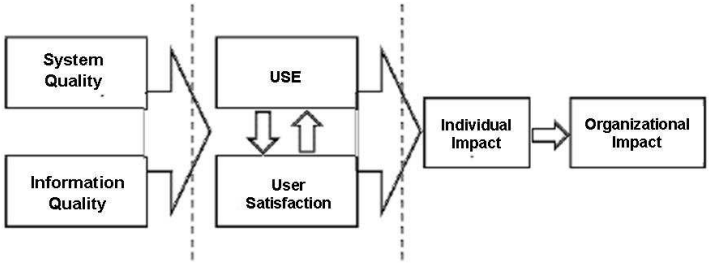


Figure 2.2 Original D&M IS success model

Numerous studies have sought to explain what makes some IS "successful". Studies that were published prior to the D&M model, such as Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975) and Technology Acceptance Model (TAM) (Davis, 1989) attempted to explain why some IS are more readily accepted by users than others. Acceptance is not equivalent to success, although acceptance of an information system is a necessary prerequisite to success. To address this IS success gap, DeLone and McLean (D&M) identified 180 references published between 1981 and 1987, and created a taxonomy of IS success based upon this review. The original version of the D&M model reviewed IS success measures and devised a model of the interrelationships between six IS success factors: (1) system quality, (2) information

quality, (3) use, (4) user satisfaction, (5) individual impact, and (6) organizational impact. Later, in the updated version DeLone and McLean (2003) added the "service quality" measure. For D&M, "to measure the success of a single system, 'information quality' or 'system quality' may be the most important quality component. For measuring the overall success of the IS department, as opposed to individual systems, 'service quality' may become the most important variable". The following list summarizes the meaning of some IS success dimensions:

- System quality – the desirable characteristics of an information system. These measures focus on ease of use, system flexibility, system reliability, and ease of learning, as well as system features of intuitiveness, sophistication, flexibility, and response times.
- Information quality – the desirable characteristics of the information system outputs. The focuses of these measures are the relevance, understandability, accuracy, conciseness, completeness, currency, timeliness, and usability. These measures focus on the quality of the information that the system produces and its usefulness for the user.
- Service quality – the quality of the support that system users receive from the IS department and IT support personnel. For example: responsiveness, accuracy, reliability, technical competence, and empathy of the personnel staff. This dimension is an enhancement of the updated D&M IS Success model, and was adapted from the field of marketing, and is a popular instrument for measuring IS service quality (Pitt et al., 1995).

- System use – the degree and manner in which staff and customers utilize the capabilities of an information system. Amount of use, frequency of use, nature of use, appropriateness of use, extent of use, and purpose of use, are some examples of system use.
- User satisfaction – users' level of satisfaction when using an IS. For example, the most widely used multi-attribute instrument for measuring user information satisfaction can be found in Ives et al. (1983).
- Individual performance – is certainly evidence that the IS has had a positive impact. Task effectiveness, productivity, usefulness, performance, decision quality, and task efficiency, are some examples of individual performance measure.

Many studies have used and supported the validity of the D&M framework. Table 2.3 reports some examples of different applications of the D&M model, such as knowledge management systems (KMS) (Wu and Wang, 2006), learning success systems (Lin, 2007), websites success goals (Schaupp *et al.*, 2006), implementation success of enterprise resource planning (ERP) (Tsai *et al.*, 2012), evaluation of the electronic health record (Bossen *et al.*, 2013), and employee portal success (Urbach *et al.*, 2010). Several authors demonstrate that D&M can be combined with other models such as the unified theory of acceptance and usage of technology (UTAUT) to explain electronic patient records (Maillet *et al.*, 2015); D&M with trust dimension to explain repurchase intention in online services (Hsu *et al.*, 2014), or continuance intention of mobile payment service (Zhou, 2013). The variety of applications of the D&M model, alone or in combination with other theories, provides a basis and support for our investigation in the m-banking context.

Table 2.3 Overview of DeLone and McLean applications

Authors	IS applications	Theory	Sample / Method	Findings
(Qian and Bock, 2005)	Knowledge Repository Systems	D&M	110 responses, PLS	Output quality and system quality influence user satisfaction. Output quality and user satisfaction influence the use. Use and user satisfaction explain 61.5% of variation in individual impact.
(Schaupp *et al.*, 2006)	Websites success goals	D&M	199 regular users, PLS	Information quality, system quality, and perceived effectiveness influence website satisfaction.
(Wu and Wang, 2006)	Knowledge management systems (KMS)	D&M	204 KMS users, CFA	Perceived benefits and user satisfaction explain 60% of variation in system use.
(Lin, 2007)	Online Learning Systems Success	D&M	232 undergraduate students	System quality, information quality, and service quality influence the use and user satisfaction.
(Teo *et al.*, 2008)	Electronic Government Success	D&M, Trust	214 university students, PLS	System quality and service quality explain 43% of variation in user satisfaction. Information quality and user satisfaction explain 40% of variation in intention to continue using,
(Lee and Chung, 2009)	M-banking	D&M, Trust	276 m-banking customers, PLS	System quality and information quality explain 56.5% of variation in customer satisfaction.
(Urbach *et al.*, 2010)	Employee portal success	D&M	6.210 responses, PLS	System quality, information quality, process quality, and collaboration quality influence user satisfaction. Collaboration quality influences the use. Use and user satisfaction explain 59.4% of the variation individual performance, and consequently explains 14.3% of variation in organizational impact.
(Park *et al.*, 2011)	Digital object identifier systems	D&M	120 respondents, PLS	Perceived usefulness and user satisfaction explain 57.8% of variation in organizational benefit.

Authors	IS applications	Theory	Sample / Method	Findings
(Tsai *et al.*, 2012)	Implementation success of enterprise resource planning	D&M	278 responses, PLS	System quality and service quality explain 68% of the variation in user perspective. User perspective explains 65% of the variation in net benefit.
(Hollmann *et al.*, 2013)	Open source software repositories	D&M	117 users, PLS	Perceived usefulness and user satisfaction explain 61% of variation in net benefit.
(Bossen *et al.*, 2013)	Evaluation of a comprehensive electronic health record	D&M	244 professionals, ANOVA	The results produced using the D&M framework are valid and reliable, and were accepted by staff, system providers, and political decision makers.
(Zhou, 2013)	Mobile payment services	D&M, Trust	195 users	Trust, flow, and satisfaction explain 58.4% of the variation in continuance intention.
(Hsu *et al.*, 2014)	Repurchase intention in online services	D&M, Trust	253 customers	Satisfaction with website, satisfaction with sellers, and perceived quality of site explain 39% of the variation in repurchase intention.
(Rana *et al.*, 2015)	Online public grievance redressal system (OPGRS)	D&M	419 users, PLS	System quality, information quality, service quality, perceived ease of use, and perceived usefulness explain 47% of the variation in perceived satisfaction

It can be seen that the most common studies applying D&M models are related to technology adoption, technology evaluation, impact on learning, and task performance, and not with individual performance as initially suggested by Goodhue and Thompson (1995), as post-adoption phase.

2.4.2. Task technology fit

Another contribution to this area came from Goodhue and Thompson, who proposed a task-technology fit (TTF) model (Goodhue and Thompson, 1995). This theory suggests that individual performance is a consequence of the use of, and the fit between, the technology and the task it supports (Goodhue and Thompson, 1995). Goodhue and Thompson (1995) empirically tested the TTF model with 600 users in two companies to evaluate whether IS and services meet end users' needs in a given organization. They found support for the link of TTF constructs and individual performance but not for a causal link between TTF and use. The following list summarizes the meaning of TTF model dimensions:

- Task characteristics – are broadly defined as the actions carried out by individuals in turning inputs into outputs.
- Technology characteristics – are viewed as tools used by individuals in carrying out their tasks.
- Task technology fit – is the degree to which a technology assists an individual in performing his or her tasks.
- Use – is the behaviour of employing the technology in completing tasks.
- Performance impact – relates to the accomplishment of a portfolio of tasks by an individual.

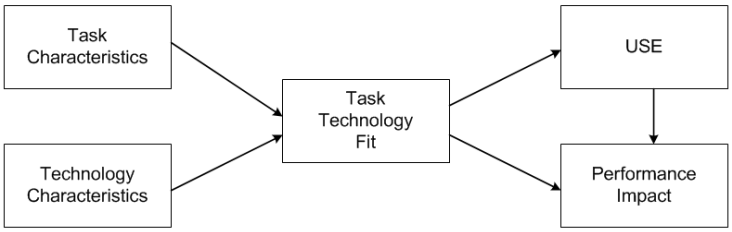


Figure 2.3 TTF model

Table 2.4 lists some examples of different applications of the TTF model, such as knowledge management systems (KMS) use (Lin and Huang, 2008), location-based services (LBS) (Junglas *et al.*, 2008), use of information technology (Dishaw and Strong, 1999), use of mobile commerce in the insurance industry (Lee *et al.*, 2007a), and performance impact using learning management systems (LMS) (McGill and Klobas, 2009). TTF can combine with other models such as UTAUT to explain user adoption of m-banking (Zhou *et al.*, 2010), TAM to explain users' intention to use wireless technology in organizations (Yen *et al.*, 2010), and UTAUT combined with initial trust model (ITM) to explain m-banking adoption (Oliveira *et al.*, 2014). Our review of the literature on TTF indicates that task-technology fit measurement has been operationalized in a variety of different ways.

Table 2.4 Overview of TTF applications

Authors	IS applications	Theory	Sample / Method	Findings
(Kositanurit *et al.*, 2006)	Enterprise resource planning (ERP) systems	TTF	349 respondents, PLS	System quality, ease of use, and use explain 73.3% of variation in individual performance.
(Lee *et al.*,	Adoption of	TTF	238 Insurance	TTF and Individual differences.

Authors	IS applications	Theory	Sample / Method	Findings
2007a)	mobile commerce in the insurance industry.		agents	
(Lin and Huang, 2008)	Understanding KMS use	TTF	192 subjects, Taiwan, PLS	Task interdependence and tacitness, perceived TTF, self-efficacy, personal and performance outcome expectation, and KMS use. The model explained 31.7% of the variation in personal outcome expectations that play a role in KMS use.
(Junglas *et al.*, 2008)	Mobile locatable IS	TTF	112 US students, ANOVA	Locatability, location sensitivity, and TTF.
(Gebauer and Ginsburg, 2009)	Overall technology evaluation	TTF	144 user community, US, Z Score	Task-related fit, Technology performance, and user context-related fit explain 43% of variation in overall technology evaluation.
(McGill and Klobas, 2009)	Learning management systems	TTF	267 Students, Australia, PLS	Attitude, social norms, facilitation conditions, TTF, and use explain 44.8% of the variation in perceived impact on learning.
(Larsen *et al.*, 2009)	Users' motivation to continue IS use	TTF	135 Respondents, PLS	Perceived TTF, perceived usefulness, utilization, confirmation, and satisfaction explain 68% of variation in IS continuance intentions.
(Zhou *et al.*, 2010)	Adopt m-banking	TTF + UTAUT	250 respondents, PLS	TTF, performance expectancy, effort expectancy, social influence, and facilitating conditions explain 57.5% of the variation in user's behavioural intention to adopt m-banking
(Yen *et al.*, 2010)	Adopt wireless technology	TTF + TAM	231 employees, US, CFA	Behavioural intention, perceived usefulness, perceived ease of use, and TTF explain 69% of the variation in user's behavioural intention to adopt wireless technology in organizations.

Authors	IS applications	Theory	Sample / Method	Findings
(Yuan *et al.*, 2010)	Mobile work support	TTF	179 mobile worker, Canada, PLS	Time criticality, mobility, location dependency, and intention to use explain variations ranging between 71% and 77% in perceived usefulness of mobile work supporting functions.
(Lepanto *et al.*, 2011)	Picture archiving and communication system (PACS)	TTF	45 professionals, Canada, ANOVA	Use and task technology fit explain 86% of the variation in perceived net benefits
(Lin, 2012)	Virtual learning system (VLS)	TAM + TTF	165 students, Taiwan, PLS	Perceived fit, satisfaction, and VLS continuance intention explain 57% of the variation in perceived impact on learning.
(Parkes, 2013)	Effects of TTF on user attitude and performance	TTF	94 Subjects, Australia, ANCOVA	Task-individual-technology fit, perceived usefulness, and decision quality explain 37.8% of the variation in user attitude and technology performance on task performance
(Oliveira *et al.*, 2014)	Adopt m-banking	TTF UTAUT ITM	194 individuals, Portugal, PLS	Facilitating conditions and behavioural intention explain 66.7% of the variation to adopt m-banking
(Yang and Lin, 2015)	Use cloud storage service	TTF TAM	294 individuals, Taiwan, PLS	Perceived usefulness explains 58.4% of the variation to use cloud storage service

It can be seen that the most common studies applying TTF models are related to technology adoption, technology evaluation, impact on learning, and task performance, and not with individual performance as initially suggested by Goodhue and Thompson (1995), as post-adoption phase.

2.5 Conclusion and future research

The financial industry, like many other industries, has grown and innovated within their own spheres of operation. The technology boom opened up new channels for banking. Channel proliferation is still underway; m-banking is being rolled out by an ever increasing number of banks. In this research we identified 50 m-banking articles published between 2002 and 2016. Although we do not claim it to be exhaustive, it does provide a reasonable amount of insight into m-banking research. In terms of theoretical perspectives, with the exception of two studies that focused on user satisfaction, our findings reveal that the literature is mostly focused on potential adopters of m-banking, characterized by behaviour intention and adoption. The independent constructs most often applied in empirical studies are, in this order: of 33 m-banking empirical studies, 18 apply perceived ease of use, perceived usefulness (15 studies), trust and perceived risk (11 studies), and perceived self-efficacy (10 studies). The main theory applied in these 33 studies was TAM. Potential gaps in the literature are therefore identified that might stimulate further research. One possible direction is to focus on the post-adoption phase of m-banking, such as individual performance, as a consequence of using m-banking. We believe that by enhancing the quality of m-banking, the service will retain more users and attract potential adopters of m-banking, with the consequence of enhancing the individual performance, in turn. Secondly, cross-country evaluations may expose different national cultural values, which impacts m-banking post-adoption (Lee *et al.*, 2007b). Cultural difference going far beyond country boundaries, can exist within a country or a city (Baskerville, 2003), influencing how people think and behave. Cultural research may enable a better understanding of certain cultural characteristics of m-banking users, which may influence potential adopters. Thirdly, the majority of m-

banking research is time-sectional, measuring perceptions at a single point in time. Longitudinal research may provide other insights into m-banking usage.

It is essential for the financial industry to be clear about what "customer centric" means, and how to convert efforts in that realm into profits. We understand the several advantages for the financial industry in encouraging customers to adopt and use the remote channel, and its relationship to the scope of research in most m-banking studies. However, knowing the determinants of the post-adoption phase, and keeping customers loyal to m-banking are the emerging issues that should be considered in future research.

The results presented herein have several important implications for future studies. There is no doubt that portable technology evolution will affect the way that customers interact with their financial institutions. One example of this evolution is Apple's launch of *iwatch* in April 2015. The financial industry is moving in that direction. This evolution would make it interesting to study different types of equipment (e.g. mobile device versus tablet, or other equipment). In addition, m-banking faces several trends for the future:

- Make the movement of money via payments and transfer easier. According to the Forrester survey Q4 2011 made in Europe, besides checking account transactions and balance enquiries, the two most popular transactions made on mobile devices are money transfers and the paying of bills (Forrester, 2011).
- Give customers the flexibility to use any channel at any time. System unavailability or other problems can harm company image and lead customers to feel less satisfied with the service.
- Leverage smartphone capabilities. For example, customer feedback guides and informs a company's decision-making and influences its product roadmap.

- Go beyond the password with authentication. According to a Deloitte report, 72% of consumers would appreciate the use of biometric identification (such as fingerprints or iris recognition) as a means of device authentication during financial services transactions (Srinivas *et al.*, 2014).

Chapter 3 - Performance impact of mobile banking: Using the task-technology fit (TTF) approach

3.1 Introduction

Mobile banking (m-banking) is an expanding application of mobile commerce that has drawn the attention and interest of e-commerce researchers (Kourouthanassis and Giaglis, 2012). These applications offered by the financial industry are applicable to mobile devices such as personal digital assistants (PDA), mobile telephones, smartphones, and tablet computers (Yun *et al.*, 2012). Mobility offers banks the opportunity to tailor products and services to their customers' exact needs - or exact location, in order to retain them (Floh and Treiblmaier, 2006). M-banking enables users to access account balances, pay bills, transfer funds, and perform other financial services. Many banks have chosen to focus their investment on the development of platforms for channels that eliminate the need to visit a branch, and offer convenient access to bank services and products. This also allows banks additional benefits such as cost savings (Hoehle and Huff, 2012).

In the last decade there has been an increase in the number of mobile devices. Over 6.8 billion user subscriptions are recorded for the second quarter of 2013, and there are almost as many mobile-cellular subscriptions as people in the world (International Telecommunication Union, 2013). Despite the exponential growth of the number of mobile devices, the use of m-banking has remained limited. For Zwass (2003), there are challenges associated with m-banking services in terms of the customer's experience with the user interface of the corresponding device, such as small

screen, uncooperative keypad, communication bandwidth, and other constraints. Some studies have established the importance of the appearance of display, graphics, and colours and how these factors affect customer satisfaction (e.g. Jarvenpaa and Todd, 1996). However, not only technical challenges but also social influence, age (Morris and Venkatesh, 2000), and gender (Riquelme and Rios, 2010) differences may affect (initial) trust in m-banking and its adoption (Kim *et al.*, 2009).

While most earlier research focuses on m-banking adoption's factors (e.g. Luo *et al.*, 2010, Lin, 2011, Kim *et al.*, 2009), our approach diverges from the majority by examining the individual performance. M-banking enables users to conduct financial services in a more efficient and effective way and thus offers many advantages for individuals, such as time savings and ease of performing banking transactions. Accomplishing a task at a high level of proficiency or ease can be a source of performance, bringing feelings of mastery and pride. Poor accomplishment and outright failure in achieving one's goals might be a source of dissatisfaction or even general feelings of shame (Sonnentag and Frese, 2002). We apply the task-technology fit (TTF) theory, defined as *"the degree to which a technology assists an individual in performing his or her portfolio of tasks"* (Goodhue and Thompson, 1995). This theory suggest that individual performance is a consequence of the use and the better fit between the technology and the task it supports (Goodhue and Thompson, 1995), which is a fundamental issue in the m-banking context.

We bring two contributions to the literature related to individual performance in the m-banking arena. Firstly, to the best of our knowledge, there is no earlier research on m-banking individual performance. By providing anytime and anywhere interaction with the user's accounts (Liang and Wei, 2004), m-banking differs in many ways from

traditional storefront banking or even internet banking. At the same time, TTF theory posits that individual performance is a function of superior fit of both task and technology characteristics and of use, which is common sense but too imprecise to provide generalization to m-banking. Our work combines these elements in a novel way. Secondly, earlier research demonstrates that age and gender play an important role in the patterns of information technology (IT) adoption and use, but rarely considers these separately in the individual performance context. Consequently, this study investigates individual performance on the young and old subsamples and also male and female subsamples. We bring new insights regarding the determinant factors that influence individual performance of m-banking. Moreover, we help researchers and practitioners in the financial industry to define comprehensive strategic demographic groups.

The structure of the paper is as follows. We next examine earlier approaches in the literature for m-banking and explain TTF theory and its model. We then present the research design, methodology, and results. Finally, the results are discussed, including the implications for m-banking adoption theory and practice, and further possible research directions are suggested.

3.2 Literature review

3.2.1 Mobile banking

Mobile devices combine the traditional functionality of a telephone and the data-processing features of an information system (IS) (Zwass, 2003). The proliferation of new IT within the financial industry has influenced the way banks service consumers. In particular, self-service technologies have enabled banks to follow an electronically

multi-channel strategy. Today automated teller machines (ATM), telephone banking, Internet banking, and m-banking are all efficient ways of selling products and services to banking customers (Hoehle and Huff, 2012). These electronic banking channels largely reduce the consumer's need to visit a branch, and offer convenient access to bank accounts. Banks also benefit from self-service technologies as they can cut costs incurred in the traditional branch network (Peevers *et al.*, 2008) and establish a stronger relationship with their customers.

M-banking is defined as the product or service offered by the financial industry using a mobile device, namely a mobile phone, smartphone, or tablet (Shaikh and Karjaluoto, 2015). In fact, mobile commerce is also known as a subset of e-commerce that uses radio-based wireless devices to conduct business transactions over the web (Keng and Zixing, 2003). In recent decades the banking industry has been facing several challenges and transformations. The evolution from a focus on local-centric (branches and ATM) to place-centric (internet banking) and then to equipment-centric (accessible anywhere, 24 hours per day and 7 days a week) has brought time savings and avoided customer queues. Equipment-centric vision brings the customer closer to the bank since (s)he needs only a mobile device to carry out a financial service. In local-centric banking customers need to go to a physical place (a branch or an ATM), which may not be close to them. In place-centric banking, customers can conveniently carry out the vast majority of banking transactions remotely provided that they have a computer with internet access. Consumers favour specific banking channels for specific product categories. Hoehle and Huff (2012) noted that branches are used for complex products categories (for example, mortgages and loans) while more simple operations such as bill payments or other domestic transactions could be done through self-service technology.

Many banks charge a fee for domestic transactions made at branches to encourage customers to adopt self-service technology.

The composite services and products offered on the mobile platform range from simple accounting balance inquiries to payment of services, funds transfers, and more complex products, such as stock exchange transactions (Suoranta and Mattila, 2004). Complex transactions are quite difficult to perform on mobile devices due to their hardware limitations, such as small screens and clumsy input mechanisms. Consequently, consumers tend to use mobile devices for simple banking transactions, in situations where they need instant access to their accounts, and their other banking channels are not in reach (for example, checking their account balance before purchasing goods at a point of sale) (Hoehle and Huff, 2012). Based on the Forrester survey Q4 2011 made in Europe, 90% of transactions made by m-banking users are consulting an account balance and 62% of transactions are checking recent transactions, and only 36% of transactions use this channel to transfer money between accounts (Forrester, 2011). These figures suggest that consumers tend to use mobile devices for simple transactions in situations where they need instant access to their account information.

In their literature review (which includes 55 studies), Shaikh and Karjaluoto (2015) report that most of the articles published in the m-banking literature between 2005 and 2014 address the motivations, attitudes, behavioural intention, social systems, and associations that influenced the potential adopters of that technology. Moreover, the two most significant drivers of intentions to adopt m-banking are perceived usefulness and attitude. It can be seen that the most common focuses of m-banking studies are adoption models, and that these overlook individual performance. In the following

sections we introduce the theoretical underpinnings that support the conceptualization of our research model.

3.2.2 Task-technology fit (TTF) model

Researchers have advanced several models for technology acceptance, including the technology acceptance model (TAM) (Davis, 1989, Venkatesh and Davis, 2000), the innovation diffusion theory (IDT) (Rogers, 1995), and more recently the unified theory of acceptance and use of technology (UTAUT) (Venkatesh *et al.*, 2003, Venkatesh *et al.*, 2012). These theories have examined the factors impacting user acceptance of new technology from different angles and bolstered technology acceptance research considerably. Goodhue and Thompson (1995) proposed the TTF model, which extends the TAM by considering how task affects the use of technology.

Earlier research has used TTF to explain knowledge management systems (KMS) use (Lin and Huang, 2008), use of blogs (Shang *et al.*, 2007), location-based services (LBS) (Junglas *et al.*, 2008), use of information technology (Dishaw and Strong, 1999), use of mobile commerce in the insurance industry (Lee *et al.*, 2007a), and performance impact using learning management systems (LMS) (McGill and Klobas, 2009). Several investigations show that TTF can combine with other models such as UTAUT to explain user adoption of m-banking (Zhou *et al.*, 2010) and TAM to explain users' intention to use wireless technology in organizations (Yen *et al.*, 2010).

In TTF theory a suitable task-technology characteristic will encourage use of m-banking, while lower TTF will reduce use intention (Lee *et al.*, 2007a). The perception of fit amongst the task, the technology, and the users of a particular IT will positively

impact the technology's use (Goodhue, 1998, Goodhue and Thompson, 1995). When the mobile users feel that the technology is able to support the task at hand, they show good performance. When discussing or defining the ability of the mobile device to support the task, we mean the functionalities of the technology that enable a smooth execution of the task, reduce the time of performing the task, and/or make the task easily accomplished.

Today we can speak of the "third era" of mobile commerce (m-commerce), which began in 2007 and continues. It is also referred to as the mobile applications (m-apps) period, the period when applications and software have been designed to run on smartphones, tablet computers, and other mobile devices (Kourouthanassis and Giaglis, 2012). The financial industry is using m-apps platforms to offer more and more functionalities, which include account balances and recent transactions overview, funds transfer between a customer's own accounts, and paying bills. Many digital banking teams are developing a range of additional functionalities based on the advancement of phone hardware features such as position system (GPS) locators to help customers easily find the location of branches and ATMs, or make bill payments more easily by using the camera on a smartphone to scan details from a bill, through quick response (QR) codes. The channel strategy needs to continuously develop new solutions and tools to attract mobile users and stay as close as possible to their needs. For Hoehle and Huff (2012) the suitability of a particular banking channel depends on the particular banking task and instant handiness.

Consistent with this study's goal of understanding the fit between task characteristics and technology characteristics is the belief that fit is a core construct. According to the TTF model, systems will help to improve individual performance

when technology is a *"good fit with the tasks it supports"* (Goodhue and Thompson, 1995). In this study the concept developed is the effectiveness with which an m-banking solution can be associated with the users' tasks. Furthermore, it seems reasonable to assume that the better the match between m-banking and banking portfolio of tasks, the greater will be the use of the service. The quality of fit depends on the attributes of the objects. The following list includes some task attributes that affect the various fit dimensions:

- Task complexity – a banking transaction task may vary from simple (for example, balance enquiry) to complex (such as a loan) (Tan and Teo, 2000);
- Task frequency – the impact of regular or habitual system use has been noted in IS research (Guinea and Markus, 2009). At the end of the month users often check their account balance to verify their salary deposit;
- Task time criticality – Financial transactions, such as stock market operations, are highly sensitive due to the market volatility and to their *just-in-time* nature.

A strategy based on any of these tasks can improve individual performance and use of technology (Topi *et al.*, 2005), since a greater level of fit will explain the match between the technology and the task characteristics.

3.2.3 Individual performance

The individual performance impact in this study is very consistent with the IS success model proposed by DeLone and McLean (1992) (D&M), which states that both use and user attitudes influence the IS impact on individual performance. IS performance as *"perceived outcome from IS use"* reveals a very strong relationship between user satisfaction and intention to use (Au *et al.*, 2008). Individual performance impact in an

IS context refers to the actual performance of an individual using an IS. The Goodhue and Thompson (1995) TTF model for studying individual performance effects indicates a positive relationship between IS use and individual performance, which is also in line with the DeLone and McLean (1992) model. DeLone and McLean (1992) accounted for benefits occurring at both levels of analysis (i.e. individual and organizational), finding that the choice of what kind of impact (individual or organizational) to be measured depends on the systems being evaluated and their purposes. Here we are interested in examining the benefits that an individual can realize from using m-banking, mainly the benefit of time savings. M-banking is a more immediate form of interaction with banking services, able to carry out banking transactions with the least waste of time and effort, thereby enhancing the well-being of the user. Grounded on the individual performance literature, the information system research discipline has been taking a greater interest in seeking to explain the individual performance in the use of technological innovations. Sonnentag and Frese (2002) link the research on individual performance to the research on work-related well-being. They discuss if and how well-being and performance are empirically related and argue, especially, that self-regulation might account for such a relationship. In the performance measurement literature, job performance comprises two dimensions: task performance and contextual performance (Sonnentag and Frese, 2002). Task performance consists of behaviours carried out to complete a job; contextual performance consists of behaviours that contribute to the social/psychological climate in which a job is performed (Sonnentag and Frese, 2002). Much research has addressed individual performance, as shown in Table 3.1, but to the best of our knowledge, none has studied the individual performance using a particular technology to undertake m-banking.

Table 3.1 Overview of IS adoption on individual performance impact and TTF applications

Authors	IS applications	Theory	Sample / Method	Findings
(Thompson *et al.*, 1991)	Fit between job and PC capabilities	Model of PC Utilization	212 workers, Canada, PLS	Complexity, job fit, long-term consequences, affect, social factors, facilitating conditions, and utilization explain 24% of the variation in fit between job and PC Capabilities.
(Igbaria and Tan, 1997)	Information technology	D&M	371 employees, Singapore, PLS	User satisfaction, system use, and individual impact explain 28% of the variation in individual impact. User satisfaction is an important factor affecting system use and has the strongest direct effect on individual impact.
(Kositanurit *et al.*, 2011)	Business processes and new IT	D&M	349 US and 304 Thai employees, Decision Tree	System quality and Information quality have positive impact on utilization and performance.
(Hou, 2012)	Business intelligence systems	D&M	380 end users, Taiwan, CFA	High level of end users' satisfaction increases system use and improves individual performance. Model explains 37% of the variation in individual performance.
(Lin, 2012)	Virtual learning system (VLS)	TAM + TTF	165 students, Taiwan, PLS	Perceived fit, satisfaction, VLS continuance intention, explains 57% of the variations in perceived impact on learning.
(Huang *et al.*, 2012)	Data mining	TAM3	206 users, Taiwan, CFA	System enhances job performance and is easy to use. Model explains 58% of the variations in behavioural intentions to use data mining tools.
(Junglas *et al.*, 2008)	Mobile locatable IS	TTF	112 US students, ANOVA	Locatability, location sensitivity, and TTF.
(Gebauer and Ginsburg, 2009)	Overall technology evaluation	TTF	144 user community, US, Z Score	Task-related fit, Technology performance, and user context-related fit, explains 43% of cumulative variance of overall technology evaluation.
(Yuan *et al.*, 2010)	Mobile work support	TTF	179 mobile worker, Canada, PLS	Time criticality, mobility, location dependency, and intention to use, explains variations ranged between 71% and 77% in perceived usefulness of mobile work supports functions.
(McGill and Klobas,	Learning management	TTF	267 Students, Australia, PLS	Attitude, social norms, facilitation conditions, TTF, and use, explains 44.8% of the variability in

Authors	IS applications	Theory	Sample / Method	Findings
2009)	systems			perceived impact on learning.
(Zhou *et al.*, 2010)	Adopt m-banking	TTF + UTAUT	250 respondents, PLS	TTF, performance expectancy, effort expectancy, social influence and facilitating conditions, explains 57.5% of the variance in user's behavioural intention to adopt m-banking
(Yen *et al.*, 2010)	Adopt wireless technology	TTF + TAM	231 employees, US, CFA	Behavioural intention, perceived usefulness, perceived ease of use, and TTF, explains 69% of the variance in user's behavioural intention to adopt wireless technology in organizations.
(Parkes, 2013)	Effects of TTF on user attitude and performance	TTF	94 Subjects, Australia, ANCOVA	Task-individual-technology Fit, perceived usefulness, and decision quality, explains 37.8% of the variance in user attitude and technology performance on task performance
(Lin and Huang, 2008)	Understanding KMS use	TTF	192 subjects, Taiwan, PLS	Task interdependence and tacitness, perceived TTF, self-efficacy, personal and performance outcome expectation, and KMS use. The model explained 31.7% of the variance in personal outcome expectations that play a role in KMS use.
(Larsen *et al.*, 2009)	Users' motivation to continue IS use	TTF	135 Respondents, PLS	Perceived TTF, perceived usefulness, utilization, confirmation, and satisfaction, explains 68% IS continuance intentions.
(Lee *et al.*, 2007a)	Adoption of mobile commerce in the insurance industry.	TTF	238 Insurance agents	TTF and Individual differences.

It can be seen that the most common studies applying TTF models are related to technology adoption, technology evaluation, impact on learning, and task performance, and not with individual performance as initially suggested by Goodhue and Thompson (1995). Our paper extends the research into this unexplored area.

3.3 Research model

The theoretical foundation for the fit dimension in the TTF perspective argues that a better fit between task requirements, technological characteristics, and individual attitudes will lead to better performance (Goodhue and Thompson, 1995). Reported studies recognize that fit affects both user's attitude and performance (Goodhue and Thompson, 1995, Kositanurit *et al.*, 2011). The research model (Figure 3.1) outlines our proposal to explain through TTF the matching between the task characteristics and technology characteristics, which explains the m-banking usage and performance impact. The TTF model posits that beliefs are based on the extent of the fit between the individual, the task, and the technology (Goodhue and Thompson, 1995). The path from use to performance impact reflects the user's perception of performance improvement to be derived from using m-banking. The essence of this construct means that the degree of using the particular system will help to save time in the performance of banking tasks (Venkatesh *et al.*, 2003). In addition, the findings of several earlier studies on age and gender also mention the role of these factors in the impact on behavioural intention to adopt an IT (e.g. Venkatesh *et al.*, 2012, Venkatesh *et al.*, 2003, Morris and Venkatesh, 2000). In terms of gender, men and women have different views of IT-based services as stated in earlier studies finding that men tend to be more task-oriented than women (Venkatesh *et al.*, 2012). In terms of age, younger consumers tend to seek novelty and innovativeness more than do older consumers (Venkatesh *et al.*, 2012, Morris *et al.*, 2005). Drawing upon these findings and applying the TTF model, we propose to study the age and gender differences.

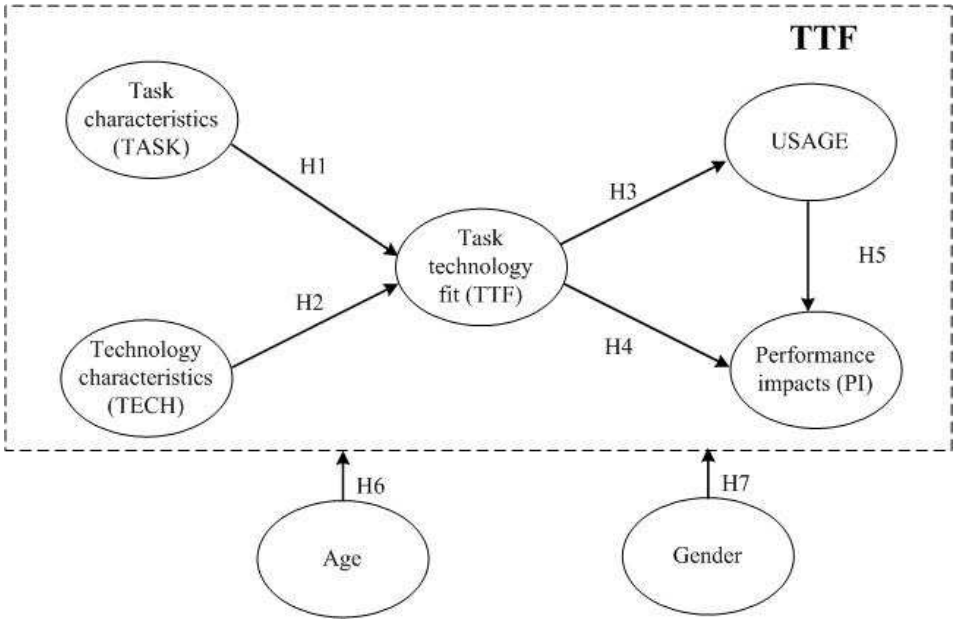


Figure 3.1 Research model

The better the fit, the more likely it is that the user will have a positive perception of the service quality. In the context of m-banking use, TTF is the degree to which a technology can assist a user in performing his/her portfolio of services or tasks. A good match of m-banking task and technology characteristics will positively affect the degree of the TTF (Zhou *et al.*, 2010). Specifically, TTF corresponds to the relationship of matching amongst task characteristics, user abilities and functionalities of technology. Thus, two hypotheses are tested in this study:

H1: Task characteristics of mobile banking positively affect the TTF.

H2: Technology characteristics of mobile banking positively affect the TTF.

The TTF model posits that m-banking will be used if, and only if, the functions offered to the end-user support (Fit) the tasks of the end-user (Zhou *et al.*, 2010, Goodhue and Thompson, 1995). A high degree of TTF will promote the use of m-banking, and the opposite, a lower degree of fit will decrease user intention to adopt m-

banking (Lee *et al.*, 2007a). Dishaw and Strong (1999) found that TTF affects users' behaviour of IT use and also establishes that TTF will affect users' individual performance. The TTF posits that IT will be used when it affects individual performance to the extent that technology options "fit" his or her task requirements. IT also influences task process, which can allow end-users to choose technologies based on that (Goodhue, 1995). TTF is directly and positively affected by the user's attitude toward the technology to individual performance. When the TTF is perceived as being useful and an improvement to individual performance (Compeau and Higgins, 1995, Davis *et al.*, 1989), it highlights the importance of fostering reliance on the technology. Therefore, perceived TTF is predicted to be a significant precursor of m-banking usage and performance impact:

H3: TTF positively affects use of mobile banking.

H4: TTF positively improves performance impacts.

Based on m-banking usage, there are applications, solutions, and products available for mobile devices that make this a valuable platform for users who expect benefits of anywhere-at-anytime connectivity (Zwass, 2003). Igbaria and Tan (1997) propose that system use has a direct positive effect on individual perceived performance impacts (i.e., perceived impact of computer systems on decision-making quality, performance, productivity, and effectiveness of the job). Based on that, using this self-service banking channel, at anytime and anywhere, could positively affect the individual performance.

H5: Use of mobile banking positively affects performance impacts.

Age is one of the most important personal characteristics amongst demographic variables. From a marketing perspective the classification of age groups within a population allows segmentation for marketing purposes (Tesfom and Birch, 2011). Age differences in individual use of new technology play an important role (Morris and Venkatesh, 2000, Morris *et al.*, 2005). In the early stages of using a new technology younger people show a greater tendency to seek novelty and innovativeness (Liu and Li, 2010). Older end-users face more difficulties in handling new or complex information, based on their decreasing cognitive and memory capabilities, which affect their learning of new technologies (Morris *et al.*, 2005, Kurniawan, 2008), and place more significance on the accessibility of adequate support (Hall and Mansfield, 1975). Based on that, we investigated the role of age in TTF, m-banking usage, and individual performance. We posit:

H6: The structure of the TTF model will differ between young and old groups.

The effect of the IT usage and the idea that men and women differ when considering their interest in and reaction to technology, have received increasing attention among researchers (Venkatesh and Morris, 2000). This gender difference in attitude about IT has been explained by some as an outcome of the socialization process. There is evidence that males and females with multiple roles experience role overload and role conflict (e.g. Barnett and Marshall, 1991, Wang, 2010). Trauth (2002) claims that there is insufficient theoretical research about gender and IT and also argues that current theories do not fully account for the variation in men's and women's relationships to IT. Grounded in the gender theory, Trauth (2013) has identified several IS investigations that suggest different implications for women's and men's attitudes and behaviour. Venkatesh and Morris (2000) report gender differences in the individual

adoption and the continuous use of technology in the workplace. Koenig-Lewis *et al.* (2010) found empirical evidence that men were significantly more likely to use m-banking than women. Riquelme and Rios (2010) investigated whether or not gender moderates the effect of behavioural intention to adopt m-banking by influencing the perceptions of ease of use and usefulness, and found that subjective norm influences adoption decision more strongly amongst women than men. Püschel *et al.* (2010) showed that m-banking users are predominantly male. For Venkatesh *et al.* (2012), given the predilection of men to play with technologies, the price value assigned by men to technologies will likely be higher than the value assigned by women to the same technologies. Driven by social role stereotypes, females will use IT-based services more frequently for personal and emotional matters, while males tend to use them for accomplishing tasks (Venkatesh *et al.*, 2003). Because the findings cited above are different, it is necessary to examine the subsample of gender. We posit:

H7: The structure of the TTF model will differ with gender.

3.4 Methods

3.4.1 Measurement

Our study was conducted in Portugal and targeted users with a wide range of m-banking experience. All measurement items (Table 3.2) were adapted from Zhou *et al.* (2010), Lin and Huang (2008), and Goodhue and Thompson (1995), with slight modifications. From the literature, TASK and TECH were adopted from Zhou *et al.* (2010); TTF from Lin and Huang (2008); USAGE from Zhou *et al.* (2010), and performance impact (PI) from Goodhue and Thompson (1995). We developed multi-item measures for each

construct in the following way. Firstly, a draft of the questionnaire, created in English and checked for content validity, was prepared by reviewing the literature. As the questionnaire was administered in Portugal, we translated the English questionnaire into Portuguese and then back into English by a different translator to ensure translation equivalence (Brislin, 1970). The scale of items was measured on a seven-point Likert scale, ranging from strongly disagree (1) to strongly agree (7). The variable age was measured in years, and gender was coded using a 0 or 1 dummy variable, where 1 represented men. Secondly, we conducted field interviews with six managers of a banking firm and modifications were made accordingly. The managers were asked to assess the terminology and the clarity of instructions and response format.

Table 3.2 Items

Constructs	Items	Adapted from
Task characteristics (TASK)	TASK1 - I need to manage my accounts anytime anywhere TASK2 - I need to make transfers anytime anywhere TASK3 - I need to have a real time control in my accounts TASK4 - The financial instructions I give can't wait	(Zhou *et al.*, 2010)
Technology characteristics (TECH)	TECH1 – M-banking provides ubiquitous services TECH2 – M-banking provides real time services TECH3 – M-banking provides a quick service TECH4 – M-banking provides secure services	(Zhou *et al.*, 2010)
Task technology fit (TTF)	TTF1 – M-banking payment services are appropriate TTF2 – M-banking account management services are appropriate TTF3 - Real time m-banking services are appropriate TTF4 - In general, m-banking services are enough	(Lin and Huang, 2008)
USAGE	USAGE1 - I use m-banking USAGE2 - I use m-banking to manage my accounts USAGE3 - I use m-banking to make transfers USAGE4 - I subscribe to financial products that are exclusive to m-banking	(Zhou *et al.*, 2010)
Performance impacts (PI)	PI1 - I gain time using m-banking PI2 – M-banking allows me to make my payments quicker	(Goodhue and Thompson, 1995)

3.4.2 Data collection

Some researchers suggest that consumer needs, interests, and attitudes vary with age, and that younger consumers have a more positive attitude toward innovation, computing, and adopting information and communication technologies (ICT), online shopping, and m-shopping (Ansari *et al.*, 2012, Pieri and Diamantinir, 2010). For Yang (2005), university students are likely to be the first customer segment to adopt mobile commerce because of their high educational level and potential income. Based on that, we considered that highly educated students, who are m-banking users, are appropriate for participating in research about m-banking individual performance. To make the results generalizable, the participants of this study were university students from the European Union (EU).

Data were collected using an online survey questionnaire to test the model. A pilot survey was conducted with 30 m-banking users in order to refine the questions and gain additional comments on the content and structure. Preliminary results of the pilot survey showed that the scales were reliable and valid; with the exception of one item (TECH3), which had a loading higher than 0.70 but lower than cross loadings. We decided not to exclude this item from the survey, however, due to the fact that it was still in the pilot-study stage and because of the importance of measuring that item in the m-banking context. Nevertheless, the data from the pilot survey were not included in the main survey. Given the constraint of data protection and the right to privacy, a sampling frame could not be obtained from any financial institution. A total of 856 students and ex-students from a university were contacted by e-mail, provided with the hyperlink of the survey, and asked to confirm that they were an m-banking user. A

follow-up email was sent in the second stage to those who did not answer in the first stage. In total, 317 accepted the invitation to respond (37% response rate) but only 256 responses were usable for further analysis (173 early respondents and 83 late respondents). To test for non-response bias, the sample distribution of the early and late respondent groups was compared using the Kolmogorov-Smirnov (K-S) test (Ryans, 1974) (Table 3.3). The sample distributions of the two groups did not differ significantly, indicating an absence of non-response bias (Ryans, 1974). The common method bias was examined using Harman's one-factor test (Podsakoff *et al.*, 2003). It revealed that there was more than one factor, with the first accounting for less than the 50% threshold value. We therefore conclude that common method bias is unlikely to be a serious concern. Thereafter, the marker-variable technique was used (Malhotra *et al.*, 2006, Lindell and Whitney, 2001). No significant common method bias was found in the data set.

Table 3.3 Testing possible biases: Early respondents vs. late respondents

	Full sample (n = 256)		**Early respondents (n = 173)**		**Late respondents (n = 83)**		**Kolmogorov-Smirnov test**
	Mean	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**	**p-value**
Task characteristics (TASK)	5.04	1.66	5.15	1.53	4.81	1.89	0.32
Technology characteristics (TECH)	5.46	1.32	5.56	1.24	5.26	1.46	0.35
Task technology fit (TTF)	5.06	1.34	5.11	1.30	4.95	1.43	0.75
USAGE	4.57	2.04	4.62	2.02	4.47	2.07	0.84
Performance impacts (PI)	5.47	1.48	5.57	1.39	5.27	1.62	0.46

The study results are based upon m-banking users. A total of 135 respondents are women and 121 are men. Regarding age, a total of 85 (33 percent) of the respondents are below 25, whilst the remaining 67 percent are above that age. Concerning m-banking experience, 25 percent of users have at least of 6 months of

usage experience, 37 percent have between 6 and 12 months experience, and 38 percent have more than a year of experience. Regarding the employment situation, we find that 57 percent of m-banking users are working professionals. Detailed descriptive statistics relating to the respondents' characteristics are shown in Table 3.4.

Table 3.4 Sample characteristics

Distribution (n=256)		**Obs.**	**(%)**
Gender	Male	121	47%
	Female	135	53%
Age	18-20	40	16%
	21-25	45	18%
	26-30	43	17%
	31-35	41	16%
	36-40	29	11%
	> 40	58	23%
Education	High School or below	122	48%
	Associate degree	77	30%
	Bachelor	53	21%
	Master's degree	4	1%
Employment	Students	111	43%
	Working professionals	145	57%
Industry	Manufacturing	33	13%
	Service	93	36%
	Education and research	119	46%
	Government agencies	4	2%
	Others	7	3%
Months using mobile Banking	<6	64	25%
	6-11	95	37%
	12-24	76	30%
	>24	21	8%

3.5. Results

Validation of the research model was performed by applying a two-step method, starting with the measurement model in order to test the reliability and validity of the instrument and then analysing the structural model (Anderson and Gerbing, 1988). Since the research is an early stage assessment of m-banking and none of the items in the data were normally distributed with the Kolmogorov–Smirnov's test ($p<0.01$), the partial least squares (PLS) is the most suitable method for this study (Hair *et al.*, 2012, Hair *et al.*, 2011). As a popular rule of thumb for robust PLS estimations, one uses a minimum of ten times the largest number of structural paths directed at a particular construct in the model (Chin, 1998a, Gefen and Straub, 2005). The sample in our research met the necessary conditions for applying PLS. The estimation and data manipulation were performed using SmartPLS (Ringle *et al.*, 2005).

3.5.1 Measurement model

The results of the measurement model are reported in Tables 3.5 and 3.6. We assessed construct reliability, indicator reliability, convergent validity, and discriminant validity. Construct reliability is commonly tested with the composite reliability (CR) coefficient. PLS prioritizes indicators according to their individual reliability. CR is employed as an alternative to Cronbach's alpha (CA) to analyse the reliability of the constructs, since the former takes into consideration indicators that have different loading (Hair *et al.*, 2011, Hair *et al.*, 2012, Henseler *et al.*, 2009, Werts *et al.*, 1974) while CA assumes that

all indicators are equally reliable (Raykov, 2007). As shown in Table 3.6, all the constructs have an adequate CR of 0.7 or greater, which suggests that the constructs are reliable as recommend by Straub (1989).

Table 3.5 PLS loadings and cross-loadings

Construct		TASK	TECH	TTF	USAGE	PI
Task characteristics (TASK) (CR=0.95; CA=0.91; AVE=0.85)	TASK1	**0.93**	0.49	0.52	0.55	0.51
	TASK2	**0.94**	0.47	0.54	0.60	0.53
	TASK3	**0.90**	0.53	0.54	0.48	0.52
Technology characteristics (TECH) (CR=0.92; CA=0.87; AVE=0.80)	TECH1	0.51	**0.89**	0.68	0.51	0.61
	TECH2	0.52	**0.92**	0.70	0.46	0.66
	TECH4	0.42	**0.88**	0.68	0.43	0.63
Task technology fit (TTF) (CR=0.96; CA=0.95; AVE=0.86)	TTF1	0.58	0.70	**0.93**	0.62	0.67
	TTF2	0.55	0.71	**0.94**	0.63	0.71
	TTF3	0.55	0.75	**0.94**	0.56	0.68
	TTF4	0.48	0.69	**0.91**	0.53	0.64
USAGE (CR=0.96; CA=0.93; AVE=0.88)	USAGE1	0.60	0.56	0.64	**0.94**	0.71
	USAGE2	0.54	0.47	0.57	**0.96**	0.59
	USAGE3	0.51	0.42	0.56	**0.93**	0.58
Performance impacts (PI) (CR=0.95; CA=0.90; AVE=0.91)	PI1	0.57	0.71	0.69	0.62	**0.95**
	PI2	0.51	0.64	0.69	0.65	**0.95**

The indicator reliability was evaluated based on the criteria that the loadings should be 0.70 or greater and that every loading less than 0.4 should be eliminated (Henseler *et al.*, 2009, Churchill Jr, 1979). As shown in Table 3.5, the loadings are greater than 0.70. TASK4, TECH3, and USAGE4 have loading lower than 0.70 and were excluded for that reason. All the items are statistically significant at 0.1%. Overall, the instrument presents good indicator reliability.

Average variance extracted (AVE) was used as the criterion to test convergent validity. The AVE should be 0.5 or higher so that latent variable explains more than half

of the variance of its indicators (Fornell and Larcker, 1981, Hair *et al.*, 2012, Henseler *et al.*, 2009). All five constructs have an AVE that exceeds the recommended threshold of 0.5 (see Table 3.5).

Discriminant validity is assessed by using the Fornell-Larcker criterion (Fornell and Larcker, 1981) and the cross-loadings between indicators and constructs. The Fornell-Larcker criterion requires the square root of AVE to be greater than the correlations between the constructs. The cross-loadings criterion requires that the loading of each indicator should be greater than all cross-loadings (Chin, 1998a, Götz *et al.*, 2010, Grégoire and Fisher, 2006). Table 3.6 reveals that the square roots of AVEs (diagonal elements) are higher than the correlation between each pair of constructs (off-diagonal elements) and Table 3.5 demonstrates that the loadings (in bold) are greater than cross-loadings. Therefore, both measures are met.

Table 3.6 Descriptive statistics, correlations, and root square of AVEs

Construct	Mean	SD	TASK	TECH	TTF	USAGE	PI
Task characteristics (TASK)	5.04	1.66	**0.92**				
Technology characteristics (TECH)	5.46	1.32	0.54	**0.89**			
Task technology fit (TTF)	5.06	1.34	0.58	0.77	**0.93**		
USAGE	4.57	2.04	0.59	0.52	0.63	**0.94**	
Performance impacts (PI)	5.47	1.48	0.56	0.71	0.73	0.67	**0.95**

Note: Diagonal elements are the square root of the AVE.

The assessment of construct reliability, indicator reliability, convergent validity, and discriminant validity of the constructs are satisfactory, indicating that the constructs can be used to test the conceptual model. These results were for the full sample, and as we will also use subsamples, we performed the same analysis for younger, older, male, and female subsamples (these tables are available from the authors on request). The

results obtained in subsamples also indicate that the constructs can be used to test the conceptual model.

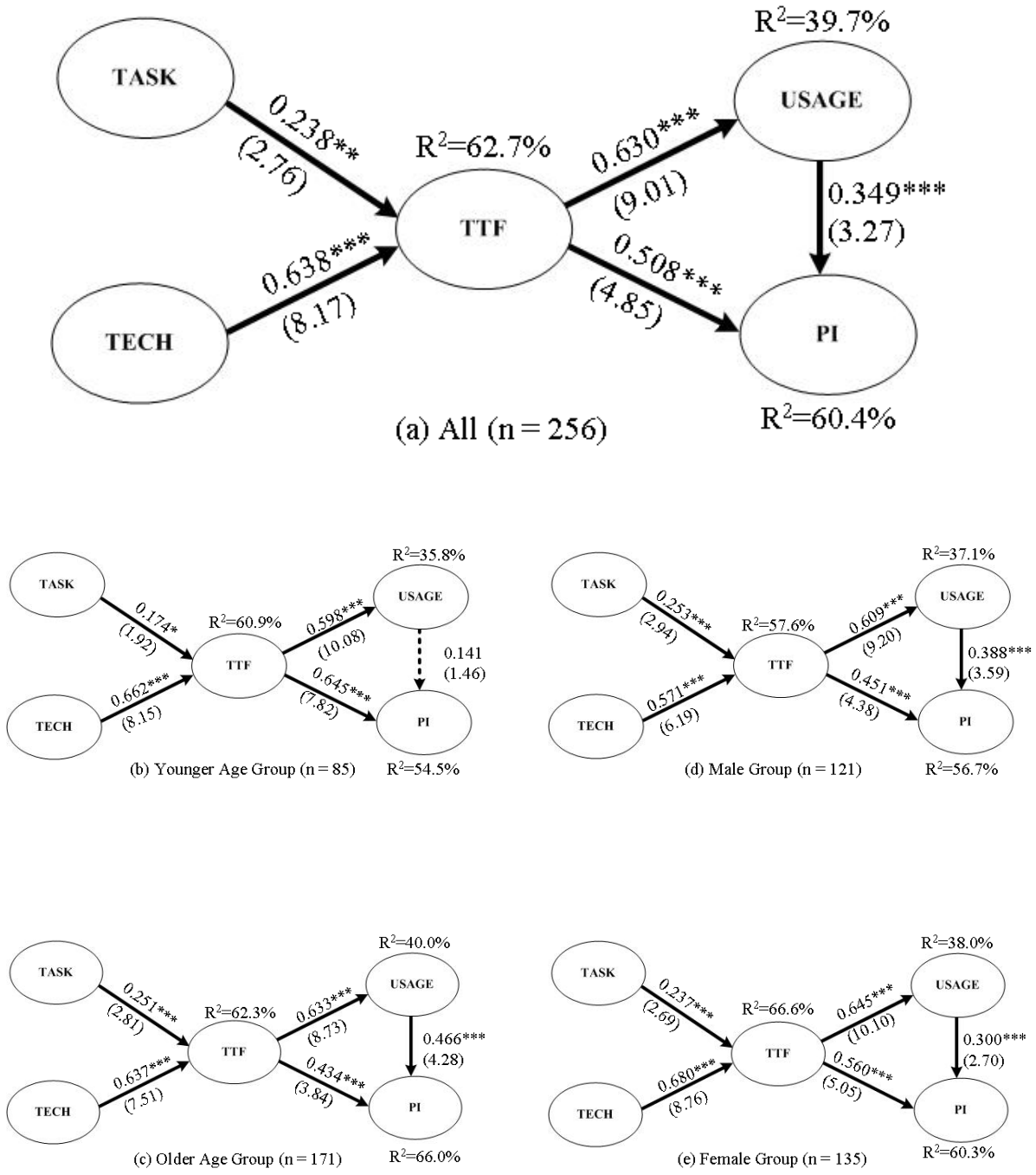
3.5.2 Structural model

Figure 3.2 shows the path coefficient for the full-sample model with bootstrapping t-statistics derived from standard error with 500 resamples. The estimates of the coefficients from a bootstrap distribution can be viewed as an approximation of the sampling distribution and its standard deviation, and can be used as a proxy for the parameter's standard error in the population. Therefore, t values are calculated to assess each indicator weight's significance (Hair *et al.*, 2014). In the full sample 62.7% of the variation in TTF is explained by task characteristics ($\hat{\beta}$=0.238, $p<0.05$) and technology characteristics ($\hat{\beta}$=0.638, $p<0.01$), and consequently H1 and H2 are supported. 39.7% of the variation in m-banking usage is explained by TTF ($\hat{\beta}$=0.630, $p<0.01$), providing support for H3. Finally, 60.4% of the variation in performance impact is explained by TTF ($\hat{\beta}$=0.508, $p<0.01$) and m-banking usage ($\hat{\beta}$=0.349, $p<0.01$), providing support for H4 and H5, respectively.

In order to test the effects of age (H6) in the model, the sample was divided into "younger" and "older" groups. The "older" group comprised those over 25 years old (67%) and the "younger" group those no more than 25 years old (33%), which is the same age division used by Moores and Chang (2006). For the older subsample, the research model accounting for 66% of the variation in performance impact, and the hypotheses H1, H2, H3, H4, and H5 were all statistically significant and consistent with the full model (see Figure 3.2). For the younger subsample, the path usage to performance impact is not significant (H5), which suggests that use of m-banking plays

no role in individual performance. The research model accounted for 54.5% of the variation in performance impact, and the H1, H2, H3, and H4 are statistically significant.

In order to test the effects of gender (H7) in the model, the sample was divided into male and female groups. For the female subsample, the research model accounting for 60.3% of the variation in performance impact, and the H1 to H5 were confirmed (see Figure 3.2), yielding results that are very similar to the full sample model. For the male subsample, the model explains 56.7% of the variation in performance impact, and H1 to H5 were again supported. The male submsaple is therefore also consistent with the full sample.



Note: t-test are shown in parentheses; *p<0.10; **p<0.05; ***p<0.01;

Figure 3.2 Path models by group

The f^2 effect size captures the contribution of m-banking TTF and usage to the R^2 value of the target construct of individual performance in the structural model. The guidelines for evaluating f^2 are that values of 0.02, 0.15, and 0.35 respectively represent small, medium, and large effects (Cohen, 1988) of the endogenous latent variable. Table 3.7 reports the evaluation of f^2 effect size on the structural model of this study. For the full sample, the individual performance evaluation defines f^2 effect size of 0.19 as belonging to a medium effect size, thereby confirming that the evaluation criteria have been met, thereby demonstrating the contribution of each of the exogenous constructs of the TTF model. In addition to assessing the degree of the R^2 values as a measure of predictive accuracy, the author examines Stone-Geisser's Q^2 value (Geisser, 1974, Stone, 1974). This measure is an indicator to show the model's predictive quality. As shown in Table 3.7, all of the Q^2 values are considerably greater than zero, suggesting the model's predictive quality.

Table 3.7 Total effects on individual performance by subgroup

Subsample	**R^2**		**f^2**	**Effect**	**Q^2**		**q^2**	**Effect**
	Included	Excluded		**Size**	Included	Excluded		**Size**
Usage → performance								
Full	0.604	0.530	0.19	Medium	0.541	0.476	0.14	Medium
Young	0.545	0.532	0.03	Small	0.457	0.463	-0.01	Small
Old	0.660	0.530	0.38	Large	0.596	0.482	0.28	Medium
Male	0.567	0.471	0.22	Medium	0.481	0.404	0.15	Medium
Female	0.620	0.568	0.14	Medium	0.566	0.520	0.11	Medium
TTF → performance								
Full	0.604	0.450	0.39	Large	0.541	0.401	0.31	Medium
Young	0.545	0.289	0.56	Large	0.457	0.245	0.39	Large
Old	0.660	0.548	0.33	Medium	0.596	0.496	0.25	Medium
Male	0.567	0.441	0.29	Medium	0.481	0.372	0.21	Medium
Female	0.620	0.440	0.47	Large	0.566	0.395	0.39	Large

For testing the last two hypotheses (H6 and H7) we calculated a pooled error term t-test to determine statistical significance of the different path coefficients by age and gender. PLS based on the multigroup analysis (MGA) approach is suitable to perform a comparison across a group such as age and gender (Keil *et al.*, 2000). The t-test is then manually calculated to determine the differences in paths between groups. This statistical comparasion was carried out as follows:

$$t = \frac{\beta_{(1)} - \beta_{(2)}}{\sqrt{\frac{(n_{(1)}-1)^2}{n_{(1)}+n_{(2)}-2} \cdot se^2_{\beta_{(1)}} + \frac{(n_{(2)}-1)^2}{n_{(1)}+n_{(2)}-2} \cdot se^2_{\beta_{(2)}}} \cdot \sqrt{\frac{1}{n_{(1)}} + \frac{1}{n_{(2)}}}}$$

Where

t = t-statistics with ($n_{(1)} + n_{(2)} - 2$) degrees of freedom

$n_{(i)}$ = sample size of the dataset for gender i or age i

$se_{\beta_{(i)}}$ = standard error of path in the structural model of gender i or age i

$\beta_{(i)}$ = path coefficient in the structural model of gender i or age i.

Table 3.8 shows the results for age and gender differences. Based on age, our results suggest that there is a difference in the path coefficients between usage to performance impact. Because usage is a more important factor for the older subsample, H6 is partially supported. For gender, the discrepancy is not statistically significant, which means that usage and performance impact are equally important for both genders (H7 is not supported).

Table 3.8 Results of pooled error term t-tests by subgroup

Path	Younger		Older		Younger - Older
	Path Coeff.	**SE from bootstrap**	**Path Coeff.**	**SE from bootstrap**	**t-Statistics**
TASK→TTF	0.174	0.104	0.176	0.081	-0.545
TECH→TTF	0.662	0.088	0.711	0.069	-0.191
TTF→USAGE	0.598	0.064	0.546	0.082	0.315
TTF→PI	0.646	0.089	0.423	0.094	1.245
USAGE→PI	0.141	0.109	0.468	0.091	**-1.933***
Path	**Male**		**Female**		**Male - Female**
	Path Coeff.	**SE from bootstrap**	**Path Coeff.**	**SE from bootstrap**	**t-Statistics**
TASK→TTF	0.253	0.086	0.237	0.088	0.133
TECH→TTF	0.571	0.092	0.680	0.078	-0.913
TTF→USAGE	0.609	0.066	0.645	0.064	-0.400
TTF→PI	0.451	0.103	0.560	0.111	-0.719
USAGE→PI	0.388	0.108	0.300	0.111	0.567

Note: *p<0.01.

3.6 Discussion

Over the past decades TTF has been applied to explain an individual performance of technology usage, but to the best of our knowledge, it has never been used to explain individual performance in the moblie banking context. We asked users if they felt a benefit of time savings and if they performed financial services faster by using m-banking. The findings of this study indicate differences in the age subsamples and differences for the gender subsamples that are not statistically significant. The results indicate that m-banking has a pronounced effect on an individual's performance. Analytical results obtained herein are consistent with those reported in the current literature that have demonstrated that both task characteristics and technology characteristics strongly affect the task technology fit. Our model explains 62.9% of the

variation in TTF, which is consistent with results from similar studies (Zhou *et al.*, 2010). Study findings are also consistent with those in the literature that state that TTF and usage positively contribute to performance improvement (McGill and Klobas, 2009, Lin, 2012). The analysis provides support for the model. In particular, the results demonstrate the importance of examining the use of a particular technology in explaining individual performance. These findings also provide evidence that individual performance is a function of both system usage and TTF, which in turn provides evidence on how m-banking adds value to individual performance.

3.6.1 Theoretical implications

These findings provide some interesting theoretical insights into the usage and individual performance of m-banking, which have not been the focus in earlier research. Our theoretical model contributes to research by highlighting the importance of studying demographic groups and by exploring the effects of age and gender differences, revealing that usage and individual performance have different results for each subsample. Considering the use of new technology, women and men have different points of view. Venkatesh *et al.* (2012) argues that women will use technology more frequently for personal and emotional matters, while men tend to use it more for task accomplishment. Our results reveal that task characteristics show no statistically significant difference between the male and female subsamples, which contradicts the literature. Technology characteristics and usage are equally important for male and female groups and therefore impact on individual performance. Goodhue and Thompson (1995) demonstrate empirically that performance impact is a function of both usage and TTF, not usage or TTF alone. However, for the age subsample, m-

banking usage is more likely to lead to performance impact for the older than for the younger group. This means that for m-banking, the usage to performance impact is not statistically significant for the younger subsample, which differs from Goodhue and Thompson (1995) findings. For the younger subsample the tendency is for an increasing importance of the novelty associated with new technology (Venkatesh *et al.*, 2012), giving more importance to TTF, assuming that the usage has no impact on performance. Consistently, the findings also reveal that the direct effect of TTF on the older user to performance impact is weaker than on the younger.

Although earlier studies have addressed m-banking adoption, the strength of the current research lies in the fit between the task and technology characteristics to the usage obtained by examining the individual performance. This is indicated by the high explanatory power of our research model. Our full sample model explains 60.4% of the individual performance of m-banking compared to the 44.8% of the perceived impact in learning management systems reported by McGill and Klobas (2009), who also apply the TTF model. Compared to earlier studies (summarized in Table 3.1), the research models are thus a valuable contribution to the existing body of research. This study therefore makes an important contribution by highlighting the role that task–technology fit may have in influencing usage and performance impact of m-banking users.

3.6.2 Managerial implications

This study provides implications for financial enterprises for influencing their customers to adopt and use m-banking. M-banking users are amongst those most likely to exhibit a motivation to keep up with trends and new ways of interacting with banking channels to save time with their financial transactions. Therefore, it is effective to

undertake strategies to attract m-banking users who would like to find new means of interaction instead of using other traditional banking channels (Hoehle and Huff, 2012). In line with findings of the age subsample, the challenge here is in meeting customers' needs and making it easy to use, even to the extent of encouraging the use of the service by promoting the benefits instead of the service, itself. Also to be considered is the fact that management information reports might help managers to understand what the customers are doing, but not what they might want to do. A survey or another form of customer feedback might help them to realize what they want to do or even capture new ideas and suggestions.

We find that the matching between TTF and usage explains individual performance. TTF plays an important function in the ability to use and lead individual performance while striving to discover new ways or channels of performing financial transactions. Potential users can also benefit by addressing their concerns about performance impact. Although organizations in general continually seek new solutions to assess, understand, and strategize the running of a successful business, this study provides some strategy insight through system development and marketing services to promote adequate services to meet end-users' needs. For the younger group, the usage plays no role on performance impact while the TTF plays a significant part, which is important to promote the technology and task through this group. Despite this, our findings reveal no significant differences based on the gender subsamples. The analyses based on both age and gender show considerable importance in the development and marketing strategy to attract customers to this channel. A possible reason is that the young group tends to have a greater degree of mobile self-efficacy coupled with less effort of use. What really matters in explaining performance impact in this group is TTF.

For the older group the usage is more important than in the younger group to explain performance impact, because the older tend to face more difficulty in processing new and complex information, and learn more through repeated use of the new technology (Venkatesh *et al.*, 2012).

3.6.3 Limitations and future research

This study has several limitations that should be taken into consideration when generalizing its findings. Firstly, the data were gathered in the European Union (EU). To enhance generalization future research should collect cross-country data that expose national cultural values as moderators in order to more thoroughly explain both use and performance impacts (Lee *et al.*, 2007b). Secondly, despite earlier research suggesting that students represent typical consumers (Remus, 1986), they may not fully represent the population of all potential m-banking users, which might be a threat to our findings. To enhance generalization and external validity, the sample for future research could include non-students. Thirdly, the model is time-sectional, it measures perceptions at a single point in time, but perceptions change over time as individuals gain experience (Mathieson *et al.*, 2001, Venkatesh and Davis, 1996). This change has implications for researchers and practitioners interested in predicting usage and performance over time, which need to be considered. Future research may include longitudinal data and examine the research model at different time periods, thereby providing greater insight into the usage and individual performance of m-banking.

3.7 Conclusion

The huge explosion of mobile device usage and the initiatives in the electronic banking sector have drawn the attention of researchers toward m-banking adoption. However, the influence of m-banking usage and individual performance considering the TTF impact has received limited attention. Our research seeks to understand the determinants of TTF, m-banking usage, and individual performance, with the added dimensions of the age and gender subsamples. In the full sample, TTF explains m-banking usage, and TTF and usage explain performance impact. In the subsample we find statistically significant differences between younger and older subsamples on path usage and TTF to performance impact. Therefore, usage is a more important factor for the older subsample and TTF is more important for the younger subsample. Overall, our study confirms the importance of TTF's impact on usage and individual performance of m-banking.

Chapter 4 - Understanding the impact of m-banking on individual performance: DeLone & McLean and TTF perspective

4.1 Introduction

Mobile banking (m-banking), also referred to as cell phone banking, is the use of mobile devices such as personal digital assistants (PDA), mobile telephones, smartphones, and tablet computers to access banking networks via the wireless application protocol (WAP) for financial services (Shaikh and Karjaluoto, 2015). M-banking enables users to access account balances, pay bills, transfer funds, and perform other financial services, at any time and anywhere. It is widely recognized that the use of m-banking is influenced by more than the core service. Use decisions might be influenced by the service quality of the interaction with personnel, task characteristics, and many other factors. These factors are considered to enlarge the core service in the eyes of the customer, such that customers respond to both the core and the enlarged service when making use decisions.

We applied the terminology of the individual performance to express the idea in the m-banking context of efficiency and effectiveness performing banking tasks. This paper explains the benefits of performing banking tasks at a high level, since time saving and effort can be a source of individual performance. Use and end-user satisfaction have an important impact on m-banking individual performance. Performing banking tasks at a high level can be a source of individual performance, bringing feelings of control and fulfilment.

An extensive body of research has been developed to understand the determinants of m-banking adoption. In their literature review of m-banking research between the years of 2005 and 2014 (which includes 55 studies), Shaikh and Karjaluoto (2015) report motivations, attitudes, behavioural intention, social systems, and associations that influenced potential m-banking adopters. Hoehle *et al.* (2012) identified 56 m-banking adoption research sources published between 2001 and 2010. Another m-banking literature review published by Dewan (2010) lists 65 articles published between January 2000 and May 2010, identifying five main categories: m-banking overview and conceptual issues, m-banking applications and cases, m-banking behavioural issues, infrastructures of mobile users and networks, and strategic, legal, and ethical issues. To enhance the current understanding of m-banking, Dewan (2010) emphasized the need for more theory-based empirical research from a non-traditional perspective. We provide further insights into individual performance implications within the broad conceptualization of fit amongst task characteristics, technology characteristics, system quality, information quality, and service quality.

The objective of this study is to address the following research questions: (1) What determinants influence m-banking use, end-user satisfaction, and individual performance? (2) Does task technology fit (TTF) have only a direct effect on individual performance? (3) Does TTF moderate the use on the individual performance and the user satisfaction on the individual performance? To answer these questions and provide a better understanding of the impact of m-banking on individual performance, we develop a theoretical model that combines the DeLone & McLean (D&M) model (DeLone and McLean, 1992, DeLone and McLean, 2003) and the TTF model (Goodhue and Thompson, 1995), by including the moderating effect of TTF on the link between

use and individual performance, and the link between user satisfaction and individual performance. Based on that, our contribution with this research is twofold. Firstly, to the best of our knowledge this is the first time that the D&M model (DeLone and McLean, 1992, DeLone and McLean, 2003) and the TTF model (Goodhue and Thompson, 1995) are combined on m-banking individual performance value. As our study is based on two well established theories, the integration into a single model contributes to the information system (IS) discipline. Secondly, this research examines the importance of TTF not only as a direct effect on individual performance, but also as the moderator effects of use and user satisfaction on individual performance. We expect this study to offer instrumental insights to m-banking managers for them to apply the right policies to retain users and attract potential m-banking adopters.

The remainder of this paper is organized as follows. We first revisit the literature related to m-banking individual performance. The theoretical bases of the study are then described. The D&M model and TTF model are the foundation for the theoretical model of the study. Following this, the research methodology and the data analysis using structural equation modeling are presented. The paper concludes with a discussion of results, contributions to theory and practice, limitations, and suggestions for future research.

4.2 Literature review

4.2.1 M-banking individual performance

M-banking is defined as the product or service offered by the financial industry using a mobile device, namely a mobile phone, smartphone, or tablet (Shaikh and Karjaluoto,

2015). Kim *et al.* (2009) also trace another definition for m-banking as the subset of applications of mobile e-commerce offered by the financial industry. In fact, mobile commerce is also known as a subset of e-commerce that uses radio-based wireless devices to conduct business transactions over the web (Keng and Zixing, 2003).

In recent decades the banking industry has faced several challenges and transformations. The evolution from a focus on local-centric (branches and ATM) to place-centric (internet banking) and then to equipment-centric (accessible anywhere, 24 hours per day and 7 days a week) has brought time savings and reduced customer queues. Equipment-centric vision brings the customer closer to the bank since (s)he needs only a mobile device to carry out a financial service. In local-centric banking customers need to go to a physical place (a branch or an ATM), which may not be close to them. In place-centric banking, customers can conveniently carry out the vast majority of banking transactions remotely, provided that they have a computer with internet access. Consumers favour specific banking channels for specific product categories.

Three broad literature reviews have examined m-banking from different angles and revealed the factors and motivations that influence the adoption and behaviour intention (Shaikh and Karjaluoto, 2015, Dewan, 2010, Hoehle *et al.*, 2012). This helped us to characterize the development of this research stream and show where it is today. To the best of our knowledge, there is no earlier research on m-banking individual performance. Based on that, and motivated by the research gap mentioned, we provide further insights on individual performance at the post-adoption phase. Additionally, the growing amount of recent m-banking research shows no signs of saturation. The targets of these recent studies are adoption (Malaquias and Hwang, 2016, Tran and Corner,

2016), behaviour intention (Afshan and Sharif, 2016), adoption and rejection behaviour (Laukkanen, 2016), and intention to use (Mortimer *et al.*, 2015). In the current research we focus on individual performance applying two models, namely the D&M IS Success model (original and updated version) (DeLone and McLean, 1992, DeLone and McLean, 2003), and the TTF model (Goodhue and Thompson, 1995). We select these models as the most appropriate and integrated to develop the proposed conceptual model for this study, which is to understand the significance of m-banking on individual performance.

The term "performance" usually relates to effectiveness and productivity. Individual performance is highly important for an organization as a whole and for the individuals working in it (Sonnentag and Frese, 2002). In this research we adopt this term not in an organizational context, but at the individual level, to express the idea in the m-banking context of efficiency and effectiveness at performing banking tasks. Performing banking tasks at a high level could enhance time saving and effort and can be a source of individual performance. For Sonnentag and Frese (2002) accomplishing tasks at a high level of proficiency or ease can be a source of performance, bringing feelings of mastery and pride. Poor accomplishment and outright failure in achieving one's goals might be a source of dissatisfaction or even general feelings of shame.

Several examples related to the criticality of time in performing financial transactions, such as stock market operations, are highly sensitive due to market volatility and to their *just-in-time* nature, Checking an account balance or even verifying a salary deposit or payments processing are m-banking transactions that aim to meet market and customer demands of high level of individual performance. In the next two subsections we describe the theories applied in this research.

4.2.2 DeLone & McLean

The original D&M taxonomy was based on Mason's (1978) modification of Shannon and Weaver's (1949) mathematical theory of communications, which identified three levels of information: (a) the technical level (accuracy and efficiency of the system that produces it); (b) the semantic level (its ability to transfer the intended message), and (c) the effectiveness level (its impact on the receiver) (Shannon and Weaver, 1949). Mason (1978) adapted this theory for IS and expanded the effectiveness level into three sub-categories: (a) receipt of information, (b) influence on the recipient, and (c) influence on the system. The original D&M model (Figure 4.1) identified six factors for the success of IS, namely system quality, information quality, system use, user satisfaction, individual impact, and organizational impact. This general theory of IS posits that the match between information quality and system quality is more likely to have a positive impact on performance if the end-user feels satisfaction and uses the system.

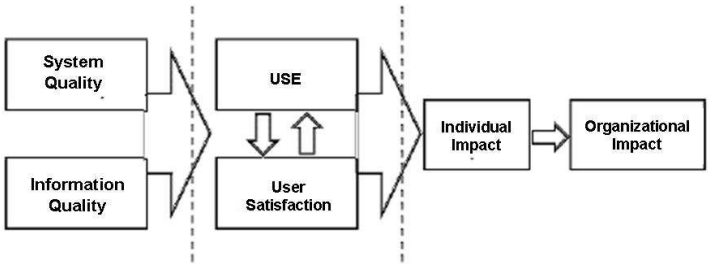


Figure 4.1 Original D&M IS success model

Pitt *et al.* (1995) observe that the D&M information system success model did not include a measure of IS service quality. They believe that it is necessary to include IS service quality, and further assert that system quality, information quality, and service quality together have an impact on IS use and user satisfaction. Based on

additional research, the Original D&M Success model was updated, and the key addition in the updated model was the inclusion of service quality. Recently Petter *et al.* (2013) reviewed the literature published from 1992-2007 that covered multiple levels of analysis, different types of IS, and different contexts to develop a taxonomy of IS success. Driven by the need for a process by which to understand IS success and its impacts, this taxonomy developed five determinant success categories: task, individual, social, project, and organizational characteristics. Nevertheless, given that the focus of task characteristics is applied to the activities supported by the organization and that we are interested in analysing at individual level, we find the Goodhue and Thompson (1995) theory more suitable (see the next sub-section).

Several articles have been published in the IT/IS field that use the D&M IS Success model (original and updated version) as the theoretical basis. These include knowledge management systems (KMS) (Velasquez *et al.*, 2009), learning success systems (Lin, 2007, Cheok and Wong, 2015), websites success goals (Schaupp *et al.*, 2006), implementation success of enterprise resource planning (ERP) (Tsai *et al.*, 2012), evaluation of the electronic health record (Bossen *et al.*, 2013), and employee portal success (Urbach *et al.*, 2010). Several authors demonstrate that D&M can combine with other models such as the unified theory of acceptance and usage of technology (UTAUT) to explain electronic patient records (Maillet *et al.*, 2015); D&M with trust dimension to explain repurchase intention in online services (Hsu *et al.*, 2014), or continuance intention of mobile payment service (Zhou, 2013). In addition, Urbach and Müller (2012) expose several applications of each dimension of the D&M model, but to the best of our knowledge there is no literature on the D&M model in m-banking individual performance

4.2.3 Task technology fit

Building on performance impact theory, Goodhue and Thompson (1995) used the TTF model (Figure 2) to explain IS performance impact. TTF refers to the matching of the capabilities of the technology to the requirements of the task, that is, the ability of technology to support a task. The model theorizes that the fit between task characteristics and technology characteristics influences the use and performance impact (Goodhue and Thompson, 1995). A better fit of task-technology characteristics will encourage the use of m-banking, while the opposite reduces use intention (Lee *et al.*, 2007a). The TTF model assumes users to be rational and that they will use the technology as long as it best supports the task. Interest in this model derives from the fact that the TTF construct is treated as a composite with these three success dimensions embedded in it.

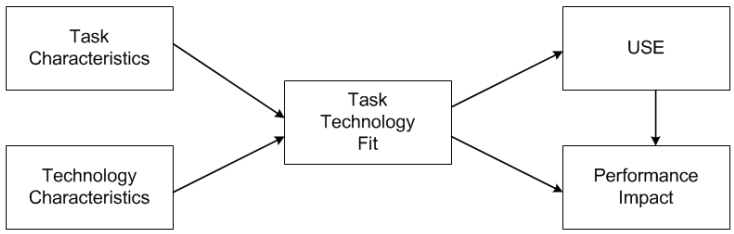


Figure 4.2 TTF model

There are several applications applying the TTF model, such as explaining use of blogs (Shang *et al.*, 2007), KMS use (Lin and Huang, 2008), location-based services (LBS) (Junglas *et al.*, 2008), use of information technology (Dishaw and Strong, 1999),

use of mobile commerce in the insurance industry (Lee *et al.*, 2007a), performance impact using learning management systems (LMS) (McGill and Klobas, 2009), and mobile work support (Yuan *et al.*, 2010). Several investigations show that TTF can combine with other models such as UTAUT to explain user adoption of m-banking (Zhou *et al.*, 2010), TAM to explain users' intention to use wireless technology in organizations (Yen *et al.*, 2010), and UTAUT combined with the initial trust model (ITM) to explain m-banking adoption (Oliveira *et al.*, 2014).

4.2.4 Integrated model of D&M and TTF

The D&M IS Success model (original and updated version) (DeLone and McLean, 1992, DeLone and McLean, 2003) and the TTF model (Goodhue and Thompson, 1995), focus on different aspects/dimensions and have different perspectives on the influence of use and individual performance. Each model focuses on a certain perspective, which can hardly be embraced in its entirety and variety of possible situations by a particular model (Abugabah and Sanzogni, 2010). Each model has strengths and weaknesses, and these are offset and complemented by combining the various models. The D&M and TTF models complement each other, meaning that their combination is useful for understanding the impact of individual performance and IS discipline. Moreover, weaknesses in the two models can be compensated for by connecting them with each other. For example, the D&M model's weakness is the lack of consideration of how well technology characteristics fit the task characteristics. On the other hand, TTF models do not include system quality, information quality, or service quality toward m-banking user satisfaction. The convergent constructs of both models improve our understanding of m-banking use and individual performance.

4.3 Research model

M-banking is one of the most important issues in financial industries. In this study we posit that TTF, the measures in D&M IS success, and the service quality in the updated D&M model play important roles in the individual performance. We propose a research model that is theoretically grounded on two well-established theories: D&M and TTF. Goodhue and Thompson (1995) tested the effect of individual performance based on the task characteristics, technology characteristics, and use. The D&M model (original and updated versions) proposed an IS success model, which argues that system quality, information quality, and service quality affect use and user satisfaction, and that all of these lead to individual and organizational performance impact. Since the use, user satisfaction, and individual performance become important issues of m-banking, the integration of both models could offer valuable insights to m-banking managers. Regarding the moderating effects, the study also tests the moderating effect of TTF on the link between use and individual performance, and the link between user satisfaction and individual performance. The research model is depicted in Figure 3.

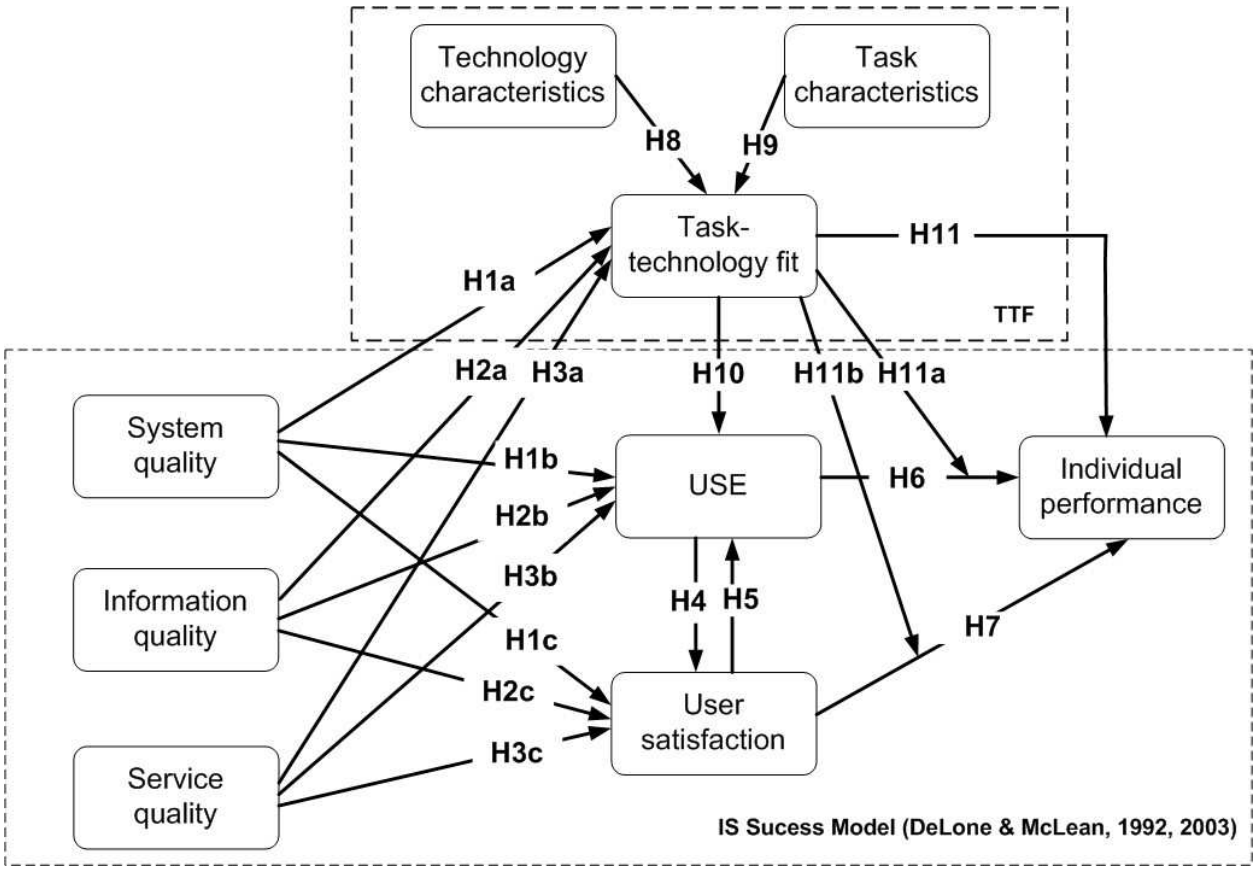


Figure 4.3 Research model

System quality comprises the desirable characteristics (e.g. ease of use, system flexibility, and system reliability) of an information system (Petter *et al.*, 2008, DeLone and McLean, 1992). Measuring the quality of information systems is a multidimensional process focusing on many of the aspects of a system such as system features, quality features, usability aspects, and other features related to technical issues (Urbach and Müller, 2012). Typical measures of the system quality in traditional studies include response time, ease of use, flexibility, and stability (Wu and Wang, 2006). Due to a device's physical restrictions, such as the small size keypad, small screen, and other constraints, by enhancing overall m-banking system quality we expect to mitigate

negative factors. Taking this background into account, higher system quality is expected to lead to greater TTF, more use, and increased user satisfaction, which will lead to positive impacts on individual performance.

H1a: System quality has a positive influence on TTF in m-banking.

H1b: System quality has a positive influence on use of m-banking.

H1c: System quality has a positive influence on user satisfaction of m-banking.

Information quality comprises the desirable characteristics (e.g. relevance, accuracy, timeliness, completeness, understanding, and accessibility) of the system outputs; that is, management reports and Web pages (Petter *et al.*, 2013). For Akter *et al.* (2013) information quality plays a critical role in developing a positive attitude toward the benefits of using a specific information technology (IT). For Urbach and Müller (2012) the "*information quality is often seen as a key antecedent of user satisfaction*". The information quality shapes attitudes about information and system satisfaction, which in turn influences behavioural beliefs, such as perceived usefulness and perceived ease of use, and, consequently, behavioural attitude and usage intention of m-banking (Wixom and Todd, 2005). Therefore, we propose the following:

H2a: Information quality has a positive influence on TTF in m-banking.

H2b: Information quality has a positive influence on use of m-banking.

H2c: Information quality has a positive influence on user satisfaction of m-banking.

Service quality is the quality of the support (e.g. responsiveness, reliability, conciseness, technical competence, and empathy of personnel) that system users receive from the IS department and IT support personnel (DeLone and McLean, 2003, Petter *et*

al., 2008). Service quality is often described as how well a delivered service level matches customer expectations. Adapted from the field of marketing, Pitt *et al.* (1995) refer to service quality as a popular instrument for measuring IS function. They note that most IS effectiveness measures focus on the products rather than the services, and IS effectiveness will be estimated incorrectly if IS service quality is not included. Due to the physical dimensions of the device, there are several issues faced by m-banking, such as usability problems. We expect that ensuring the overall quality of the support can reduce or even eliminate potential usage problems. Therefore, we hypothesize:

H3a: Service quality has a positive influence on TTF in m-banking.

H3b: Service quality has a positive influence on use of m-banking.

H3c: Service quality has a positive influence on user satisfaction of m-banking.

The individual performance in this study is very consistent with the IS success model proposed by DeLone and McLean (1992), which states that both use and user attitudes influence the IS impact on individual performance. IS performance as "perceived outcome from IS use" reveals a very strong relationship between user satisfaction and intention to use (Au *et al.*, 2008). Individual performance impact in an IS context refers to the actual performance of an individual using an IS. In the m–banking context it is the ability to carry out banking transactions with the least expenditure of time and effort, thereby enhancing the well-being of the user. Sonnentag and Frese (2002) link their research on individual performance to the research on work-related well-being. They discuss if and how well-being and performance are empirically related and argue, especially, that self-regulation might account for such a relationship. In the updated version, (DeLone and McLean, 2003) the model explained the construct

as follows: “Use must precede ‘user satisfaction’ in a process sense, but positive experience with ‘use’ will lead to greater ‘user satisfaction’ in a causal sense”. The increased user satisfaction will lead to a greater intention to use, which will subsequently affect individual performance. Hence, the following hypotheses are proposed:

H4: The use affects the user satisfaction of m-banking.

H5: The user satisfaction affects the use of m-banking.

H6: The use of m-banking influences individual performance.

H7: The user satisfaction of m-banking influences individual performance.

In the broad TTF perspective, tasks are defined as actions carried out by individuals in turning inputs to outputs to satisfy their information needs (Goodhue and Thompson, 1995). Task characteristics are those for which a user might use information technology. Tasks can vary in a number of dimensions: task non-routineness, task interdependence, and time criticality. The proposition is that as tasks become more demanding or the information technology offers less functionality, users’ evaluation of the information technology will decrease. Technology characteristics is the tool (hardware, software, data) used by end-users in carrying out their tasks (Goodhue and Thompson, 1995). The attributes of these technologies such as design and other factors can affect usage and users’ perceptions of the technology. M-banking technology characteristics make the technology attractive to the users, and allow tasks such as accessing account balances, paying bills, transferring funds, and other financial services. Another important aspect is the design. Design affects how, and how much, a technology will be used (Fildes *et al.*, 2006). Thus, poor or unintended design choices

will result in a technology being ignored or overshadowed by another. Thus, we hypothesize the following:

H8: Technology characteristics have a positive influence on TTF in m-banking.

H9: Task characteristics have a positive influence on TTF in m-banking.

TTF is the perception of fit amongst the task characteristics and technology characteristics that will positively influence the technology's use and individual performance (Goodhue and Thompson, 1995, Goodhue, 1998). When the users feel that the technology is capable of supporting the task at hand, they show good individual performance. Therefore, perceived TTF is predicted to be a significant precursor of m-banking use and individual performance.

H10: Task-technology fit has a positive influence on use of m-banking.

H11: Task-technology fit of m-banking has a positive influence on individual performance.

We expect that the effect of TTF moderates the effect of use on individual performance, because the task and technology characteristics of m-banking will encourage the use of this service. It is possible that when users perceive that a technology supports m-banking end users' task requirements, the TTF will be high. When consumers begin to use a particular technology such as m-banking they will pay more attention to its novelty and the tasks its supports (Venkatesh *et al.*, 2012); as experience increases, the user will expect that higher TTF will positively moderate the effect on individual performance. On the other hand, the moderating effect of TTF on user satisfaction to explain the individual performance is weaker for m-banking users

with high TTF. Based on this, we expect that user satisfaction is less important in explaining individual performance when the TTF level is high. Thus, we hypothesize:

H11a: TTF will moderate the effects of use on individual performance, such that the effects will be stronger among users with high TTF.

H11b: TTF will moderate the effects of user satisfaction on individual performance, such that it will be weaker among users with high TTF.

4.4 Methods

4.4.1 Measurement

Our target population is the current users of m-banking. Our study was conducted in a European country (Portugal) in the context of users of m-banking. M-banking supports miscellaneous financial services that can be accessed using a mobile device over a wide geographic area and at any time.

All measurement items (Appendix A) were adapted from Urbach *et al.* (2010), Zhou *et al.* (2010), Wu and Wang (2006), and Lin and Huang (2008), with slight modifications. From the literature, system quality (SYSQ), information quality (INFQ), service quality (SERQ), and individual performance (PI) came from Urbach *et al.* (2010); task characteristics (TASK), technology characteristics (TECH), and USE were adopted from Zhou *et al.* (2010); user satisfaction (US) from Wu and Wang (2006), and task technology fit (TTF) from Lin and Huang (2008). The items for all constructs are included in Appendix A.

4.4.2 Data

A questionnaire was initially developed in English, based on the literature, and the final version was independently translated into Portuguese by a professional translator, and

then back into English by a different translator to ensure translation equivalence (Brislin, 1970). The data were collected using an online survey conducted via a popular survey website between November 2014 and February 2015. Most items were measured using seven-point Likert scales, ranging from totally disagree (1) to totally agree (7). To test the instrument, a pilot study was conducted on a group of 30 college students who were not included in the main survey. A total of 1,100 e-mails were sent in November 2014 providing the hyperlink to the survey and inviting participation in it. A follow-up reminder was sent in January 2015 to non-respondents. 329 responses were received at the end of February 2015, which corresponds to a 29.9 percent response rate. 96 responses were removed due to incompleteness, leaving 233 (21.2 percent) with valid and complete responses. To test for non-response bias, the sample distribution of the early and late respondent groups were compared using the Kolmogorov-Smirnov (K-S) test (Ryans, 1974). The sample distributions of the two groups did not differ significantly, indicating an absence of non-response bias (Ryans, 1974). The results revealed no statistically significant difference ($p>0.01$), indicating the absence of non-response bias. Additionally, to test for common method bias, the marker variable technique was employed (Malhotra *et al.*, 2006, Lindell and Whitney, 2001). No significant common method bias was found in the data set.

The study addresses m-banking users. A total of 139 respondents (60%) are men; 111 (48%) of the respondents are 35 years old or younger. Concerning m-banking usage frequency, 33 percent use it every day and 41 percent between three to five times per month. Detailed descriptive statistics relating to the respondents' characteristics are in Table 4.1.

Table 4.1 Sample characteristics

Distribution (n=233)					
Age			Education		
<25	19	8%	High School or below	19	8%
25-30	46	20%	Undergraduate degree	30	13%
31-35	46	20%	Bachelor	129	55%
36-40	39	17%	Master's degree or higher	55	24%
41-50	57	24%			
>50	26	11%			
Gender			M-banking usage frequency		
Male	139	60%	Occasionally use	24	10%
Female	94	40%	1-3 times a week	38	16%
			3-5 times a month	94	41%
			Every day	77	33%

4.5 Results

The data analysis was carried out using structural equation modeling (SEM). The models were estimated with partial least squares (PLS), which has been widely selected as a tool in the IS/IT field (Chin *et al.*, 2003). PLS was chosen because: (i) not all items in our data are distributed normally ($p<0.01$ based on Kolmogorov-Smirnov's test); (ii) the research model has not been tested in the literature; (iii) the research model is considered to be complex; (iv) PLS estimation requires ten times the largest number of structural paths directed at a particular construct in the model (Chin, 1998a, Gefen and Straub, 2005). The sample in our study met the necessary conditions for using PLS.

Smart PLS 2.0 M3 (Ringle *et al.*, 2005) was the software used to analyse the relationships defined by the theoretical model.

4.5.1 Measurement model

Tables 4.2 and 4.3 present the measurement model results. The results for composite reliability (CR) are greater than 0.9, indicating that the model has good internal consistency. The good indicator reliability was evaluated based on the criterion that the loadings should be greater than 0.70. As seen in Table 4.3, the loadings are above 0.70. Average variance extracted (AVE) was used to test convergent validity. AVE should be higher than 0.50 so that the latent variables explain more than half of the variance of their indicators (Henseler *et al.*, 2009, Hair *et al.*, 2014). As is also seen in Table 4.3, AVE for each construct is above the expected threshold of 0.5, ensuring convergence. These results assure the validity and reliability of the measures in this research. To further examine the discriminant validity of the measures used, two methods were employed. First, the square roots of AVEs (diagonal elements) are greater than the correlation between each pair of constructs (off-diagonal elements) (Fornell and Larcker, 1981). Second, to ensure the discriminant validity, the loadings should be larger than cross loadings (Chin, 1998a, Götz *et al.*, 2010, Grégoire and Fisher, 2006). In Table 4.3 we can see that the square root of AVE (in bold) is higher than the correlation between constructs. The measurement model results indicate that the model has good internal consistency, indicator reliability, convergent validity, and discriminant validity. Hence, the constructs of our model are statistically distinct and can be used to test the structural model.

Table 4.2 PLS loadings and cross-loadings

Constructs		SYSQ	INFQ	SERQ	USE	US	PI	TASK	TECH	TTF
System quality	SYSQ1	**.94**	.79	.59	.69	.79	.77	.44	.69	.72
	SYSQ2	**.95**	.79	.54	.63	.73	.70	.41	.66	.67
	SYSQ3	**.95**	.82	.59	.61	.74	.68	.40	.67	.71
	SYSQ4	**.95**	.81	.55	.67	.76	.74	.47	.67	.71
	SYSQ5	**.90**	.82	.56	.67	.80	.69	.44	.71	.74
Information	INFQ1	.82	**.94**	.58	.71	.77	.75	.48	.75	.78
quality	INFQ2	.82	**.93**	.59	.70	.77	.74	.43	.70	.75
	INFQ3	.73	**.87**	.54	.61	.67	.63	.42	.63	.67
	INFQ4	.78	**.91**	.59	.62	.72	.68	.45	.67	.72
	INFQ5	.72	**.87**	.57	.58	.72	.61	.40	.63	.67
	INFQ6	.76	**.88**	.48	.63	.73	.65	.39	.72	.74
Service quality	SERQ1	.58	.58	**.96**	.51	.58	.57	.45	.51	.54
	SERQ2	.60	.60	**.97**	.51	.59	.59	.45	.54	.57
	SERQ3	.56	.58	**.97**	.46	.56	.54	.41	.49	.53
	SERQ4	.57	.60	**.92**	.47	.56	.55	.39	.48	.52
Use	USE1	.68	.69	.51	**.97**	.81	.78	.55	.61	.69
	USE2	.67	.66	.49	**.95**	.80	.78	.58	.58	.64
	USE3	.66	.70	.47	**.95**	.81	.77	.53	.57	.67
User	US1	.76	.74	.55	.81	**.96**	.80	.48	.65	.75
satisfaction	US2	.82	.82	.59	.82	**.98**	.84	.52	.71	.78
	US3	.81	.82	.60	.83	**.98**	.83	.53	.70	.78
	US4	.79	.78	.59	.83	**.98**	.84	.53	.68	.77
Individual	PI1	.71	.69	.55	.76	.78	**.95**	.50	.58	.66
performance	PI2	.71	.72	.55	.71	.78	**.92**	.47	.61	.67
	PI3	.72	.71	.55	.81	.83	**.94**	.55	.68	.67
Task	TASK1	.35	.35	.35	.50	.42	.42	**.84**	.36	.40
characteristics	TASK2	.45	.48	.38	.56	.51	.51	**.90**	.45	.52
	TASK3	.41	.40	.42	.48	.46	.46	**.86**	.40	.50
	TASK4	.36	.39	.37	.44	.40	.40	**.82**	.33	.43
Technology	TECH1	.66	.68	.50	.57	.66	.64	.42	**.91**	.71
characteristics	TECH2	.57	.63	.41	.45	.55	.49	.35	**.88**	.65
	TECH3	.69	.72	.44	.56	.64	.64	.40	**.91**	.69
	TECH4	.59	.62	.50	.56	.59	.54	.41	**.78**	.62
Task	TTF1	.71	.73	.51	.69	.76	.71	.50	.73	**.94**
technology fit	TTF2	.72	.75	.55	.67	.76	.67	.53	.71	**.95**
	TTF3	.68	.74	.52	.56	.67	.59	.49	.68	**.89**

Table 4.3 Means, standard deviations, correlations, and reliability and validity measures (CR, CA, and AVE) of latent variables.

Constructs	Mean	SD	CR	CA	1	2	3	4	5	6	7	8	9
(1) SYSQ	5.40	1.17	.97	.97	**.94**								
(2) INFQ	5.47	1.15	.96	.95	.86	**.90**							
(3) SERQ	5.16	1.30	.98	.97	.61	.62	**.95**						
(4) USE	5.37	1.92	.97	.95	.70	.71	.51	**.96**					
(5) US	5.38	1.50	.99	.98	.81	.81	.60	.84	**.98**				
(6) PI	5.63	1.50	.96	.93	.76	.75	.59	.81	.85	**.94**			
(7) TASK	5.83	1.27	.92	.88	.46	.48	.45	.58	.53	.54	**.86**		
(8) TECH	5.77	1.10	.93	.89	.72	.76	.53	.61	.70	.67	.46	**.87**	
(9) TTF	5.63	1.20	.95	.92	.76	.80	.57	.69	.79	.71	.55	.77	**.93**

4.5.2 Structural model

Since hypotheses H4 and H5 include a mutual influence between use and user satisfaction that cannot be tested simultaneously, we tested two different models. Model 1 assumes that the influence is from use to user satisfaction (H4), whereas model 2 flows from user satisfaction to use (H5). The results of the tests performed on the two structural models are depicted in Figure 4.4. The upper path coefficients give the results of model 1 and the lower ones of model 2. The path coefficient for the model with bootstrapping t-statistics is derived from standard error with 5,000 iterations (Hair *et al.*, 2014).

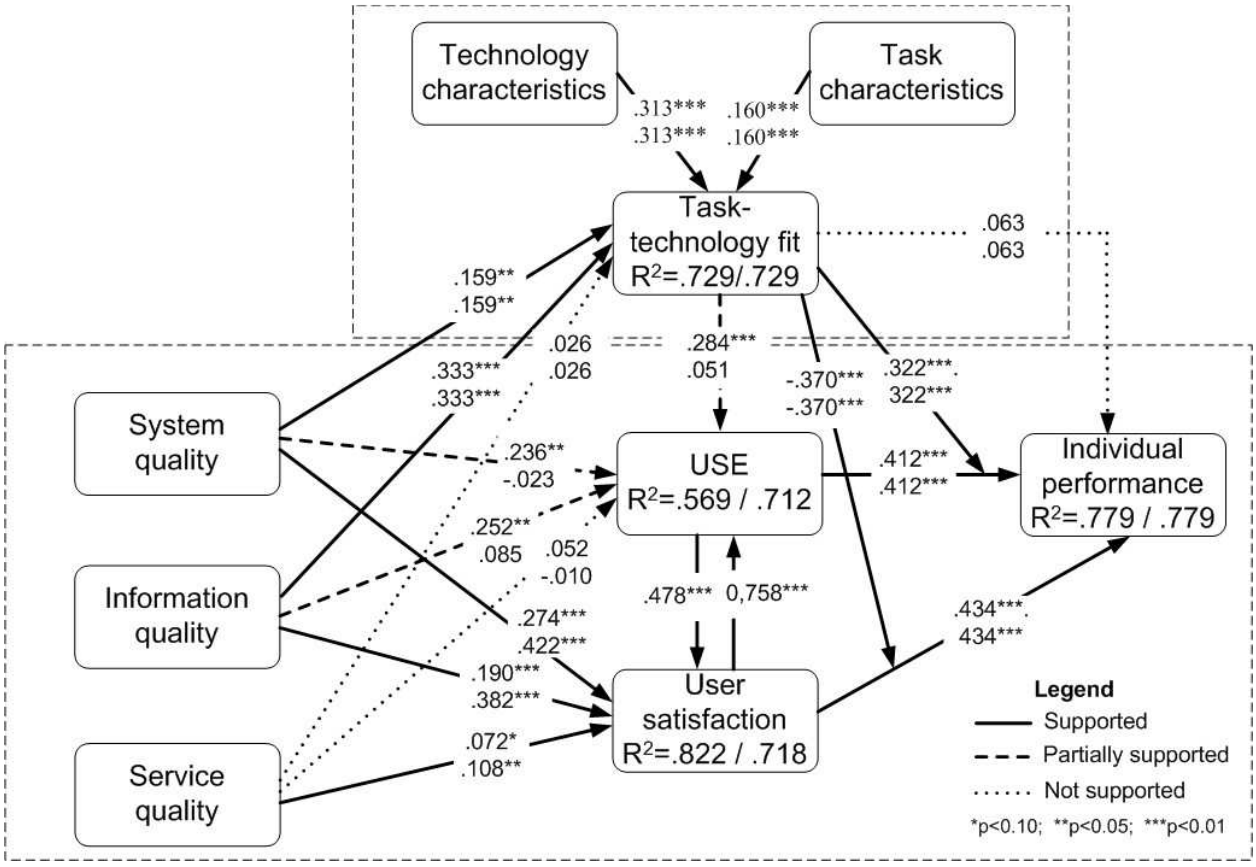


Figure 4.4 Research model

The results can be summarized as follows. The model explains 56.9% (in model 1) and 71.2% (in model 2) of the variation in m-banking use. The user satisfaction ($\hat{\beta}$ = .758, p < .01) is statistically significant in explaining the use, thus confirming hypothesis H5. The system quality ($\hat{\beta}$ = .236, p < .01 in model 1), information quality ($\hat{\beta}$ = .252, p < .01 in model 1), and TTF ($\hat{\beta}$ = .284, p < .01 in model 1) are statistically significant in explaining use in model 1, but in model 2 are not statistically significant, thus partially confirming hypotheses H1b, H2b, and H10. The service quality is not statistically significant in explaining the use, and consequently H3b is not confirmed.

The system quality ($\hat{\beta}$ = .274, p < .01 in model 1 and $\hat{\beta}$ = .422, p < .01 in model 2), information quality ($\hat{\beta}$ = .190, p < .01 in model 1 and $\hat{\beta}$ = .382, p < .01 in model 2),

service quality ($\hat{\beta}$ = .072, p < .10 in model 1 and $\hat{\beta}$ = .108, p < .05 in model 2), and use ($\hat{\beta}$ = .478, p < .01 in model 1) are statistically significant in explaining user satisfaction, thus confirming hypotheses H1c, H2c, H3c, and H4. The model explains 82.2% (in model 1) and 71.8% (in model 2) of the variation in user satisfaction of m-banking.

The system quality ($\hat{\beta}$ = .159, p < .05), information quality ($\hat{\beta}$ = .333, p < .01), technology characteristics ($\hat{\beta}$ = .313, p < .01), and task characteristics ($\hat{\beta}$ = .160, p < .01) are statistically significant in explaining TTF, thus confirming hypotheses H1a, H2a, H8, and H9. The service quality is not statistically significant, and consequently H3a is not confirmed. The model explains 72.9% of the variation in TTF.

The use ($\hat{\beta}$ = .412, p < .01), and user satisfaction ($\hat{\beta}$ = .434, p < .01) are statistically significant in explaining individual performance, thus confirming hypotheses H6 and H7. The TTF is not statistically significant, and consequently H11 is not confirmed. The TTF was assessed as a moderating variable in the relationship between use and individual performance (hypothesis H11a). The high value of TTF will enhance the relationship between use and performance impact ($\hat{\beta}$= .322, p<.01). The hypothesis H11b, due the ($\hat{\beta}$= -.370, p<.01) lower value of TTF, will enhance the relationship between user satisfaction and individual performance. Thus, hypotheses H11a and H11b are confirmed. The model explains 77.9% of the variation in individual performance of m-banking.

Most of the hypotheses derived from the TTF model and D&M model are partially or totally supported (13 hypotheses in a total of 19 hypotheses) by our study.

The f^2 effect size captures the contribution of one construct on another. Table 4.4 reports the evaluation of f^2 effect size for both models on the structural model of this study. In our model all significant structural paths to the individual performance range

from small to large effect size. The path TTF to individual performance shows a small effect size; the path use to individual performance shows a mediunm effect size, and the path user satisfaction to individual performance defines f^2 effect size of .362 as belonging to a large effect size.

The models' predictive power was tested with a non-parametric Stone-Geisser's Q^2 value (Geisser, 1974, Stone, 1974). This measure is an indicator to show a model's predictive quality. The test results show positive values for use (Q^2= .518 in model 1 and Q^2= .647 in model 2), user satisfaction (Q^2= .779 in model 1 and Q^2= .679 in model 2), individual performance (Q^2= .673 in both models), and TTF (Q^2= .621 in both models). Positive Q^2 values indicate that the prerequisites of predictive power for the model are fulfilled (Hair *et al.*, 2014). The findings regarding the 19 hypotheses are summarized in Table 4.4

Table 4.4 Results of hypotheses tests

Hypothesis	β	Support	f^2	Effect size	R^2
Use					.569 / .712
H1b: System quality → Use	.236***/-.023	Partial	.032/,000	Small/-	
H2b: Information quality → Use	.252***/.085	Partial	.030/.003	Small/-	
H3b: Service quality → Use	.052/-.010	No	.005/.000	-	
H5: User satisfaction → Use	- /.758***	Yes	- /.497	Large/Large	
H10: TTF → Use	.284***/.051	Partial	.063/.000	Small/-	
User satisfaction					.822 / .718
H1c: System quality → User satisfaction	.274***/.422***	Yes	.101/.163	Small/Medium	
H2c: Information quality → User satisfaction	.190***/.382***	Yes	.045/.131	Small/Small	
H3c: Service quality → User satisfaction	.072*/.108**	Yes	.017/.025	-/Small	
H4: Use → User satisfaction	.478***/ -	Yes	.584/ -	Large/Large	
Task technology fit					.729 / .729
H1a: System quality → TTF	.159**/.159**	Yes	.026/.026	Small/Small	
H2a: Information quality → TTF	.333***/.333***	Yes	.089/.089	Small/Small	
H3a: Service quality → TTF	.026/.026	No	.004/.004	-	
H8: Technology characteristics → TTF	.313***/.313***	Yes	.144/.144	Small/Small	
H9: Task characteristics →TTF	.160***/.160***	Yes	.070/.070	Small/Small	
Individual performance					.779 / .779
H6: Use → Individual performance	.412***/.412***	Yes	.181/.181	Medium/ Medium	
H7: User satisfaction → Individual performance	.434***/.434***	Yes	.362/.362	Large/Large	
H11: TTF → Individual performance	.063/.063	No	.104/.104	Small/Small	
H11a: Use x TTF → Individual performance	.322***/.322***	Yes	.063/.063	Small/Small	
H11b: User satisfaction x TTF → Individual performance	-.370***/-.370***	Yes	.095/.095	Small/Small	

Path- β: *p<.10; **p<.05; ***p<.01; Effect size: > .350 large; > .150 and ≤ .350 medium; > .020 and ≤ .150 small (Chin, 1998b, Cohen, 1988)

4.6 Discussion

To the best of our knowledge, this is the first empirical research that investigates the relationship integrating the TTF and D&M models, and considers the moderating effect of TTF on the use to individual performance and user satisfaction to individual

performance in m-banking. Our results show, except for H3a, H3b, and H11, that our hypotheses are totally or partial supported.

The use of m-banking in our model is explained by system quality, information quality, service quality, and TTF. The model explains 56.9% in model 1 (when the use explains user satisfaction) and 71.2% in model 2 (when the user satisfaction explains the use) of the variation in m-banking use. Our hypotheses derived from system quality, information quality, and TTF to explain use are partially supported, i.e. only supported in model 1, and service quality is not supported (in either model). Considering only the results of overall quality (SYSQ, INFQ, and SERQ) of m-banking to explain use, the results are consistent with those reported in similar studies (e.g. Urbach *et al.*, 2010).

Our research model validates the relationship between the overall quality (SYSQ, INFQ, and SERQ) of m-banking and user satisfaction. The model explains 82.2% in model 1 and 71.8% in model 2 of the variation in user satisfaction m-banking. There are several influences of overall quality of the m-banking system that enhance user satisfaction, and consequently the positive effect on use, which is comparable with other studies (e.g. Lin and Lee, 2006, Hollmann *et al.*, 2013, Lin, 2007). Specifically, the findings demonstrate how important it is to enhance the system quality, information quality, and service quality and the influence of these on the user satisfaction.

The research model explains 72.9% of the variation in TTF. Compared with other investigations exploring m-banking adoption with TTF application (Zhou *et al.*, 2010), our study obtains a greater predictive power. These results demonstrate the positive effects of system quality, information quality, technology characteristics, and task characteristics on TTF.

The research model explains 77.9% of the variation in individual performance, which presents a stronger predictive power (Chin, 1998a). Based on the result, we argue that use and user satisfaction lead to m-banking individual performance. In addition, it also confirms that TTF moderates the relationship between the use and user satisfaction of m-banking to explain individual performance. Our results suggest that having a high value of TTF means that the effects of use on individual performance will be stronger, but on the other hand, the moderate effects of user satisfaction on the individual performance will be weaker. If the m-banking users feel that service fits their task needs, the use will gain power and user satisfaction will lose power in explaining the individual performance.The implications of the study to theory and practice are summarized below.

4.6.1 Theoretical implications

From the theoretical perspective this study integrates D&M and TTF to explain individual performance of m-banking. We found that TTF has no direct influence on individual performance, but when we applied the moderating effect of TTF on use to individual performance, and user satisfaction to individual performance, our results demonstrated that TTF plays an important role. With these results the contributions of the study are twofold: first, the study enhances the limited body of knowledge on m-banking individual performance. To the best of our knowledge, most m-banking research focuses on potential adopters. This is an area of m-banking research that is as yet unexplored. Second, some constructs have no direct impact one to another, but testing in combination with other constructs as a moderation effect could play an important role. This would enhance the validity of testing several scenarios to uncover other insights.

Regarding the effect of system quality, information quality, and service quality on use and user satisfaction, the results indicate that m-banking users are more likely to use m-banking if they feel satisfaction using it (Baptista and Oliveira, 2015). Once again, the results suggest that the overall quality of the m-banking system has no statistically significant influence on use when user satisfaction explains use (model 2). While earlier work has emphasized the importance of m-banking adoption, in post-adoption behaviour we advance the knowledge base by suggesting that overall quality affects user satisfaction and their relationship with use of m-banking.

We believe that researchers undertaking future studies on technology individual performance will find this study useful. The integrative approach presented in this paper should serve as a suitable model to evaluate the determinant factors in technology performance impact and can be used as a basis for future research.

4.6.2 Managerial implications

This research has important practical implications for decision makers, specifically, an approach to identifying IS properties that banking managers can leverage on to improve user performance on m-banking tasks. Exploring the effects of time saving and less effort on performing banking tasks can be a source of individual performance. Our concern here is the time criticality and its relationship with efficiency and effectiveness, and to expose the drivers that should be taken into account.

Our results suggest that managers seeking potential adopters and users for continuous use of m-banking service should focus on the system quality, information quality, and service quality in order to enhance user satisfaction. This finding is perhaps the most important managerial lesson to be learned because today managers tend to believe that the importance of measuring the overall quality of the system diminishes as

the m-banking system matures and becomes more stable. Therefore, the alignments of task characteristics, technology characteristics, system quality, and information quality strongly affect the task technology fit. Because m-banking provides service at any time and anywhere, we recommend that managers focus on improving users' utilitarian benefits with m-banking service by, for example, enhancing system speed, reducing system down time, enhancing the variety of features, and personalizing information and tasks. Continually updating all information that supports the m-banking users could enhance the information quality. Irrelevant, inaccurate, or out-of-date information could affect user satisfaction. One of the major challenges of providing the excellence of service quality is keeping the competence, courtesy, helpfulness, and empathy of the personnel, and their behaviour effects on the generation of a positive customers' word-of-mouth (Choudhury, 2014). Due to lower labour costs, several firms make strategic decisions to outsource the call centre. A knowledgeable agent can solve technical problems in a timely fashion, while an incompetent agent can aggravate a customer's frustration, leading to customer complaints, reducing the likelihood of future use of the system, and harming the user company's image (Ren and Zhou, 2008, Ye *et al.*, 2014).

Based on these results, an understanding of user behaviour toward m-banking use, users' satisfaction, and finally the individual performance requires concepts from different theories. To achieve successful strategies it is recommended that decision-makers base their action plans on the factors that impact the user.

4.6.3 Limitations and future research

Several limitations to our research must be acknowledged. First, since it is our assumption that there will be greater use of m-banking over time, a longitudinal study to

assess this evolution will be of interest and may provide more insights on how user behaviour changes over time. Second, our study did not include all task characteristics for mobile work (such as task complexity). Here, our major concern is time criticality and its effects on efficiency and effectiveness in performing banking tasks. Third, we conducted this research in a single country having one of the highest mobile penetrations in the European Union (EU), but not in m-banking. To enhance generalization, a comparison with different countries, with a larger sample size, variety of ages, and across a variety of cultures is welcome.

We explained m-banking individual performance using D&M and TTF. Future research may draw on other theories such as trust or even perceived theory and explore the effects of other factors. We encourage researchers to conduct replication studies to confirm (or possibly challenge) findings of this study in different regions or countries.

4.7 Conclusions

As the main focus of this work is the m-banking individual performance field, a literature review was conducted in order to identify the gaps and the best way to move forward. While the majority of m-banking studies focus on adoption and behaviour intention, this work focuses on the post-adoption stage. Retaining m-banking users may be as valuable as thinking about potential adopters. By integrating the D&M and TTF model, which complement each other, our empirical work seeks to understand the drivers of use, user satisfaction, TTF, and individual performance.

Our results point to a significant effect of system quality, information quality, and TTF on m-banking use in model 1 (in which use explains user satisfaction). The system quality, information quality, and service quality play an important role on user satisfaction. The TTF of m-banking is positively affected by system quality, information

quality, technology characteristics, and task characteristics. The results demonstrate that use and user satisfaction are important precedents of individual performance, and also reveal the importance of the moderating effects of TTF over use and user satisfaction to individual performance. Additionally, the use, user satisfaction, and moderating effects of TTF provided more predictive power to m-banking individual performance, which is an important aspect to retain m-banking users. Thus, we might learn more about how to help m-banking managers to apply strategies to retain users or even attract potential adopters. We believe researchers undertaking future studies on technology individual performance will find this study beneficial, and may provide more insights on user behaviour development.

Chapter 5 - Understanding m-banking individual performance: The DeLone & McLean Model and the moderating effects of individual cultural

5.1. Introduction

In recent years there has been a proliferation of new channels in the financial industry, one of which is the mobile banking (m-banking), which is important for allowing customers to conduct a vast number of banking transactions at anytime from anywhere. The effects of "anytime and anywhere" play an important role in efficiency and effectiveness of performing banking tasks, and their relationship with individual performance.

It is important to include cultural characteristics in information system (IS) research because a user's cultural profile shapes his/her perceptions of a system's features (Garfield and Watson, 1997). Users with a certain cultural profile could focus their attention on some information while ignoring other (Overby *et al.*, 2004). For Leidner and Kayworth (2006), information technology (IT) is often implicated in failings of culture. Therefore, m-banking system features appropriate for one culture may not be suitable for others of a different culture. Despite the importance of this issue, there is little empirical evidence on the cultural influence in the IS/IT field (e.g. Lee *et al.*, 2013, Al-Smadi, 2012). In this paper we analyze the individual performance, considering use and user satisfaction moderated by the culture dimension.

Several authors relate "performance" to effectiveness and productivity (e.g. Manzoor, 2012, Adler and Benbunan-Fich, 2012, Mahdi *et al.*, 2014). In this research

we adopt the term “performance” to express the idea of efficiency and effectiveness at performing m-banking tasks. This paper draws on m-banking individual performance and cultural influence to link the use, continued use, and user satisfaction, and makes three contributions. First, we focus on system quality, information quality, and service quality, with the appropriate level (e.g. functionality of the service, quality of the information that m-banking provides, and overall support related to the service), and the ability to convince and influence use and user satisfaction. The importance of continually measuring the general quality of the service and the alignment of those three dimensions could reduce potential problems of m-banking service.

Second, we identify the importance of leveraging the individual performance that links the use and continued use of the service: (1) individual performance, or the ability to perform banking tasks at a higher level of efficiency and effectiveness, and its implications of time saving and less effort; (2) user satisfaction, which mediates the quality of the overall system and the continued use of the service; (3) use, which satisfies all of the users’ needs. A higher correlation among those three drivers could reduce the attrition effect or even leverage the number of potential adopters of the service.

Third, which cultural characteristics moderate the use and user satisfaction effect on individual performance? Studying the cultural relationship with usage and users’ satisfaction at the individual level may explain their beliefs and behaviors. Toward this end, connecting those constructs between use and user satisfaction to individual performance may obtain insights to m-banking.

The structure of the paper is as follows. We next examine earlier approaches in the literature for m-banking and explain cultural theory and its model. We then present

the research design, methodology, and results. Finally, the results are discussed, including the implications for m-banking theory and practice, and further possible research directions are suggested.

5.2 Theoretical background and hypotheses

Adoption drivers dominate as the focus of most research about m-banking, and there is an overload of m-banking adoption models. Recently, in their literature review of m-banking research, Shaikh and Karjaluoto (2015) report 55 studies (between 2005 to 2014) associated with different kinds of motivations that influenced m-banking potential adopters. Another m-banking literature review carried out by Dewan (2010) emphasized the need for more theory-based empirical research from a non-traditional perspective. The constantly growing number of m-banking papers is a sign that m-commerce research shows no signs of saturation (Kourouthanassis and Giaglis, 2012). Based on that, instead of presenting another research analyzing other determinants of m-banking adoption, we believe it may be more valuable to focus on retaining users instead of thinking about potential adopters.

We focus on individual performance as a source of efficiency and effectiveness in performing banking tasks. The challenge is to provide m-banking service with a high level of individual performance. Sonnentag and Frese (2002) link the research on individual performance to the research on work-related well-being. For them "accomplishing tasks and performing at a high level can be a source of satisfaction, with feelings of mastery and pride. Low performance and not achieving the goals might be experienced as dissatisfying or even as a personal failure". They also discuss if and how well-being and performance are empirically related, and argue, especially, that self-

regulation might account for such a relationship. For Burton-Jones and Grange (2012) achieving maximum performance of using IS, the system must be used effectively. Based on that, we propose to analyze the framework that points to the interconnections among use, user satisfaction, and individual performance, as critical enablers of m-banking continued use and possible attraction of potential adopters. Other arguments in the performance impact literature suggest that the initial effects should occur at the quality of the overall IT framework assets and resources (Mithas *et al.*, 2011, Kannan and Tan, 2005), which is very consistent with the DeLone & McLean's (D&M) IS success model.

Figure 5.1 presents the proposed model of this study. The dependent variable is individual performance, referring to the efficiency and effectiveness at performing m-banking tasks. The IS/IT adoption literature has been influential in providing guidance for achieving excellence in technological use and adoption by individuals. While the overall quality of IT/IS infrastructure provides the basis or the foundation for m-banking success, this paper draws its influence from the usage and user satisfaction and its influences on the individual performance. In other words, although the D&M model allows for evaluating the organizational impact level, we adopt the model to study individual performance, because it is reasonably compatible with prior conceptualization in the IS literature. Several investigations show that the D&M model can be partially applied or combined with other models. For example, for Igbaria and Tan (1997), individual performance becomes an important issue in IT acceptance, usage, and user satisfaction in the organizational context. They concluded that user satisfaction is an important factor affecting system use and that it has the strongest direct effect on individual performance. In an empirical study of m-banking, Lee and Chung (2009)

found that system quality and information quality significantly influence customers' trust and satisfaction. Ali and Younes (2013) studied the relationship between information systems and users by examining individual performance on several factors, including system quality and information quality. They combined the D&M, task-technology fit (TTF), and technology acceptance model (TAM) to study the impact of information systems on user performance.

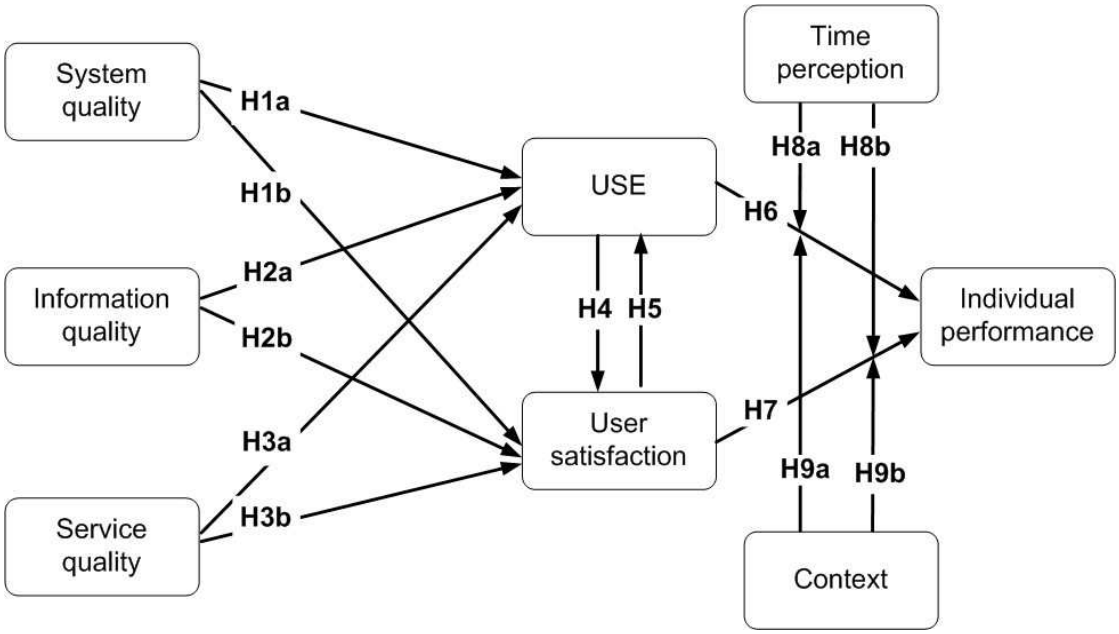


Figure 5.1 Research model

5.2.1 Original and updated DeLone and McLean's IS success model

Our study is based on DeLone & McLean's IS Success model (original and updated version) (DeLone and McLean, 1992, DeLone and McLean, 2003). The original version of the D&M model reviewed IS success measures and devised a model of the interrelationships between six IS success factors: (1) system quality, (2) information

quality, (3) use, (4) user satisfaction, (5) individual impact and (6) organizational impact. Later, in the updated version, DeLone and McLean (2003) added the ‘‘service quality” measure. For D&M, “to measure the success of a single system, ‘information quality’ or ‘system quality’ may be the most important quality component. For measuring the overall success of the IS department, as opposed to individual systems, ‘service quality’ may become the most important variable”. M-banking users may face several problems and usage trouble that should be mitigated. Providing adequate support for the end user could encourage continued use and end user satisfaction.

The purpose of this study, therefore, is to make both theoretical and empirical advances concerning the relationships among the perceptions of system quality, information quality, service quality, use, user satisfaction, and the influence on individual performance in m-banking. The main hypothesis that we advance in this paper is that a high level of the overall quality of the system in an m-banking context will influence the use and user satisfaction, and consequently that both of these lead to individual performance. The hypotheses are presented below.

DeLone and McLean (1992) investigated the reliability of the system, system accuracy, flexibility, online response time, and ease of use as a part of the system quality dimension. More specifically, they incorporated four scales from Bailey and Pearson (1983) into the system quality: (1) convenience of access, (2) flexibility of system, (3) integration of systems, and (4) response time. There are several negative effects associated with m-banking services, such as small screen, uncooperative keypad, communication bandwidth, and other constraints (Chae and Kim, 2004, Zwass, 2003). Such challenges could be turned into strengths, by increasing system quality, concern

with user interface, ease of use, usefulness, performance, and quality of documents (Seddon, 1997). Thus, two hypotheses are tested in this study:

H1a: System quality has a positive influence on use of m-banking.

H1b: System quality has a positive influence on user satisfaction of m-banking.

There are many definitions of information quality. Some consider the user's information (Lee *et al.*, 2002), and others assess the degree to which it is helpful in completing a particular task (Fisher and Kingma, 2001). Fisher and Kingma (2001) divide information quality into five categories: accuracy, completeness, consistency, relevance, and fitness for use. DeLone and McLean (1992) consider information quality from Bailey and Pearson (1983) research as a "good example of this cross linkage" – showing the "desirable characteristics of the system outputs". For m-banking usage, the experience of using the service during the adoption or post-adoption phase could be affected by information quality, such as overall product and usage description. If the information is irrelevant, inaccurate, or out-of-date, users may doubt service providers integrity and ability to present quality services (Zhou, 2013). At the same time, due to the screen size of mobile devices, information improperly designed can cause unnecessary work for users and can negatively affect their usage (Lee and Chung, 2009). Therefore, we propose the following:

H2a: Information quality has a positive influence on use of m-banking.

H2b: Information quality has a positive influence on user satisfaction of m-banking

One decade after of the original D&M IS success model, in the "Ten-Year Update" research the service quality dimension was added to the DeLone and McLean

(2003) model. For D&M, "service quality is the overall support delivered by the service provider", and quoting Petter *et al.* (2008), it is "the quality of the support that system users receive from the IS department and IT support personnel" (e.g. responsiveness, reliability, conciseness, technical competence, and empathy of the personnel staff). Providing high quality service and ensuring user satisfaction are widely recognized as important dimensions that lead to the continued use and success of the service. In an empirically study of banking industry, Marinkovic and Obradovic (2015) found that service quality significantly influences users' satisfaction and its influence on customers' emotional reactions. Therefore,

H3a: Service quality has a positive influence on use of m-banking.

H3b: Service quality has a positive influence on user satisfaction of m-banking.

After analyzing the overall quality of the framework, we propose to focus our attention on the usage and user satisfaction, and particularly on the factors that cause individual performance and the resistance to the technology, continued use. While the system usage and user satisfaction may not ensure the enhancing of individual performance, it is critical to ensure that quality has been taken into consideration (Guimaraes and Igbaria, 1997). Although several m-banking studies focus on m-banking adoption, as reported by Shaikh and Karjaluoto (2015), the literature lacks an examination of the consequences of the usage. One of the drivers of this study is the individual performance, which has been associated with efficiency and effectiveness in performing banking tasks with less time and effort. One of the most important advantages of this channel over other traditional banking channels (e.g. automated teller machines (ATM), telephone banking, Internet banking, or branch) is the availability

from everywhere and anywhere, 24 hours per day and 7 days a week. We propose that with the m–banking service, users can carry out banking transactions with the least time and effort, thereby enhancing the well-being of the user.

Sonnentag and Frese (2002) link their research on individual performance to the research on work-related well-being. They discuss if and how well-being and performance are empirically related. An important rationale behind this interest is the belief that happy users tend to be more productive than other users (Taris and Schaufeli, 2015). User satisfaction is considered as a key factor affecting continued use and individual performance. Thakur (2014) found empirical evidence in the m-banking context that user satisfaction and loyalty are correlated. User satisfaction is an emotional reaction to a transaction experience that meets user expectations (Kim *et al.*, 2004). Based on that, user satisfaction is evaluated based on evidence of the m-banking service's ability to meet user expectations, such as service quality, information quality, and system quality. The use and continued use of m-banking is based on prior experience that leads to repeated action. Hence, the following hypotheses are proposed:

H4: The use affects the user satisfaction of m-banking.

H5: The user satisfaction affects the use of m-banking.

H6: The use of m-banking influences individual performance.

H7: The user satisfaction of m-banking influences individual performance.

5.2.2 Culture

There are many definitions of culture. For example, Leidner and Kayworth (2006), quoting Kroeber and Kluckhohn (1952), report 164 definitions of culture. Hall (1976) asserted that beliefs and values dictate the way people think, behave, solve problems, make decisions, plan and lay out their homes and cities, and even organize their

economic, political, and transportation systems. Hofstede (1980) explained culture as "the collective programming of the mind that distinguishes the members of one group or category of people from another" (Hofstede, 1980). As such, it is a set of shared and enduring meanings, values, attitudes, opinions, and beliefs that characterize national, ethnic, or other groups, and guide their behavior (Triandis, 1995).

Although several definitions may adequately express the meaning of culture, the literature has been trying to provide theoretical explanations for the lack of applications with the several culture levels and dimensions. Leidner and Kayworth (2006) examine culture in the IS/IT context, and compile a long list of value dimensions and levels including national, organizational, and group, and the possible influence of the successful implementation and use of information technology. Cultural characteristics going far beyond country differences could be enclosed within a country (Baskerville, 2003), or even two people may have different cultural characteristics though living in the same country (Straub *et al.*, 2002).

In order to test the application of different dimensions and levels of culture, several empirical studies published in the IT/IS field have applied culture in different contexts, such as: technology acceptance in national cultures (Srite and Karahanna, 2006), comparison of post-adoption of mobile internet in three different countries (Lee *et al.*, 2007b), communication values in high-low context among Norwegian middle managers (Warner-Søderholm, 2013), differences between employees among two countries in the process of knowledge sharing (Li, 2010), cultural differences among customers of a single bank in the use of electronic channels (Al-Smadi, 2012), cultural responses to the download time of websites (Rose *et al.*, 2003), nature of Internet adoption in Arab cultures (Loch *et al.*, 2003), factors influencing the adoption of m-

banking in Australia and Thailand, cross-cultural comparison (Mortimer *et al.*, 2015), m-banking adoption in Africa combining the extended unified theory of acceptance and use of technology model and cultural moderators (Baptista and Oliveira, 2015), and many others.

Although information systems researchers have conceptualized several dimensions of culture value, we adopted two proposed by Hall (1969): context, and time perception. These two dimensions have been tested in a variety of ways and contexts. Kittler *et al.* (2011) reviewed the literature related to Hall's context model and reports a significant theoretical framework within intercultural studies during last five decades. Also, in one of few applications of time perception, Rose *et al.* (2003) investigated time perception as a culture value. Based on that, our approach examines the influence of national culture on individual behavior. We posit that national culture influences the cultural values that an individual holds, which in turn influence and moderate the use and user satisfaction affecting the individual performance.

5.2.2.1 Time perception

Time perception refers to the subjective experience of time, which is measured by someones own perception of the duration of the indefinite and continuous unfolding of events. Time perception and the way it is handled have much to do with the structuring of space, and different cultures perceive time differently (Nonis *et al.*, 2005, Hall, 1969). Hall (1976) differentiates two notions of time: monochronic (M-time) and polychronic (P-time), which are attitudes toward use of time in performing tasks focusing either on issues one at a time (monochronic) or performing more than one activity in parallel (polychronic). People characterized with monochronic culture have a tendency for

accurate planning, segmentation of time, doing one thing at a time, and strict keeping to schedules and timetables. On the other hand, people of polychronic societies tend to be engaged in several actions at the same time. We believe, m-banking user focuses on one task at a time, and that it will enhance individual performance, and that the tendency will be to complete the banking task more quickly. Therefore, we propose the following:

H8a: A monochronic inclination will moderate the effects of use on individual performance, such that the effects will be stronger among users with higher monochronic inclination.

H8b: A monochronic inclination will moderate the effects of user satisfaction on individual performance, such that it will be weaker among users with high monochromic inclination.

5.2.2.2 Context

The context usually tells the hearer which level of discourse is being used. Hall (1976) defines context as "the amount of information that is in a given communication as a function of the context in which it occurs". High context cultures prefer a communication style in which individuals prefer to draw inferences from non-explicit or implicit information; the verbal part of a message carries less information, there are many contextual elements that help people to understand the rules. Individuals in low context cultures prefer information to be stated directly and exhibit a preference for quantifiable detail. In other words, low context cultures are characterized by explicit messages in which words carry most of the information. There is evidence that the users in high-context cultures may prefer symbolic and indirect expressions when they communicate with others using mobile data services (e.g. Lee *et al.*, 2007b). Based on

that, we believe that in an m-banking context non-verbal communication plays an important part in high context cultures and that it will enhance individual performance. Thus, we hypothesize the following:

H9a: A high-context inclination will moderate the effects of use on individual performance, such that the effects will be stronger among users with high-context inclination.

H9b: A high-context inclination will moderate the effects of user satisfaction on individual performance, such that it will be weaker among users with high-context inclination.

5.3 Methods

5.3.1 Measurement

All measurement items (Appendix B) were adapted from Urbach *et al.* (2010), Zhou *et al.* (2010), Wu and Wang (2006), and Lee *et al.* (2007b), with slight modifications. From the literature, system quality (SYSQ), information quality (INFQ), service quality (SERQ), and individual performance (IP) were adopted from Urbach *et al.* (2010); use from Zhou *et al.* (2010), and user satisfaction (US) from Wu and Wang (2006); and context (CT) and time perception (TP) from Lee *et al.* (2007b).

5.3.2 Data collection

The questionnaire was initially developed in English, based on the literature, and the final version was independently translated into Portuguese by a professional translator, and then back into English by a different translator to ensure translation equivalence (Brislin, 1970). First, we conducted field interviews with managers of a banking

company and made modifications accordingly. They were asked to assess the terminology, clarity of instructions, and response format. Most items were measured using a numerical scale ranging from strongly disagree (1) to strongly agree (7). The questionnaire was modified and pretested among 30 m-banking users so that further problems with the measures and response format could be detected. These were not included in the main survey. Preliminary results of the pilot survey showed that the scales were reliable and valid; with the exception of four items (SYSQ6, INFQ3, INFQ5, and USE4), which had a loading higher than 0.70 but did not meet the cross-loadings criterion. However, in that stage, we decided not to apply the cross-loading criterion exclusion, due to the fact that it is the pilot study stage and because of the importance of measuring those items in the m-banking context.

Second, the data were collected in Portugal using an online survey conducted via a popular survey website between November 2014 and February 2015. A total of 1,400 e-mails were sent in November 2014. A follow-up reminder was sent in January 2015 to non-respondents. 354 responses were received by the end of February 2015, which corresponds to a 25.3 percent response rate. 49 responses were removed due to incompleteness, leaving 305 (21.8 percent) valid and complete responses. To test for non-response bias, we compared the sample distribution of the first and second respondent groups. We used the Kolmogorov–Smirnov (K–S) test to compare the sample distributions of the two groups (Ryans, 1974). The K–S test suggests that the sample distributions of the two independent groups do not differ statistically (Ryans, 1974). This means that non-response bias is not present. Further, we examined the common method bias by using Harman's one factor test (Podsakoff *et al.*, 2003). This test found no significant common method bias in our dataset. Additionally, to test for

common method bias, the marker variable technique was employed (Malhotra *et al.*, 2006, Lindell and Whitney, 2001). No significant common method bias was found in the data set.

Third, the study results are based upon m-banking users. A total of 181 respondents (59%) are men. Regarding age, 180 (60 percent) of the respondents are 35 years old or younger. Concerning m-banking usage frequency in a month, 55 percent use over 10 times in a month, and 19 percent of the users between six to ten times a month. Detailed descriptive statistics relating to the respondents' characteristics are in Table 5.1.

Table 5.1 Sample characteristics

Distribution (n=305)					
Age			Education		
<25	84	28%	High School or below	71	23%
25-30	48	16%	Undergraduate degree	19	6%
31-35	48	16%	Bachelor	154	51%
36-40	40	13%	Master's degree or higher	61	20%
41-50	59	19%			
>50	26	8%			
Gender			M-banking usage frequency in a month		
Male	181	59%	One time a month	31	10%
Female	124	41%	2-5 times	49	16%
			6-10 times	57	19%
			11-20 times	67	22%
			Over 20 times	101	33%

5.4 Results

Our analysis focused on measurement validation and hypothesis testing. Validation efforts assessed the absence of common method bias and the reliability and validity of

the measures, while hypothesis testing analyzed the hypotheses. Structural equation modeling (SEM) with partial least squares (PLS) was used to perform a simultaneous evaluation of both measurement quality (measurement model) and construct interrelationship (structural model). PLS provides the ability to model latent constructs even under conditions of non-normality and small- to medium-size samples (Chin, 1998b). By using ordinary least squares as the estimation technique, PLS performs an iterative set of factor analyses and a bootstrap procedure to estimate the significance of the paths. In this study we used Smart PLS 2.0 M3 to evaluate the measurement properties and test hypotheses (Ringle *et al.*, 2005).

5.4.1 Measurement model

The strength of the measurement model can be demonstrated through measures of convergent and discriminant validity (Hair *et al.*, 2014). Convergent validity is normally assessed using three tests: reliability of questions, composite reliability of constructs, and variance extracted by constructs (Fornell and Larcker, 1981).

Tables 5.2 and 5.3 present the measurement model results. The results for composite reliability (CR) are greater than 0.9, indicating that the model has good internal consistency. The good indicator reliability was evaluated based on the criterion that the loadings should be greater than 0.70. As seen in Table 5.2, the loadings are above 0.70. Average variance extracted (AVE) was used to test convergent validity. AVE should be higher than 0.50, so that the latent variables explain more than half of the variance of its indicators (Henseler *et al.*, 2009, Hair *et al.*, 2014). As is also seen in Table 5.3, AVE for each construct is above the expected threshold of 0.5, ensuring convergence.

Table 5.2 PLS loadings and cross-loadings

Constructs		SYSQ	INFQ	SERQ	USE	US	IP	TP	CT
System quality	SYSQ1	**.95**	.80	.58	.67	.74	.73	.37	.25
(SYSQ)	SYSQ2	**.95**	.79	.55	.61	.70	.68	.27	.23
	SYSQ3	**.95**	.81	.59	.61	.72	.68	.29	.24
	SYSQ4	**.95**	.81	.56	.63	.71	.71	.32	.29
	SYSQ5	**.91**	.81	.56	.64	.75	.67	.32	.25
Information	INFQ1	.82	**.94**	.57	.65	.73	.73	.37	.28
quality (INFQ)	INFQ2	.81	**.93**	.57	.64	.73	.72	.38	.26
	INFQ3	.74	**.87**	.55	.57	.65	.62	.28	.25
	INFQ4	.78	**.91**	.61	.62	.71	.68	.29	.27
	INFQ5	.73	**.89**	.55	.56	.69	.62	.32	.26
	INFQ6	.76	**.90**	.49	.63	.70	.65	.30	.27
Service quality	SERQ1	.59	.59	**.95**	.48	.57	.56	.33	.26
(SERQ)	SERQ2	.59	.58	**.97**	.48	.57	.56	.34	.24
	SERQ3	.56	.57	**.96**	.43	.53	.53	.29	.25
	SERQ4	.57	.58	**.92**	.44	.54	.54	.29	.26
Use (USE)	USE1	.67	.67	.49	**.98**	.82	.75	.40	.22
	USE2	.65	.64	.48	**.97**	.81	.75	.38	.20
	USE3	.64	.66	.44	**.96**	.80	.73	.39	.24
User satisfaction	US1	.74	.73	.57	.79	**.96**	.80	.40	.23
(US)	US2	.78	.77	.56	.82	**.98**	.82	.41	.26
	US3	.76	.77	.58	.83	**.98**	.82	.40	.25
	US4	.75	.75	.57	.83	**.98**	.83	.41	.25
Individual	IP1	.71	.71	.55	.77	.83	**.94**	.38	.25
performance (IP)	IP2	.69	.68	.54	.70	.76	**.95**	.33	.26
	IP3	.68	.70	.53	.69	.76	**.92**	.35	.25
Time perception	TP1	.31	.31	.28	.33	.35	.33	**.87**	.25
(TP)	TP2	.32	.35	.31	.40	.40	.35	**.93**	.21
	TP3	.27	.30	.29	.34	.35	.33	**.87**	.24
Context (CT)	CT1	.25	.26	.25	.24	.28	.27	.25	**.89**
	CT2	.16	.18	.13	.09	.11	.10	.18	**.70**
	CT3	.24	.28	.25	.20	.20	.25	.22	**.90**

The discriminant validity refers to two factors. First, the square roots of AVEs (diagonal elements) are greater than the correlation between each pair of constructs (off-

diagonal elements) (Fornell and Larcker, 1981). Second, to ensure the discriminant validity, the loadings should be larger than cross loadings (Chin, 1998a, Götz *et al.*, 2010, Grégoire and Fisher, 2006). In Table 5.3 we see that the square root of AVE (in bold) is higher than the correlation between constructs. In order to meet cross-loading criteria, we excluded two items (SYSQ6, and USE4). After the exclusion, we found that no indicator has loadings (in bold) with lower values than their cross loadings (Table 5.2). Therefore, both measures are met.

Table 5.3 Means, standard deviations, correlations, and reliability and validity measures (CR, CA, and AVE) of latent variables.

Constructs	Mean	SD	CR	CA	SYSQ	INFQ	SERQ	USE	US	IP	TP	CT
System quality (SYSQ)	5.25	1.19	.97	.97	**.94**							
Information quality (INFQ)	5.32	1.18	.97	.96	.85	**.91**						
Service quality (SERQ)	4.94	1.35	.97	.96	.61	.61	**.95**					
Use (USE)	4.91	2.17	.98	.97	.67	.68	.48	**.97**				
User satisfaction (US)	5.11	1.62	.99	.98	.77	.78	.58	.84	**.98**			
Individual performance (IP)	5.47	1.52	.96	.93	.74	.74	.58	.77	.84	**.94**		
Time perception (TP)	4.61	1.45	.92	.87	.27	.29	.26	.23	.25	.27	**.89**	
Context (CT)	4.12	1.41	.87	.80	.34	.36	.33	.40	.41	.38	.26	**.84**

The measurement model results indicate that the model has good internal consistency, indicator reliability, convergent validity, and discriminant validity. Hence, the constructs from our model are statistically distinct and can be used to test the structural model.

5.4.2 Structural model

After determining that the measurement model and the results meet all conditions, the research model was assessed by examining the significance of paths in the structural model. Figure 5.2 shows the path coefficient with bootstrapping t-statistics derived from standard error with 5,000 iterations. The estimates of the coefficients from a bootstrap distribution can be viewed as an approximation of the sampling distribution and its standard deviation, and can be used as a proxy for the parameter's standard error in the population. Therefore, t values are calculated to assess each indicator weights significance (Hair *et al.*, 2014).

The hypotheses were tested using the significance of the path coefficients as determined by t-values. Since hypotheses H4 and H5 include a mutual influence between use and user satisfaction that cannot be simultaneously tested, we tested two different models. Model 1 assumes the influence to be from use to user satisfaction (H4), whereas model 2 flows from user satisfaction to use (H5). The results of the tests performed on the two structural models are depicted in Figure 5.2. The upper path coefficients give the results of model 1 and the lower ones of model 2.

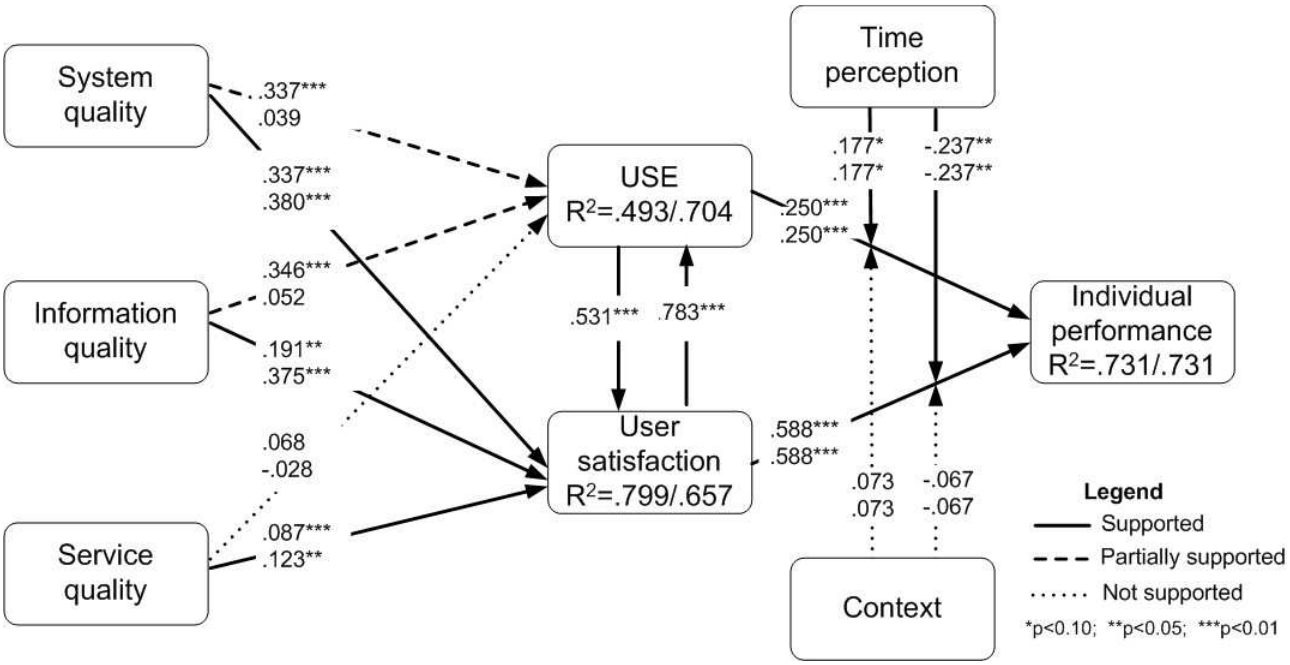


Figure 5.2 Research model

The model explains 49.3% (in model 1) and 70.4% (in model 2) of the variation in m-banking use. The system quality ($\hat{\beta}$ = .337, p < .01), and information quality ($\hat{\beta}$ = .346, p < .01) are statistically significant in explaining use in model 1, but in model 2 are not statistically significant, thus partially confirming hypotheses H1a and H2a. The service quality is not statistically significant in explaining the use, and consequently H3a is not confirmed. The user satisfaction ($\hat{\beta}$ = .783, p < .01) is statistically significant in explaining the use, thus confirming hypothesis H5.

The model explains 79.9% (in model 1) and 65.7% (in model 2) of the variation in user satisfaction of m-banking. The system quality ($\hat{\beta}$ = .337, p < .01 in model 1 and $\hat{\beta}$ = .380, p < .01 in model 2), information quality ($\hat{\beta}$ = .191, p < .05 in model 1 and $\hat{\beta}$ = .375, p < .01 in model 2), service quality ($\hat{\beta}$ = .087, p < .10 in model 1 and $\hat{\beta}$ = .123, p < .05 in model 2), and use ($\hat{\beta}$ = .531, p < .01 in model 1) are statistically significant in explaining user satisfaction, thus confirming hypotheses H1b, H2b, H3b, and H4.

The model explains 73.1% of the variation in individual performance of m-banking. The use ($\hat{\beta}$ = .250, p < .01), and user satisfaction ($\hat{\beta}$ = .588, p < .01) are statistically significant in explaining individual performance, thus confirming hypotheses H6 and H7. The time perception was assessed as a moderating variable in the relationship between use and individual performance (hypothesis H8a). The high value of time perception will be stronger in the relationship between use and individual performance ($\hat{\beta}$= .177, p<.10). For hypothesis H8b, due to the ($\hat{\beta}$= -.237, p<.05), the high value of time perception will be weaker in the relationship between user satisfaction and individual performance. Thus hypotheses H8a and H8b are confirmed. The context was assessed as a moderating variable in the relationship between use and individual performance (hypothesis H9a), and between user satisfaction and individual performance (hypothesis H9b). The hypotheses H9a and H9b are not confirmed.

Table 5.4 reports the evaluation of f^2 of the both structural models. The f^2 effect size captures the influence of one construct on another, by evaluating R^2 values of all endogenous constructs. In our model, all significant structural paths to the individual performance ranging from small to large effect size. For assessing the predictive value, we apply a blindfolding procedure (Q^2 value) of the path model. The Q^2 values larger than zero suggest that the model has predictive power for a certain endogenous construct. In contrast, values of zero and below indicate a lack of predictive power (Hair *et al.*, 2014). In both model all of the Q^2 values are considerably greater than zero, suggesting the model's predictive quality.

Table 5.4 Results of hypotheses tests

Hypothesis	β	Support	f^2	Effect size	R^2
Use					.493 / .704
H1a: System quality → Use	.337***/.039	Partial	.057/.000	Small/-	
H2a: Information quality → Use	.346***/.052	Partial	.059/.003	Small/-	
H3a: Service quality → Use	.068/-.028	No	.004/.000	-/-	
H5: User satisfaction → Use	-/.783***	Yes	-/.713	-/Large	
User satisfaction					.799 / .657
H1b: System quality → User satisfaction	.201***/.380***	Yes	.045/.111	Small/Small	
H2b: Information quality → User satisfaction	.191***/.375***	Yes	.04/.105	Small/Small	
H3b: Service quality → User satisfaction	.087***/.123**	Yes	.020/.026	-/Small	
H4: Use → User satisfaction	.531***/-	Yes	.706/-	Large/-	
Individual performance					.731 / .731
H6: Use → Individual performance	.250***/.250***	Yes	.074/.074	Small/Small	
H7: User satisfaction → Individual performance	.588***/.588***	Yes	.465/.465	Large/Large	
H8a: Use x Time perception → Individual performance	.177*/.177*	Yes	.030/.019	Small/-	
H8b: User satisfaction x Time perception → Individual performance	-.237**/-.237**	Yes	.019/.030	-/Small	
H9a: Use x Context → Individual performance	.073/.073	No	.004/.004	-/-	
H9b: User satisfaction x Context → Individual performance	-.067/-.067	No	.004/.004	-/-	

Path- β: *p<00.10; **p<00.05; ***p<00.01; Effect size: >0.350 large; >0.150 and ≤0.350 medium; >0.020 and ≤0.150 small (Chin, 1998b, Cohen, 1988)

5.5 Discussion

The scope of this research is to increase the understanding around the cultural influence on m-banking individual performance. To do so, we conduct an empirical research that focuses on culture variables and individual performance. Since there is an extensive array of literature of the concept of culture and several dimensions, the greatest challenge is in defining exactly what culture is and how to measure it. Straub *et al.* (2002) reports the deficiency in clear concepts and measures of culture may help to explain why cultural research has been so difficult to conduct. We adopted two

dimensions proposed by Hall (1976): context (high-context inclination), and time perception (monochronic inclination). To measure individual performance, we adopted the D&M IS Success model (original and updated versions). Our results show that except for H3a, H9a, and H9b, our hypotheses are totally or partially supported.

The research model explains 73.1% of the variance in the individual performance of m-banking compared to 67% indicated by Guimaraes and Igbaria (1997) in impact on end-user jobs. Based on our results, we argue that use and user satisfaction lead to m-banking individual performance. Our results suggest that having a high value of time perception (monochronic inclination) means that the effect of use in individual performance will be stronger, but on the other hand, the moderate effect of user satisfaction on the individual performance will be weaker. In other words, the use of m-banking will gain power and user satisfaction will lose power in explaining the individual performance. If the m-banking users feel that service will enhance individual performance, the users will focus on task completion time. The implications of the study to theory and practice are summarized below.

5.5.1 Theoretical implications

This research makes several contributions to the theory and practice of information systems. The theoretical contribution to the body of knowledge on IS-Culture research properties and individual performance are the following: First, the individual performance (efficiency and effectiveness of performing banking tasks) becomes a source of retention and attraction of potential adopters of m-banking service. While the majority of m-banking research focuses on potential adopters, we test the use, user satisfaction, and individual performance, as sources of retention and reduction of

attrition effects (Singh and Kumar, 2014, Campbell and Frei, 2010). We believe that by maintaining the overall quality of the m-banking service and enhancing individual performance, potential problems could be mitigated along with (possibly) customer complains (Kumar and Telang, 2012).

Second, we test monochronic and high-context inclination that moderate the use and user satisfaction to the individual performance. We decided to test high-context inclination because (a) there is evidence in mobile contexts that the users prefer pictorial or symbolic expressions to detailed information from a system (Lee *et al.*, 2007b), and (b) there are negative effects associated with the user interface, such as small screen, and other constraints (Chae and Kim, 2004), which limit the amount of information that can be displayed. Our results show that the high-context inclination (H9a and H9b) is not statistically significant, and thus, that construct plays no role in individual performance.

Third, the monochronic inclination moderators are statistically significant. Based on Hall (1969) Northern European and American cultures tend to be monochronic cultures (e.g. arrive on time; keep to agendas, schedules, and deadlines; deal with one project or task at a time before moving onto the next). On the other hand, when dealing with polychronic culture, such as Portugal, Latin, or African cultures, the people answer the phone, drink coffee, transmit sign language to their colleagues, listen to a presentation, and think about lunch all at the same time. Focusing on individual performance in the m-banking context, we decided to test monochronic inclination in Portugal. Our results reveal that it is statistically significant in Portugal, indicating that in terms of individual performance, customers focus on one task at a time, which is different in this case from the literature.

Finally, based on our findings and given the fact that the system quality, information quality, and service quality all together play an important role on user satisfaction, and then enhance continued use of m-banking, it is important to periodically monitor the overall quality. Therefore, effective management of overall quality can enable the service providers to increase the number of potential adopters and reduce attrition effects.

5.5.2 Managerial implications

From a practical perspective, our research shows that the overall quality of the m-banking system has a significant effect on the user satisfaction, which influences the usage and individual performance. We have included the cultural dimension in this research because it could trigger other insights that improve the individual performance of using m-banking. Although it may not be possible to provide all user segments with differentiated services, service developers and banking managers could devise differentiation strategies for some cluster of target users, providing them with culturally specific m-banking services. The results of this study support the importance of continually improve the quality of the service in general, which will lead to greater user satisfaction and influences continued use and individual performance of the m-banking. In terms of system quality, there are several enhancements that could be made, such as ease of use, ease of learning, response time, etc. Customers and stakeholders of the financial industry are increasingly reliant on information produced by regulated entities. Reliable and comprehensive information is crucial. Continually updating all information that supports the m-banking users could enhance the information quality. Irrelevant, inaccurate, or out-of-date information could affect user satisfaction. Bank customers

have more choices in how, when, and where they can do their banking today. Changing banks is easy and the engagement with one specific bank is no longer a lifetime arrangement. One of the major challenges in providing excellence in service quality is keeping the competence, courtesy, helpfulness, and empathy of the personnel staff, and their behavior impacts a generation of positive customers' word-of-mouth (Choudhury, 2014). Due to lower labor costs, several firms have made strategic decisions to outsourcing the call centers. A knowledgeable agent can solve technical problems in a timely fashion, while an incompetent agent can aggravate a customer's frustration, lead to customer complaints, reduce the likelihood of future use of the system, and harm the user company's image (Ren and Zhou, 2008, Ye *et al.*, 2014).

5.6 Conclusion

Retaining users and attracting potential adopters of m-banking becomes important for service providers. Combining the DeLone and McLean information systems success model and two cultural dimensions from Hall (1969), this research identified the drivers that affect use, and user satisfaction, with the moderating effects of culture and its influence on individual performance.

System quality, information quality, and user satisfaction play important roles in m-banking use. Our results reveal the significant effect of system quality, information quality, service quality, and use on m-banking user satisfaction. The results point to a significant effect of use and users' satisfaction on m-banking individual performance, and the importance of the moderating effect of time perception over use and user satisfaction to individual performance. In addition, this research demonstrates

empirically the importance of including a culture dimension, which may help service providers to segment m-banking users and develop different strategies.

This study has several limitations that should be taken into consideration when generalizing its findings. First, we focused on m-banking users from Portugal. In order to enhance generalization, future research can examine other regions or countries. Second, we apply this study to the m-banking context. Other technologies or services could produce different results. Third, we apply two cultural dimensions in our model. There are several cultural dimensions, such as masculinity–femininity, uncertainty avoidance, individualism-collectivism, and many others, that may provide other insights on m-banking users.

Chapter 6 - Does culture influence m-banking use and individual performance?

6.1 Introduction

In the last decade, the use of mobile devices and their applications have seen exponential growth in popularity. The vastness of products, services, and functionalities carried out on mobile devices cannot be strategically ignored (Sheng *et al.*, 2005). The use of mobile banking (m-banking) in the retail banking becomes one of the most strategic channels to be used by bank customers. In the second quarter of 2015 there were 7.1 billion mobile-cellular user subscriptions, and there are almost as many user subscriptions as people in the world (International Telecommunication Union, 2015). The number of services and products offered for mobile platforms can go from a simple account balance inquiry to a more complex stock exchange transaction, available at anytime from anywhere (Suoranta and Mattila, 2004). Unfortunately, the percentage of population access to online banking in Portugal is only 28%, which compares to 47% to the Euro zone, and 90% in Norway, which is the highest rate (Statista, 2015). In order to enhance usage and retain m-banking users, this research proposes to study the cultural usage behaviour and its strategic implications to service providers.

Culture plays an important role in information technology (IT) adoption and use. Many authors have sought to explain the culture influence of IT use (e.g. Calhoun *et al.*, 2002, Rose *et al.*, 2003), which may affect the use and successful implementation of IT (Leidner and Kayworth, 2006). This paper studies the influence of culture on m-banking use by individuals. We focus on Portugal using an online survey to collect the data. It may be revealing to include the culture dimension with other models. Indeed, the

culture dimension has important moderating effects for behavioural intention to adopt m-banking (Baptista and Oliveira, 2015).

While the most common demand-side determinants of m-banking are addressed in adoption models, this research focuses on the post-adoption phase. In their recent literature review of m-banking research, Shaikh and Karjaluoto (2015) report 55 studies (between 2005 and 2014) associated with different kinds of motivations that influence potential adopters of m-banking. Understanding post-adoption may help to increase retention of m-banking users and decrease attrition effects (Singh and Kumar, 2014, Campbell and Frei, 2010). Our main goals are to (a) retain m-banking users and to link use and individual performance, and (b) provide some specific strategic measures for service providers to retain users.This paper studies the relationship between task-technology fit (TTF) and use of m-banking, and tests the effect of culture on m-banking use and individual performance. The theoretical support for this study is based on the task-technology fit (TTF) theory (Goodhue and Thompson, 1995), and Hofstede's (1980) cultural dimensions of uncertainty avoidance and individualism.

The contributions of this work are threefold. Firstly, we identify how fit of task and technology influence the m-banking use. Extensive research has been undertaken to understand the determinants of m-banking adoption. This study helps us to characterize the development of this research stream and show where it is today. Based on that, we provide further insights on the drivers of effective use of m-banking. Secondly, we show the importance of individual performance in the m-banking context. Performing banking tasks at a high level could enhance time saving and reduce effort, and can be a source of individual performance. Finally, but perhaps most importantly, we investigate the cultural characteristics that moderate the m-banking use and individual performance.

Studying the cultural relationship with use and m-banking users may explain their beliefs and behaviours toward m-banking.

Section 6.2 presents the m-banking concept, explains the TTF model and cultural theory, and formulates the study hypotheses. Thereafter we describe the methodology and results, and present the analysis. Finally, the last section discusses conclusions, limitations, and possible further research directions.

6.2 Literature review and hypotheses

6.2.1 M-banking concept

Today, one of the most widely accepted banking relationships undertaken by customers is made by means of a mobile device. M-banking is a service or product offered by financial institutions that makes use of portable technologies (Shaikh and Karjaluoto, 2015). Accessing account information, paying bills, transferring funds, and other services via mobile devices is not exclusive to progressive financial institutions (Luarn and Lin, 2005). Accessing and interacting with banking accounts at anytime, from anywhere, has become the most common action in m-banking. Mobile applications become more and more user friendly, and the number of available m-banking functions is expanded further (e.g. recently, interactions with smartwatch).

There are several features that highlight m-banking service. For financial institutions that develop and promote this service, it allows cost savings compared to the traditional storefront banking (Hoehle and Huff, 2012). M-banking enables cross-selling and up-selling products in wide-ranging market coverage. Different products can be offered to the different customer segments, enabling customer relationships and

bringing multiple benefits to financial institutions. For customers who habitually carry a mobile device accessing banking accounts anywhere, 24 hours per day and 7 days a week, m-banking has a tremendous advantage over other channels such as internet banking, automated teller machines, telephone contact, and branch banking.

6.2.2 Task-technology fit (TTF) model and hypotheses

Adoption models have dominated m-banking research in recent years. Several literature reviews of m-banking studies (e.g. Shaikh and Karjaluoto (2015), Hoehle *et al.* (2012), and Dewan (2010)) report motivations, attitudes, behavioural intention, social systems, and associations that have influenced potential m-banking adopters. Based on that and to the best of our knowledge, there are no m-banking studies that focus on the post-adoption stage. Motivated by this research gap, we provide further insights on individual performance at the post-adoption phase. Also, the growing body of research on m-banking shows that there is no sign of research saturation (Kourouthanassis and Giaglis, 2012). Based on that, instead of presenting another investigation analysing other drivers of m-banking adoption, we believe it may be more valuable to focus on retaining users instead of thinking about potential adopters.

Figure 6.1 illustrates our proposed model for this study. We focus this research on use and individual performance, investigating the individual performance as a source of efficiency and effectiveness in performing banking tasks. Effectiveness is commonly defined as "*doing the right things"*, while efficiency is described as "*doing things right"* (Sink and Tuttle, 1989). Performing banking tasks more quickly and avoiding mistakes could be a source of individual performance. To enhance the current understanding of m-banking use and individual performance, we apply the task-

technology fit (TTF) theory, defined as "*the degree to which a technology assists an individual in performing his or her portfolio of tasks"* (Goodhue and Thompson, 1995). Goodhue and Thompson (1995) suggest that individual performance is a consequence of the use and the better fit between the technology and task it supports, which is an essential subject in the m-banking service. The following list summarizes the meaning of TTF model dimensions:

- Task characteristics – are broadly defined as the actions carried out by individuals in turning inputs into outputs.
- Technology characteristics – are viewed as tools used by individuals in carrying out their tasks.
- Task technology fit – is the degree to which a technology assists an individual in performing his or her tasks.
- Use – is the behaviour of employing the technology in completing tasks.
- Performance impact – relates to the accomplishment of a portfolio of tasks by an individual.

Many studies have used and supported the validity of the TTF model, such as knowledge management systems use (Lin and Huang, 2008), location-based services (Junglas *et al.*, 2008), use of information technology (Dishaw and Strong, 1999), use of mobile commerce in the insurance industry (Lee *et al.*, 2007a), and performance impact using learning management systems (McGill and Klobas, 2009). The TTF model can combine with other models such as the technology acceptance model (TAM) to explain users' intentions to use wireless technology in organizations (Yen *et al.*, 2010), the unified theory of acceptance and use of technology (UTAUT) to explain user adoption

of m-banking (Zhou *et al.*, 2010), and UTAUT combined with the initial trust model (ITM) to explain m-banking adoption (Oliveira *et al.*, 2014).

Several studies applying TTF models are related to technology adoption, technology evaluation, impact on learning, and task performance, and not with individual performance as initially suggested by Goodhue and Thompson (1995), as post-adoption phase. In this study the individual performance refers to the consequences or a result of using m-banking. By carrying the mobile device everywhere, the customer using this channel will enjoy the availability of this service anytime/anywhere faster than any other channel. Taking this background into account, we propose to test the following hypotheses:

H1: Task characteristics of m-banking positively affect the TTF.

H2: Technology characteristics of m-banking positively affect the TTF.

H3: TTF positively affects use of m-banking.

H4: TTF positively improves individual performance.

H5: Use of m-banking positively affects individual performance.

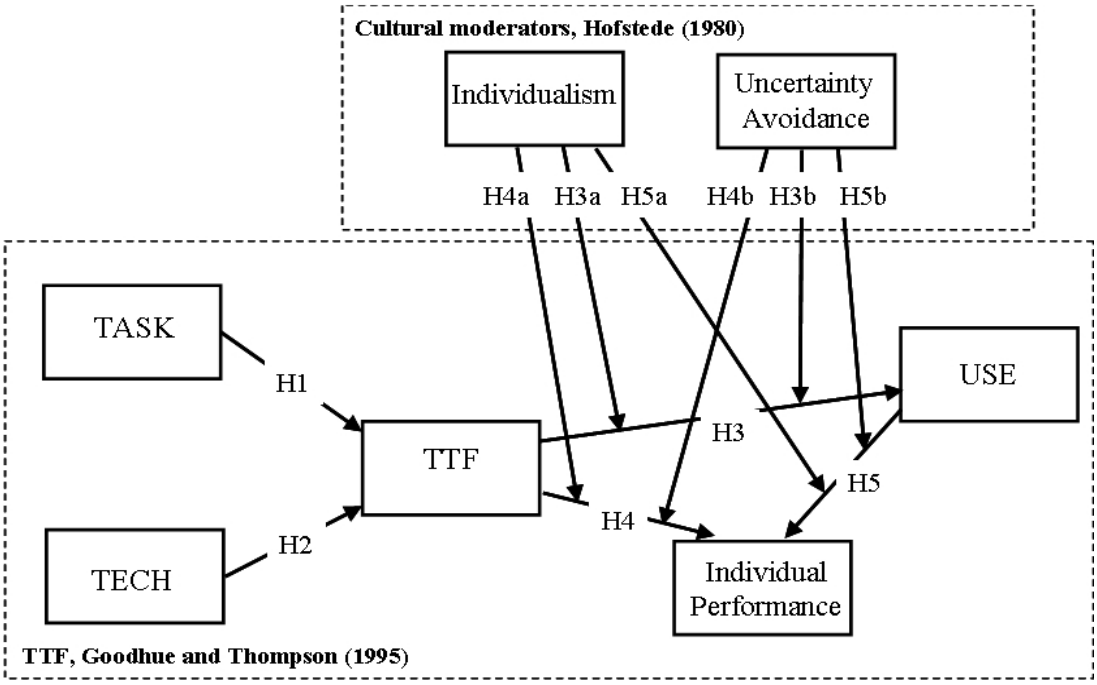


Figure 6.1 Research model

6.2.3 Cultural models

The word *"culture"* is derived from Latin *"cultura"*, from the verb *"colere"*, with the meaning of tending or cultivation. Culture is wide and multifaceted and this may justify the abundance of definitions it has been given. For example, Kroeber and Kluckhohn (1952) report 164 definitions of culture. Kluckhohn and Strodtbeck (1961) list more than 300 definitions of culture. Despite the vastness of definitions of culture, the central idea is "the sum total of values, beliefs, perceptions, and customs that are shared by a society". Leidner and Kayworth (2006) examine culture in the IS/IT context, and compile a long list of value dimensions and levels including individual, group, organizational, and national, and the potential influence of the successful implementation and use of IS/IT. Cultural characteristics going far beyond country differences can exist within a country or a city (Baskerville, 2003), or even two people may have different cultural characteristics though living in the same place (Straub *et al.*, 2002).

Since understanding individual-difference cultural characteristics is a bona fide issue to study, we propose investigating the moderating effect of culture over use and individual performance. One of the most well grounded theories applied to the IS/IT field was developed by Hofstede. Leidner and Kayworth (2006) reported that over 60 percent of IS/IT research examined utilized one or more of Hofstede's culture dimensions. Table 6.1 presents the description of five of Hofstede's national culture dimensions. Based on the successful application of Hofstede's culture dimensions, we adopt two of them: uncertainty avoidance and individualism. There are four main reasons why we select these. First, the dimension proposed by Hofstede is well established theory. Second, many researchers have empirically tested the validity (e.g. Baptista and Oliveira, 2015, Lee *et al.*, 2007b). Hofstede's culture dimensions have been applied to the m-banking adoption context (Baptista and Oliveira, 2015), and in this research we test the culture influence in the m-banking post-adoption phase, which was not yet been tested. Third, in their literature review of application of Hofstede's culture dimensions on IT adoption and use, Leidner and Kayworth (2006) found that the most applied dimension was uncertainty avoidance and individualism-collectivism. The main reasoning is that uncertainty avoidance plays a strong role in how people will use or not use the IT, which means the adoption of IT includes some stress and risk. At the same time, for people with high propensity to individualism the in social behaviour addresses their personal interest, while for people with high propensity to collectivist culture, the main influence of social behaviour addresses the group or collective interest (Triandis, 1990). Finally, there are some studies that have successfully applied these two of Hofstede's culture dimensions (e.g. Lee *et al.*, 2007b).

The selection of the most appropriate and relevant cultural dimensions to answer the research questions is undoubtedly the most important challenge. For example, a scholar may be interested only in issues affecting personal behaviour and may wish to exclude dimensions related to the workplace behaviour. The selection of relevant dimensions that distinguish culture/personality is quite a hard task. On the other hand, a single model will hardly explain all the complex phenomena of culture (Taras *et al.*, 2009). The model presented here differs from traditional m-banking adoption research in that it focuses on use and individual performance combining individual culture differences. We posit that individual culture differences influence and moderate use and individual performance.

Table 6.1 Hofstede's national culture dimension

Dimension	Description
Uncertainty Avoidance	The degree to which novel phenomena or ambiguity are perceived as threats.
Power Distance	The degree to which differences in power, status, and privileges are accepted in society, and considered a "natural order".
Masculinity–Femininity	The distinction could be related to what motivates people, wanting to be the best (Masculine) or liking what one does (Feminine). It is related to gender roles.
Individualism/ Collectivism	This is the degree to which people derive their identity primarily from being an individual ("I") versus being a member of social groups ("We").
Time-orientation	Degree of how society prioritizes and deals with its own past with the challenges of the present and the future.

6.2.3.1 Individualism

Individualism is defined as *"ties between individuals are loose: everyone is expected to look after himself or herself and his or her immediate family"* (Hofstede, 1980). This

means that individuals do things in their own best interests. People with a greater propensity for individualism may tend to use mobile Internet services that will showcase their personality, and are more likely to focus on personalized objectives (Kim *et al.*, 2006). Based on that, we believe m-banking users with high individualistic propensity will negatively influence the use of m-banking, and that this will consequently impact the individual performance. Therefore, we propose the following:

H3a: Individualism moderates the effects of TTF on use, such that the effects are weaker amongst users with greater individualism.

H4a: Individualism moderates the effects of TTF on individual performance, such that the effects are weaker amongst users with greater individualism.

H5a: Individualism moderates the effects of use on individual performance, such that the effects are weaker amongst users with greater individualism.

6.2.3.2 Uncertainty avoidance

Uncertainty avoidance is defined as *"the extent to which the members of a culture feel threatened by uncertain or unknown situations"* (Hofstede, 1980). People with high uncertainty avoidance perceive novel or ambiguous phenomena as threats. For Hofstede (2011), high uncertainty avoidance culture is characterized by treating unstructured situations as novel, and in which people dislike the unknown situations, and seek security. Uncertainty avoidance affects the usage of mobile Internet services (Kim *et al.*, 2006). Based on that, users with high uncertainty avoidance play an important role in the m-banking use and individual performance. Thus, we hypothesize the following:

H3b: Uncertainty avoidance moderates the effects of TTF on use, such that the effects are weaker amongst users with greater uncertainty avoidance.

H4b: Uncertainty avoidance moderates the effects of TTF on individual performance, such that the effects are weaker amongst users with greater uncertainty avoidance.

H5b: Uncertainty avoidance moderates the effects of use on individual performance, such that the effects are weaker amongst users with greater uncertainty avoidance.

6.3 Methodology

We collected data by means of a questionnaire directed to m-banking users on a popular survey website. The questionnaire was first developed in English and reviewed for content validity. We translated the English questionnaire to Portuguese and then back to English to ensure translation consistency (Brislin, 1970). All measurement items (see Table 6.2) were adapted from Zhou *et al.* (2010), Lin and Huang (2008), Goodhue and Thompson (1995), and Lee *et al.* (2007b), with slight modifications. Most items were measured using a numerical scale ranging from strongly disagree (1) to strongly agree (7). The data were collected in POrtugal between November 2014 and February 2015. A total of 720 e-mails were sent in November 2014 to m-banking users with introduction letter, explaining the purpose and procedures of the study. The survey was accessed 315 times. 111 responses were removed due to incompleteness, leaving 204 valid and complete responses.

Our demographics analysis indicated that of the 204 respondents 58% are men. Regarding age, 51 (25%) of the respondents are below 30 years old, 90 (44%) of the respondents are between 30 and 40 years old, and the remainder (63 respondents) are above 40 years old. Concerning m-banking usage frequency in a month, 63% use it over 10 times in a month, and 15% of the users between 6 to 10 times a month, and the rest use it fewer than 6 times a month.

To test for common method bias we applied Harman's one factor test (Podsakoff *et al.*, 2003). No significant common method bias was found in our dataset. We also used the marker variable technique (Malhotra *et al.*, 2006, Lindell and Whitney, 2001) to test for common method bias. No significant bias was found in the data set.

Table 6.2 Items

Constructs	Items	Adapted from
Task characteristics	TASK1 - I need to manage my accounts anytime anywhere TASK2 - I need to do transfer anytime anywhere TASK3 - I need to have a real time control in my accounts TASK4 - The financial instructions I give can't wait	(Zhou *et al.*, 2010)
Technology characteristics	TECH1 – M-banking provides ubiquitous services TECH2 – M-banking provides real time services TECH3 – M-banking provides a quick service TECH4 – M-banking provides secure services	(Zhou *et al.*, 2010)
Task technology fit	TTF1 – M-banking payment services are appropriate TTF2 – M-banking account management services are appropriate TTF3 - Real time m-banking services are appropriate TTF4 - In general, m-banking services are enough	(Lin and Huang, 2008)
Use	USE1 - I use m-banking USE2 - I use m-banking to manage my accounts USE3 - I use m-banking to make transfers USE4 - I subscribe to financial products that are exclusive to m-banking	(Zhou *et al.*, 2010)
Individual performance	IP1: The m-banking enables me to accomplish tasks more quickly IP2: The m-banking makes it easier to accomplish tasks	(Goodhue and Thompson, 1995)
Individualism	ID1: I frequently use m-banking services that express my personality. ID2: I do not want to feel like an anonymous member of a group that uses an m-banking service. ID3: I frequently use m-banking services that can differentiate me from other people.	(Lee *et al.*, 2007b)
Uncertainty avoidance	UA1: I do not use m-banking content when I am unsure of its quality. UA2: I am bothered when an m-banking service does something strange. UA3: I am reluctant to use an m-banking service if the security of operations is compromised in any way.	(Lee *et al.*, 2007b)

6.4 Data analysis and results

The data analysis was carried out using partial least squares structural equation modeling (PLS-SEM) (Hair *et al.*, 2014) supported on the software SmartPLS 2.0 M3 (Ringle *et al.*, 2005). The measurement model's strength is revealed in the evaluation of (i) convergent and (ii) discriminant validity (Hair *et al.*, 2014). (i) The convergent validity refers to three factors: reliability of questions, composite reliability of constructs, and average variance extracted (AVE) by constructs (Fornell and Larcker, 1981). (ii) The discriminant validity refers to two factors. First, the square roots of AVEs (diagonal elements) are greater than the correlation between each pair of constructs (off-diagonal elements) (Fornell and Larcker, 1981). Second, to ensure the discriminant validity, the loadings should be greater than cross loadings (Chin, 1998a, Götz *et al.*, 2010, Grégoire and Fisher, 2006).

Tables 6.3 and 6.4 present the measurement model results. The results for composite reliability (CR) are greater than 0.8, indicating that the model has satisfactory internal consistency. Factor loadings should be at least 0.6 and preferably greater than 0.7 (Chin, 1998a). For this reason and to meet cross-loading criteria, the item USE4 was excluded from our PLS model estimation. After the exclusion, we found that no indicator has loadings (in bold) with values lower than their cross loadings (please see Table 6.4). The AVE was used to test convergent validity, and are above the cut-off of 0.50 (Henseler *et al.*, 2009, Hair *et al.*, 2014). Additionally, the square root of AVE (in bold) is higher than the correlation between constructs. In short, the measurement model measures are met, and consequently the constructs developed can be used to assess the conceptual model and its hypotheses.

Table 6.3 PLS loadings and cross-loadings

Constructs		TASK	TECH	TTF	USE	IP	ID	UA
Task	TASK1	**.87**	.37	.39	.52	.46	.30	.06
characteristics	TASK2	**.91**	.44	.48	.58	.55	.30	.10
(TASK)	TASK3	**.85**	.39	.45	.48	.45	.25	.13
	TASK4	**.80**	.32	.38	.44	.38	.22	.21
Technology	TECH1	.40	**.90**	.70	.57	.60	.34	.06
characteristics	TECH2	.33	**.87**	.63	.42	.44	.25	.06
(TECH)	TECH3	.37	**.91**	.67	.53	.60	.34	.09
	TECH4	.44	**.78**	.64	.57	.55	.36	-.02
Task technology	TTF1	.49	.72	**.90**	.68	.68	.34	.14
fit (TTF)	TTF2	.50	.71	**.94**	.66	.62	.39	.07
	TTF3	.47	.67	**.88**	.53	.52	.28	.14
	TTF4	.24	.54	**.76**	.49	.48	.24	.10
USE	USE1	.57	.60	.68	**.97**	.80	.41	.09
	USE2	.59	.59	.64	**.96**	.79	.40	.03
	USE3	.54	.56	.65	**.95**	.78	.40	.05
Individual	IP1	.55	.66	.64	.82	**.97**	.45	.07
performance (IP)	IP2	.49	.56	.65	.76	**.96**	.43	.09
Individualism	ID1	.35	.41	.41	.46	.50	**.94**	.14
(ID)	ID2	.02	.04	.05	.01	.05	**.60**	.07
	ID3	.16	.20	.17	.22	.24	**.76**	-.03
Uncertainty	UA1	.17	.02	.13	.02	.03	.13	**.71**
avoidance (UA)	UA2	.12	.06	.13	.07	.10	.11	**.95**
	UA3	.09	.05	.05	.02	.04	.00	**.77**

Table 6.4 Means, standard deviations, correlations, and reliability and validity measures of latent variables

Constructs	Mean	SD	CR	CA	TASK	TECH	TTF	USE	IP	ID	UA
Task characteristics (TASK)	5.79	1.29	.92	.88	**.86**						
Tech. characteristics (TECH)	5.73	1.09	.92	.89	.45	**.87**					
Task technology fit (TTF)	5.50	1.15	.93	.89	.50	.76	**.87**				
Use	5.33	1.96	.97	.96	.59	.61	.68	**.96**			
Individual performance (IP)	5.67	1.54	.96	.93	.54	.63	.67	.82	**.96**		
Individualism (ID)	3.69	1.58	.82	.75	.32	.38	.37	.43	.47	**.78**	
Uncertainty avoidance (UA)	5.16	1.62	.86	.78	.14	.06	.13	.06	.08	.10	**.82**

Figure 6.2 shows the path coefficient and t-statistics derived from bootstrapping with 5,000 resamples, and the R^2 values. The estimates of the coefficients from a bootstrap distribution can be viewed as an approximation of the sampling distribution and its standard deviation, and can be used as a proxy for the parameter's standard error in the population. Therefore, t values are calculated to assess each indicator weight's significance (Hair *et al.*, 2014).

The model explains 61.4% of the variation in TTF. The task characteristics ($\hat{\beta}$ = .196, p<.01) and technology characteristics ($\hat{\beta}$ = .676, p<.01) are statistically significant in explaining TTF, thus confirming hypotheses H1 and H2. The model explains 54.5% of the variation in m-banking use, which is explained by TTF ($\hat{\beta}$=.808, p<.01), providing support for H3. Finally, 71.9% of the variation in individual performance is explained by TTF ($\hat{\beta}$=.148, p<.05) and m-banking use ($\hat{\beta}$=.613, p<.01), providing support for H4 and H5, respectively. Regarding the cultural moderators, our results show that of six hypotheses, only two (H3a and H4b) are supported, and the paths are negative. For hypothesis H3a, due to the ($\hat{\beta}$= -.844, p<.01), the high value of individualism traits weakens the effect of TTF on m-banking use. For hypothesis H4b, due to the negative beta value ($\hat{\beta}$ = -.142, p<.10), the high value of uncertainty avoidance will be weaker in the relationship between TTF and individual performance.

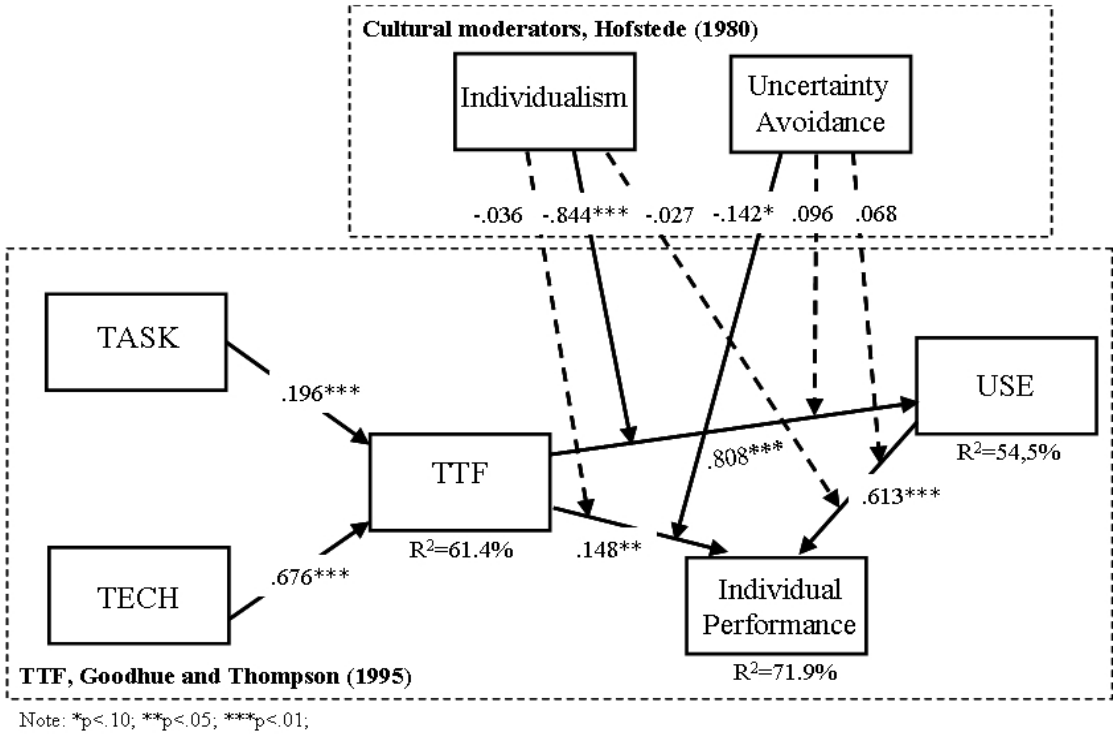


Figure 6.2 Structural model results

6.5 Discussion

Our results suggest that TTF has the strongest direct and positive impact on the m-banking usage. This finding is consistent with earlier findings from similar studies (Zhou *et al.*, 2010). Our results show that TTF and usage positively influence the individual performance and are also consistent with the literature (McGill and Klobas, 2009, Lin, 2012). We decided to test the individualism because of its negative association with the use of mobile Internet services (Kim *et al.*, 2006). Our results show that high individualism scores (and based on the negative value) decrease the effect of TTF on use of m-banking. This means that for individuals with low individualism the importance of TTF is greater; for individuals with high individualism the importance of TTF for explaining the m-banking use is lower (see Figure 6.3). The uncertainty avoidance moderator is statistically significant between the path TTF and individual

performance. Due to the negative beta value for m-banking users with high uncertainty avoidance propensity, the effect between TTF and individual performance will be weaker than for users with low uncertainty avoidance propensity (see Figure 6.3).

Figure 3 shows the impact of statistically significant moderators, the individualism over TTF to m-banking use, and uncertainty avoidance over TTF to individual performance. The individualism moderator suggests the major impact of TTF over use among people with low individualism. For users with high individualism the TFF is not important in explaining the m-banking use. The uncertainty avoidance moderator suggests a major impact of high TTF on individual performance when the user has low uncertainty avoidance.

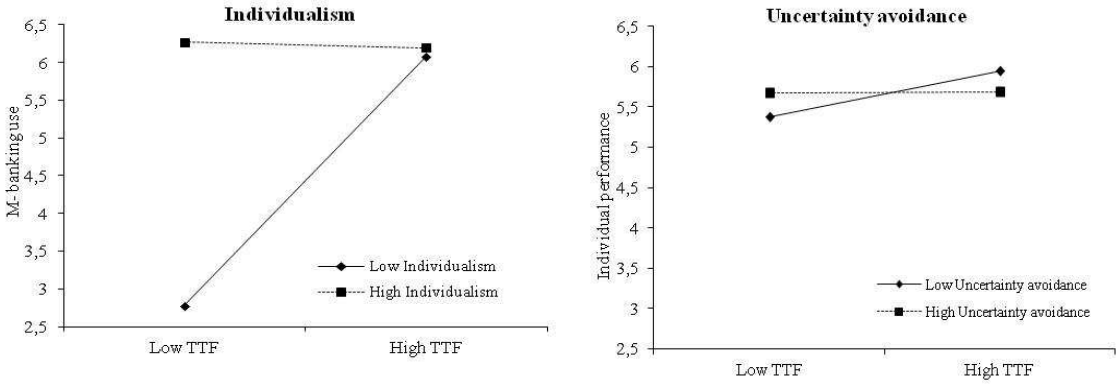


Figure 6.3 Moderators effects

6.5.1 Theoretical implications

Most empirical studies of m-banking seek to understand the factors and motivations that influence the adoption or behaviour intention. In their m-banking literature review Shaikh and Karjaluoto (2015) report that fact. On the other hand, the TTF model was applied in combination with other models such as the unified theory of acceptance and

usage of technology (UTAUT) (Zhou *et al.*, 2010), and UTAUT with the initial trust model (ITM) (Oliveira *et al.*, 2014) to evaluate m-banking adoption. Based on that and despite its limitations, our research makes several contributions to the theory and practice of information systems. First, we applied the TTF model to evaluate the use and individual performance, as sources of retention and reduction of attrition effects (Singh and Kumar, 2014, Campbell and Frei, 2010). Understanding how to retain users and attract potential adopters has become a critical strategic issue to service providers (Xu *et al.*, 2014). Second, we combine cultural characteristics as moderator of the path between TTF on use and on individual performance. We also test the cultural characteristics as moderator of the path between use on individual performance. By combining the TTF model and culture dimensions, it formulates a new concept of culture-task-technology fit. This approach may provide other insights to m-banking developers and managers. Third, cultural differences go far across national borders, or may be enclosed in the same region. Our model reveals that the individualism had a negative statiscally significant moderating effect on TTF over use of m-banking. The uncertainty avoidance inclination is a statistically significant moderator and had a negative effect on TTF over individual performance.

6.5.2 Practical implications

There are practical implications of this study that are key to building solid relationships with m-banking users and service providers. These key strategies may engage customer loyalty and attract potential adopters to this channel. First, while the majority of m-banking studies focus on the adoption and behaviour intention phase, this study focuses on post-adoption and retention of m-banking users. Understanding the post-adoption usage stage could help service providers to design strategies to deal with this group of

m-banking users. Second, we find that TTF and use explain individual performance, which indicates that there are possible benefits associated with the banking tasks accomplished by using this channel. Understanding how m-banking enables users to conduct financial services in a more efficient and effective way, thereby offering many advantages for individuals, such as time savings and ease of performing banking transactions, may retain more m-banking users. Third, understanding cultural characteristics could be significant in developing and managing the m-banking solutions. For instance, for people with a high tendency to individualism, service providers should offer personalized services such as bookmarks. For those with a high tendency to uncertainty avoidance, service providers should offer solutions that mitigate the risk of using m-banking, which could positively influence customers' sense of security and their willingness to adopt this service. Based on the Deloitte survey January-2014 made in the US, 64% of respondents said they were either extremely or very concerned about data security when using m-banking (Srinivas *et al.*, 2014). In addition, in the same report 72% of consumers would appreciate the use of biometric identification (such as fingerprints or iris recognition) as a means of device authentication during financial services transactions, which would help to mitigate the uncertainty risk. Finally, considering theses changes, and how these affect the fit of task and technology characteristics and the implications to the use and individual performance, changing the strategies can make it possible.

6.6 Conclusion

To better understand the use and individual performance of m-banking we propose a research model that combines the task-technology fit model with two of Hofstede's cross-cultural dimension scales (individualism and uncertainty avoidance). We tested

the research model in Portugal. We find that individualism moderates the path between TTF and use, and uncertainty avoidance moderates the path between TTF and individual performance. The cultural relationship with usage and individual performance influences users' beliefs and behaviours. This presents a new challenge to any researcher seeking to explain culture's impact on use and individual performance in the IS/IT field. Our results are confirmed with evidence that TTF explains the use of m-banking, and TTF and use explain nearly 72% of the variation in individual performance.

For any business that provides services or products to customers, attracting customers and retaining then are among the top priorities. M-banking is one of the most strategic channel launches in retail banking during the last decade. Understanding the customer needs would help to retain and attract more m-banking users; for example, by mitigating the risk and offering more functionalities such as personalized services.

Our research has several limitations. One is the use of data from a single country. Although this limits the generalizability, our findings can be the basis for future studies. The second limitation is that this study applied only two of Hoftstede's cultural dimensions, individualism and uncertatinty avoidance. Including other culture dimensions could be interesting in future studies, and could provide further insight into m-banking and its users.

Chapter 7 - Conclusions

Powerful technological forces are transforming the retail banking industry. The technology boom opened up new channels for banking. Channel proliferation is still underway; m-banking is being rolled out by an ever increasing number of banks. Although we do not claim this dissertation to be exhaustive, it does provide a reasonable amount of insight into m-banking research. In terms of theoretical perspectives, with the exception of two studies that focused on user satisfaction, our findings reveal that the literature is mostly focused on potential adopters of m-banking, characterized by adoption and behaviour intention. One possible direction for future research is to focus on the post-adoption phase of m-banking, such as individual performance, as a consequence of using m-banking. We believe that by enhancing the quality of m-banking service, it will retain more users and attract potential adopters of m-banking, with the consequence of enhancing the individual performance, in turn.

In Chapter 2 the literature review indicates that the topics of m-banking adoption and behavioural intention dominate the majority of research, but finds no studies on post-adoption and use stage. Moreover, the two most significant drivers of intentions to adopt m-banking are perceived ease of use and perceived usefulness. We found several m-banking definitions, as a consequence of technological changes over time. Based on that, we propose a new broader definition: “M-banking is a service or product offered by financial institutions that makes use of portable technologies.”

In Chapter 3 based on empirical testing in Portugal, the results reveal that TTF and use are important precedents of individual performance. We found statistically significant differences in path TTF and use to performance impact for the age

subsample, and no statistically significant differences for the gender subsample. Our theoretical model contributes to research by highlighting the importance of studying demographic groups and by exploring the effects of age and gender differences, revealing that usage and individual performance have different results for each subsample. Although organizations in general continually seek new solutions to assess, understand, and strategize the running of a successful business, this chapter provides some practical strategy insight through system development and marketing services to promote adequate services to meet end-users' needs. For the younger group, the usage plays no role on performance impact while the TTF plays a significant part, which is important to promote the technology and task through this group. Despite this, our findings reveal no significant differences based on the gender subsamples. The analyses based on both age and gender show considerable importance in the development and marketing strategy to attract customers to this channel.

In Chapter 4, combining the DeLone & McLean IS success model and the TTF model to evaluate the impact of m-banking on individual performance, the results reveal that usage and user satisfaction are important precedents of individual performance, and the importance of the moderating effects of TTF over usage to individual performance. We found also that system quality, information quality, and service quality positively affect user satisfaction. While earlier work has emphasized the importance of m-banking adoption, in post-adoption behaviour we advance the knowledge base by suggesting that overall quality affects user satisfaction and its relationship with use of m-banking. We found that the integrative approach presented in this chapter should serve as a suitable model to evaluate the determinant factors in technology performance impact and can be used as a basis for future research. Regarding practical implications,

our results suggest that managers seeking potential adopters and users for continuous use of m-banking service should focus on the system quality, information quality, and service quality in order to enhance user satisfaction. This finding is perhaps the most important managerial lesson to be learned because today managers tend to believe that the importance of measuring the overall quality of the system diminishes as the m-banking system matures and becomes more stable. Continually updating all information that supports the m-banking users could enhance the information quality. Irrelevant, inaccurate, or out-of-date information could affect user satisfaction. One of the major challenges of providing the excellence of service quality is keeping the competence, courtesy, helpfulness, and empathy of the personnel, and their behaviour effects on the generation of a positive customers' word-of-mouth (Choudhury, 2014). Due to lower labour costs, several firms make strategic decisions to outsource the call centre. A knowledgeable agent can solve technical problems in a timely fashion, while an incompetent agent can aggravate a customer's frustration, leading to customer complaints, reducing the likelihood of future use of the system, and harming the user company's image (Ren and Zhou, 2008, Ye *et al.*, 2014).

In Chapter 5 we combine the DeLone & McLean IS success model and culture dimension to evaluate the impact of m-banking on individual performance. The results reveal that system quality, information quality, and service quality play important roles in user satisfaction, and influence its use and individual performance. Additionally, the results show the relevance of the moderating effect of time perception over the use and user satisfaction to individual performance. These results reveal that it is statistically significant in Portugal, indicating that in terms of individual performance, customers tends to focus on one task at a time, which differs in this case from the literature. In

terms of practical implications, we believe that by maintaining the overall quality of the m-banking service and enhancing individual performance, potential problems could be mitigated along with (possible) customer complaints (Kumar and Telang, 2012).

In Chapter 6 we show evidence on the influence of culture on m-banking use and individual performance, using a combination of the TTF model and two of Hofstede's cross-cultural dimension scales: uncertainty avoidance and individualism. We show that individualism moderates the relationship between TTF and use, and uncertainty avoidance moderates the relationship between TTF and individual performance. The remaining constructs, which represent the core of the TTF model, can still empirically explain the TTF, use, and individual performance of m-banking. Cultural differences go far across national borders, or may be enclosed in the same region. Our model reveals that individualism had a negative statiscally significant moderating effect on TTF over use of m-banking. Our results show that high individualism scores (based on the negative value) decrease the effect of TTF on use of m-banking. This means that for individuals with low individualism the importance of TTF is greater; for individuals with high individualism the importance of TTF for explaining the m-banking use is lower. The uncertainty avoidance inclination is a statistically significant moderator and had a negative effect on TTF over individual performance. Due to the negative beta value for m-banking users with high uncertainty avoidance propensity, the effect between TTF and individual performance will be weaker than for users with low uncertainty avoidance propensity. In terms of practical implications, understanding cultural characteristics could be important in developing and managing the m-banking solutions. For instance, for people with a high tendency to individualism, service providers should offer personalized services such as bookmarks.

For those with a high tendency to uncertainty avoidance, service providers should offer solutions that mitigate the risk of using m-banking, which could positively influence customers' sense of security and their willingness to adopt this service.

7.1 Contributions

Technology shapes the usage but usage should also shape the technology. User-centric design is a well-established approach based on a body of research and practice that aims to create technology that better fits the needs and capabilities of the users who will use the technology. A continuous dialogue will be needed between users and service providers. Based on that, the objective of this dissertation is twofold: first, to study the state of the art in m-banking within the framework of post-adoption, and secondly, to establish a series of models that allow us to understand the determinants of individual performance as a benefit for the consumer, and its influence for service providers.

This dissertation makes several important contributions. First, to the best of our knowledge, this is the first time the individual performance dimension is applied to m-banking as a dependent variable. While the majority of the empirical studies in m-banking fields address adoption and behaviour intention, this dissertation focuses on the post-adoption and use stage. Second, earlier research demonstrates that age and gender play important roles in the patterns of information technology (IT) adoption and use, but rarely considers these separately in the individual performance context. Consequently, this study investigates individual performance on the young and old subsamples and also male and female subsamples. Third, by integrating two well established theories, D&M IS Success model and TTF model, this research demonstrates the usefulness and value of combining different theories. Each model has strengths and weaknesses, and these are offset and complemented by combining the various models. Fourth, combining

D&M IS Success model with Hall's cultural dimension, we show that the cultural relationship with usage and users' satisfaction may explain their beliefs and behaviours to the individual performance. Fifth, combining the TTF model and two of Hofstede's cross-cultural dimension scales, we show that individualism moderates the relationship between TTF and use, and uncertainty avoidance moderates the relationship between TTF and individual performance. The remaining constructs, which represent the core of the TTF model, can still empirically explain the TTF, use, and individual performance of m-banking. Finally, we provide recommendations regarding where the focus of effort should be in the future and outline future research avenues.

7.2 Limitations and future work

This study has several limitations that should be taken into consideration when generalizing its findings. First, we conducted this research in a single country having one of the highest mobile penetrations in the European Union (EU), but not in m-banking. To enhance generalization, a comparison with different countries, with a larger sample size, variety of ages, and across a variety of cultures is welcome. Second, all data collected support the applied time-sectional model, measuring perceptions at a single point in time, but perceptions change over time as individuals gain experience. Longitudinal study to assess this evolution would be of interest and could provide more insights on how user behaviour changes over time.

It is essential for the financial industry to be clear about what 'customer centric' means, and how to convert efforts in that realm into profits. We understand the several advantages for the financial industry in encouraging customers to adopt and use the remote channel, and its relationship to the scope of research in most m-banking studies.

However, knowing the determinants of the post-adoption phase, and keeping customers loyal to m-banking are the emerging issues that should be considered in future research. There is no doubt that portable technology evolution will affect the way customers interact with their financial institutions. The pace of change is increasing and banks need to do even more to ensure that they are well-positioned to succeed in the future. We have identified some trends for the future that could be priorities for success:

- Make the movement of money via payments and transfer easier. According to the Forrester survey Q4 2011 made in Europe, besides checking account transactions and balance enquiries, the two most popular transactions made on mobile devices are money transfers and the paying of bills (Forrester, 2011).
- Give customers the flexibility to use any channel at any time. System unavailability or other problems can harm company image and lead customers to feel less satisfied with the service.
- Leverage smartphone capabilities. For example, customer feedback guides and informs a company's decision-making and influences its product roadmap.
- Go beyond the password with authentication. According to a Deloitte report, 72% of consumers would appreciate the use of biometric identification (such as fingerprints or iris recognition) as a means of device authentication during financial services transactions (Srinivas *et al.*, 2014).

Finally, there are multiple priorities that the financial industry can achieve, not only improving customer service, but also in differentiating brands and growing revenues by cross-selling the right product through the right channel to the right customer.

References

Aboelmaged, M. G., and Gebba, T. R. (2013), "Mobile banking adoption: an examination of technology acceptance model and theory of planned behavior", *International Journal of Business Research and Development (IJBRD),* Vol. 2 No. 1., pp. 35-50

Abugabah, A. J. A., and Sanzogni, L. (2010), "Re-conceptualizing information systems models: An experience from ERP systems environment", *International Journal for Infonomics,* Vol. 3 No. 4, pp. 414-421.

Adler, R. F., and Benbunan-Fich, R. (2012), "Juggling on a high wire: Multitasking effects on performance", *International Journal of Human-Computer Studies,* Vol. 70 No. 2, pp. 156-168.

Afshan, S., and Sharif, A. (2016), "Acceptance of mobile banking framework in Pakistan", *Telematics and Informatics,* Vol. 33 No. 2, pp. 370-387.

Akter, S., D'Ambra, J., and Ray, P. (2013), "Development and validation of an instrument to measure user perceived service quality of mHealth", *Information & Management,* Vol. 50 No. 4, pp. 181-195.

Al-Smadi, M. O. (2012), "Factors affecting adoption of electronic banking: An analysis of the perspectives of banks' customers", *International Journal of Business and Social Science,* Vol. 3 No. 17, pp. 294-309.

Al-Somali, S. A., Gholami, R., and Clegg, B. (2009), "An investigation into the acceptance of online banking in Saudi Arabia", *Technovation,* Vol. 29 No. 2, pp. 130-141.

Alafeef, M., Singh, D., and Ahmad, K. (2011), "Influence of Demographic Factors on the Adoption Level of Mobile Banking Applications in Jordan", *Research Journal of Applied Sciences,* Vol. 6 No. 6, pp. 373-377.

Ali, B. M., and Younes, B. (2013), "The impact of information systems on user performance: An exploratory study", *Journal of Knowledge Management, Economics and Information Technology,* Vol. 3 No. 2.

Amin, H., Hamid, M. R. A., Tanakinjal, G. H., and Lada, S. (2006), "Undergraduate attitudes and expectations for mobile banking", *Journal of Internet Banking and Commerce,* Vol. 11 No. 3, pp. 2006-2012.

Amin, H., Supinah, R., Aris, M. M., and Baba, R. (2012), "Receptiveness of mobile banking by Malaysian local customers in Sabah: an empirical investigation", *Journal of internet banking and commerce,* Vol. 17 No. 1, pp. 1-12.

Anderson, J. C., and Gerbing, D. W. (1988), "Structural equation modeling in practice: A review and recommended two-step approach", *Psychological bulletin,* Vol. 103 No. 3, pp. 411-423.

Ansari, M. S., Channar, Z. A., and Syed, A. (2012), "Mobile phone adoption and appropriation among the young generation", *Procedia - Social and Behavioral Sciences,* Vol. 41, pp. 265-272.

Au, N., Ngai, W. T., and Cheng, T. C. (2008), "Extending the understanding of end user information systems satisfaction formation: An equitable needs fulfillment model approach", *MIS Quarterly,* Vol. 32 No. 1, pp. 43-66.

Bailey, J. E., and Pearson, S. W. (1983), "Development of a tool for measuring and analyzing computer user satisfaction", *Management Science,* Vol. 29 No. 5, pp. 530-545.

Baptista, G., and Oliveira, T. (2015), "Understanding mobile banking: The unified theory of acceptance and use of technology combined with cultural moderators", *Computers in Human Behavior,* Vol. 50, pp. 418-430.

Barnes, S. J., and Corbitt, B. (2003), "Mobile banking: concept and potential", *International Journal of Mobile Communications,* Vol. 1 No. 3, pp. 273-288.

Barnett, R. C., and Marshall, N. L. (1991), "The relationship between women's work and family roles and their subjective well-being and psychological distress", *In:* Frankenhaeuser, M., Lundberg, U. and Chesney, M. (eds.), *Women, work, and health,* Springer US, New York, pp. 111-136.

Baskerville, R. F. (2003), "Hofstede never studied culture", *Accounting, organizations and society,* Vol. 28 No. 1, pp. 1-14.

Bossen, C., Jensen, L. G., and Udsen, F. W. (2013), "Evaluation of a comprehensive EHR based on the DeLone and McLean model for IS success: Approach, results, and success factors", *International Journal of Medical Informatics,* Vol. 82 No. 10, pp. 940-953.

Brislin, R. W. (1970), "Back-translation for cross-cultural research", *Journal of Cross-Cultural Psychology,* Vol. 1 No. 3, pp. 185-216.

Burton-Jones, A., and Grange, C. (2012), "From use to effective use: a representation theory perspective", *Information Systems Research,* Vol. 24 No. 3, pp. 632-658.

Calhoun, K. J., Teng, J. T. C., and Cheon, M. J. (2002), "Impact of national culture on information technology usage behaviour: An exploratory study of decision making in Korea and the USA", *Behaviour & Information Technology,* Vol. 21 No. 4, pp. 293-302.

Campbell, D., and Frei, F. (2010), "Cost structure, customer profitability, and retention implications of self-service distribution channels: Evidence from customer behavior in an online banking channel", *Management Science,* Vol. 56 No. 1, pp. 4-24.

Chae, M., and Kim, J. (2004), "Do size and structure matter to mobile users? An empirical study of the effects of screen size, information structure, and task complexity on user activities with standard web phones", *Behaviour & Information Technology,* Vol. 23 No. 3, pp. 165-181.

Cheah, C. M., Teo, A. C., Sim, J. J., Oon, K. H., and Tan, B. I. (2011), "Factors affecting Malaysian mobile banking adoption: An empirical analysis", *International Journal of Network and Mobile Technologies,* Vol. 2 No. 3, pp. 149-160.

Cheok, M. L., and Wong, S. L. (2015), "Predictors of e-learning satisfaction in teaching and learning for school teachers: A literature review", *International Journal of Instruction,* Vol. 8 No. 1, pp. 75-90.

Chin, W. W. (1998a), "Issues and opinion on structural equation modeling", *MIS Quarterly,* Vol. 22 No. 1, pp. 7-25.

Chin, W. W. (1998b). The partial least squares approach to structural equation modeling. *In:* Marcoulides, G. A. (ed.) *Modern methods for business research.* Mahwah: Lawrence Erlbaum Associates.

Chin, W. W., Marcolin, B. L., and Newsted, P. R. (2003), "A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study", *Information Systems Research,* Vol. 14 No. 2, pp. 189-217.

Chitungo, S. K., and Munongo, S. (2013), "Extending the technology acceptance model to mobile banking adoption in rural Zimbabwe", *Journal of Business Administration and Education,* Vol. 3 No. 1, pp. 51-79.

Choudhury, K. (2014), "Service quality and word of mouth: a study of the banking sector", *International Journal of Bank Marketing,* Vol. 32 No. 7, pp. 612-627.

Chung, N., and Kwon, S. J. (2009), "Effect of trust level on mobile banking satisfaction: a multi-group analysis of information system success instruments", *Behaviour & Information Technology,* Vol. 28 No. 6, pp. 549-562.

Churchill Jr, G. A. (1979), "A paradigm for developing better measures of marketing constructs", *Journal of Marketing Research,* Vol. 16 No. 1, pp. 64-73.

Clarke III, I. (2008), "Emerging value propositions for m-commerce", *Journal of Business Strategies,* Vol. 25 No. 2, pp. 41-57.

Cohen, J. (1988), *Statistical power analysis for the behavioral sciences,* Hillsdale, NJ: Erlbaum.

Compeau, D. R., and Higgins, C. A. (1995), "Computer self-efficacy: Development of a measure and initial test", *MIS Quarterly,* Vol. 19 No. 2, pp. 189-211.

Coursaris, C., and Hassanein, K. (2002), "Understanding m-commerce: a consumer-centric model", *Quarterly journal of electronic commerce,* Vol. 3 , pp. 247-272.

Crabbe, M., Standing, C., Standing, S., and Karjaluoto, H. (2009), "An adoption model for mobile banking in Ghana", *International Journal of Mobile Communications,* Vol. 7 No. 5, pp. 515-543.

Cruz, P., Neto, L. B. F., Muñoz-Gallego, P., and Laukkanen, T. (2010), "Mobile banking rollout in emerging markets: evidence from Brazil", *International Journal of Bank Marketing,* Vol. 28 No. 5, pp. 342-371.

Davis, F. D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly,* Vol. 13 No. 3, pp. 319-340.

Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. (1989), "User acceptance of computer technology: A comparison of two theoretical models", *Management Science,* Vol. 35 No. 8, pp. 982-1003.

DeLone, W. H., and McLean, E. R. (1992), "Information systems success: The quest for the dependent variable", *Information Systems Research,* Vol. 3 No. 1, pp. 60-95.

DeLone, W. H., and McLean, E. R. (2003), "The DeLone and McLean model of information systems success: A ten-year update", *Journal of Management Information Systems,* Vol. 19 No. 4, pp. 9-30.

Dewan, S. M. (2010). Past, present and future of m-banking research: A literature review. *21st Australasian Conference on Information Systems*. Brisbane, Australia.

Dishaw, M. T., and Strong, D. M. (1999), "Extending the technology acceptance model with task–technology fit constructs", *Information & Management*, Vol. 36 No. 1, pp. 9-21.

Ensor, B., and Wannemacher, P. (2015), "Building A World-Class Mobile Banking Strategy", *The Mobile Banking Strategy Playbook For 2015*, Forrester Research, Inc.

Fildes, R., Goodwin, P., and Lawrence, M. (2006), "The design features of forecasting support systems and their effectiveness", *Decision Support Systems*, Vol. 42 No. 1, pp. 351-361.

Fishbein, M., and Ajzen, I. (1975), *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*, Reading, Mass.: Addison-Wesley.

Fisher, C. W., and Kingma, B. R. (2001), "Criticality of data quality as exemplified in two disasters", *Information & Management*, Vol. 39 No. 2, pp. 109-116.

Floh, A., and Treiblmaier, H. (2006), "What keeps the e-banking customer loyal? A multigroup analysis of the moderating role of consumer characteristics on e-loyalty in the financial service industry", *Journal of Electronic Commerce Research*, Vol. 7 No. 2, pp. 97-110.

Fornell, C., and Larcker, D. F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, pp. 39-50.

Forrester (2011), "European technographics financial services online survey, Q4 2011". *Consumer Technographics*, available at: http://www.forrester.com/European+Technographics+Financial+Services+Online+Survey+Q4+2011/-/E-SUS884 (accessed 3 March 2014).

Garfield, M. J., and Watson, R. T. (1997), "Differences in national information infrastructures: the reflection of national cultures", *The Journal of Strategic Information Systems*, Vol. 6 No. 4, pp. 313-337.

Gebauer, J., and Ginsburg, M. (2009), "Exploring the black box of task-technology fit", *Communications of the ACM*, Vol. 52 No. 1, pp. 130-135.

Gefen, D., and Straub, D. (2005), "A practical guide to factorial validity using PLS-graph: tutorial and annotated example", *Communications of the Association for Information Systems,* Vol. 16 No. 1, pp. 91-109.

Geisser, S. (1974), "A predictive approach to the random effect model", *Biometrika,* Vol. 61 No. 1, pp. 101-107.

Goodhue, D. L. (1995), "Understanding user evaluations of information systems", *Management Science,* Vol. 41 No. 12, pp. 1827-1844.

Goodhue, D. L. (1998), "Development and measurement validity of a task-technology fit instrument for user evaluations of information systems", *Decision Sciences,* Vol. 29 No. 1, pp. 105-138.

Goodhue, D. L., and Thompson, R. L. (1995), "Task-technology fit and individual performance", *MIS Quarterly,* Vol. 19 No. 2, pp. 213-236.

Götz, O., Liehr-Gobbers, K., and Krafft, M. (2010), "Evaluation of structural equation models using the partial least squares (PLS) approach", *In:* Vinzi, V. E., Chin, W. W., Henseler, J. and Wang, H. (eds.), *Handbook of Partial Least Squares,* Springer Berlin Heidelberg, pp. 691-711.

Grégoire, Y., and Fisher, R. (2006), "The effects of relationship quality on customer retaliation", *Marketing Letters,* Vol. 17 No. 1, pp. 31-46.

Gu, J.-C., Lee, S.-C., and Suh, Y.-H. (2009), "Determinants of Behavioral Intention to Mobile Banking", *Expert Systems with Applications,* Vol. 36 No. 9, pp. 11605-11616.

Guimaraes, T., and Igbaria, M. (1997), "Client/Server System Success: Exploring the Human Side", *Decision Sciences,* Vol. 28 No. 4, pp. 851-876.

Guinea, A. O., and Markus, M. L. (2009), "Why break the habit of a lifetime? Rethinking the roles of intention, habit, and emotion in continuing information technology use", *MIS Quarterly,* Vol. 33 No. 3, pp. 433-444.

Hair, J. F., Hult, G. T., Ringle, C. M., and Sarstedt, M. (2014), *A primer on partial least square structural equation modeling (PLS-SEM),* US, SAGE.

Hair, J. F., Ringle, C. M., and Sarstedt, M. (2011), "PLS-sem: Indeed a silver bullet", *The Journal of Marketing Theory and Practice,* Vol. 19 No. 2, pp. 139-152.

Hair, J. F., Sarstedt, M., Ringle, C. M., and Mena, J. A. (2012), "An assessment of the use of partial least squares structural equation modeling in marketing research", *Journal of the Academy of Marketing Science,* Vol. 40 No. 3, pp. 414-433.

Hall, D. T., and Mansfield, R. (1975), "Relationships of age and seniority with career variables of engineers and scientists", *Journal of Applied Psychology*, Vol. 60 No. 2, pp. 201-210.

Hall, E. T. (1969), *The hidden dimension*, Anchor Books New York.

Hall, E. T. (1976), *Beyond culture*, Garden City, CA, Anchor.

Hanafizadeha, P., Behboudib, M., Koshksarayc, A. A., and Tabarc, M. J. S. (2014), "Mobile-banking adoption by Iranian bank clients", *Telematics and Informatics*, Vol. 31 No.1, pp. 62-78.

Henseler, J., Ringle, C. M., and Sinkovics, R. R. (2009), "The use of partial least squares path modeling in international marketing", *New Challenges to International Marketing*, Vol. 20, pp. 277-319.

Hoehle, H., and Huff, S. (2012), "Advancing task-technology fit theory: A formative measurement approach to determining task-channel fit for electronic banking channels", *In:* Hart, D. N. and Gregor, S. D. (eds.), *Information Systems Foundations: Theory Building in Information Systems*, ANU E Press, Australia, pp. 133-169.

Hoehle, H., Scornavacca, E., and Huff, S. (2012), "Three decades of research on consumer adoption and utilization of electronic banking channels: A literature analysis", *Decision Support Systems*, Vol. 54 No. 1, pp. 122-132.

Hofstede, G. (1980), *Culture's consequences: International differences in work-related values*, Beverly Hills, CA, Sage.

Hofstede, G. (2011), "Dimensionalizing cultures: The Hofstede model in context", *Online readings in psychology and culture*, Vol. 2 No. 1., pp. 1-26

Hollmann, V., Lee, H., Zo, H., and Ciganek, A. P. (2013), "Examining success factors of open source software repositories: the case of OSOR.eu portal", *International Journal of Business Information Systems*, Vol. 14 No. 1, pp. 1-20.

Hou, C.-K. (2012), "Examining the effect of user satisfaction on system usage and individual performance with business intelligence systems: An empirical study of Taiwan's electronics industry", *International Journal of Information Management*, Vol. 32 No. 6, pp. 560-573.

Hsu, M.-H., Chang, C.-M., Chu, K.-K., and Lee, Y.-J. (2014), "Determinants of repurchase intention in online group-buying: The perspectives of DeLone & McLean IS success model and trust", *Computers in Human Behavior*, Vol. 36, pp. 234-245.

Huang, T. C.-K., Liu, C.-C., and Chang, D.-C. (2012), "An empirical investigation of factors influencing the adoption of data mining tools", *International Journal of Information Management*, Vol. 32 No. 3, pp. 257-270.

Igbaria, M., and Tan, M. (1997), "The consequences of information technology acceptance on subsequent individual performance", *Information & Management*, Vol. 32 No. 3, pp. 113-121.

International Telecommunication Union, I. T. U., (2013), "*ICT facts and figures*". available at: http://www.itu.int/en/ITU-D/Statistics/Pages/default.aspx (accessed 28 April 2014).

International Telecommunication Union, I. T. U., (2015), "*ICT facts and figures*". available at: https://www.itu.int/net/pressoffice/press_releases/2015/17.aspx (accessed 26 May 2015).

Jarvenpaa, S. L., and Todd, P. A. (1996), "Consumer reactions to electronic shopping on the world wide web", *International Journal of Electronic Commerce*, Vol. 1 No. 2, pp. 59-88.

Jeong, B. K., and Yoon, T. E. (2013), "An empirical investigation on consumer acceptance of mobile banking services", *Business and Management Research*, Vol. 2 No. 1, pp. 31-40.

Junglas, I., Abraham, C., and Watson, R. T. (2008), "Task-technology fit for mobile locatable information systems", *Decision Support Systems*, Vol. 45 No. 4, pp. 1046-1057.

Kannan, V. R., and Tan, K. C. (2005), "Just in time, total quality management, and supply chain management: understanding their linkages and impact on business performance", *Omega*, Vol. 33 No. 2, pp. 153-162.

Keil, M., Tan, B. C. Y., Wei, K.-K., Saarinen, T., Tuunainen, V., and Wassenaar, A. (2000), "A Cross-Cultural Study on Escalation of Commitment Behavior in Software Projects", *MIS Quarterly*, Vol. 24 No. 2, pp. 299-325.

Keng, S., and Zixing, S. (2003), "Building customer trust in mobile commerce", *Communications of the ACM*, Vol. 46 No. 4, pp. 91-94.

Khraim, H. S., Shoubaki, Y., and Khraim, A. S. (2011), "Factors affecting Jordanian consumers' adoption of mobile banking services", *International Journal of Business and Social Science*, Vol. 2 No. 20, pp. 96-105.

Kim, G., Shin, B., and Lee, H. G. (2009), "Understanding dynamics between initial trust and usage intentions of mobile banking", *Information Systems Journal*, Vol. 19 No. 3, pp. 283-311.

Kim, H.-W., Xu, Y., and Koh, J. (2004), "A Comparison of online trust building factors between potential customers and repeat customers", *Journal of the Association for Information Systems*, Vol. 5 No. 10, pp. 392-420.

Kim, J., Lee, I., Choi, B., Hong, S.-J., Tam, K. Y., and Naruse, K. (2006), "Towards Reliable Metrics for Cultural Aspects of Human Computer Interaction", *In:* Galletta, D. and Zhang, P. (eds.), *Human-Computer Interaction and Management Information Systems: Applications in Management Information Systems*, M.E. Sharpe, Inc., Armonk, NY, pp. 173.

Kittler, M. G., Rygl, D., and Mackinnon, A. (2011), "Special Review Article: Beyond culture or beyond control? Reviewing the use of Hall's high-/low-context concept", *International Journal of Cross Cultural Management*, Vol. 11 No. 1, pp. 63-82.

Kluckhohn, F. R., and Strodtbeck, F. L. (1961), *Variations in Value Orientations*, Row, Peterson.

Koenig-Lewis, N., Palmer, A., and Moll, A. (2010), "Predicting young consumers' take up of mobile banking services", *International Journal of Bank Marketing*, Vol. 28 No. 5, pp. 410-432.

Kositanurit, B., Ngwenyama, O., and Osei-Bryson, K.-M. (2006), "An exploration of factors that impact individual performance in an ERP environment: an analysis using multiple analytical techniques", *European Journal of Information Systems*, Vol. 15 No. 6, pp. 556-568.

Kositanurit, B., Osei-Bryson, K.-M., and Ngwenyama, O. (2011), "Re-examining information systems user performance: Using data mining to identify properties of IS that lead to highest levels of user performance", *Expert Systems with Applications*, Vol. 38 No. 6, pp. 7041-7050.

Kourouthanassis, P. E., and Giaglis, G. M. (2012), "Introduction to the special issue mobile commerce: The past, present, and future of mobile commerce research", *International Journal of Electronic Commerce*, Vol. 16 No. 4, pp. 5-18.

Kroeber, A. L., and Kluckhohn, C. (1952), "Culture: A critical review of concepts and definitions", *Peabody Museum of Archaeology & Ethnology, Harvard University*.

Kumar, A., and Telang, R. (2012), "Does the web reduce customer service cost? Empirical evidence from a call center", *Information Systems Research,* Vol. 23 No. 3-part-1, pp. 721-737.

Kurniawan, S. (2008), "Older people and mobile phones: A multi-method investigation", *International Journal of Human-Computer Studies,* Vol. 66 No. 12, pp. 889-901.

Larsen, T. J., Sørebø, A. M., and Sørebø, Ø. (2009), "The role of task-technology fit as users' motivation to continue information system use", *Computers in Human Behavior,* Vol. 25 No. 3, pp. 778-784.

Laukkanen, T. (2007), "Internet vs mobile banking: comparing customer value perceptions", *Business Process Management Journal,* Vol. 13 No. 6, pp. 788-797.

Laukkanen, T. (2016), "Consumer adoption versus rejection decisions in seemingly similar service innovations: The case of the Internet and mobile banking", *Journal of Business Research,* Vol. 69 No. 7, pp. 2432-2439.

Laukkanen, T., and Kiviniemi, V. (2010), "The role of information in mobile banking resistance", *International Journal of Bank Marketing,* Vol. 28 No. 5, pp. 372-388.

Laukkanen, T., Sinkkonen, S., Kivijärvi, M., and Laukkanen, P. (2007), "Innovation resistance among mature consumers", *Journal of Consumer Marketing,* Vol. 24 No. 7, pp. 419-427.

Lee, C.-C., Cheng, H. K., and Cheng, H.-H. (2007a), "An empirical study of mobile commerce in insurance industry: Task–technology fit and individual differences", *Decision Support Systems,* Vol. 43 No. 1, pp. 95-110.

Lee, I., Choi, B., Kim, J., and Hong, S.-J. (2007b), "Culture-technology fit: Effects of cultural characteristics on the post-adoption beliefs of mobile internet users", *International Journal of Electronic Commerce,* Vol. 11 No. 4, pp. 11-51.

Lee, K. C., and Chung, N. (2009), "Understanding factors affecting trust in and satisfaction with mobile banking in Korea: A modified DeLone and McLean's model perspective", *Interacting with Computers,* Vol. 21 No. 5–6, pp. 385-392.

Lee, S.-G., Trimi, S., and Kim, C. (2013), "The impact of cultural differences on technology adoption", *Journal of World Business,* Vol. 48 No. 1, pp. 20-29.

Lee, Y. W., Strong, D. M., Kahn, B. K., and Wang, R. Y. (2002), "AIMQ: a methodology for information quality assessment", *Information & Management,* Vol. 40 No. 2, pp. 133-146.

Leidner, D. E., and Kayworth, T. (2006), "Review: A review of culture in information systems research: toward a theory of information technology culture conflict", *MIS Quarterly*, Vol. 30 No. 2, pp. 357-399.

Lepanto, L., Sicotte, C., and Lehoux, P. (2011), "Assessing Task–Technology Fit in a PACS Upgrade: Do Users' and Developers' Appraisals Converge?", *Journal of Digital Imaging*, Vol. 24 No. 6, pp. 951-958.

Li, W. (2010), "Virtual knowledge sharing in a cross-cultural context", *Journal of Knowledge Management*, Vol. 14 No. 1, pp. 38-50.

Liang, T.-P., and Wei, C.-P. (2004), "Introduction to the special issue: Mobile commerce applications", *International Journal of Electronic Commerce*, Vol. 8 No. 3, pp. 7-17.

Lin, H.-F. (2007), "Measuring online learning systems success: Applying the updated DeLone and McLean model", *CyberPsychology & Behavior*, Vol. 10 No. 6, pp. 817-820.

Lin, H.-F. (2011), "An empirical investigation of mobile banking adoption: The effect of innovation attributes and knowledge-based trust", *International Journal of Information Management*, Vol. 31 No. 3, pp. 252-260.

Lin, H.-F., and Lee, G.-G. (2006), "Determinants of success for online communities: an empirical study", *Behaviour & Information Technology*, Vol. 25 No. 6, pp. 479-488.

Lin, T. C., and Huang, C.-C. (2008), "Understanding knowledge management system usage antecedents: An integration of social cognitive theory and task technology fit", *Information & Management*, Vol. 45 No. 6, pp. 410-417.

Lin, W.-S. (2012), "Perceived fit and satisfaction on web learning performance: IS continuance intention and task-technology fit perspectives", *International Journal of Human-Computer Studies*, Vol. 70 No. 7, pp. 498-507.

Lindell, M. K., and Whitney, D. J. (2001), "Accounting for common method variance in cross-sectional research designs", *Journal of Applied Psychology*, Vol. 86 No. 1, pp. 114.

Liu, Y., and Li, H. (2010), "Mobile internet diffusion in China: An empirical study", *Industrial Management & Data Systems*, Vol. 110 No. 3, pp. 309-324.

Loch, K. D., Straub, D. W., and Kamel, S. (2003), "Diffusing the Internet in the Arab world: The role of social norms and technological culturation", *Engineering Management, IEEE Transactions on,* Vol. 50 No. 1, pp. 45-63.

Luarn, P., and Lin, H.-H. (2005), "Toward an Understanding of the Behavioral Intention to Use Mobile Banking", *Computers in Human Behavior,* Vol. 21 No. 6, pp. 873-891.

Luo, X., Li, H., Zhang, J., and 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,* Vol. 49 No. 2, pp. 222-234.

Mahdi, S. M., Liao, J., Muhammad, S., and Nader, H. M. (2014), "The impact of high performance work system (HPWS) on employee productivity as related to organizational identity and job engagement", *European Journal of Business and Management,* Vol. 6 No. 39, pp. 1-24.

Maillet, É., Mathieu, L., and Sicotte, C. (2015), "Modeling factors explaining the acceptance, actual use and satisfaction of nurses using an Electronic Patient Record in acute care settings: An extension of the UTAUT", *International Journal of Medical Informatics,* Vol. 84 No. 1, pp. 36-47.

Malaquias, R. F., and Hwang, Y. (2016), "An empirical study on trust in mobile banking: A developing country perspective", *Computers in Human Behavior,* Vol. 54 , pp. 453-461.

Malhotra, N. K., Kim, S. S., and Patil, A. (2006), "Common method variance in IS research: A comparison of alternative approaches and a reanalysis of past research", *Management Science,* Vol. 52 No. 12, pp. 1865-1883.

Manzoor, Q.-A. (2012), "Impact of employees motivation on organizational effectiveness", *Business management and strategy,* Vol. 3 No. 1, pp. pp. 1-12.

Marinkovic, V., and Obradovic, V. (2015), "Customers' emotional reactions in the banking industry", *International Journal of Bank Marketing,* Vol. 33 No. 3, pp. 243-260.

Martins, C., Oliveira, T., and Popovič, A. (2014), "Understanding the Internet banking adoption: A unified theory of acceptance and use of technology and perceived risk application", *International Journal of Information Management,* Vol. 34 No. 1, pp. 1-13.

Mason, R. O. (1978), "Measuring information output: A communication systems approach", *Information & Management,* Vol. 1 No. 4, pp. 219-234.

Mathieson, K., Peacock, E., and Chin, W. W. (2001), "Extending the technology acceptance model: The influence of perceived user resources", *The DATA BASE for Advances in Information Systems,* Vol. 32 No. 3, pp. 86-112.

McGill, T. J., and Klobas, J. E. (2009), "A task–technology fit view of learning management system impact", *Computers & Education,* Vol. 52 No. 2, pp. 496-508.

Mithas, S., Ramasubbu, N., and Sambamurthy, V. (2011), "How Information Management Capability Influences Firm Performance", *MIS Quarterly,* Vol. 35 No. 1, pp. 137-A15.

Moores, T. T., and Chang, J. C.-J. (2006), "Ethical decision making in software piracy: Initial development and test of a four-component model", *MIS Quarterly,* Vol. 30 No. 1, pp. 167-180.

Morawczynski, O., and Miscione, G. (2008), "Examining trust in mobile banking transactions: The case of M-PESA in Kenya", *Social dimensions of information and communication technology policy,* Springer, pp. 287-298.

Morris, M. G., and Venkatesh, V. (2000), "Age differences in technology adoption decisions: Implications for a changing work force", *Personnel Psychology,* Vol. 53 No. 2, pp. 375-403.

Morris, M. G., Venkatesh, V., and Ackerman, P. L. (2005), "Gender and age differences in employee decisions about new technology: An extension to the theory of planned behavior", *IEEE Transactions on Engineering Management,* Vol. 52 No. 1, pp. 69-84.

Mortimer, G., Neale, L., Hasan, S. F. E., and Dunphy, B. (2015), "Investigating the factors influencing the adoption of m-banking: a cross cultural study", *International Journal of Bank Marketing,* Vol. 33 No. 4, pp. 545-570.

Nonis, S. A., Teng, J. K., and Ford, C. W. (2005), "A cross-cultural investigation of time management practices and job outcomes", *International Journal of Intercultural Relations,* Vol. 29 No. 4, pp. 409-428.

Oliveira, T., Faria, M., Thomas, M. A., and Popovič, A. (2014), "Extending the understanding of mobile banking adoption: When UTAUT meets TTF and ITM", *International Journal of Information Management,* Vol. 34 No. 5, pp. 689-703.

Orlando, B., Renzi, A., Vagnani, G., and Volpe, L. (2013), "Determinants of innovation adoption: a literature review and future avenues of research". *Atti del XXV Convegno annuale di Sinergie*.

Overby, J. W., Gardial, S. F., and Woodruff, R. B. (2004), "French versus American consumers' attachment of value to a product in a common consumption context: A cross-national comparison", *Journal of the Academy of Marketing Science*, Vol. 32 No. 4, pp. 437-460.

Park, S., Zo, H., Ciganek, A. P., and Lim, G. G. (2011), "Examining success factors in the adoption of digital object identifier systems", *Electronic Commerce Research and Applications*, Vol. 10 No. 6, pp. 626-636.

Parkes, A. (2013), "The effect of task–individual–technology fit on user attitude and performance: An experimental investigation", *Decision Support Systems*, Vol. 54 No. 2, pp. 997-1009.

Peevers, G., Douglas, G., and Jack, M. A. (2008), "A usability comparison of three alternative message formats for an SMS banking service", *International Journal of Human-Computer Studies*, Vol. 66 No. 2, pp. 113-123.

Petter, S., DeLone, W., and McLean, E. R. (2008), "Measuring information systems success: models, dimensions, measures, and interrelationships", *European Journal of Information Systems*, Vol. 17 No. 3, pp. 236-263.

Petter, S., DeLone, W., and McLean, E. R. (2013), "Information systems success: The quest for the independent variables", *Journal of Management Information Systems*, Vol. 29 No. 4, pp. 7-62.

Pieri, M., and Diamantinir, D. (2010), "Young people, elderly and ICT", *Procedia - Social and Behavioral Sciences*, Vol. 2 No. 2, pp. 2422-2426.

Pitt, L. F., Watson, R. T., and Kavan, C. B. (1995), "Service quality: A measure of information systems effectiveness", *MIS Quarterly*, Vol. 19 No. 2, pp. 173-187.

Podsakoff, P. M., MacKenzie, S. B., Jeong-Yeon, L., and Podsakoff, N. P. (2003), "Common method biases in behavioral research: A critical review of the literature and recommended remedies", *Journal of Applied Psychology*, Vol. 88 No. 5, pp. 879-903.

Porteous, D. (2006). The enabling environment for mobile banking in Africa. Report commissioned by DFID.

Pousttchi, K., and Schurig, M. Assessment of today's mobile banking applications from the view of customer requirements. System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on, 2004. IEEE, 10 pp.

Püschel, J., Mazzon, J. A., and Hernandez, J. M. C. (2010), "Mobile banking: Proposition of an integrated adoption intention framework", *International Journal of Bank Marketing*, Vol. 28 No. 5, pp. 389-409.

Qian, Z., and Bock, G.-W. An empirical study on measuring the success of knowledge repository systems. Proceedings of the 38th Annual Hawaii International Conference on System Sciences, 2005 Hawaii. IEEE, 29a-29a.

Rana, N., Dwivedi, Y., Williams, M., and Weerakkody, V. (2015), "Investigating success of an e-government initiative: Validation of an integrated IS success model", *Information Systems Frontiers*, Vol. 17 No. 1, pp. 127-142.

Raykov, T. (2007), "Reliability if deleted, not 'alpha if deleted': Evaluation of scale reliability following component deletion", *British Journal of Mathematical and Statistical Psychology*, Vol. 60 No. 2, pp. 201-216.

Remus, W. (1986), "Graduate students as surrogates for managers in experiments on business decision making", *Journal of Business Research*, Vol. 14 No. 1, pp. 19-25.

Ren, Z. J., and Zhou, Y.-P. (2008), "Call center outsourcing: Coordinating staffing level and service quality", *Management Science*, Vol. 54 No. 2, pp. 369-383.

Ringle, C., Wende, S., and Will, A., (2005), "*SmartPLS 2.0 M3"*. available at: http://www.smartpls.de (accessed 10 January 2014).

Riquelme, H. E., and Rios, R. E. (2010), "The moderating effect of gender in the adoption of mobile banking", *International Journal of Bank Marketing*, Vol. 28 No. 5, pp. 328-341.

Rogers, E. (1995), *Diffusion of innovations*, New York, Free Press.

Rose, G. M., Evaristo, R., and Straub, D. (2003), "Culture and consumer responses to web download time: a four-continent study of mono and polychronism", *Engineering Management, IEEE Transactions on*, Vol. 50 No. 1, pp. 31-44.

Ryans, A. B. (1974), "Estimating consumer preferences for a new durable brand in an established product class", *Journal of Marketing Research*, Vol. 11 No. 4, pp. 434-443.

Saleem, Z., and Rashid, K. (2011), "Relationship between customer satisfaction and mobile banking adoption in Pakistan", *International Journal of Trade, Economics and Finance,* Vol. 2 No. 6, pp. 537-544.

Schaupp, L. C., Fan, W., and Belanger, F. Determining success for different website goals. 39th Hawaii International Conference on System Sciences (HICSS), 2006 Hawaii IEEE, 107b-107b.

Schierz, P. l. G., Schilke, O., and Wirtz, B. W. (2010), "Understanding consumer acceptance of mobile payment services: An empirical analysis", *Electronic Commerce Research and Applications,* Vol. 9 No. 3, pp. 209-216.

Seddon, P. B. (1997), "A respecification and extension of the DeLone and McLean model of IS success", *Information Systems Research,* Vol. 8 No. 3, pp. 240-253.

Shaikh, A. A., and Karjaluoto, H. (2015), "Mobile banking adoption: A literature review", *Telematics and Informatics,* Vol. 32 No. 1, pp. 129-142.

Shang, R.-A., Chen, Y.-C., and Chen, C.-M. (2007), "Why people blog? An empirical investigations of the task technology fit model", *PACIS 2007 Proceedings,* pp. 212-225.

Shannon, C. E., and Weaver, W. (1949), "The mathematical theory of communication", *University of Illinois Press, Urbana*.

Sharma, S. K., and Govindaluri, S. M. (2014), "Internet banking adoption in India: Structural equation modeling approach", *Journal of Indian Business Research,* Vol. 6 No. 2, pp. 155-169.

Sharma, S. K., Govindaluri, S. M., and Al Balushi, S. M. (2015), "Predicting determinants of Internet banking adoption: A two-staged regression-neural network approach", *Management Research Review,* Vol. 38 No. 7, pp. 750-766.

Shen, Y.-C., Huang, C.-Y., Chu, C.-H., and Hsu, C.-T. (2010), "A benefit–cost perspective of the consumer adoption of the mobile banking system", *Behaviour & Information Technology,* Vol. 29 No. 5, pp. 497-511.

Sheng, H., Nah, F. F.-H., and Siau, K. (2005), "Strategic implications of mobile technology: A case study using Value-Focused Thinking", *The Journal of Strategic Information Systems,* Vol. 14 No. 3, pp. 269-290.

Singh, P., and Kumar, D. (2014), "Impact of Internet Banking on Customer", *International Journal of Research,* Vol. 1 No. 4, pp. 394-413.

Sink, D., and Tuttle, T. (1989), *Planning and measurement in your organisation of the future,* Norcross, USA, Industrial Engineering and Management Press.

Sonnentag, S., and Frese, M. (2002), "Performance concept and performance theory", *In:* Sonnentag, S. (ed.) *Psychological management of Individual performance*, John Wiley & Sons, Ltd, Germany.

Srinivas, V., Friedman, S., and Eckenrode, J. (2014). Mobile financial services - Raising the bar on customer engagement. Deloitte University Press.

Sripalawat, J., Thongmak, M., and Ngramyarn, A. (2011), "M-banking in metropolitan Bangkok and a comparison with other countries", *Journal of Computer Information Systems*, Vol. 51 No. 3, pp. 67-76.

Srite, M., and Karahanna, E. (2006), "The role of espoused national cultural values in technology acceptance", *MIS Quarterly*, Vol. 30 No. 3, pp. 679-704.

Statista, (2015), "*Online banking penetration in selected European markets in 2015"*. available at: http://www.statista.com/statistics/222286/online-banking-penetration-in-leading-european-countries/.

Stone, M. (1974), "Cross-validatory choice and assessment of statistical predictions", *Journal of the Royal Statistical Society. Series B (Methodological)*, Vol. 36 No. 2, pp. 111-147.

Straub, D., Loch, K., Evaristo, R., Karahanna, E., and Srite, M. (2002), "Toward a theory-based measurement of culture", *Human factors in information systems*, Vol. 10 No.1, pp. 61-82.

Straub, D. W. (1989), "Validating instruments in MIS research", *MIS Quarterly*, Vol. 13 No.2 , pp. 147-169.

Suoranta, M., and Mattila, M. (2004), "Mobile banking and consumer behaviour: New insights into the diffusion pattern", *Journal of Financial Services Marketing*, Vol. 8 No. 4, pp. 354-366.

Tam, C., and Oliveira, T. (2016a), "Performance impact of mobile banking: Using the task-technology fit (TTF) approach ", *International Journal of Bank Marketing*, Vol. 34 No. 4, *(in press).*

Tam, C., and Oliveira, T. (2016b), "Understanding the impact of m-banking on individual performance: DeLone & McLean and TTF perspective", *Computers in Human Behavior*, Vol. 61, pp. 233-244.

Tan, M., and Teo, T. S. H. (2000), "Factors influencing the adoption of internet banking", *Journal of the Association for Information Systems*, Vol. 1 No. 5, pp. 1-42.

Taras, V., Rowney, J., and Steel, P. (2009), "Half a century of measuring culture: Review of approaches, challenges, and limitations based on the analysis of 121 instruments for quantifying culture", *Journal of International Management*, Vol. 15 No. 4, pp. 357-373.

Taris, T. W., and Schaufeli, W. B. (2015), "Individual well-being and performance at work: A conceptual and theoretical overview", *In:* Veldhoven, M. V. and Peccei, R. (eds.), *Well-being and Performance at Work*, Psychology Press, NY.

Teo, T. S. H., Srivastava, S. C., and Jiang, L. I. (2008), "Trust and Electronic Government Success: An Empirical Study", *Journal of Management Information Systems*, Vol. 25 No. 3, pp. 99-131.

Tesfom, G., and Birch, N. J. (2011), "Do switching barriers in the retail banking industry influence bank customers in different age groups differently?", *Journal of Services Marketing*, Vol. 25 No. 5, pp. 371-380.

Thakur, R. (2014), "What keeps mobile banking customers loyal?", *International Journal of Bank Marketing*, Vol. 32 No. 7, pp. 628-646.

Thompson, R. L., Higgins, C. A., and Howell, J. M. (1991), "Personal computing: Toward a conceptual model of utilization", *MIS Quarterly*, Vol. 15 No. 1, pp. 125-143.

Topi, H., Valacich, J. S., and Hoffer, J. A. (2005), "The effects of task complexity and time availability limitations on human performance in database query tasks", *International Journal of Human-Computer Studies*, Vol. 62 No. 3, pp. 349-379.

Tran, H. T. T., and Corner, J. (2016), "The impact of communication channels on mobile banking adoption", *International Journal of Bank Marketing*, Vol. 34 No. 1, pp. 78-109.

Trauth, E. M. (2002), "Odd girl out: An individual differences perspective on women in the IT profession", *Information Technology & People*, Vol. 15 No. 2, pp. 98-118.

Trauth, E. M. (2013), "The role of theory in gender and information systems research", *Information and Organization*, Vol. 23 No. 4, pp. 277-293.

Triandis, H. C. (1990), "Cross-cultural studies of individualism and collectivism", *In:* Berman, J. J. (ed.) *Cross-cultural perspectives. Current theory and research in motivation*, University of Nebraska Press, NE, US, pp. 41-133.

Triandis, H. C. (1995), *Individualism & collectivism*, Westview Press.

Tsai, W.-H., Lee, P.-L., Shen, Y.-S., and Lin, H.-L. (2012), "A comprehensive study of the relationship between enterprise resource planning selection criteria and enterprise resource planning system success", *Information & Management,* Vol. 49 No. 1, pp. 36-46.

Urbach, N., and Müller, B. (2012), "The updated DeLone and McLean model of information systems success", *Information systems theory*, Springer, pp. 1-18.

Urbach, N., Smolnik, S., and Riempp, G. (2010), "An empirical investigation of employee portal success", *The Journal of Strategic Information Systems,* Vol. 19 No. 3, pp. 184-206.

Velasquez, N. F., Durcikova, A., and Sabherwal, R. Studying knowledge management system success in system administration. 42nd Hawaii International Conference on System Sciences (HICSS), 5-8 Jan. 2009 2009 Hawaii. 1-7.

Venkatesh, V., and Davis, F. D. (1996), "A model of the antecedents of perceived ease of use: Development and test", *Decision Sciences,* Vol. 27 No. 3, pp. 451-481.

Venkatesh, V., and Davis, F. D. (2000), "A theoretical extension of the technology acceptance model: Four longitudinal field studies", *Management Science,* Vol. 46 No. 2, pp. 186-204.

Venkatesh, V., and Morris, M. G. (2000), "Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior", *MIS Quarterly,* Vol. 24 No. 1, pp. 115-139.

Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. (2003), "User acceptance of information technology: Toward a unified view", *MIS Quarterly,* Vol. 27 No. 3, pp. 425-478.

Venkatesh, V., Thong, J. Y. L., and Xu, X. (2012), "Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology", *MIS Quarterly,* Vol. 36 No. 1, pp. 157-178.

Wang, E. S.-T. (2010), "The effects of browsing frequency and gender on the relationship between perceived control and patronage intentions in e-tail", *International Journal of Electronic Commerce,* Vol. 14 No. 3, pp. 129-144.

Warner-Søderholm, G. (2013), "Beyond a Literature Review of Hall's Context Dimension: Scale Development, Validation & Empirical Findings Within a Norwegian Study", *International Journal of Business and Management,* Vol.8 No.10, pp. 27-40.

Werts, C. E., Linn, R. L., and Jöreskog, K. G. (1974), "Intraclass reliability estimates: Testing structural assumptions", *Educational and Psychological Measurement,* Vol. 34 No. 1, pp. 25-33.

Wixom, B. H., and Todd, P. A. (2005), "A Theoretical integration of user satisfaction and technology acceptance", *Information Systems Research,* Vol. 16 No. 1, pp. 85-102.

Wu, J.-H., and Wang, Y.-M. (2006), "Measuring KMS success: A respecification of the DeLone and McLean's model", *Information & Management,* Vol. 43 No. 6, pp. 728-739.

Xu, Y., Yang, Y., Cheng, Z., and Lim, J. (2014), "Retaining and attracting users in social networking services: An empirical investigation of cyber migration", *The Journal of Strategic Information Systems,* Vol. 23 No. 3, pp. 239-253.

Yang, H.-L., and Lin, S.-L. (2015), "User continuance intention to use cloud storage service", *Computers in Human Behavior,* Vol. 52, pp. 219-232.

Yang, K. C. C. (2005), "Exploring factors affecting the adoption of mobile commerce in Singapore", *Telematics and Informatics,* Vol. 22 No. 3, pp. 257-277.

Ye, G., Zhu, X., and Mukhopadhyay, S. K. (2014), "Managing Service Quality in Multiple Outsourcing", *International Journal of Electronic Commerce,* Vol. 18 No. 3, pp. 125-149.

Yen, D.-C., Wu, C.-S., Cheng, F.-F., and Huang, Y.-W. (2010), "Determinants of users' intention to adopt wireless technology: An empirical study by integrating TTF with TAM", *Computers in Human Behavior,* Vol. 26 No. 5, pp. 906-915.

Yu, C.-S. (2012), "Factors affecting individuals to adopt mobile banking: Empirical evidence from the UTAUT model", *Journal of Electronic Commerce Research,* Vol. 13 No. 2, pp. 104-121.

Yuan, Y., Archer, N., Connelly, C. E., and Zheng, W. (2010), "Identifying the ideal fit between mobile work and mobile work support", *Information & Management*, Vol. 47 No. 3, pp. 125-137.

Yun, H., Kettinger, W. J., and Lee, C. C. (2012), "A new open door: The smartphone's impact on work-to-life conflict, stress, and resistance", *International Journal of Electronic Commerce*, Vol. 16 No. 4, pp. 121-152.

Zhou, T. (2012a), "Examining mobile banking user adoption from the perspectives of trust and flow experience", *Information Technology and Management*, Vol. 13 No. 1, pp. 27-37.

Zhou, T. (2012b), "Understanding users' initial trust in mobile banking: An elaboration likelihood perspective", *Computers in Human Behavior*, Vol. 28 No. 4, pp. 1518-1525.

Zhou, T. (2013), "An empirical examination of continuance intention of mobile payment services", *Decision Support Systems*, Vol. 54 No. 2, pp. 1085-1091.

Zhou, T., Lu, Y., and Wang, B. (2010), "Integrating TTF and UTAUT to explain mobile banking user adoption", *Computers in Human Behavior*, Vol. 26 No. 4, pp. 760-767.

Zwass, V. (2003), "Electronic commerce and organizational innovation: Aspects and opportunities", *International Journal of Electronic Commerce*, Vol. 7 No. 3, pp. 7-37.

Appendix

Appendix A - Items

Constructs	Items	Adapted from
System quality	SYSQ1 – M-banking is easy to navigate SYSQ2 – M-banking allows me to easily find the information I am looking for SYSQ3 – M-banking is well structured SYSQ4 – M-banking is easy to use SYSQ5 – M-banking offers appropriate functionality	(Urbach *et al.*, 2010)
Information quality	INFQ1 - The information provided by m-banking is useful INFQ2 - The information provided by m-banking is understandable INFQ3 - The information provided by m-banking is interesting INFQ4 - The information provided by m-banking is reliable INFQ5 - The information provided by m-banking is complete INFQ6 - The information provided by m-banking is up-to-date	(Urbach *et al.*, 2010)
Service quality	SERQ1 - The responsible service personnel are always highly willing to help whenever I need support with the m-banking SERQ2 - The responsible service personnel provide personal attention when I experience problems with the m-banking SERQ3 - The responsible service personnel provide services related to the m-banking at the promised time SERQ4 - The responsible service personnel have sufficient knowledge to answer my questions with respect to the m-banking	(Urbach *et al.*, 2010)
Use	USE1 - I use m-banking USE2 - I use m-banking to manage my accounts USE3 - I use m-banking to make transfers USE4 - I subscribe to financial products that are exclusive to m-banking	(Zhou *et al.*, 2010)
User satisfaction	US1 - I am satisfied that m-banking meets my knowledge or information processing needs US2 - I am satisfied with m-banking efficiency US3 - I am satisfied with m-banking effectiveness US4 - Overall, I am satisfied with m-banking	(Wu and Wang, 2006)

Individual performance	PI1: The m-banking enables me to accomplish tasks more quickly PI2: The m-banking makes it easier to accomplish tasks PI3: The m-banking is useful for my job	(Urbach *et al.*, 2010)
Task characteristics	TASK1 - I need to manage my accounts anytime anywhere TASK2 - I need to do transfer anytime anywhere TASK3 - I need to have a real time control in my accounts TASK4 - The financial instructions I give can't wait	(Zhou *et al.*, 2010)
Technology characteristics	TECH1 – M-banking provides ubiquitous services TECH2 – M-banking provides real time services TECH3 – M-banking provides a quick service TECH4 – M-banking provides secure services	(Zhou *et al.*, 2010)
Task technology fit	TTF1 – M-banking payment services are appropriate TTF2 – M-banking account management services are appropriate TTF3 - Real time m-banking services are appropriate TTF4 - In general, m-banking services are enough	(Lin and Huang, 2008)

Appendix B - Items

Constructs	Items	Adapted from
System quality	SYSQ1 – M-banking is easy to navigate SYSQ2 – M-banking allows me to easily find the information I am looking for SYSQ3 – M-banking is well structured SYSQ4 – M-banking is easy to use SYSQ5 – M-banking offers appropriate functionality SYSQ6 - M-banking offers comfortable access to all the business applications	(Urbach *et al.*, 2010)
Information quality	INFQ1 - The information provided by m-banking is useful INFQ2 - The information provided by m-banking is understandable INFQ3 - The information provided by m-banking is interesting INFQ4 - The information provided by m-banking is reliable INFQ5 - The information provided by m-banking is complete INFQ6 - The information provided by m-banking is up-to-date	(Urbach *et al.*, 2010)
Service quality	SERQ1 - The responsible service personnel are always highly willing to help whenever I need support with the m-banking SERQ2 - The responsible service personnel provide personal attention when I experience problems with the m-banking SERQ3 - The responsible service personnel provide services related to the m-banking at the promised time SERQ4 - The responsible service personnel have sufficient knowledge to answer my questions in respect of the m-banking	(Urbach *et al.*, 2010)
Use	USE1 - I use m-banking USE2 - I use m-banking to manage my accounts USE3 - I use m-banking to make transfers USE4 - I subscribe to financial products that are exclusive to m-banking	(Zhou *et al.*, 2010)
User satisfaction	US1 - I am satisfied that m-banking meets my knowledge or information processing needs US2 - I am satisfied with m-banking efficiency US3 - I am satisfied with m-banking effectiveness US4 - Overall, I am satisfied with m-banking	(Wu and Wang, 2006)
Individual	IP1: The m-banking enables me to accomplish tasks more quickly	(Urbach

performance	IP2: The m-banking makes it easier to accomplish tasks IP3: The m-banking is useful for my job	*et al.*, 2010)
Time perception	TP1: When I use the m-banking, I only use the services I planned to use beforehand. TP2: Before connecting to the m-banking, I usually decide which service I am going to use. TP3: When I search for information on the m-banking, I search for one piece at a time.	(Lee *et al.*, 2007b)
Context	CT1: When using m-banking, I prefer to see symbolic information in the form of pictures or drawings, instead of detailed information in text form. CT2: When I use e-mail or a chat room, I prefer indirect expressions (e.g., emoticons) to direct expressions (e.g., text). CT3: When I am searching for information, symbolic iconic representation is more convenient than detailed textual information.	(Lee *et al.*, 2007b)