AN INVESTIGATION OF THE FACTORS THAT INFLUENCE USER ACCEPTANCE OF MOBILE INFORMATION SYSTEMS IN THE WORKPLACE

by

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A thesis
submitted to Victoria University of Wellington
in fulfilment of the
requirements for the degree of
Doctor of Philosophy
in Information Systems

Victoria University of Wellington
2010

Abstract

Mobile information systems (IS) such as field force automation and mobile office applications are rapidly being adopted by a large number of organizations. Despite its popularity and widespread adoption, the body of knowledge regarding user acceptance of mobile information systems in the workplace still is largely anecdotal. The purpose of this study was to develop and rigorously test a model of the factors that influence user acceptance of mobile information systems in the workplace. A thorough review of relevant literature in electronic business, mobile business, user acceptance of technology and user acceptance of mobile technology provided the basis for the development of the conceptual model that guided this research.

The model hypothesized that temporal, spatial and structural characteristics of the portfolio of tasks performed by users of mobile information systems in the workplace (namely, temporal requirements of job, spatial dispersion of job, spatial dependence of job, job structuredness and job interdependence) would influence their perceived individual need for mobile information systems (PINMIS). It also suggested that the perceived individual need for mobile IS would influence the performance expectancy as well as intention to use mobile IS. In addition, the model posed that system portability would influence effort expectancy and intention to use mobile IS.

In order to develop a research instrument, construct domains were specified and an initial set of items was generated. This was followed by an extensive purification process which consisted of card sorting and expert review rounds, survey pre-tests as well as a pilot study with 234 respondents from a large telecommunications company in New Zealand. The results obtained in this stage helped to refine the measurements and provided the foundations for the main study.

The main study was based on a survey with 309 respondents from a wide range of organizations in New Zealand. Using Partial-Least-Squares (PLS) the data collected in the main study was used to test the model. The model was successfully validated and statistically significant evidence was provided that temporal requirements of job, spatial dispersion of job, spatial freedom of job and job interdependence positively influenced PINMIS. On the other hand, job structuredness did not significantly influence PINMIS. It was also found that PINMIS significantly influences performance expectancy and that system portability has a positive effect over effort expectancy as well as intentions to use mobile IS.

Acknowledgments

I would like to express my sincere gratitude and appreciation to the people and organizations that have supported me during this venture, especially to:

My wife Suzana and daughter Chiara, for their love, never-ending support and the fantastic ability to make me smile during difficult times.

My supervisors. Firstly, Professor and “Jedi Master” Sid Huff , who acted as the main supervisor during the majority of this project, for being an extraordinary mentor – much more than a thesis supervisor. His generosity, knowledge, friendship and diligence played a vital role throughout my learning process. Secondly, Professor Stuart Barnes, who was the main supervisor during the early stages of this project, for welcoming me to New Zealand and providing valuable insights and important initial direction in this research. Thirdly, Associate Professor Hans Lehmann, who acted as secondary supervisor, for helping me to stay motivated during this long process.

My parents, Sonia and Pio, for being supportive throughout this process despite the physical distance.

My colleagues and students at Victoria University - Hartmut Hoehle, Val Hooper, Brian Harmer, Joerg Evermann, Mary Tate, Allan Sylvester, Tony Hooper, Dan Dorner, Diane Strode, Wendy Chen, Brenda Chawner, Jim Richard, Benoit Aubert, Liz Medford, Mishul Prasad and Peter Thirkell - for their encouragement and valuable support at different stages of this journey.

The many practitioners and organizations that supported this study, in particular Mark Tanner, for his friendship, insights and precious assistance; and Telecom New Zealand, for providing full support to this project.

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1 Introduction

1.1 The Rise of Mobile Business

The shift from an industrial-based economy to an information-based economy becomes all the more evident when observing the expansion of telecommunication infrastructure and role of information systems in today's organizations (Tapscott and Caston 1993; Evans and Wurster 2000). Information is no longer just a management control tool, but a key organizational resource as important as raw materials, capital or human resources (Davidow and Malone 1993; Mowshowitz 1997; Barnes and Hunt 2001).

In this context, the world wide web of computer networks - where the Internet is the main structure - became a very fertile soil for drastic changes in the business world (Kalakota and Whinston 1996; Mowshowitz 1997; Betancourt 1999; Evans and Wurster 1999; Orlikowski 1999; Evans and Wurster 2000; Turban and King 2003; Rayport and Jaworski 2004). The benefits enabled by the Internet are many and varied; customers and companies alike benefit from the new ways of exchanging information, communicating and conducting trade (Rayport and Jaworski 2004). As a consequence, electronic business (EB) spread at an amazing speed throughout the world (Turban and King 2003; The Economist 2004).

In addition to the Internet, another technology that has played an increasingly important role in our society in the past twenty years is the mobile phone (Barnes 2003; Ngai and Gunasekaran 2007; Scornavacca and Marshall 2007). With well over 5.3 billion subscribers worldwide, mobile phones have been one of the fastest adopted consumer products of all time (Chen 2000; De Haan 2000; Emarketer 2002; Kalakota and Robinson 2002; Magura 2003; International_Telecommunication_Union 2010).

The developments of the Internet and mobile phones have followed two separate paths. Only in 2001 these technologies have converged, making possible a vast range of wireless data communication technologies such as the wireless internet (Scornavacca, Barnes et al. 2006). As a result, the proliferation of mobile Internet enabled devices is creating an extraordinary opportunity for business to leverage the benefits of mobility (Clarke III 2001; Durlacher Research 2002; Barnes and Huff 2003; Yuan and Zhang 2003; Tilson 2007). This technological revolution is deeply affecting the way many organizations do business, allowing firms to expand beyond the traditional limitations of the fixed-line personal computer (Kalakota and Robinson 2002; Sadeh 2002; Barnes 2003; Scornavacca and Barnes 2004; Scornavacca and Cairns 2005; Scornavacca, Barnes et al. 2006; Junglas 2007).

Mobile business, commonly known as m-business, is characterized as the use of wireless networks and other mobile information technologies for organizational communication and coordination, and the management of the firm (Barnes 2003). M-business promises a unique value proposition: providing access to information independent of temporal and spatial preferences (Kannan, Chang et al. 2001; Newell and Lemon 2001; Bayne 2002; Innes, Barnes et al. 2005; Chatterjee and Sarker 2007).

There is little doubt that m-business applications are providing a significant opportunity not only to enhance organizational productivity but also to transform business practices (Barnes 2002; Beulen and Streng 2002; Wolf and Heinonen 2003; Yuan and Zhang 2003; Barnes 2004; Kadyte 2004; Tollefsen, Myung et al. 2004; Westelius and Valiente 2004; Scornavacca, Barnes et al. 2006; Scornavacca and Hoehle 2007). Jain (2003) suggests that most enterprise mobile applications are likely to be motivated by the need to reduce latency, increase speed of response, enhance efficiency of operations and workforce, improve productivity, boost revenues, and increase competitive advantage. Overall, wireless data communications can provide significant business benefits for corporate infrastructure, representing the next step in the evolutionary development of information systems (Müller and Zimmermann 2003; Innes, Barnes et al. 2005).

1.2 Overview of the M-business Literature

The proliferation of mobile business applications is challenging academics to provide a better understanding of its impact and potential. This is leading to the emergence of a new research stream, building on research in areas such as electronic business, marketing, computer science, and business strategy (Scornavacca, Barnes et al. 2006; Ngai and Gunasekaran 2007). The last decade saw a steadily increasing number of papers in mobile business in existing journals and conferences – most found in special issues or dedicated conference tracks. Furthermore, entire conferences, journals and books have been devoted to aspects of mobile business (i.e. including the International Conference on Mobile Business, Mobility Roundtable, and International Journal of

Mobile Communications). This suggests that m-business is a new and rapidly emerging domain of business activity, worth of careful academic study.

An initial search of ten mainstream Information Systems (IS) and Electronic Commerce (EC) journals found only 65 articles on this subject – mainly published in special issues. When the search was expanded to also include IS and EC conferences this number rose to over 250 articles. A total of 530 articles were identified and 235 of them were analysed in depth– see details in section 2.3.1. The results of the analysis confirm Anckar et al.'s (2003) statement that much of the m-business literature is descriptive, dominated by intuition-based reasoning and conceptual analysis rather than empirical investigations. Most academics have approached this matter only from a consumer point of view – aiming to establish the value proposition of business-to-consumer (B2C) wireless applications. It is interesting to observe that a similar phenomenon is found in the early e-business literature, where the same approach and focus was taken by academia (Wareham, Zheng et al. 2005).

Despite the academic focus on wireless B2C applications, according to studies published by the Boston Consulting Group (Manget 2002; AT Kearney 2003; MediaLab South-Pacific 2003) and Forester Research (2005), the international market for wireless applications for the workplace such as B2E applications was expected to grow twice as rapidly as the market for wireless B2C applications. AT Kearney predicted in 2003 that a large proportion of U.S. corporations would start using some form of wireless data service in the next few years. A study by Media Lab South Pacific (2003) confirmed that New Zealand companies were also following this international trend.

In summary, given the novelty of the field, there is an understandable lack of empirical studies within the mobile business literature (Scornavacca, Barnes et al. 2006). Additionally, many researchers have focused their efforts on describing and evaluating wireless consumer applications. Therefore, despite its increasing popularity and widespread adoption, academics have not given much attention to mobile applications in the workplace (e.g. sales force automation (SFA), field force automation (FFA) and mobile office applications (MOA)). As a result, it would be opportune to investigate applications of this nature - making an important contribution to the mobile business body of knowledge.

In addition, given the increasing number of failures of implementation of such systems reported in the literature, it is specially relevant and timely to investigate the factors that influence successful user acceptance of this technology (Benbasat and Zmud 1999; Ali and Al-Quirim 2003; Jain 2003; Liang, Xue et al. 2003; Amberg, Hirschmeier et al. 2004; Barnes 2004; Pesonen, Rossi et al. 2004; Westelius and Valiente 2004; McIntosh and Baron 2005; Walker and Barnes 2005; Mallat, Rossi et al. 2006; Benbasat and Barki 2007; Junglas 2007; Yuan, Archer et al. 2010).

1.3 User acceptance of mobile technology

The adoption and use of information systems in the workplace has remained a central concern of information systems research and practice (Venkatesh and Davis 2000; Venkatesh, Morris et al. 2003; Benbasat and Barki 2007). Explaining the user acceptance of new technologies - focusing on individual acceptance of technology by using intention or usage as a dependent variable - is frequently described as one of the most mature areas of information systems research (Hu, Chau et al. 1999; Venkatesh, Morris et al. 2003; Straub and Burton-Jones 2007). Research in this area has resulted in quite a few theoretical models, with roots in information systems, psychology, and sociology (Davis 1989; Taylor and Todd 1995; Venkatesh and Davis 2000; Venkatesh, Morris et al. 2003; Benbasat and Barki 2007). However, little is known about user acceptance of mobile technologies (Mallat, Rossi et al. 2006; Pagani 2006; Junglas 2007; Yuan, Archer et al. 2010)

As presented in section 2.5.1 (which examines the current literature on user acceptance of mobile technology) most of the literature regarding user acceptance of mobile technology is recent and heavily focused on consumer issues - despite evidence suggesting the great importance of business and enterprise applications as major areas of deployment of these technologies.

It was also identified that most of the literature on user acceptance of mobile technology relies heavily on well-known IS theories and models such as Davis' (1989) Technology Acceptance Model (TAM) and Rogers' (1995) Diffusion of Innovation (DoI) Theory. In addition, over 40 new models (most extended or hybrid models) have been identified in the literature. However, most of them have not captured the specificities of mobile technologies or presented new constructs that have been thoroughly developed and validated (Mallat et al., 2006). There is an apparent lack of high-quality empirical research in this area (Anckar, Carlsson et al. 2003; Scornavacca, Barnes et al. 2006; Ngai and Gunasekaran 2007).

Finally, the literature review identified that it is necessary a solid theoretical foundation exploring user mobility in the context of the technology adoption theories from the information systems discipline - supporting the development of an empirical study on the acceptance of mobile information systems in the workplace.

1.4 Focus of this Research

Above all, the focus of this research is on mobile business. However, due to the lack of extant theory in this area to sustain this research effort, it will seek support in more consolidated bodies of knowledge - such as electronic business and technology acceptance. It is a tradition of the IS discipline to take advantage of reference disciplines when investigating emerging topics (Zmud, Olson et al. 1989; Benbasat and Weber 1996). This multidisciplinary approach aims to strengthen the potential contribution of this work to the mobile business domain.

The purpose of this study is to develop and validate a model of the factors that influence user acceptance of mobile information systems in the workplace. In doing so, it aims to understand the relationship between mobile information systems and technology acceptance.

Consequently, the initial research question that will guide this study is:

What factors influence the acceptance of mobile information systems in the workplace at the individual level?

Thus, in order answer this question, the following objectives were set:

-To explore and understand the key attributes, capabilities and limitations of mobile information systems in the workplace;

-To explore and understand theories of user acceptance of technology at the individual level ;

-To develop, and validate a user acceptance model of mobile information systems in the workplace.

1.5 Research Strategy

The research strategy was developed aiming to achieve the research objectives and to answer the research question. A three-phase approach was developed:

The first phase of the research was focused on the conceptualization of the research model. In this phase, the research question presented above served as guidance to develop a thorough literature review on mobile business, technology adoption of information systems. This procedure provided substance for the development of the conceptual research model and associated hypotheses.

The second phase aimed to develop the research instrument. In this stage, construct domains were specified and initial items were generated. This was followed by an extensive refinement process which consisted of card sorting and expert review rounds, survey pre-tests as well as a pilot study.

The third phase aimed to test the theoretical model. A large-scale survey with people using mobile information system for work purposes was carried out. This was followed by the evaluation of the measurement and structural models.

1.6 Contributions

One of the new frontiers of the IS discipline concerns the study of the impact and applications of wireless technologies in organizations. Even though the "mobile bandwagon" has attracted considerable interest among researchers, its body of knowledge is still at an underdeveloped stage. Most of the current studies published about mobile technologies are focused on consumer applications and are limited to identifying future research challenges and to calling for empirical research in this area.

Therefore, from an academic perspective, this research contributes to the body of knowledge of two emerging areas of m-business that have been widely employed in organizations, although insufficiently explored by academia: mobile business applications in the workplace and mobile technology acceptance. Thus, through a technology acceptance perspective, this research helps to extend the body of knowledge of one of the most mature and explored areas of IS into the mobile domain.

On the other hand, from a practitioner perspective, this research offers a roadmap towards user acceptance of mobile technologies in the workplace. In addition, not only managers and end-users profit from the contributions of this research effort, it will also provides insights and guidance for developers.

Specifically, this research makes the following contributions:

Provides a better understanding of the characteristics and capabilities of mobile information systems in the workplace

Provides a better understanding of the relationship between the characteristics of work and the perceived need for mobile information systems in the workplace

Provides academics and practitioners with a theoretical user acceptance model relevant to mobile information systems in the workplace

Extends technology acceptance theory in the context of a mobile technology and provides a foundation for further research on user acceptance of mobile technologies

Provides guidance to practitioners when developing, implementing and managing mobile information systems in the workplace

1.7 Organization of the Remaining Chapters

This dissertation is organized in the following manner. Chapter 2 presents the theoretical foundations of this study, providing a clearer and more comprehensive theoretical basis for the thesis. Chapter 3 describes the development of a conceptual model. Accordingly, Chapter 4 explains the research methodology. This is followed by Chapter 5 which presents the development of the measurement items and the results of the pilot study. Chapter 6 presents the findings of the main survey, and an evaluation of the measurement and structural model. Finally, Chapter 7 presents a discussion of the findings and conclusions.

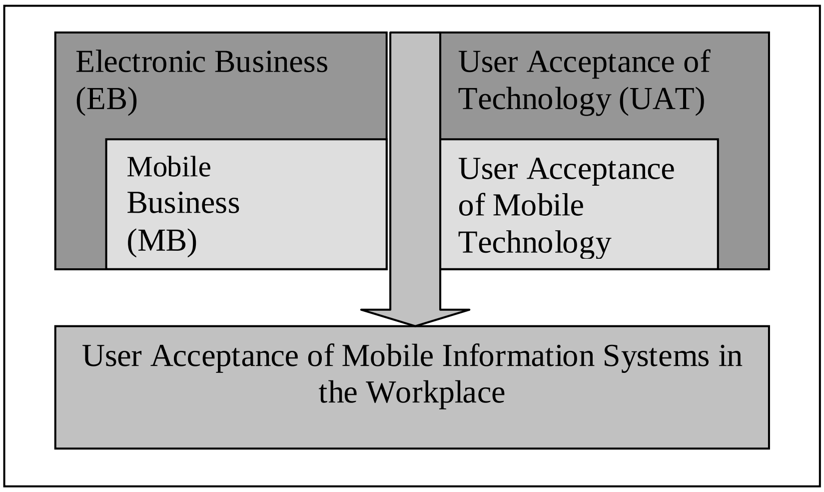
2 Literature Review

2.1 Introduction

In this chapter the literature review is presented with the purpose of establishing the theoretical foundations of this research (Jasperson, Carte et al. 2002; Webster and Watson 2002). Given the multidisciplinary nature of IS research and of this study, in particular, it is important, at this stage, to define the informing disciplines that will structure this investigation (Benbasat and Weber 1996).

Since little is known about user acceptance of mobile information systems in the workplace, it is necessary to seek support in two main bodies of relevant literature and their respective correlated sub-disciplines: 1) electronic business (EB) and mobile business (MB); 2) user acceptance of technology (UAT) and user acceptance of mobile technology (UAMT). Figure 2.1 schematically represents the scope of this literature review.

Figure 2.1 Informing Disciplines

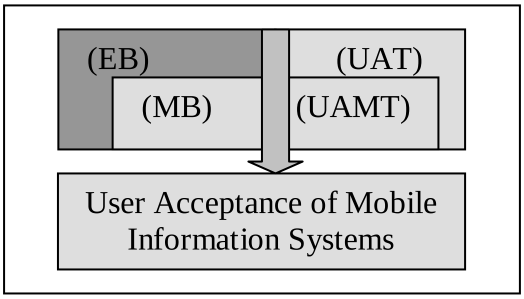


Notice that a compact version of the figure above (2.1) will be used through this chapter as a guideline for the informing disciplines. The literature domain of each sub-section will be indicated by a darker colour.

The mobile business literature has its foundations in electronic business. Therefore, section 2.2 begins with a review of the foundations of e-business. The goal of this initial segment is not to be exhaustive on this topic but to describe the e-business literature that is particularly relevant to the development of m-business. Section 2.3 then presents a comprehensive review of the m-business literature.

Section 2.4 presents a review of the IS literature on user acceptance of technology. This is followed by a review of the research on user acceptance of wireless and mobile technologies (Section 2.5).

2.2 e-business (EB)



E-business embraces all aspects of business and market processes enabled by the computer networks such as the Internet and web technologies. As a result, similarly to IS, e-business has an interdisciplinary nature and it borrows concepts and theories from a wide range of disciplines such as computer science, management, psychology, economics and law (Bharati and Tarasewich 2002). In order to understand the nature of e-business and to properly evaluate the possible impact of its expansion beyond the traditional limitations of the fixed-line personal computer, it is necessary to define and understand e-business.

2.2.1 Defining e-commerce and e-business

Electronic commerce is no novelty. Some forms of e-commerce have existed for over 25 years - e.g. electronic data interchange (EDI) in sectors such as retail and automotive; and Computer Assisted Lifecycle Support (CALS) in sectors such as defence and heavy manufacturing (Rayport and Jaworski 2004). However, these forms of electronic commerce were limited in their diffusion (Choi, Stahl et al. 1997). In the mid 90’s, there was an explosive development in electronic commerce facilitated by the tremendous growth of the Internet and the World Wide Web (Kalakota and Whinston 1996; Choi, Stahl et al. 1997; Mowshowitz 1997; Betancourt 1999; Evans and Wurster 1999; Orlikowski 1999; Evans and Wurster 2000; Coltman, Devinney et al. 2001; Rayport and Jaworski 2001; Turban and King 2003).

It is interesting to observe that in the literature, the terms e-business and e-commerce are used interchangeably without a consistent differentiation (Wareham, Zheng et al. 2005). When searching for “e-commerce” in The Economist Encyclopedia (The Economist 2004), the result is the following: “e-commerce is the conduct of business on the Internet, including the electronic purchasing and selling of goods and services, servicing customers, and communications with business partners”. Now, when searching for “e-business” the result is: “e-business = e-commerce” (The Economist 2004). Unfortunately this notion of “e-business = e-commerce” is not restricted to the business press. It is also found in the academic e-business literature. Blanning (2002) and Slyke and Belanger (2003) also noticed that despite a general understanding about the differences between the definitions of e-business and e-commerce, often, these terms are not used correctly throughout many academic publications.

Let us examine a few definitions of e-commerce and e-business given by some influential authors during the past decade. Before investigating mobile business it is important to clearly understand what e-commerce and e-business are.

Slyke and Belanger (2003) believe that there are two common elements among the endless definitions of e-commerce: 1) electronic commerce concerns some sort of economic activity (e.g. sending an electronic mail message to a recording company inquiring about price or specifications of a product would be e-commerce, while sending a message to your grandmother would not); and 2) an economic activity occurs via some electronic media, such as a computer network (e.g. walking into the local music store to check the price of a compact disk is not e-commerce, while checking the price on the World Wide Web is). They agree that there are an increasing number of e-commerce experts who distinguish between e-commerce and e-business. In their view, the main difference between the two is that e-commerce defines interactions between organizations and their customers, clients, or constituents; while e-business is a broader term that also encompasses an organization’s internal operations. Their understanding is that e-commerce typically crosses organizational boundaries and has to utilize the Internet or Web while e-business does not have the same requirements. However, they use e-business rather than e-commerce throughout their book because they also consider e-business to be a more encompassing term.

Canzer (2003) also notices that some people use the term e-commerce instead of e-business. For him, in a strict sense, e-business refers to all business activities conducted on the Internet by an individual firm or industry. In contrast, he says that e-commerce is a part of e-business; the term refers only to the activities involved in buying and selling online. These activities may include identifying suppliers, selecting products or services, making purchase commitments, completing financial transactions, and obtaining service. He concludes that people generally use the term e-business because of its broader definition and scope.

Finally, Blanning (2002) understands that organizations are moving from e-commerce to e-business applications. The author attributes this growth to three factors: 1) an expansion of the possible transactions between business and consumers, 2) the participation of government in e-business, and 3) the extension into the intra-organizational sphere.

At this point it becomes quite obvious that there is a strong convergence of understanding among authors that e-business and e-commerce are not equivalent terms. Furthermore, the literature consistently refers to e-business as a broader term than e-commerce. Most authors understand e-commerce to be a sub-domain of e-business domain.

Another issue is that some definitions of e-business are attached to economic activities that have profit as the main purpose. Such definitions do not include government and non-profit organizations. Since the organizational application of e-business is not limited to the private sector, some authors have used new terms such as e-government and e-society as an attempt to differentiate the notion of e-business in different types of organizational domain or sectors.

Chronologically, there is an evident progression of the terminology used to define e-commerce and e-business (Figure 2.2). Most of the time new terms characterized a fundamental change of the understanding people had about *e-commerce*.

Figure 2.2 From EC to EB: evolution of terminology through time

Year	1994	2008
Focus	e-commerce	e-business
Sector	Private	Private/Public/ Non-profit
Parties Involved	Consumer/ Business	Individual/ Organization
Relationship	Buyer /Seller	Sender/Receiver
Type of Interaction	Transaction ($)	Data Exchange
Organizational Domain	External	Internal/External
Medium	Internet/WWW	Networks

Even though business-to-business applications (e.g. EDI) had been available since the late 70's, only during the mid-90's did "e-commerce" become a term widely used in the public domain. The tremendous growth of the Internet and the World Wide Web (WWW) allied to the dissemination of Internet based commerce (used by many as a synonymous to e-commerce) drew the attention of many IS researchers into this subject.

This initial hype generated a sort of "e-commerce myopia" that did not allow researchers to see much further than the commercial aspects of e-business accomplished over the Internet. At this time, business-to-consumer applications also were a centre of attention. Therefore, the initial research focus of the e-commerce literature was almost exclusively business-to-consumer Internet based commerce. As a result, there was a notion that e-commerce concerned mostly organizations of the private sector and the parties involved in these processes were consumers or businesses with a buyer-seller relationship (the nature of relationship was used as the main principle for classifying e-commerce – e.g. B2C, B2B…). Accordingly, the interactions between parties were focused on exchanges with monetary value – commonly referred as "transactions" (Kalakota and Whinston 1996). It is also interesting to observe that the early focus of research only considered interactions that occurred with parties outside the organizational domain – not considering intra-business applications. Finally, there was also a general understanding that e-commerce was directly related and limited to the Internet and the WWW as its medium – not acknowledging the use of other technologies such as EDI.

As shown in Figure 2.2 the terminology used in 1994 was, slowly, replaced by new terms. The shift from e-commerce to e-business reflected a fundamental transformation of our understanding of the scope of ICT mediated exchanges used on business relevant activities. Undoubtedly, the escalating number of intra-organizational applications as well as the expansion of IT in public and non-profit organizations contributed to this expansion of scope. Almost as a direct consequence of this broader view, some terms such as “buyer and seller; consumers and business” were no longer appropriate to describe some of the relationships and parties involved in these processes and in many cases were replaced by much broader and appropriate terms such as “sender and receiver; individual and organizations”. Another essential revision that e-business brought along refers to types of interactions between parties: exchanges with monetary value were not the only type interaction happening in the e-business domain - forcing “transactions” to be replaced by “data exchanges”. Also the general perception that the Internet is the ultimate “e-medium” was overtaken by a contemporary understanding that e-business can be conducted over a vast range of communication options supported by ICT.

The examination of the e-commerce and e-business definitions as well as the key terms used during the past decade provide substantial evidence to present a contemporary definition of e-business. Thus, for the purposes of this study, *e-business is understood as: economically[1] relevant ICT mediated exchanges between senders and receivers, who could be individuals and/or organizations from private, public or non-profit sectors in an intra- or extra-organizational context*.

Consequently, deriving from the above definition of e-business, for the purposes of this study, e-commerce is characterized as a part of e-business in which business

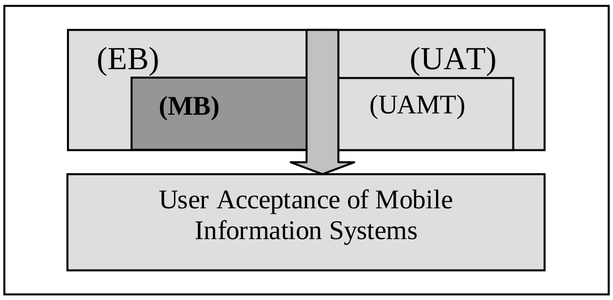
[1] Economically is being used here as an equivalent to “monetary value”. In an e-business context, all exchanges must ultimately aim to create economic benefits for an individual or an organization (e.g. sending an e-mail to an organization or a co-worker inquiring about some information would be e-business, while sending a message to your friend would not).

relevant ICT mediated exchanges happen between buyers and sellers (individuals and/or organizations) in an intra-or-extra-organizational context.

Now e-business has been defined, let us proceed into a comprehensive review of the mobile business literature.

2.3 Mobile Business

The review of the m-business literature developed in this section is divided in two parts: the first part presents a general overview of the m-business literature, while the second part explores definitions of m-business and its value propositions.



2.3.1 Initial analysis of the m-business literature

There is an established tradition in information systems research of examining the research literature itself in order to better understand the "state of play" of research in the field, and to discern patterns in the development of the field itself (Culnan and Swanson 1986; Alavi and Carlson 1992; Banker and Kauffman 2004). In that tradition, the principal aim of this section is to understand the state of mobile business research, via an examination of the m-business research literature.

First, it was necessary to locate conferences and journals which have published relevant research on this topic. The search began with an examination of published lists of outlets containing information systems research (e.g., Mylonopoulos and Theoharakis 2001) and e-commerce research more specifically (e.g., Bharati and Tarasewich 2002). The selection was refined via discussions with senior academics actively researching in this domain.

This part of the investigation was carried out in early 2005 and the scope of the scope of the literature limited to the timeframe January 2000 until December 2004[2]. Table 2.1 presents the initial list of journals and conferences examined.

[2] The m-business literature analysis presented in this section helped the researcher to identify existent gaps in the literature. It was carried out in the beginning of the doctoral thesis. For that reason the timeframe is limited to December 2004. The results have been published as an article -

Table 2.1 Scope of the m-business literature review

M-business Conferences
International Conference on Mobile Business (mBusiness)
Mobility Roundtable
M-business Journals
IJMC - International Journal of Mobile Communications
MONET - Mobile Networks and Applications
IS and e-business Conferences
ICIS - International Conference on Information Systems
HICSS – Hawaii International Conference On System Sciences
ECIS - European Conference on Information Systems
PACIS - Pacific-Asia Conference on Information Systems
ACIS - Australian Conference of Information Systems
ICEB - International Conference on Electronic Business
Bled eConference
AmCIS - Americas Conference on Information Systems
ICEC – International Conference on Electronic Commerce
IS and e-business Journals
ISR – Information Systems Research
IJEC - International Journal of Electronic Commerce
CACM - Communications of ACM
MISQ - MIS Quarterly
IJEB - International Journal of Electronic Business
JAIS - Journal of the Association of Information Systems
JMIS - Journal of Management Information Systems
E-services Journal
Electronic Markets
CAIS – Communications of AIS
ECRA -Electronic Commerce Research and Applications

The next step was to examine the abstracts of every paper published during the selected period in these research outlets. All abstracts were scrutinized and any articles considered pertinent to the topic were selected for analysis. The general guideline for article selection was as follows:

1. The central theme should be mobile or wireless applications
2. Articles should be in the IS/e-business domain

Papers with a primarily technical focus were not considered pertinent to this research effort and were therefore excluded. This included papers in the computer science

Scornavacca, E.; Barnes, S. J. and Huff, S. (2006). "Mobile Business Research Published in 2000-2004: Emergence, Current Status, and Future Opportunities". Communications of the Association for Information Systems. Vol. 17, pp. 635-646 domain such as those published in MONET and in the technical tracks at HICSS. A total of 530 papers were selected for further analysis. Table 2.2 details the source and year of publication of the articles selected for this analysis.

Table 2.2 Contribution of each source for the article selection

Source (total)	Number of Articles/year				
	2000	01	02	03	04
M-business Conferences (183)					
mBusiness (112)	-	-	62	50	NA
Mobility Roundtable (71)	-	-	22	22	27
M-business Journal (37)					
IJMC (37)	-	-	-	18	19
IS and e-business Conferences (247)					
ICIS (7)	0	1	3	3	NA
HICSS (62)	1	8	15	16	22
ECIS (24)	0	2	7	6	9
PACIS (21)	0	0	4	7	10
ACIS (9)	1	2	5	1	NA
ICEB (9)	-	2	7	NA	NA
Bled eConference (30)	1	1	9	13	6
AmCIS (67)	1	10	13	14	29
ICEC (18)	0	2	8	8	NA
IS and e-business Journals (65)					
ISR (0)	0	0	0	0	0
IJEC (6)	0	0	0	6	0
CACM (25)	0	2	4	15	4
MISQ (0)	0	0	0	0	0
IJEB (8)	-	-	-	1	7
JAIS (0)	0	0	0	0	0
JMIS (0)	0	0	0	0	0
E-service Journal (5)	-	0	0	5	0
Electronic Markets (8)	0	0	8	0	0
CAIS (9)	0	0	4	3	2
ECRA (2)	-	-	1	1	0
Total (530)	4	30	172	189	135

(-) it did not exist at that time; (NA) not accessible/available

In addition to the articles mentioned above, it was made sure that key articles published in other available sources were not missed. To this end, a keyword search (using the keywords mobile, wireless, m-business, and m-commerce) was executed on three major bibliographic databases (Proquest, Emerald and Interscience). From this search an additional thirty articles were selected for inclusion. Additional searches on Google and Amazon.com identified ten pertinent books on mobile business.

The following step was to obtain the full version of the 570 selected publications and carry out the review process. After reviewing these publications, it is easy to agree with Anckar, Carlsson and Walden (2003) that much of them are descriptive, dominated by intuition-based reasoning and conceptual analysis rather than empirical investigations. At this point, the main challenge was to quantify these perceptions. Therefore, the following questions needed to be answered:

1. How much of m-business literature is descriptive, dominated by intuition-based reasoning and conceptual analysis rather than empirical investigations?

2. What is the main focus of research (e.g. consumers, business applications, telecommunications industry, wireless technologies)?

3. What research methods where used?

4. Was primary data collection carried out?

5. What were the key contributions of the studies?

In order to answer the questions above, the candidate articles needed to be carefully categorized. One of the main issues that arose was the quality of the research published. Perhaps due to the novelty of the subject area, the review and selection process of some of the conferences and journals from which articles were extracted did not appear very rigorous. For this reason, articles from two of the m-business conferences were dropped from further consideration. (Most of the higher-quality papers published at these conferences also appeared in IJMC or in special issues of other journals.) Papers from the AIS (Association for Information Systems) sponsored conferences and forums (ICIS, AmCIS, ECIS, PACIS and CAIS), as well as those from HICSS, were included in the analysis on the assumption that sufficiently rigorous reviewing would have occurred. This collection allowed to select conference papers that meet to AIS and IEEE standards.

In all, 235 separate articles, from eight sources, were selected for detailed analysis: 181 (77%) from conferences and 54 (23%) from journals (see Table 2.3). These articles were read in their entirety, categorized and subsequently analysed.

Table 2.3 Sources for the m-business literature analysis

Sources	Qt.	Freq.
AmCIS	67	28.5%
HICSS	62	26.4%
IJMC	37	15.7%
ECIS	24	10.2%
PACIS	21	8.9%
CAIS	9	3.8%
e-markets	8	3.4%
ICIS	7	3.0%
Total	235	100%

The absolute contribution from AmCIS and HICSS is notable. This is mainly a reflection of the overall size of these conferences and the large number of papers presented there. Also due to the novelty of the subject, 26 articles (11.1%) were based on research in progress (22 of them were published at AmCIS). There were also two tutorials (0.9%) published in CAIS.

First and foremost, it is clear that mobile business research has expanded rapidly, more than doubling each year so far. Table 2.4 presents an overview of the growth.

Table 2.4 Number of Publications per Year

Year	Qt. cit.	Freq.
2004	85	36.2%
2003	75	31.9%
2002	52	22.1%
2001	21	8.9%
2000	2	0.9%
Total	235	100%

There is a general perception that most academics have approached m-business research from a consumer point of view, as was the case with the early e-business literature. In order to identify the research focus in relation to the target group, each article was classified into one of the following five categories: consumer, business, technology, industry and general. Table 2.5 presents a characterization of each category, and the distribution of articles across the five categories. The hypothesis – that mobile business research to date has been skewed towards a focus on consumer issues - was confirmed by our analysis at a very significant level ($p < 0.01$). Overall, research focused on consumer applications corresponded to 55.7 percent of the total.

Table 2.5 Focus for the m-business research

Category	Definition	Qt.	Freq.
Consumer	Consumer applications, consumer behaviour, implications of mobile/wireless technology to consumers	131	55.7%
Business	Business applications, organizational impact, implications of mobile/wireless technology to Businesses	41	17.4%
Technology	Mobile/wireless technology, networks, development of applications	38	16.2%
General	General issues about m-business, broad and unspecific focus	17	7.2%
Industry	Telecommunications industry and wireless service providers	8	3.4%
Total		235	100%

This result has important implications. Practitioner research published by the Boston Consulting Group (Manget 2002), Media Lab South Pacific (2003) and AT Kearney (2003), point out that the international market for business applications of mobile technology in the workplace - especially business-to-employee wireless applications – is expected to grow twice as rapidly as the market for consumer applications.

Yet the analysis above indicates that a large proportion of m-business research has been focused on consumer issues. This suggests that *business* applications of mobile/wireless technologies is an area which is in need of more thorough development in future research.

A wide range of research topics was evident in the 235 articles analysed. Based on the purpose (goal, aim, objective) stated in each article, the classification presented in Table 2.6 was developed.

Table 2.6 Research topic

Topic	Qt.	Freq.		Topic (cont)	Qt.	Freq.
M-commerce	39	16.6%		Entertainment	4	1.7%
Strategy	17	7.2%		3G	4	1.7%
Location	16	6.8%		Mobility	4	1.7%
Network	16	6.8%		Security	4	1.7%
Healthcare	13	5.5%		Context	4	1.7%
Internet (WAP, i-mode)	13	5.5%		Emergency Alerts	3	1.3%
Services	13	5.5%		Education	3	1.3%
Marketing	12	5.1%		Media	3	1.3%
Finance	10	4.3%		Social	2	0.9%
Enterprise	9	3.8%		Agriculture	2	0.9%
Mob. Communications	9	3.8%		Government	1	0.4%
Devices	8	3.4%		Knowledge Mgt.	1	0.4%
Content	8	3.4%		Insurance	1	0.4%
Technologies	8	3.4%		Real estate	1	0.4%
Software development	7	3.0%		Total.	235	100%

As expected, the most frequent topic was mobile commerce (16.6%), usually approached from a consumer perspective. Typically this topic was approached in a very broad manner without focusing on a specific type of mobile business application. Strategic analysis (e.g., describing or conceptualizing business models and presenting intuition-based reasoning about the future of m-commerce) also emerged as a popular topic (7.2%). It is interesting to observe that among the 41 papers published about business applications, nine focused on enterprise applications such as field force automation and job dispatching, eight investigated wireless applications in healthcare, and only four explored the strategic implications of wireless and mobile technologies for businesses. It's also remarkable that among 235 papers only one article had as its main topic the use of wireless and mobile technologies in government agencies.

In order to investigate whether the m-business literature is dominated by intuition-based reasoning and conceptual analysis rather than empirical investigations, a categorization was needed to classify the selected articles (Hirschheim 1991). In this case, "empirical research" was considered as all research originating in or based on observation or experience, independently of whether the researcher gathered data through primary or secondary data collection (e.g. case studies based on information collected from secondary sources such as websites and practitioner reports were considered empirical). Papers based on intuition-based reasoning and academic literature reviews were classified as "conceptual research." Following classification, 153 articles (61.5%) were found to be empirical research and 82 (34.9%) conceptual (see Table 2.7).

A substantial number of studies were not based on *primary* data collection. Primary data collection is understood as data gathered directly by the authors of the publication - not from secondary sources (e.g. case studies based on information collected from secondary sources such as websites and practitioner reports were considered as *secondary* data collection). After an examination only 98 articles (41.7%) described a process of primary data collection (Table 2.7). Note that from the 153 articles classified as "empirical", 35 percent (55 articles) were not based on primary data collection. In most cases, these articles were case studies or simulations based on data gathered from external sources.

Table 2.7 Nature of Research and Data collection

	Data Collection		**Total**
Research Nature	Freq. (%)	Freq. (%)	Freq. (%)
	Primary	Secondary	
Empirical	98 (41.7)	55 (23.4)	153 (65.1)
Conceptual	0 (0.0)	82 (34.9)	82 (34.9)
Total	98 (41.7)	137 (58.3)	235 (100)

Another interesting result obtained from the analysis is that among the 41 papers published about business applications, 28 (68.26%) were based on secondary data collection. Also 89.4 percent (34) of the papers focused on technology and 76.6 percent (13) of the papers focused on general issues were not based on primary data collection.

On the other hand, among the 41 papers published about business applications, 28 (68.2%) *were* based on primary data collection. Regardless of the fact that only 17.4% of the m-business literature focuses on businesses applications of wireless and mobile technologies, this result shows that the academia has taken a more empirical research approach in this category.

Another positive finding is the increasing proportion of articles based on primary data collection published in 2004 (Table 2.8). As m-business gains credibility as a separate discipline worthy of study, it is likely that the growth of primary research will continue to increase.

Table 2.8 Year of publication and Data collection

	Data Collection		Total
Year	Freq. (%)	Freq. (%)	Freq. (%)
	Primary	Secondary	
2000	0 (0.0)	2 (0.9)	2 (0.9)
2001	8 (3.4)	13 (5.5)	21 (8.9)
2002	20 (8.5)	32 (13.6)	52 (22.1)
2003	26 (11.1)	49 (20.9)	75 (31.9)
2004	44 (18.7)	41 (17.4)	85 (36.2)
Total	98 (41.7)	137 (58.3)	235 (100)

In order to identify the research methods or research approaches used in the m-business literature, all articles were classified according to the method or approach stated in each article (Yin 1984; Benbasat, Goldstein et al. 1987; Kaplan and Duchon 1988). Table 2.9 presents the distribution found in the sample. Due to the large number of papers based on conceptual analysis, literature review was the most common research approach used by the authors (31.9%). Case studies, usually focused on specific applications, were also commonly employed (23.8%). (It should be noted that 44 percent of the case studies were based on secondary data collection.) Surveys were also commonly used in the m-business literature. Most of surveys were administered to large samples of consumers, and questionnaires were administered through the Internet. Surveys of university students were common.

Table 2.9 Research Methods

Method	**Qt. cit.**	**Freq.**
Literature review	75	31.9%
Case study	56	23.8%
Survey	40	17.0%
Simulation	32	13.6%
Experiment	13	5.5%
Interviews	6	2.6%
Focus Group	5	2.1%
Field study	3	1.3%
Delphi	3	1.3%
Not Stated	2	0.9%
Total.	235	100%

It has been observed in other domains that early research tends to be dominated by conceptual studies, later giving way to empirical work (Keen 1980). In order to determine whether there has been a longitudinal variation in the research methods used in the m-business literature, an independence test between year of publication and research method was carried out. It did not reveal significant relationship between these two variables.

Finally, an analysis of the main contributions of each article was conducted. Many authors clearly highlighted the main contributions of their articles; however, in a number of cases (86), due to the lack of information given by the authors, this classification required a reviewer judgment. Table 2.10 presents the findings. The fact that “literature review” was the most common research method undoubtedly resulted in “insights” and to a lesser extent “frameworks” emerging as the most common type of contribution of the articles reviewed. Also it is interesting to observe that only 30 percent (18) of the papers that offered a framework as its main contribution are based on primary data collection.

Table 2.10 Primary Contribution

Contribution	Qt.	Freq.
Insights	67	28.5%
Framework	60	25.5%
Model	58	24.7%
Future research	30	12.8%
Application	15	6.4%
Algorithm	2	0.9%
Construct	2	0.9%
Policy	1	0.4%
Total	235	100%

As expected, a longitudinal analysis of the articles revealed that in 2004 there was a significant reduction in papers with future research directions as their main contribution. Also in 2004, there was a significant growth in the number of articles offering mobile business models (Chi-square=25.94, df = 8, p<0.01).

Through a categorization and statistical analysis of the salient academic literature on mobile business, this section has attempted to provide a general picture of the main characteristics of research into mobile business during the initial stages of this research project. The findings above provide evidence that Anckar, Carlsson and Walden’s (2003) perceptions were quite accurate at that point of time: “much of the m-business literature was descriptive, dominated by intuition-based reasoning and conceptual analysis rather than empirical investigations”.

As the body of research into mobile business grows, the discipline is likely to mature and develop a research tradition of its own. However, the analysis presented in this section suggests that for this to happen, the following areas of research should be the main focus of m-business researchers:

- *Research into business and organizational applications*. Current research is heavily skewed toward consumer issues, despite evidence suggesting that business and enterprise applications are the biggest growth area. While consumer-oriented mobile research is useful, more research into business, government, healthcare and other industry areas is needed to bridge the gap between theory and practice.
- *Empirical research.* The existing body of research on mobile business has a disproportionately high level of secondary research studies. Although there is some evidence that the balance is being redressed, more effort should be focused on high-quality research projects using first-hand, empirical data that lend themselves to the development of theory. While there are plenty of case studies (23.8%), taken at face value this implies a change to research method: there should be a reduction in the proportion of papers based solely on literature reviews (currently 31.9%) and an increase of empirically-based studies (surveys, interviews, experiments, action research, ethnography, and so on) as well as simulation.
- *Theory development.* Mobile business is unlikely to become fully recognized as a research area in its own right until is has a solid theoretical foundation. The IS discipline has a number of key theories, such as the technology acceptance model (TAM), that have become a cornerstone of IS research. While other theories have been applied to mobile business, it does not yet have theory to call its own.

2.3.2 Understanding m-business

Similar to the e-business literature, the mobile business literature use *m-business* and *m-commerce* without a consistent differentiation (Balasubramanian, Peterson et al. 2002; Junglas and Watson 2006). Also, as presented in the section above, the main focus of m-business research so far has been business-to-consumer applications based on cellular phones.

Mobile e-business, commonly known as m-business, is mostly understood as e-business conducted through wireless networks (Mahrer and Brandtweiner 2001; Bhushan 2002; Veijalainen and Markkula 2002; Yu 2002; Figge, Schrott et al. 2003; Leonidou, Andreou et al. 2003; Barnes and Scornavacca 2004; Dekleva 2004). However, this definition does not seem to capture some of the unique characteristics of m-business (Zhang and Yuan 2002; Stafford and Gillenson 2003).

In order to understand what m-business is as well as its value propositions, this section aims to explore the m-business world. The initial point of analysis is the difference between e-business and m-business, and this is followed by a definition of m-business. Once m-business is defined, a discussion about wireless and mobile technologies is presented followed by a discussion about m-business value propositions and the concept of mobility. The section ends examining the relevant literature on mobile technologies in the organizational domain.

2.3.2.1 Differences between e-business and m-business

Most of the existent literature aiming to understand the differences between m-business and e-business is focused on the distinction between business-to-consumer commercial applications on “wired” PCs and on cellular phones (Louis 2001; Sadeh 2002; Zhang and Yuan 2002; Chau, Leung et al. 2003; Magura 2003; Wyse 2003; Vogel, Yeh et al. 2004; Wen and Mahatanankoon 2004; Lawrence, Bachfischer et al. 2008).

In order to understand the differences between e-business and m-business it is necessary to first examine the differences between e-commerce and m-commerce.

The original concept of m-commerce was centered on consumers using their cell phones and other wireless devices to purchase goods and services just as they would do using their personal computers over the Internet. It was once believed that if mobile communications and the Internet were brought together, it would rapidly generate an enormous growth of e-commerce through this new wireless extension (May 2001; Andreou, Chrysostomou et al. 2002; Ng-Kruelle, Swatman et al. 2002; Pippow, Eifert et al. 2002; Raisinghani 2002; Jarvenpaa, Lang et al. 2003; Stafford and Gillenson 2003; Varshney 2003; Zeng, Yen et al. 2003; Siau, Nah et al. 2004). It is easy to find some very optimistic views in the early m-business literature. One good example is the following statement:

"Within five years, individual e-commerce services will be primarily delivered by wireless and the wireless terminal will become the window of choice to the transactional e-world." Hoffman (2000), p.20 in Clarke (2001)

Currently it is clear that m-commerce has been a very frustrating experience to many consumers because it did not meet their euphoric expectations (Ahn, Byun et al. 2003; Anckar, Carlsson et al. 2003; Dahlberg, Mallat et al. 2003; Heinonen and Strandvik 2003; Vrechopoulos, Constantiou et al. 2003; Wu and Wang 2003; Wyse 2003; Shchiglik, Barnes et al. 2004). Yuan and Zhang (2003) concluded that in many ways, m-commerce and the wireless Internet have been the victims of an over-excited speculation. The use of the wired desktop-based Internet as an analogy to explain to consumers what they would get on cellular phone-based wireless Internet can be seen as a mistake and one of the major drivers of this general over-excitement and high expectations.

Jarvenpaa et al. (2004) point out that when users acquired their first mobile devices or upgraded to newer models and services they did so with certain expectations of partaking in joys that would come with the capability of doing anything, anywhere and anytime – a concept widely promised and promoted by marketers. Whether these expectations were reasonable or unrealistic, people were anticipating that their new gadgets would make their lives easier and enable them to do things they couldn't before. However, users learned quite early that the technology currently available is only capable of delivering a crude approximation of their initial expectations.

Junglas and Watson (2003; 2006) point out that compared to e-commerce, m-commerce has the following unique characteristics that make it distinct: reachability, accessibility, localization, identification, and portability.

Reachability refers to the idea that a person can be in touch and reached by other people 24 hours a day, 7 days a week—assuming that the mobile network coverage is sufficient and the mobile device is switched on. In contrast to reachability, *accessibility* describes the fact that a user can access the mobile network at any time from any location—again, assuming adequate mobile network coverage. *Localization* refers to the ability to locate the position of a mobile user. As such, localization is key to providing geographically specific value-added services (so-called location-based services) and is expected to be the most distinct characteristic of m-commerce compared to e-commerce. *Identification* of the user can be enabled by technologies such as "smart cards" embedded or inserted in mobile devices, containing not only personal information, but also billing information. Finally, *portability* comprises the physical aspects of mobile devices - one is able to readily carry them.

Zhang et al. (2003) suggest that m-commerce should not be viewed as e-commerce with limitations, but rather as a unique form of e-commerce with its own unique benefits. Additionally, they point out that m-commerce is not simply a new distribution channel, a mobile Internet or a substitute for PCs. Rather, it is a new way to communicate with customers.

Zhang and Yuan (2002), Zhang et al. (2003) and Yuan and Zhang (2003) outlined fundamental differences between m-commerce and e-commerce in terms of their origin, technology and the nature of the services:

Origin: Due to rapidly expanding networks and nearly free access to the Internet, e-commerce bridges distances and enables companies to display and sell goods and services cheaply to consumers and businesses around the world. In the Internet world, much is given away free or at a discount in the hope that a way will eventually be found (presumably through advertising income) to turn traffic into profits. On the other hand, m-commerce is rooted in paid services. In the telecom world, users pay for airtime, data transmitted, as well as any services they may use. Therefore, due to their different origins, the customer bases of m-commerce and e-commerce are quite different.

Technology: The fundamental infrastructure of e-commerce is the Internet. It has a well-established protocol, TCP/IP (Transmission Control Protocol/Internet Protocol), which solves the global internetworking problem and ensures that computers communicate with one another in a reliable fashion. In contrast, m-commerce services are constrained by a variety of wireless media communication standards ranging from global (Satellite), regional (3G, IEEE 802,11a/b, DoCoMo I-mode), to short distance (Bluetooth). Cellular carriers use different systems and standards such as GSM (Global Service for Mobile), TDMA (Time Division Multiple Access), and CDMA (Code Division Multiple Access) to compete with each other. As a consequence, m-commerce applications tend to be device and carrier dependent. The boom in e-commerce applications could be partially attributed to the widespread use of PCs, which have a complete text input keyboard, large screen, substantial memory, and high processing power. In contrast, mobile devices such as mobile phones and PDAs (Personal Digital Assistants) still present some obstacles such as uniform standards, ease of operation, security for transactions, minimum screen size and display type.

Nature of services: The web is widely accessible enabling search and delivery of rich information. Sophisticated online transaction processes can be integrated with backend enterprise information systems. In contrast, the delivery of m-commerce applications relies on private wireless communication carriers. These services are usually delivered to a specific region, and are rather simple, personalized, location-specific and time sensitive. Also the rapid growth of e-commerce was driven by the rapid growth of dot.com companies aimed at online shopping and customer services. Gradually, the emphasis shifted to B2B, and more recently e-business, to take advantage of the real business value of the Internet. In contrast, mobile commerce started from person to person communication, and gradually more services were introduced through interactions between people and systems: checking the weather, finding a local restaurant, etc.

The major differences between m-commerce and e-commerce according to Zhang, Yuan and Archer (2003) are summarized in Table 2.11.

Table 2.11 Major differences between m-commerce and e-commerce

Origin	E-commerce	M-commerce
Sponsorship	Government-sponsored Internet	Private mobile phone industry
Business entry cost	Low	High
Access cost	Free or low cost Internet access	High mobile service charge
Technology	E-commerce	M-commerce
Message transmission	Packet-switched data transmission	Circuit switched for streamlined voice communication
Protocol	TCP/IP, HTTPML	GSM, TDMA, CDMA, 3G
Standardization	Highly standardized	Multiple incompatible standards
Connectivity	Global	Mainly regional
Bandwidth	High	Low
Identity	URL with IP and domain name	Phone number
Application development	General computer applications	Device-specific applications
Interface device	Personal computers	Cell phones and PDAs
Mobility	Fixed location	Mobile
Display	Big screen	Small screen
Main input mode	Keyboard for full text input	Voice with small key pad
Main output mode	Text and graphics	Voice with small text display
Local processing power	Powerful CPU with large memory and disk space	Limited processing power with small memory chip
Software and programming	Support a variety of programming languages	Java or specific script languages
Trend	Towards sophistication	Towards minimization
Services	**E-commerce**	**M-commerce**
Service range	Global	Regional
Delivery destination	PC connected to the Internet	Person with a mobile device
Transaction complexity	Complete and complex transactions	Simple transactions
Information provided	Rich information	Simple and short messages
Timing	Less time-critical	Time critical
Geographic Location	No	Yes
Target mobility	Service to a fixed point	Service to a moving target
Backend business connection	Strong connection to backend business information systems	Weak connection to backend business information systems

Source: adapted from Zhang, Yuan and Archer (2003), p.57

Understanding the difference above is critical to understanding the emergence of m-business and its value propositions. Notice that the comparison above is labelled as "differences between m-commerce and e-commerce". However, most of the characteristics used above would also be relevant in an m-business/e-business comparison. One critical factor to be highlighted is that even though they describe cellular phones and PDAs as m-commerce devices, most of the technology limitations illustrated are directly and exclusively related to mobile phones. Other developments such as tablet PCs were not considered.

In summary, the difference between e-business and m-business seems to mostly relate to the nature of the medium (wired and unwired - see section 2.3.2.3) supporting exchanges between parties. However, it is important to realize that in order to better understand m-business, researchers should focus on understanding the uniqueness of m-business instead of focusing on the limitation of devices. This uniqueness reflects a change of paradigm in relation to how IS supported interactions can take place in the time and space continuum.

At this point, the background built in this literature review allows us to finally examine a definition of m-business.

2.3.2.2 Definition of m-business

M-business is mostly understood as wireless and/or mobile electronic business (Mahrer and Brandtweiner 2001; Bhushan 2002; Veijalainen and Markkula 2002; Yu 2002; Figge, Schrott et al. 2003; Leonidou, Andreou et al. 2003; Dekleva 2004). Barnes (2003) expands this notion defining m-business as the use of wireless networks and other mobile information technologies for organizational communication and coordination, and the management of the firm. Similarly, Wyse (2007) points out that mobile business occurs when transactions and interactions take place electronically through communication channels that permit a high degree of mobility by at least one of the transactional/interactional parties.

On the other hand, Balasubramanian et al. (2002) conceptualizes m-business as any phenomenon that exhibits all of the following five characteristics:

1. It involves communication, either one-way or interactive, between two or more humans, between a human (or humans) and one or more inanimate objects (such as databases), or between two or more inanimate objects (e.g., between devices).
2. At least one of the parties engaged in the communication must be mobile, in the sense that his, her, or its ability to communicate is not contingent on being at a fixed physical location at a particular point in time.

3. The ability to communicate must possess the potential to be continuously maintained for at least one of the parties during a substantial physical movement from one location to another.
4. The communication signals between parties must be primarily carried by electromagnetic waves, without direct sensory perception of the signals.
5. If humans are communicating, at least one seeks to benefit economically from the communication, either in the short or the long run. If the communication is entirely between inanimate objects, such communication must be ultimately aimed at creating economic benefits for a human or a firm.

The first characteristic identifies information transmitters and receivers in a similar sense described in the definition of e-business in the last section (see definition of e-business - section 2.2.2). It also implies that communication can occur between individuals and inanimate objects. If "inanimate objects" (as databases and devices) are being used as synonymous to "systems", perhaps it would be more appropriate if Balasubramanian et al. (2002) had explored the notion that a system always acts on behalf of an individual or an organization (virtual of physical) (Mowshowitz 1997). Therefore, it is reasonable to affirm that m-business involves communication between individuals and/or organizations.

The second characteristic highlights the ubiquitous nature of m-commerce – anywhere, anytime and on any device (Junglas and Watson 2003; Scornavacca and Barnes 2004). It also implies that "mobile" is not necessarily "wireless". This issue is discussed in the next section.

The third characteristic pointed out by Balasubramanian et al. (2002) further clarifies the notion of mobility by emphasizing the concept of "communication-in-motion". This excludes from consideration a sequence of communications from fixed but distinct locations, such as communications through a wired network. More details about mobility will be discussed later in this document.

The fourth characteristic aims to define a range of wireless technologies, excluding more primitive wireless technologies – e.g. communications by means of directly perceived sound and light signals. However, in this case, communications by means of laser beams that are electronically deciphered are included in this characteristic.

Finally, the fifth characteristic emphasizes that, whether in the short term or long term, m-business ultimately has an economic nature. However, this characteristic ensures that the conceptualization accommodates exchanges between parties without immediate monetary value (e.g. GPS monitoring and routing of truck fleets).

The definitions of m-business presented above (Barnes 2003; Wyse 2007) combined with the five characteristics of m-business pointed by Balasubramanian et al. (2002) provide an understanding that the definition of m-business goes beyond “e-business conducted through wireless networks”. Even though most of literature examining business applications of wireless technologies has so far addressed business-to-consumer markets, it is now becoming clear that the impact of m-business goes much further (Barnes 2002; Kakihara and Sørensen 2003; Nah, Siau et al. 2004; Pica, Sørensen et al. 2004; Siau, Nah et al. 2004; Junglas and Watson 2006; Zmijewska and Lawrence 2006). Wireless technologies have the potential to transform activities both within and between businesses (Barnes 2002). This broad understanding enables a straightforward definition of m-business based on the contemporary definition of e-business previously presented in this study.

Consequently, for the purposes of this study, m-business is understood as economically relevant exchanges between senders and receivers (individuals and/or organizations from private, public or non-profit sectors) mediated by wireless networks and/or mobile information technologies in an intra- or extra-organizational context.

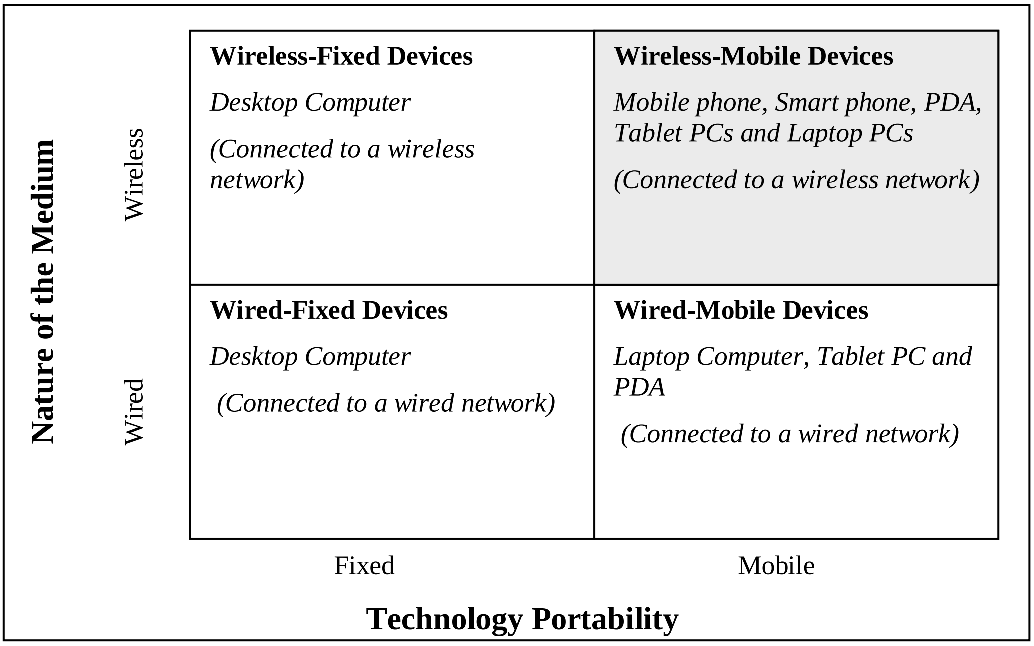
The next section explores distinction between "*wireless*" and “*mobile*".

2.3.2.3 Wireless mobile business

In the m-business literature, the terms “*wireless*” (or “unwired”) and “*mobile*” are often used interchangeably – typically referring to applications derived from the convergence of wireless and mobile technologies (e.g. cellular phones, PDAs). However, there are some conceptual differences between these two terms (Balasubramanian, Peterson et al. 2002; Kalakota and Robinson 2002; Varshney 2003).

The general understanding of *wireless* or *unwired* usually refers to some sort of data transmission using radio waves (Balasubramanian, Peterson et al. 2002; Barnes 2003; Varshney 2003). The data exchange can occur directly from one device to another or mediated by a wireless network (Barnes 2002; Varshney 2002). On the other hand, the term *mobile* usually implies portability of the device (Kakihara and Sørensen 2002; Kalakota and Robinson 2002; Jarvenpaa, Lang et al. 2004).

Figure 2.3 Wireless mobile business



As shown in Figure 2.3, *wireless* and *mobile* are key characteristics of the technologies underlying m-business (Hsu and Bruner II 2002; Kalakota and Robinson 2002; Lehmann and Lehner 2002). One example of wireless but not mobile technology would be someone using a desktop computer connected to a WiFi network. Similarly, a person using a PDA that does not support wireless connectivity (e.g. data synchronization occurs via a docking station) would qualify as mobile but not wireless. Alternatively, someone using a PDA that supports wireless connectivity – and the service is available - would qualify as mobile and wireless.

Kalakota and Robinson (2002) classified mobile devices into two categories: “offline” – without wireless connectivity; and “online” – capable of exchanging data through a wireless connection. This classification is based on the idea that “online” devices would be able to receive and transmit real-time data while “offline” mobile devices would have to use a data synchronization process in a docking station or wired network (e.g. dial-up, LAN and ADSL). What is important to keep in mind is that the distinction between “offline” and “online” mobile devices deeply affects how m-business applications are designed and used (Kalakota and Robinson 2002; Scornavacca and Barnes 2004). The convergence of mobile and wireless technologies is what creates an extraordinary opportunity for e-business to leverage the benefits of mobility (Clarke III 2001; Durlacher Research 2002; Barnes and Huff 2003; Yuan and Zhang 2003). In addition, due to rapid technological development "offline" mobile devices have become increasingly rare (Yang, Chatterjee et al. 2004).

As a result, to be consistent with the current literature, and for the purpose of this study, the broadest meaning of the term "*mobile*" will be used in the text – assuming that the devices are capable of wireless connectivity. Cases exclusively mobile or wireless technologies are exceptions and consequently will be properly noted.

Now that some of the conceptual differences between mobile and wireless in the m-business context have been outlined, the following section explores the value propositions of m-business. Specifically it aims to identify attributes that can be related to the fulfillment of user's needs.

2.3.2.4 M-business value propositions

Value propositions define the relationship between supplier offerings and consumer purchases by identifying how the supplier fulfils the customer's needs across different consumer roles (Porter 1998). The value proposition furthermore solidifies the relationship between the user and various dimensions of product value.

Most of the existent literature aiming to understand the value propositions of m-business focuses on m-commerce from a business-to-consumer perspective (Barnes and Hunt 2001; Barnes 2002; Anckar, Carlsson et al. 2003; Yuan and Zhang 2003). In addition, the major body of reference used to understand m-business value propositions is the e-business literature.

Clarke (2001) presented one of the first conceptualizations of m-business value propositions. The author understood that m-commerce differs from e-commerce on the following value proposition attributes:

Ubiquity: Mobile devices offer users the ability to receive information and perform transactions from virtually any location on a real-time basis. M-commerce users are everywhere, or in many places simultaneously, with a similar level of access available through fixed-line technology. Communication can take place independently of the user's location. The advantages presented from the omnipresence of information and continual access to commerce will be exceptionally important to time-critical applications.

Convenience: The agility and accessibility provided by wireless devices allow m-commerce to differentiate its abilities from e-commerce. People are no longer constrained by time or place in accessing e-commerce activities. Consumers may recognize a special convenience, which can translate into an improved quality of life. M-commerce also offers opportunities to expand a client-base by providing value-added services to customers difficult to reach.

Localization: Knowing the location of the Internet user creates a significant advantage for m-commerce over wired e-commerce. Location-based technologies such as Global Positioning Systems (GPS) can accurately identify the location of the user. Utilizing this technology, m-commerce providers are able to receive and send information relative to a specific location. Location-specific information leverages the key value proposition of m-commerce over traditional e-commerce by supplying information relevant to the current geographic position of the user.

Personalization: Since mobile devices are typically used by one individual, it is ideal for individual-based targeted information. Mobile technology offers the opportunity to personalize messages to various segments, based upon time and location, by altering both sight and sound. Mobile databases become a primary factor of m-commerce success by compiling personalized databases and providing personalized services. A value proposition is developed as superior consumer value is created through an increasingly targeted Internet experience for mobile users.

From a slightly different perspective, Zhang and Yuan (2002) analysed key differences between m-commerce and e-commerce business models. They concluded that the differentiation between m-commerce and e-commerce value propositions derive from their differences in terms of mobility, location dependence, personalization, cost of communication and device capabilities (Table 2.12).

Table 2.12 Differences between e-commerce and m-commerce value propositions

Value proposition	e-commerce	m-commerce
Mobility	Low	High
Location Dependence	High	Low
Personalization	Low	High
Cost of Communication	Low	High
Device Capabilities	High	Low

Source: adapted from Zhang and Yuan (2002), p.1899

Zhang and Yuan (2002) focused on a consumer perspective, considering what attracts customers to enter the e-commerce world is the very low cost and unlimited Internet access. On the other hand, they point out that mobile person-to-person communication is what initially brings consumers to m-commerce, followed by the possibility of accessing several services anywhere at anytime. Based on a similar argument used by Clarke (2001), they also highlighted the idea that location awareness creates significant value for m-commerce. In theory that is correct, but in practice, due to technological limitations of the mobile devices, very few mobile/wireless systems have up to now leveraged from this value proposition (Wyse 2007). One interesting addition is that despite Zhang and Yuan's (2002) consumer focus, they noticed that support of mobile workers could be one of the major value propositions of m-business.

The value propositions presented so far focus the analysis on consumer applications and do not fully contemplate the possible impact of mobile business at the organizational level (Basole 2004; Krogstie, Lyytinen et al. 2004). In addition, some of the m-business value propositions described above overlap with each other. Intrinsically, most of them have been based on the utopian notion of "unlimited ubiquity" – to be able to do anything, anywhere, at anytime (Junglas and Watson 2003; Jarvenpaa, Lang et al. 2004). This ambitious idea - that implies omnipotence and omnipresence of information systems - is what appears to most differentiate mobile technologies from other information technologies.

Some more recent studies argue that in order to effectively understand the value propositions of mobile IS it is important to also identify its main characteristics – since the value propositions of mobile IS are considered to be a product of its main characteristics (Barnes 2002; Pica and Kakihara 2003; Basole 2004; Junglas and Watson 2006; Tilson 2007; Hoehle and Scornavacca 2008). Despite the wide interest in this issue, only a few articles have empirically explored the characteristics and value propositions of mobile IS (Tilson 2007; Hoehle and Scornavacca 2008). A clear understanding of individuals' perceptions of mobile IS may be of assistance for the development of specifically related theories to this field of research (Bauer, Reichardt et al. 2005; Er and Kay 2005; Gallivan and Shen 2005; Sheng, Nah et al. 2005; Carlsson, Carlsson et al. 2006; Scornavacca, Barnes et al. 2006; Tilson 2007).

Based on an extensive literature review and qualitative interviews, Hoehle and Scornavacca (2008) consolidated a set of seven key characteristics and three value propositions of mobile IS (Table 2.13).

Table 2.13 Key characteristics and value propositions of mobile IS

Characteristics	
Portable	Refers to the physical attributes of mobile devices which enable users to easily carry them around most of the time.
Multi-functional	Refers to the diversity of functionalities performed by mobile IS.
Personal	Refers to the perception that a mobile device belongs - and is normally used - by a single person.
Always Connected	Refers to the capability to be connected to other devices and wireless networks.
Secure	Refers to the notion that mobile IS are normally as secure as "wired" information systems.
Expensive	Refers to the high costs usually associated with mobile IS.
Bounded by Hardware	Refers to the limitations of mobile IS as well as the usability/portability trade-off usually faced by this type of system.
Value Propositions	
Ubiquitous Access	Refers to the notion that, independently of time and location, mobile IS enables users to have continuous access to information as well as to reach and to be reached by others.
Productivity Enabler	Refers to the gains in efficiency, effectiveness, and flexibility enabled by the use of mobile IS.
Positive Image	Refers to the positive perceptions (social status and professionalism) that individuals and organizations may gain by using mobile IS.

Source: adapted from Hoehle and Scornavacca (2008), p.338

Some of the characteristics such as "portable" and "personal" identified by Hoehle and Scornavacca (2008) are also commonly found throughout the m-business literature (Zhang and Yuan 2002; Anil, Ting et al. 2003; Lee and Benbasat 2003; Maamar 2003; Siau and Shen 2003; Stafford and Gillenson 2003; Venkatesh, Ramesh et al. 2003; Basole 2004; Barnes and Scornavacca 2005; Kauffman and Techatassanasoontorn 2005; Smith 2006; Urbaczewski and Koivisto 2008). In addition, the author's conceptualization of "always on" fused the notions of connected and available from the literature in one single characteristic (Barnes 2003; Junglas and Watson 2003; Stafford and Gillenson 2003; Basole 2004; Junglas 2005; Nah, Siau et al. 2005; Shim, Varshney et al. 2006). Secure is a characteristic that is not normally associated to mobile IS in the current literature (Boncella 2002; Carlsson, Walden et al. 2006; Lassila 2007). Finally, “bounded by hardware” has also been identified by other authors as one of the key characteristics that distinguish mobile IS form conventional stationary IS such as desktop PCs (Chae and Kim 2003; Urbaczewski and Koivisto 2008).

Regarding the mobile IS value propositions, Hoehle and Scornavacca (2008) point out that “ubiquitous access” was found to be the only value proposition exclusive to mobile IS – all others are also evident in stationary IS. In addition, their broad conceptualization of “productivity enabler” included in a single item value propositions such as efficiency, effectiveness, and flexibility which are often found in the literature (Clarke III 2001; Siau, Lim et al. 2001; Zhang and Yuan 2002; Tarasewich, Nickerson et al. 2003; Basole 2004; Gebauer, Shaw et al. 2004; Nah, Siau et al. 2005; Varshney 2005; Chang, Lee et al. 2006; Tilson 2007). Lastly, positive image, which is normally found in the m-marketing literature, was also indentified as a key value proposition of mobile IS (Anckar and D'Incau 2002; Carroll, Barnes et al. 2005; Haghirian and Madlberger 2005).

In addition, Hoehle and Scornavacca (2008) argued that “mobility” is neither a characteristic nor value proposition of mobile IS – it is a pervasive concept that emerges as a result of all characteristics as well as value proposition of mobile IS. The next section investigates the concept of mobility.

2.3.2.5 Mobility

For quite a long time, mobility has been almost exclusively a theme of interest of disciplines such as environmental psychology and behavioural geography – primarily focusing on human temporospatial cognition and movement (Gold 1980; Frieze, Hansen et al. 2006; Hunecke, Haustein et al. 2007).

Within the IS discipline, the interest in mobility and various issues relating to “being mobile” is quite new – e.g. only recently IS scholars have started to investigate temporal, spatial and structural impacts caused by the dissemination of mobile ICT (Abraham 2001; Perry, O'hara et al. 2001 ; Dawson, Fisher et al. 2002; Kakihara and Sørensen 2002; Lee and Sawyer 2002; Lyytinen and Yoo 2002; BenMoussa 2003; Pica and Kakihara 2003; Basole 2004; Pica, Sørensen et al. 2004; Shen, Yoo et al. 2005; Junglas and Watson 2006; Towers 2006; Zmijewska and Lawrence 2006; Chatterjee and Sarker 2007; Gebauer, Shaw et al. 2007; Lawrence and Er 2007; Tilson 2007;

Zheng and Yuan 2007; Hoehle and Scornavacca 2008; Shen, Lyytinen et al. 2008; Urbaczewski and Koivisto 2008; Chatterjee, Chakraborty et al. 2009; Gebauer and Ginsburg 2009; Junglas, Abraham et al. 2009; Mallat, Rossi et al. 2009; Yuan, Archer et al. 2010). Additionally, only in the past decade, the interest in mobile technologies has migrated from being purely technical - concerned with devices and technological capabilities - to a more sociological and philosophical approach that considers the dialectic between technology and society (Pica, Sørensen et al. 2004). Gebauer, Shaw et al (2007) point out that there is a clear need to improve the operationalization of the latent constructs of user mobility which they believe to be a complex and multidimensional concept that has not been explored systematically in information systems research.

Mobility is often referred as the most important feature of mobile business (Massoud and Gupta 2003; Siau and Shen 2003; Gebauer and Tang 2008; Hoehle and Scornavacca 2008). However, as Pica and Kakihara (2003) argue, issues concerning mobility are discussed without a clear understanding of “mobility” itself and that the concept of mobility and the significance of “being on the move” are used in remarkably diverse ways. They believe that because of such diversity of definitions, current mobility studies lack a well-defined common ground as well as thorough attempts to develop theory, both of which are essential for the sustained development of any scholarly discourse in social sciences. Chatterjee and Sarker (2007) also acknowledged the diversity of viewpoints in the current literature on mobility. They identified five “streams” of work in this area: 1) aiming to understand the philosophical nature of mobility; 2) focusing on the purpose/need of mobility); 3) aiming to categorize mobility; 4) researching the physical manifestations of mobility (in terms of users, devices and services); and 5) examining the effects of mobility on society. Hoehle and Scornavacca (2008) also found that the mobile business literature still is in a stage of conceptual bewilderment regarding mobility.

The initial conception of mobility found in the m-business literature derives from Weiser’s (1991) concept of ubiquitous and pervasive computing (Clarke III 2001; Dawson, Fisher et al. 2002). One example is Siau and Shen (2003) understanding that mobility is related to getting information through a ubiquitous network on a mobile device anytime and regardless of location. Chatterjee and Sarker (2007) summarize this type of conception of mobility as the existence of a communication channel independent of temporal or spatial preferences.

Jarvenpaa et al. (2004) presented a quite broad conceptualization of mobility, affirming that it is, ideally, the ability to do anything, anywhere, at anytime. Similarly, Junglas and Watson (2003) acknowledged the existing drive to have access to information unconstrained by time and space. They called this concept "ubiquity" instead of "mobility" and focused on the features of the environment that enables users to be mobile.

Other authors have conceptualized this matter focused on geographic/spatial issues, viewing mobility in terms of human independence from geographical constraints (Barnes 2003; BenMoussa 2003).

Barnes (2004) approached the concept of mobility for distributed work from a geographical/spatial perspective (see section 2.3.3.2 Enterprise Mobility). In his framework, mobility is a variable that describes the level of geographic independence of enterprise workers, enabled by the wireless data solution. He understands that - in that context - mobility can be characterized in three basic levels:

> "*The first level of mobility is "transient", describing the basic support of employees as they move from one location to another. These employees are geographically tied to the locations between which they move. The second level is "mobile". Here, employees have a much higher degree of geographic independence from the enterprise, and have geographic independence for prolonged periods of time, but they inevitably return to corporate locations to perform certain functions. Finally, the highest level of mobility is "remote". At this level, employees are almost completely removed from the corporate location, being empowered with a very high degree of geographic independence."* Barnes (2004), p.3.

While geographical movement appears in the literature as a possible measure of user mobility, recent studies have shown that the distance traveled by mobile users does not influence their perception of mobile IS usefulness (Gebauer, Shaw et al. 2007; Gebauer and Tang 2008).

Kakihara and Sørensen (2002) developed a concept of mobility which expands the traditional view, understanding that being mobile is not just a matter of people travelling but it relates more to the interactions people perform and the way in which they interact. By relating mobility to interaction, they expand the concept to embrace spatial, temporal and contextual mobility:

Spatial mobility is the most immediate aspect of mobility in our social lives. The rapid diffusion of mobile ICTs has energized human geographical movement, in urban life and work environments. The support provided by these technologies increases the human natural tendency to be geographically independent. Spatial mobility refers not only to extensive geographical movement of people; it also signifies the global flux of objects, information, and spatial reality (cyberspace) - creating complex patterns of human interaction.

Temporal mobility refers to “when” human interactions occur. The recent developments of ICTs have significantly transformed temporal attributes of human interaction. It can no longer be explained from a linear “clock-time” perspective; it is now highly mobilized into multiple temporal modes based on each actor’s perspective and interpretation of time itself. This creates a complex social environment where temporal aspects of interactions among humans are constantly tangled and renegotiated. The increasing temporal mobilization of human interaction is simultaneously creating new opportunities and constraints for the ecology of social life.

Contextual mobility constitutes a crucial aspect of interaction just as time and space do. Understanding the context - “in what way,” “in what particular circumstance,” and “towards which actor(s)” – a task is performed can be critical for capturing the nature of interactions. Mobile ICTs influence the context of interaction in various ways by diversifying modalities of interaction. In addition, the relationship between interaction among people and the contexts in which they are occurring is becoming more flexible.

Table 2.14 summarizes the three dimensions of mobility presented by Kakihara and Sørensen (2002).

Table 2.14 Three dimensions of mobility

Dimension of Mobility	Aspects of Interaction	Extended Perspectives
Spatiality	-Where	-Geographical movement of not just human but objects, symbols, images, voice, etc.
Temporality	-When	-Clock time vs. Social time Objective vs. Subjective -Monochronicity vs. Polychronicity
Contextuality	-In what way -In what circumstance -Towards each actor(s)	-Multi modality of interaction Unobtrusive vs. Obtrusive Ephemeral vs. Persistent - Weakly and strongly tied social networks

Adapted from Kakihara and Sørensen (2002) p.3

The dimensions above make it quite clear that, when exploring mobility, it is essential to understand the nature of what is being mobilized. Contrary to Junglas and Watson's (2003) conceptualization of "ubiquity", Kakihara and Sørensen's (2002) notion of mobility focuses on the user being an active component in a ubiquitous environment.

Following the concepts presented by Kakihara and Sørensen (2002) and Pica and Kakihara (2003) it is acknowledged that being mobile is a matter of interaction and that the device is not the only thing mobilized - but also information. Based on this assumption, Pica and Kakihara (2003) argue that the literature related to mobility is based in two diverging perspectives: one view is based on *stability,* perceiving mobility as creating perpetual, stable and controllable contact (networks), while the other view is based on *fluidity,* seeing mobility as creating fluidity through the formation of ad-hoc, de-contextualized contacts (networks). They suggest that the word mobile might be better conceptualized if associated with a *duality,* understanding that mobility does not mean independence from place but rather the convergence of stability and fluidity as well as real and virtual environments. Müller and Zimmermann (2003) also believe that with the rise of numerous mobile applications in the business environment, physical and virtual worlds are merging more intensively.

Extending these ideas and relating to the workplace, Pica, Sørensen and Allen (2004) identified that in most work environments supported by ICT there is a mixture between virtual and real environments, thus making it extremely relevant to investigate the work relation with the environment (active or passive). In addition they acknowledge that work can be divided in two general categories: structured and unstructured. Structured work requires a high degree of routine and simplicity while an unstructured work involves a high level of improvisation and complexity.

The findings of their research critically link the tasking of the environment and the structure of the mobile device interaction. Based on these ideas, Figure 2.4 presents an analytical model for contextualizing mobility in the workplace (Pica, Sørensen et al. 2004).

Figure 2.4 Analytical Model for contextualizing mobility in the workplace

	MOBILE DEVICE INTERACTION	
ENVIRONMENT TASKING	STRUCTURED (Routine Access to Information)	UNSTRUCTURED (Ad-hoc Access to Information)
ACTIVE (Environment tasking)	• High Usage for Voice Services on the go* • Low Data Usage on the go • Concentrate on exchange rather than processing of information	• Limited Usage of Mobile Services while on the go • Mostly Voice Services • Concentrate on routing and filtering of information
PASSIVE (Technology Tasking)	• High usage of both voice and data services while on the go • Need for added intermediaries	• High usage of both voice and data service while on the go • High need for information and interaction filtering • Hybrid environments of stationary and mobile equipment

*"On the go" refers to usage of mobile device while performing mobile work

Source: Pica, Sørensen and Allen (2004), p.10

The categorization of mobile device interaction is driven by the nature of work task (structured or unstructured). A mobile interaction supporting a structured work task can be understood as one that has a repetitive character in its information access for problem resolution. On the other hand, a mobile interaction supporting an unstructured work task is one that has to be supported by ad-hoc access to information through multiple channels. Alongside, the work relation with the environment (named "environmental tasking") was classified as active – where workers mostly interact with the environment – and passive – where workers mostly interact with the technology. This categorization of mobility shows that the use of a mobile device by an individual cannot be analysed without contextualizing and relating it to the work tasks that the device is supporting.

In summary, due to the large diversity of conceptual perspectives and viewpoints, the literature on mobility can be quite confusing and there is still not a clear understanding of what mobility means in the context if the IS discipline (Chatterjee and Sarker 2007;

Gebauer and Tang 2008). Hoehle and Scornavacca (2008) suggest that the difficulty of capturing and defining mobility as an isolated variable is due to the pervasive nature of this concept. They propose that, possibly, well-established constructs of the IS literature may need to be revised and adapted for use “under mobile conditions”. So far, the research question remains open to what extent previously developed theories to information systems use and impacts are applicable to mobile IS (Gebauer, Shaw et al. 2007; Yuan, Archer et al. 2010).

However, based on the discussion above, a common theme seems to emerge from the distinct conceptualizations of mobility: the phenomenon where individuals are being able to accomplish tasks with the support of ICT in a way which is unconstrained by temporal or spatial boundaries.

The notion of mobility in IS can be further examined from three distinct perspectives:

Individual - having the ability of accomplishing tasks with the support of ICT unconstrained by temporal and spatial boundaries. This notion focuses on the user *per se*, as an active component in a ubiquitous environment, which is able to accomplish tasks with the support of ICT when and where he/she needs or wants it.

Technology – the provision of ICT support to individual’s task requirements unconstrained by temporal and spatial boundaries. This notion focuses on the features of the environment (technological infrastructure) that enables users to be mobile.

Work/Task – requiring ICT support unconstrained by temporal and spatial boundaries. This notion focuses mostly on the work environment which requires that individuals are able to accomplish tasks with the support of ICT at a given point of time and space.

Junglas and Watson (2006) point out that the desire to have access to information unconstrained by time and space is still restricted by technology (e.g. limited applications, network access, and device capabilities as well as data synchronization). However, this “drive” for information access could be more broadly understood as the “need” for ICT support (e.g. accessing, processing and/or exchange information). In addition, the authors have not acknowledged that mobility can also be restrained by temporal and spatial boundaries – not only technology.

At this point, the utopian and widely used concept of mobility without boundaries or "absolute mobility"– to be able to do anything, anywhere, at anytime - is still a fallacy and does not capture the experiences a user gets from using today's mobile technologies. Perhaps it would be appropriate to propose that, at this stage, mobile technologies offer "bounded mobility" - to be able to accomplish IS supported tasks, in most places at most times. The development of mobile solutions should aim to minimize the existing mobility boundaries.

The next section investigates current research in mobile applications in relation to the work domain. This should enable a better understanding the nature and impact of mobile information systems in the workplace.

2.3.3 In business with m-business

This section aims to explore some relevant literature related to mobile business applications in the work domain. As previously discussed in section 2.3.1, the body of research in m-business is heavily skewed towards B2C applications - mobile business applications corresponded to only 17.4 percent of the articles found in the sample while B2C applications represented 55.7 percent. Another relevant issue in this area is the lack of empirical research and theory development. A significant part of the existing body of research on m-business enterprise applications is based on secondary data collection. In addition, the small number of empirical studies found in this area has been limited to identifying the perceived benefits this technology for businesses.

In contrast to the lack of research in this field, evidence suggests that business and enterprise applications are the biggest growth area in mobile business (Manget 2002; AT Kearney 2003; MediaLab South-Pacific 2003; Lehmann, Kuhn et al. 2004; Pesonen, Rossi et al. 2004; Walker and Barnes 2005). The following sub-section explores the potential benefits of m-business applications in the firm's value chain. This is followed by a review of the concept of enterprise mobility.

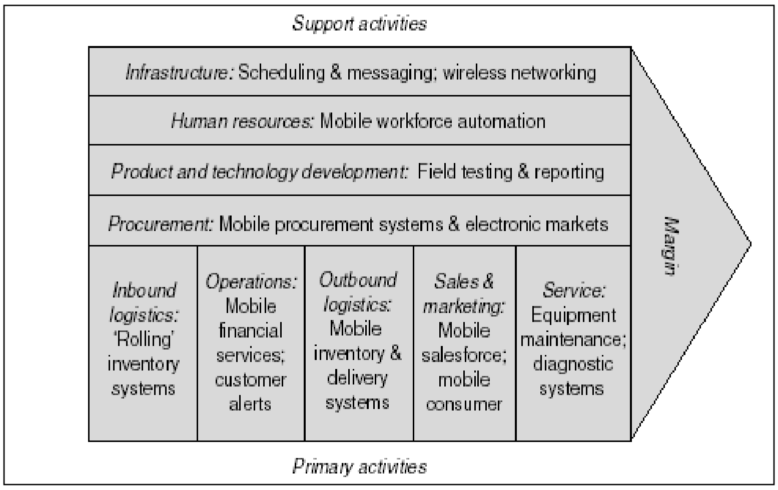
2.3.3.1 Mobilizing the value chain

There is a common agreement among authors that m-business applications are providing a significant opportunity not only to enhance organizational productivity but also to transform business practices (Barnes 2002; Beulen and Streng 2002; Wolf and Heinonen 2003; Yuan and Zhang 2003; Barnes 2004; Kadyte 2004; Tollefsen, Myung et al. 2004; Basole 2005). Jain (2003) suggested that most enterprise mobile applications are likely to be motivated by the need to reduce latency, increase speed of response, enhance efficiency of operations and workforce, improve productivity, boost revenues, and increase competitive advantage.

Porter demonstrated the value chain as the series of interdependent activities that bring a product or service to the customer (Porter 1980). Mobile applications can provide significant business benefits for corporate infrastructure, representing the next step in the evolutionary development of IT integration in the value chain (Müller and Zimmermann 2003; Barnes 2004).

Barnes (2002) presented a systematic analysis of the potential opportunities of mobile technologies in a company's value chain (Figure 2.5). Figure 2.5 and Table 2.15 present the standard value chain of the firm with examples of the possible impact of mobile applications for businesses (Barnes 2002).

Figure 2.5 Mobile applications in the firm value chain



Source: Barnes (2002), p.2.

Based on the analysis of the possible impact of a wide range of mobile applications for businesses, Barnes (2002) identified eight core and not mutually exclusive benefits: business transformation, efficiency, effectiveness, flexibility, ubiquity, connectivity, interactivity and location-awareness.

The first three business benefits are considered generic to most IT applications (Evans and Wurster 2000; Laudon and Laudon 2000), while the remaining five are specific benefits of mobile technologies (Clarke III 2001; Barnes 2002; Zhang and Yuan 2002; Barnes 2004).

Barnes (2002) argues that *business transformation* can happen at different levels, by automating specific business tasks, networking and sharing information, transforming sets of business processes, transforming relationships with other entities, and creating new revenue streams. Westelius and Valiente (2004) supported this, affirming that the core benefits of mobile technology are brought by changes to the business processes.

Efficiency is usually related to productivity gains or cost reduction achieved by process automation (Barnes 2002; Ali and Al-Quirim 2003; Jain 2003). Westelius and Valiente (2004) noticed that processes prompted by mobile technology provide gains in efficiency. Ali and Al-Qirim (2003) studied seven organizations using mobile business applications in New Zealand. They reported from these cases that efficiency gains are the principal perceived business benefits emerging from this type of technology. Other researchers also found that mobile technologies deeply affect task performance of mobile workers and promotes efficiency gains (Abraham 2004; Basole 2004; Pesonen, Rossi et al. 2004). From a more strategic perspective, Chung (2003) showed that mobile applications can be of great utility in supporting organizationally-interdependent decision-making.

Table 2.15 Mobile applications in the firm value chain

Support Activities	Impact of Mobile Applications
Infrastructure	Wireless networks and devices can help to strongly integrate remote, disparate or roaming employees into the corporate infrastructure.
Human resources	Handheld training devices and location aware technologies may be useful for remote or roaming workers (e.g. field and sales force automation).
Product and technology development	The impact of mobile technologies in product and technology development is quite embryonic. However, field testing and reporting is one area where it is likely to have an important role.
Procurement	Exceptional roaming employees who are involved in procurement might be aided by using mobile IT in the B2B domain.
Primary Activities	**Impact of Mobile Applications**
Inbound logistics	Mobile applications can accurately monitor inbound inputs to the firm. By knowing the location of 'rolling' inventory, times between transaction, manufacture and delivery can be further reduced.
Operations	The impact of mobile ICTs on the operations component of the value chain is likely to be enormous. There are many applications such as meter reading, customer alerts and credit authorization that would benefit from the mobile value propositions
Outbound logistics	Mobile ICTs – especially location technologies – can play an important part in outbound logistics. Fleet management systems help freight companies to monitor the status of deliveries and other outbound logistics activities
Sales and marketing	In many industries, the sales force is becoming increasingly mobile and teleworking is a very real part of sales activity. Mobile technologies allow strong integration of a remote sales force into ERP and other key systems. Mobile marketing is another emerging application in this area of the value chain.
Service	Similarly to the product and technology development activity, devices can be embedded in products to bring benefits to the service activity. Mobile technologies can provide information for field workers (e.g. technicians), increasing productivity and customer satisfaction.

Source: Adapted from Barnes (2002)

In contrast to efficiency, *effectiveness* can be quite difficult to measure (Jessup and Valacich 2003). In the case of mobile business applications, gains in effectiveness have mostly being reported in conjunction with process transformations in the organizations (Barnes 2002; Ali and Al-Quirim 2003; Chung 2003; Jain 2003; Müller and Zimmermann 2003; Pesonen, Rossi et al. 2004; McIntosh and Baron 2005). Beulen and Streng (2002) and Wolf and Heinonen (2003) perceived a high influence of the nature of the task supported by mobile technology in relation to the perceived efficiency and effectiveness of mobile workers' behaviour.

Flexibility refers to the high degree of adaptability and portability of mobile technologies (Barnes 2002; Scheepers and Steele 2002; Jain 2003; Müller and Zimmermann 2003). Scheepers and Steele (2002) pointed out that the use of mobile devices removes a great deal of the traditional constraints associated with using information systems with stationary computers, thus providing much greater flexibility in the times at which the system may be used – e.g. it may be possible to exchange data not just at work within working hours. In addition, Jain (2003) suggested that giving workers access from wherever they are allows them to access task-critical enterprise applications in a timelier manner than having to wait until they are back at the desktop. Barnes (2002) also pointed out that in some types of organizations, such as offices and supermarkets, mobile technologies allow rearranging IT equipment without significant cabling issues. Müller and Zimmermann (2003) added to this point by drawing the attention to the role that passive and active tags, microprocessors, sensors and transmitters have in the convergence of physical and informational – enabling a higher level of continuous and automated information processing.

Ubiquity is frequently labeled as "mobility" (Jarvenpaa, Lang et al. 2004; Tuunanen and Vainio 2004; McIntosh and Baron 2005; Walker and Barnes 2005). Junglas and Watson (2006 *p.578*) pointed out that both terms are conceptually similar: "Whereas ubiquity takes the lens of the environment to provide the functionality for a user to move, mobility takes on the lens of a user being active component in a ubiquitous environment". Barnes (2002) defined this benefit as the capability of having data communication anytime and anywhere as long as under network coverage. Zimmermann (2003) suggested that new services or new cost saving business processes will be enabled by the development of ubiquitous networks and embedded devices. Wolf and Heinonen (2003) and Jarvenpaa et al. (2004) reported that the implementation of some mobile technologies in the organizational domain generated a fairly high level of user expectations - based on false assumptions that this technology would enable them to "do anything, anywhere, anytime". Westelius and Valiente (2004) noticed that besides the high level of expectations it also produces a high level of uncertainty among staff – perhaps caused by the novelty and/or the existing myths evolving around this kind of technology. If this benefit becomes a widespread reality, users no longer have to think about the problems of establishing device networking, only its benefits.

Connectivity refers to the ability to transmit and receive data wirelessly (Barnes 2002; Zimmermann 2003; Basole 2004). Concomitantly, *interactivity* refers to the potential for complex information to be shared among devices, increasing systems interactivity (Barnes 2002; Sun and Poole 2004). Notice that most of the issues related to connectivity and interactivity have characteristics in common with flexibility and ubiquity.

At present, business benefits enabled by advances in location awareness can be considered much more of a promise than a reality of m-business (Junglas and Watson 2006). Whereas expectations of business benefits enabled by location awareness are high, only a limited number of mobile applications have actually leveraged tangential benefits from this technology (Lankhorst, Kranenburg et al. 2002; Gruhn, Hülder et al. 2003; Henfridsson and Lindgren 2003; Kviselius 2004; Scornavacca and Barnes 2006).

The eight benefits enabled by mobile business applications in the firm's value chain proposed by Barnes (2002) have found support in the literature. There is clear empirical evidence that these technologies enhance business transformation, efficiency, effectiveness, flexibility and interactivity. On the other hand, ubiquity, connectivity and location awareness are mostly referred as potential benefits that, at this stage, remain bounded by the level of technological development – reinforcing the relevance of "bounded mobility" as an important concept be explored in m-business research. In addition, all the benefits abovementioned seem to be a direct effect of the increasing degree that ICT are assisting individuals in performing their portfolio of tasks in a way which is unconstrained by temporal or spatial boundaries.

The next section explores the concept of enterprise mobility.

2.3.3.2 Enterprise Mobility

The use of mobile technologies can undoubtedly improve the efficiency of the members of an organization, especially the mobile workforce (Jain 2003; Rodina, Zeimpekis et al. 2003; Yuan and Zhang 2003; Lehmann, Kuhn et al. 2004; Westelius and Valiente 2004; Barnes and Scornavacca 2005; Basole 2005; Walker and Barnes 2005). In several cases, as Jain (2003) and Walker and Barnes (2004) reported, mobile technologies replaced inefficient paper data entry processes and enabled the capture of complete and accurate data at the point-of-origin.

It is clear that different industries require distinct levels of mobility (Jain 2003; Pica, Sørensen et al. 2004; Barnes and Scornavacca 2005). Enterprise mobility requirements can be generally divided in three categories (Jain 2003):

1) *Industries with high mobility requirements:* This group involves the organizational settings where users as well as the assets are moving constantly. Examples of such settings include shipping and trucking industries as well as law enforcement agencies (Pica, Sørensen et al. 2004).

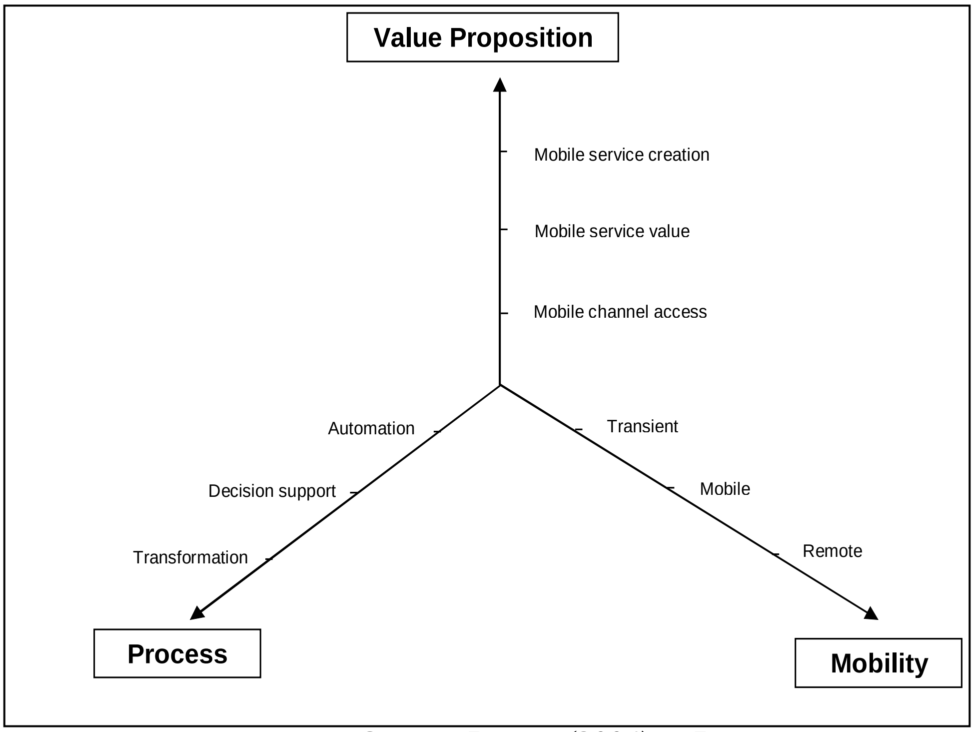
Although in agricultural and utility industries assets are fixed, these assets are spread over a wide geographic region and most tasks are accomplished in the field. For this industry group, mobile technologies are crucial as they liberate mobile employees from wired connections and enable them to accomplish IS supported tasks needs in a broader temporal and spatial boundary.

2) *Industries with medium mobility requirements:* This group involves the settings where users are highly mobile in a restricted perimeter and perform most critical tasks at "base" (e.g. office or kiosk). Examples of such settings include healthcare and university settings.

3) *Industries with low mobility requirements:* Users belonging to this category are rarely mobile and the support of mobile IS hardly influence the fulfilment of their tasks. An example of this setting would be a traditional office setting.

Undoubtedly, the nature of tasks accomplished by the mobile workforce involves a high level of geographically dispersed work (Pica, Sørensen et al. 2004; Westelius and Valiente 2004; Innes, Barnes et al. 2005; McIntosh and Baron 2005; Walker and Barnes 2005). Barnes (2003; 2004) pointed out that "enterprise mobility" is defined by the degree to which an organization's operations and information needs, typically employee activity, are supported in a "geographically independent way". The author presented a conceptual framework for understanding the potential of mobile application in the B2E space, which he refers to as the Mobile Work Model (MWM). Figure 2.6 shows the MWM diagram.

Figure 2.6 Dimensions and stages of Mobile Work Model



Source: Barnes (2004), p.5

The axes are mobility, process and value proposition. Notice that each axis indicates three distinct stages in relation to its dimension. Briefly, the axes can be described as follows:

Mobility describes the level of "geographic independence" of enterprise workers, enabled by the wireless data solution. The first level is "*transient*", which describes the basic support of employees as they move from one location to another. These employees are restrained by spatially bounded mobility. The second level is "*mobile*" where employees have a much higher degree of spatial independence from the enterprise, and have spatial independence for prolonged periods of time, but they inevitably return to corporate locations to perform certain functions. Finally, the highest level of mobility is "*remote*". At this level, employees are almost completely removed from the corporate location, being empowered with a very high degree of spatial independence.

Process describes the change in work configuration and processes resulting from the adoption of a mobile application. The first level, "*automation*", refers to efficiency gains in existing processes transferred to the mobile data environment. "*Decision support*" brings in a degree of effectiveness and knowledge work gains via the mobile solution. Finally, "*transformation*" describes a fundamental degree of change in organizational processes using the mobile medium. At this level, the nature of work and job roles may be transformed by the mobile medium.

Value proposition describes the value proposition in the marketplace; typically, it refers to the alterations in products, services and relationships with customers, but it may also contain market experiences with suppliers and business partners. *Mobile channel access* – positioned at the lowest level - indicates that the mobile medium is being used largely as a conduit for information for mobile employees, without significantly different services. *Mobile service value* – positioned at the intermediate level- refers to the wireless solution being used to add significant value to the market offering. There are specific areas where the product or service level is being significantly enhanced using mobile distributed work. *Mobile service creation* – positioned at the highest level, indicates that the wireless medium is being used to create entirely new service offerings or products.

Some of the concepts regarding business transformation presented in the MWM were also captured by Basole (2005). In addition, a few researchers applied the MWM to case studies and provided some insights on mobile work solutions (Barnes 2004; Innes, Barnes et al. 2005; Walker and Barnes 2005). Three major phases in the use of mobile distributed work in organizations were identified:

Phase I: Mobile employee linkage. This phase of enterprise mobility focuses on establishing the appropriate wireless infrastructure to “link-in” transient employees, enabling access to corporate data and improving the efficiency of existing work.

Phase II: Mobile employee empowerment. In this phase, the work patterns of employees are driven by the availability of corporate knowledge via the mobile medium. In this stage, mobile employees are able to significantly improve the effectiveness of work configurations and therefore of the products or service provided.

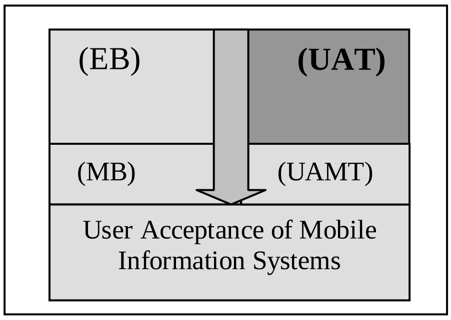
Phase III: Mobile enterprise creation. Only in this highest phase of enterprise mobility can the organization boast truly mobile employees and services. At this level, employees can exist separately of the geographic constraints of an organization, supported by wireless solutions. The nature of work has been significantly transformed to take advantage of the new environment, and the roles of individuals are likely to be very different. In addition, the mobile enterprise is able to offer new and different products and services.

Most of the case studies found in the literature relating mobile applications in the workplace could be classified as belonging to second phase - mobile employee empowerment (Ali and Al-Quirim 2003; Jain 2003; Liang, Xue et al. 2003; Barnes 2004; Pesonen, Rossi et al. 2004; Westelius and Valiente 2004; Basole 2005; Innes, Barnes et al. 2005; McIntosh and Baron 2005; Walker and Barnes 2005). Pesonen et al. (2004) observed that most business-to-employee mobile solutions based on cellular phones only integrated e-mail and calendar systems. In this case it was noticed that some mobile operators promoted the latest innovations - even if they have little field experience of them – increasing risks of failure and user rejection. Pica, Sørensen and Allen (2004) believe that the nature of work is a critical success factor for the usage of mobile devices in the workplace.

Walker and Barnes (2004), using the mobile enterprise model, examined the impact of wireless sales force technologies on three organizations in the New Zealand food industry. They observed that sales force and overall organizational performance improved as a result of applying wireless technologies to their sales function. Several positive impacts were derived from mobile channel access providing better remote access to back office systems, more efficient provision of up-to-date information, and improved ability to communicate with sales people. However, the authors found that the development of mobile solutions has been limited to the improvement of existing processes, and is quite dependent on the performance of mobile networks and bandwidth availability. Finally they acknowledged the gap in the academic literature regarding mobile information systems in the workplace.

Additionally, the body of knowledge of mobile information systems user acceptance is anecdotal (Scornavacca, Barnes et al. 2006; Ngai and Gunasekaran 2007). Jain (2003) suggests that it is crucial to develop and tailor these systems to the enterprise's specific needs in order to enhance user acceptance. However, even though it seems reasonable, there is no clear evidence supporting this idea. In order to understand user acceptance of mobile information systems in the workplace, the following section reviews the second major informing discipline of this research: IS research into user acceptance of technology.

2.4 User acceptance of technology



User acceptance of new technology is often described as one of the most mature research areas within the information systems discipline (Hu, Chau et al. 1999; Venkatesh, Morris et al. 2003; Benbasat and Barki 2007; Hirschheim 2007). Research in this area has produced many theoretical models - with roots in information systems, psychology and sociology – and still is a critical and pertinent issue for the IS field (Davis, Bagozzi et al. 1989; Venkatesh and Davis 2000; Venkatesh, Morris et al. 2003; Bagozzi 2007; Benbasat and Barki 2007; Goodhue 2007; Hirschheim 2007; Lucas, Swanson et al. 2007; Schwarz and Chin 2007; Silva 2007; Straub and Burton-Jones 2007; Venkatesh, Davis et al. 2007).

This section presents a review of some prominent models of the IS literature on user acceptance of information technology. This is followed by a review of the literature on user acceptance of mobile technologies.

2.4.1 Review of Extant User Acceptance Models

The study of user acceptance and use of technology have produced several research streams (Venkatesh, Morris et al. 2003; Venkatesh, Davis et al. 2007). One stream of research focuses on individual acceptance of information technology (Davis, Bagozzi et al. 1989; Compeau and Higgins 1995) while other streams have focused on implementation success at the organizational level (Leonard-Barton and Deschamps 1988; Straub and Burton-Jones 2007) and task-technology fit (Goodhue 1995; Goodhue and Thompson 1995), among others. The theoretical models that are included in this review have in common the intention to use and/or usage of technology as the key dependent variable.

Venkatesh et al. (2003) point out that the role of intention as a predictor of behaviour (e.g. usage) is also critical and it has been well established in the IS discipline (Sheppard, Hartwick et al. 1988; Ajzen 1991; Taylor and Todd 1995).

A large literature survey was carried out in order to identify some of the most prominent user acceptance models/theories used in the m-business domain (see section 2.5 for more details). Five theories/models emerged from this review: 1) Theory of

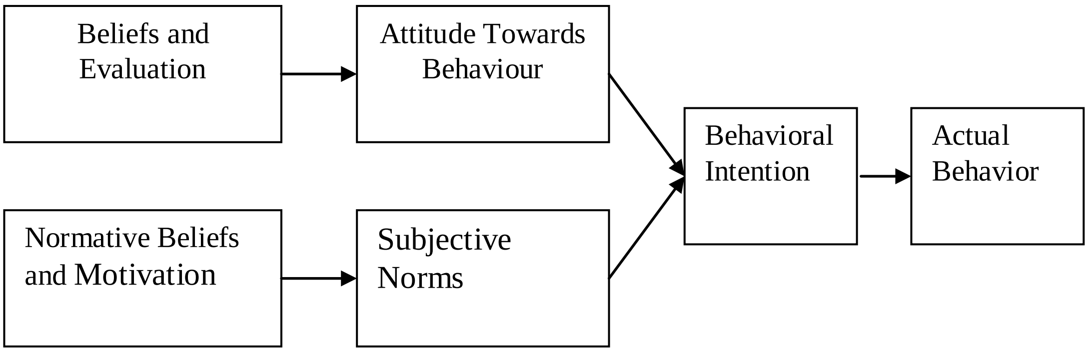
Reasoned Action (TRA); 2) Technology Acceptance Model (TAM); 3) Theory of Planned Behaviour (TPB); 4) Diffusion of Innovation (DoI); and 5) Unified Theory of Acceptance and Use of Technology (UTAUT).

The first four models will be briefly reviewed in the following subsections. The UTAUT will be reviewed in depth, since it will be used as the foundations of the user acceptance component of this research.

2.4.1.1 Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) has been drawn from social psychology and is one of the most fundamental and influential theories of human behaviour (Fishbein and Ajzen 1975; Venkatesh, Morris et al. 2003). Sheppard et al. (1988) recognized that this theory has been used to predict a wide range of behaviours.

Figure 2.7 Theory of Reasoned Action (TRA)



Source: Fishbein and Ajzen (1975)

According to Fishbein and Ajzen (1975), this theory implies that subjective norms and attitude towards a certain behaviour will influence the behavioural intention, and therefore, lead to an actual behaviour (Figure 2.7). Attitude Towards Behaviour can be understood as "an individual's positive or negative feelings (evaluative affect) about performing the target behaviour" (Fishbein and Ajzen 1975). Subjective Norm is defined as "the person's perception that most people who are important to him think he should or should not perform the behaviour in question" (Fishbein and Ajzen 1975) p.325). It is a social factor that reflects user perception of social pressures such as the expectation that others will perform or not perform the behaviour. Above all, the theory of reasoned action (TRA) draws the attention to the importance of attitudinal and normative variables in the study of user behaviour.

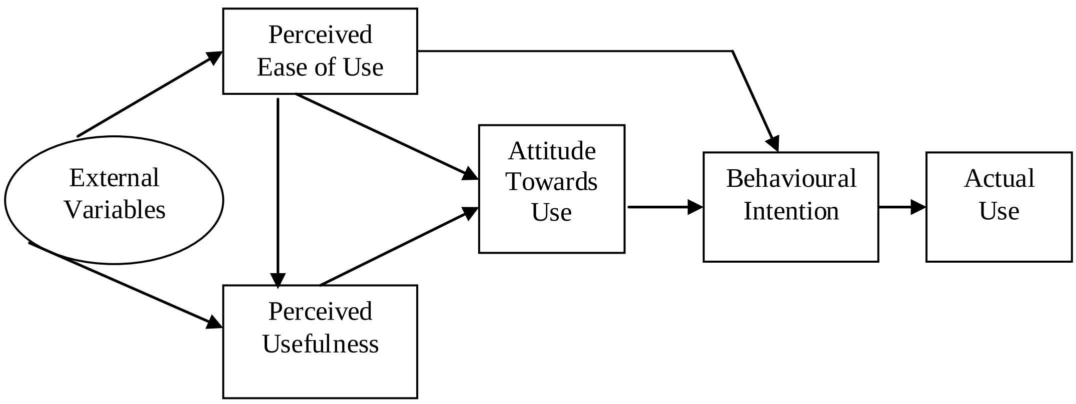
In the IS domain, Davis et al. (1989) applied TRA to individual acceptance of technology and found that the variance explained was largely consistent with studies that had employed TRA in the context of other behaviours.

2.4.1.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) (Davis 1989) was originally adapted from the TRA (Fishbein and Ajzen 1975), however unlike the TRA, the final conceptualization of TAM excludes the attitude construct in order to better explain intention parsimoniously (Venkatesh, Morris et al. 2003). It presents two independent variables: *Perceived Usefulness* which is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis 1989) p. 320); and *Perceived Ease of Use* – defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis 1989)p. 320); (see Figure 2.8).

TAM is possibly one of the most used models found in the IS literature. In early 2006, in the Institute for Scientific Information's Social Science Index there were over 450 journal citations to the two journal articles *that* introduced TAM (Davis 1989; Davis, Bagozzi et al. 1989). A search on Google Scholar, also in early 2006, found 1947 citations of Davis (1989) and 1195 citations of Davis *et al.* (1989).

Figure 2.8 Technology Acceptance Model (TAM)



Source: Davis, 1989, p.985

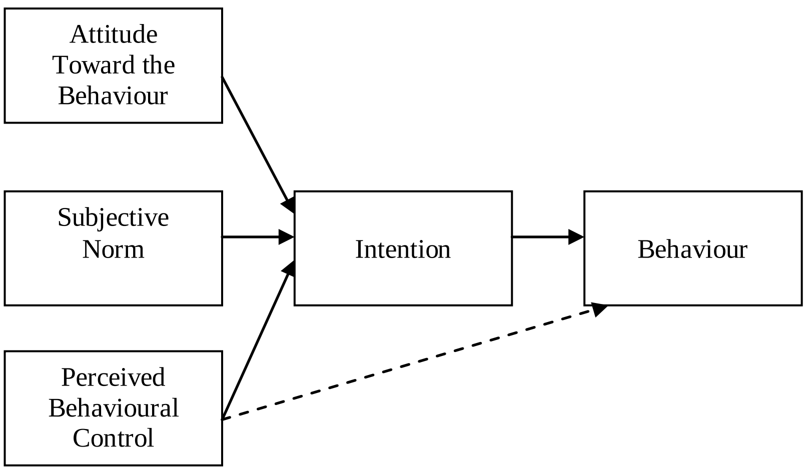
The Technology Acceptance Model is tailored to IS contexts, and was designed to predict information technology acceptance and usage in the workplace (Venkatesh, Morris et al. 2003). It has been widely applied to diverse set of technologies and users (Venkatesh and Davis 2000). Subsequently, Venkatesh and Davis (2000) presented

TAM2. It extended the original TAM by including subjective norms as an additional predictor of intention in the case of mandatory settings.

2.4.1.3 Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) is derived from the Theory of Reasoned Action (TRA) (Ajzen 1991). The main purpose of TPB was to predict behaviours from people who have restrained volitional control. Ajzen (1991) points out that some people may not actually obtain performance behavior even though they may be very highly motivated by their attitude and subjective norm - due to environmental conditions that may intervene. In TPB, Perceived Behavioural Control is theorized to be an additional determinant of intention and behaviour (see Figure 2.9). Ajzen (1991, p. 188) defines this construct as "the perceived ease or difficulty of performing the behaviour". In the context of IS research, Taylor and Todd (1995b) have proposed a slightly different definition: "perceptions of internal and external constraints on behaviour".

Figure 2.9 Theory of Planned Behaviour (TPB)



Source: Ajzen, 1991, p 182

TPB is grounded in psychology and has not been widely used in the IS domain (in comparison to TAM or DoI). However some IS studies (Venkatesh and Davis 2000; Chang and Cheung 2001) have successfully applied this theory to the understanding of individual acceptance and usage of different technologies.

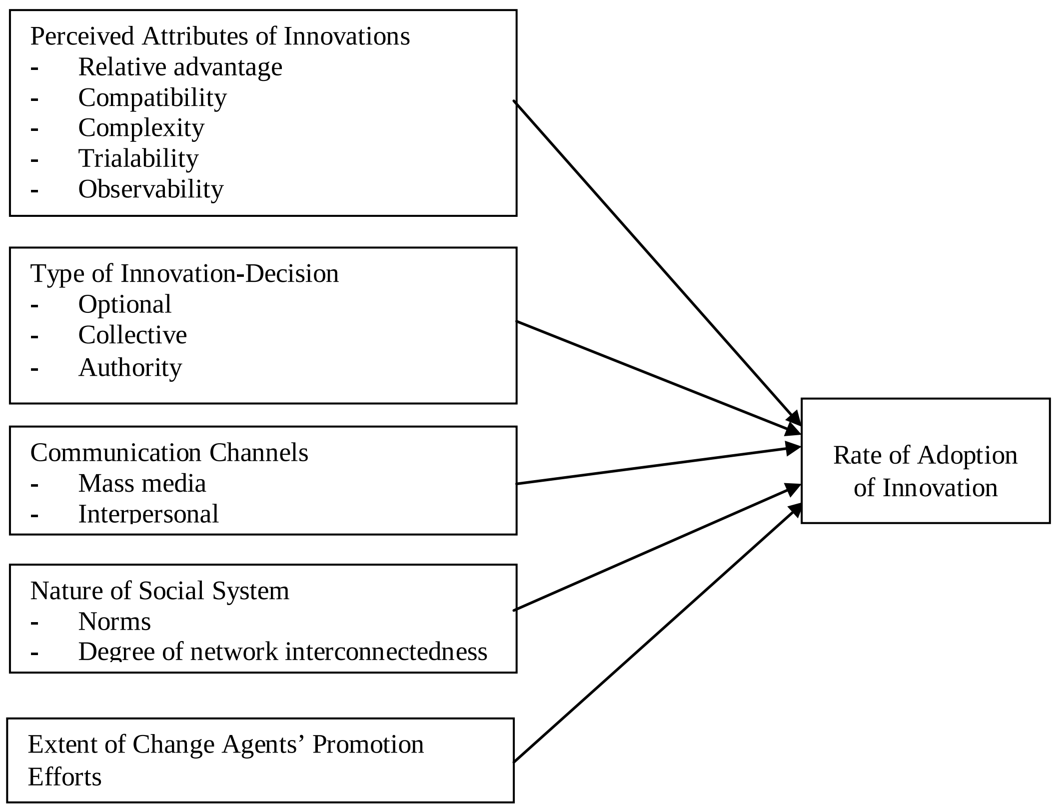
A related model is the Decomposed Theory of Planned Behaviour (DTPB). DTPB is identical to TPB regarding the prediction of intention. However, in contrast to TPB but similar to TAM, DTPB decomposes attitude, subjective norms, and perceived behavioural control into its underlying belief structure within technology adoption contexts (Venkatesh, Morris et al. 2003).

2.4.1.4 Diffusion of Innovations (DoI)

Grounded in sociology, the Diffusion of Innovations (DoI) theory (Rogers 1995) has been used since the 1960s to study a variety of innovations, ranging from agricultural tools to organizational innovation (Venkatesh, Morris et al. 2003).

Rogers (1995) defined the innovation diffusion process as a mean to spread new ideas from the source of invention or creation through many channels of information to their adopters or users. The author identified five variables that determine the rate of adoption of innovation (Figure 2.10).

Figure 2.10 DoI - Variables determining the rate of adoption of innovations



Source: Rogers, 1995, p. 207

Within information system, Moore and Benbasat (1991) operationalized Rogers's model in order to study the adoption and diffusion of information technology. Table 2.16 presents Moore and Benbasat's (1991) core constructs and its definitions.

Table 2.16 Moore and Benbasat's (1991) core constructs and its definitions

Core constructs	Definitions
Relative Advantage	"the degree to which an innovation is perceived as being better than its precursor"
Easy of Use	"the degree to which an innovation is perceived as being difficult to use"
Image	"the degree to which an innovation is perceived to enhance one's image or status in one's social system"
Visibility	"the degree to which one can see others using the system in the organization"
Compatibility	"the degree to which an innovation is perceived as being consistent with the existing values, needs and past experiences of potential adopters"
Results Demonstrability	"the tangibility of the results of using the innovation, including their observability and communicability"
Voluntariness of Use	"the degree to which an innovation is perceived as being voluntary, or of free will"

Source: Moore and Benbasat, 1991, p. 195

Further on, Moore and Benbasat as well as Karahana et al. found support for the predictive validity of these innovation characteristics (Moore and Benbasat 1996; Karahanna, Straub et al. 1999).

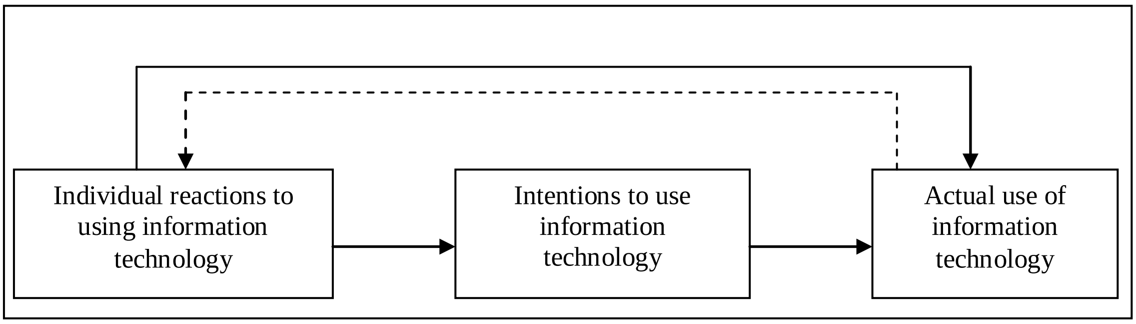
2.4.1.5 Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003) provides a sound basis for understanding user acceptance research within the IS domain (Zmijewska and Lawrence 2006). Therefore, it is reviewed in depth in this section.

In order to develop the UTAUT, Venkatesh et al. (2003) conducted the following steps: (1) reviewed user acceptance literature and discussed some prominent models, (2) empirically compared eight models and their extensions, (3) formulated a unified model that integrates elements across the eight models, and (4) empirically validated the unified model.

Figure 2.11 presents the basic conceptual framework underlying the class of models regarding the acceptance of information technology that forms the basis of Venkatesh et al.'s (2003) research.

Figure 2.11 Basic concept underlying user acceptance models



Source: Venkatesh et al. (2003), p. 427

Venkatesh et al.'s (2003) literature review resulted in the identification of eight key competing theoretical models of user acceptance of technology. In addition to the four models (TRA, TAM, TPB, and DoI) previously reviewed, Venkatesh's et al. (2003) review also included the following models: Motivational Model (MM) (Davis, Bagozzi et al. 1992; Vallerand 1997), Combined TAM and TPB (C-TAM-TPB)(Taylor and Todd 1995), Model of PC Utilization (MPCU) (Triandis 1977; Thompson, Higgins et al. 1991), and Social Cognitive Theory (SCT) (Bandura 1986; Compeau and Higgins 1995).

Overall, the eight models analyzed hypothesized between two and seven determinants of acceptance, for a total of 32 constructs. In addition, four key moderating variables (experience, voluntariness, gender, and age) were found to be significant.

Venkatesh et al. (2003) also investigated prior model tests and model comparisons. They noticed that there have been many tests of the eight models, however, there have only been four studies reporting empirically-based comparisons of two or more of the eight models published in the major information systems journals (Davis et al. (1989) – TRA and TAM, Mathieson (1991) – TAM and TPB; Taylor and Todd (1995b) - TAM, TPB/DTPB; and Plouffe et al. (2001) - TAM, DoI). As a result, five limitations were identified on previous model tests and comparisons (Table 2.17).

Table 2.17 Limitations of Prior Model Comparisons

Limitation	Main Issues	Actions taken by Venkatesh et al. (2003)
Technology studied	The technologies that have been studied in many of the model development and comparison studies have been relatively simple (individual-oriented information technologies).	They studied more complex and sophisticated organizational technologies that are the focus of managerial concern.
Participants	While there have been some tests of each model in organizational settings, the participants in three of the four model comparison studies have been students (only Plouffe et al. (2001) conducted their research in a nonacademic setting).	Their research was conducted using data collected from employees working in distinct functional areas. Participants belonged to four different organizations/industries.
Timing of measurement	In general, most of the tests of the eight models were conducted well after the participants' acceptance or rejection decision rather than during the active adoption decision-making process. Because behavior has become routinized, individual reactions reported in those studies are retrospective (e.g. Fiske and Taylor, 1991; Venkatesh et al., 2000). With the exception of Davis et al. (1989), the model comparisons examined technologies that were already familiar to the individuals at the time of measurement.	They examined technologies from the time of their initial introduction to stages of greater experience.
Nature of measurement	Even studies that have examined experience have typically employed cross-sectional and/or between-subjects comparisons (e.g. Davis et al. 1989; Karahanna et al. 1999; Szajna 1996; Taylor and Todd 1995a; Thompson et al. 1994). This limitation applies to model comparison studies also.	Their work tracks participants through various stages of experience with a new technology and compares all models on all participants.
Voluntary vs. mandatory contexts	Most of the model tests and all four model comparisons were conducted in voluntary usage context. Therefore, one must use caution when generalizing those results to the mandatory settings that are possibly of more interest to practicing managers.	Their research examines both voluntary and mandatory implementation contexts.

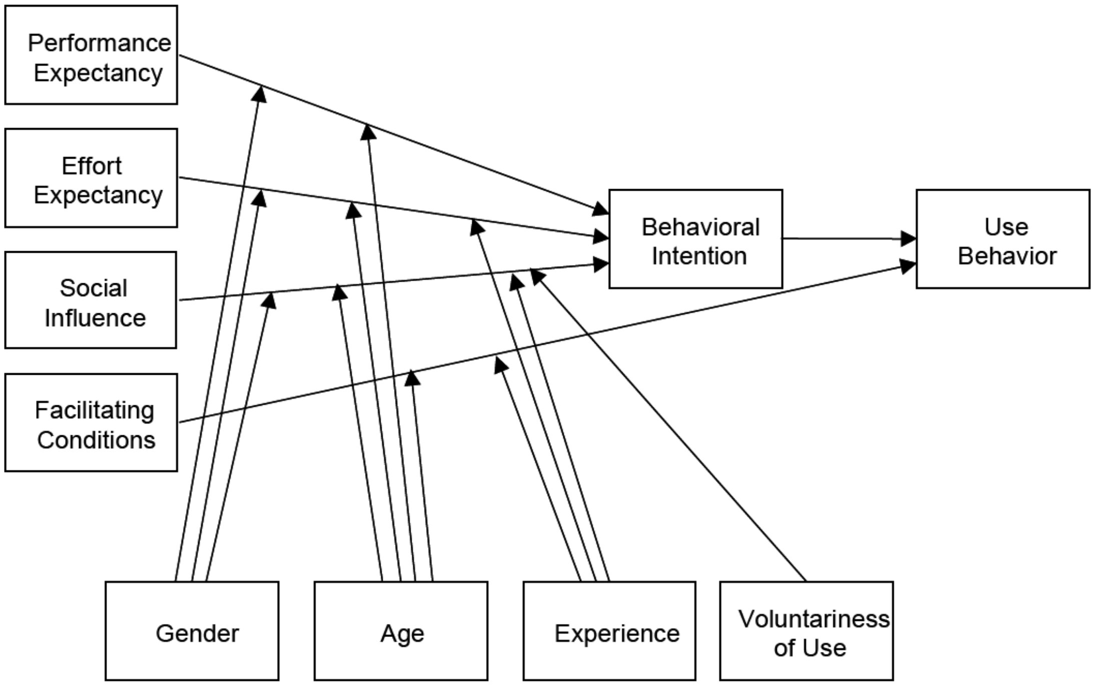
Once the literature review was carried out, the next step taken by the authors was to empirically compare the eight selected models. A pre-tested questionnaire containing items measuring constructs from all eight models was administered at three different points in time: post-training (T1), one month after implementation (T2), and three months after implementation (T3). The actual usage behaviour was measured over the six month post-training period. The total sample size was 215 participants – approximately 54 individuals per organization.

The following findings emerged from this empirical comparison of the eight competing models.

- For every model, there was at least one construct that was significant in all time periods and that construct also had the strongest influence—e.g., attitude in TRA and TPB/DTPB, perceived usefulness in TAM/TAM2 and C-TAM-TPB, extrinsic motivation in MM, job-fit in MPCU, relative advantage in DoI, and outcome expectations in SCT.
- Several other constructs were initially significant, but then became non-significant over time, including perceived behavioural control in TPB/DTPB and C-TAM-TPB, perceived ease of use in TAM/TAM2, complexity in MPCU, ease of use in DoI, and self-efficacy and anxiety in SCT.
- The voluntary vs. mandatory context did have an influence on the significance of constructs related to social influence: subjective norm (TPB/DTPB, C-TAM-TPB and TAM2), social factors (MPCU), and image (DoI) were only significant in mandatory implementations.

The next step was to formulate a unified model that integrated elements across the eight models – the UTAUT (Figure 2.12) and cross-validating it using data gathered from two additional organizations. During this process Venkatesh et al. (2003) used the same data collection and analysis procedures mentioned above.

Figure 2.12 Unified Theory of Acceptance and Use of Technology (UTAUT)



Source: Venkatesh et al., 2003, p. 447

Seven constructs appeared to be significant direct determinants of intention or usage in one or more of the individual models (performance expectancy, effort expectancy, social influence, and facilitating conditions, attitude toward using technology, self-efficacy, and anxiety). Of these, Venkatesh et al. (2003) found that four constructs played a significant role as direct determinants of user acceptance and usage behaviour while the remaining were not direct determinants of intention.

The influence of *performance expectancy* on behavioural intention was positive and moderated by gender and age, such that the effect was stronger for men and for younger workers. *Effort expectancy* influenced behavioural intention and was moderated by gender, age, and experience, such that the effect was stronger for women, older workers, and those with limited experience. *Social influence* was also a determinant of behavioural intention and was moderated by gender, age, voluntariness, and experience, such that the effect was stronger for women, older workers, under conditions of mandatory use, and with limited experience.

On the other hand, *facilitating conditions* did not have a significant influence on behavioural intention because it was captured by effort expectancy. However, facilitating conditions influenced usage and was moderated by age and experience such that the effect was found stronger on older workers, with increasing experience.

Computer self-efficacy was not found to have a significant influence on behavioural intention due to the fact that it was captured by effort expectancy. *Computer anxiety* also did not have a significant influence on behavioural intention because it was captured by effort expectancy. In addition, *attitude toward using technology* did not have a significant influence on behavioural intention because its effect was captured by process expectancy and effort expectancy. Finally, behavioural intention was found to have a direct effect on *usage*.

Table 2.18 presents the final constructs and items used by Venkatesh et al., 2003.

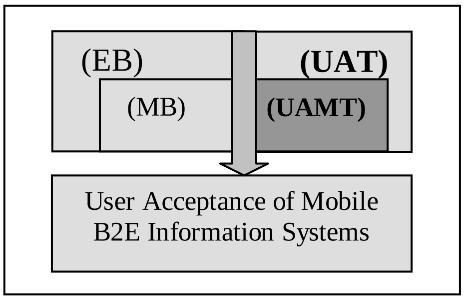
Table 2.18 UTAUT Constructs

Construct	Definition	Origin
Performance expectancy	The degree to which an individual believes that using the system will help him or her to attain gains in job performance.	Perceived Usefulness (Davis 1989; Davis, Bagozzi et al. 1989) Relative Advantage (Moore and Benbasat 1991) Outcome Expectations (Compeau and Higgins 1995; Compeau, Higgins et al. 1999)
Effort expectancy	The degree of ease associated with the use of the system.	Perceived Ease of Use (Davis 1989; Davis, Bagozzi et al. 1989) Ease of Use (Moore and Benbasat 1991)
Social Influence	The degree to which an individual perceives that important others believe he or she should use the new system.	Subjective Norm (Fishbein and Ajzen 1975; Davis, Bagozzi et al. 1989; Ajzen 1991; Mathieson 1991; Taylor and Todd 1995; Taylor and Todd 1995) Social Factors (Thompson, Higgins et al. 1991)
Facilitating conditions	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.	Perceived Behavioral Control (Ajzen 1991; Taylor and Todd 1995; Taylor and Todd 1995) Facilitating Conditions (Thompson, Higgins et al. 1991)
Behavioural intention to use the system	A measure of the strength of one's intention to perform a specified behaviour	Behavioural intention (Davis 1989; Davis, Bagozzi et al. 1989; Ajzen 1991)

The UTAUT was able to account for 70 percent of the variance (adjusted R^2) in usage intention – a substantial improvement over the original eight models abovementioned. Venkatesh et al., (2003) point out that the UTAUT synthesizes well what is known about technology adoption and provides a good foundation to guide future research in this area. In addition, they suggest a number of areas that warrant further attention: the measures used for the UTAUT should be viewed as preliminary and future research should be targeted at more fully developing and validating appropriate scales for each of the constructs with an emphasis on content validity. Also, further research should focus on additional theoretically motivated moderating influences, different technologies - collaborative systems and e-business applications; different user groups - individuals in different functional areas, and other organizational contexts. Furthermore, additional determinants that have not been explicitly tied into this research stream but merit consideration in future work include task-technology fit (Goodhue and Thompson 1995; Dishaw and Strong 1999; Fang, Chan et al. 2006; Goodhue 2007).

The next section analyses the current literature on user acceptance of mobile technologies.

2.5 User acceptance of mobile technology



The review of the literature on user acceptance of mobile technologies developed in this section is divided in two parts: the first part presents a general overview of the literature, while the second part explores in-depth some emerging ideas in this area.

2.5.1 Initial analysis of the literature on user acceptance of mobile technology

Similarly the approach taken in section 2.3, this section examines the research literature on user acceptance of mobile technologies (Culnan and Swanson 1986; Alavi and Carlson 1992; Banker and Kauffman 2004; Scornavacca, Barnes et al. 2006).

This part of the investigation was carried out in late 2006 and, as a result, the timeframe of this analysis was from January 2000 until June 2006[3]. Table 2.19 presents the list of journals and conferences examined in this analysis.

Table 2.19 Sources on user acceptance of mobile technologies

M-business Conferences
ICMB - International Conference on Mobile Business
Mobility Roundtable
M-business Journals
IJMC - International Journal of Mobile Communications
IS and e-business Conferences
ICIS - International Conference on Information Systems
HICSS – Hawaii International Conference On System Sciences
ECIS - European Conference on Information Systems
PACIS - Pacific-Asia Conference on Information Systems
ACIS - Australian Conference of Information Systems
ICEB - International Conference on Electronic Business
Bled eConference
AMCIS - Americas Conference on Information Systems
IS and e-business Journals
ISR – Information Systems Research
IJEC - International Journal of Electronic Commerce
CACM - Communications of ACM
MISQ - MIS Quarterly
IJEB - International Journal of Electronic Business
JAIS - Journal of the Association of Information Systems
JMIS - Journal of Management Information Systems
E-services Journal
Electronic Markets
CAIS – Communications of AIS
ECRA -Electronic Commerce Research and Applications

In addition to the sources mentioned above, a keyword search (using the keywords mobile, wireless, m-business, and m-commerce, adoption, acceptance, drivers) was executed on three major bibliographic databases (Proquest, Emerald and Interscience) to assure that key articles published in other available sources were not missed.

[3] The literature analysis presented in this section helped the researcher to identify existent gaps in the literature of user acceptance of mobile information systems. It was carried out in the beginning of the doctoral thesis. For that reason the timeframe is limited to June 2006. The results have been published as an article - Scornavacca, E. and Huff, S. (2008) "Exploring the Literature on User Acceptance of Mobile Technologies" 7th Global Mobility Roundtable. Auckland, New Zealand. November

The next step was to examine the abstracts of every paper published during the selected period in the research outlets mentioned above. All abstracts were scrutinized and articles considered pertinent to the topic were selected for further analysis. The general guideline for article selection was as follows:

1) The central theme should be acceptance of mobile information technologies; and

2) Articles should be in the information systems / e-business domain

A total of 106 articles were selected for further analysis. Table 2.20 details the number of contributions from each source.

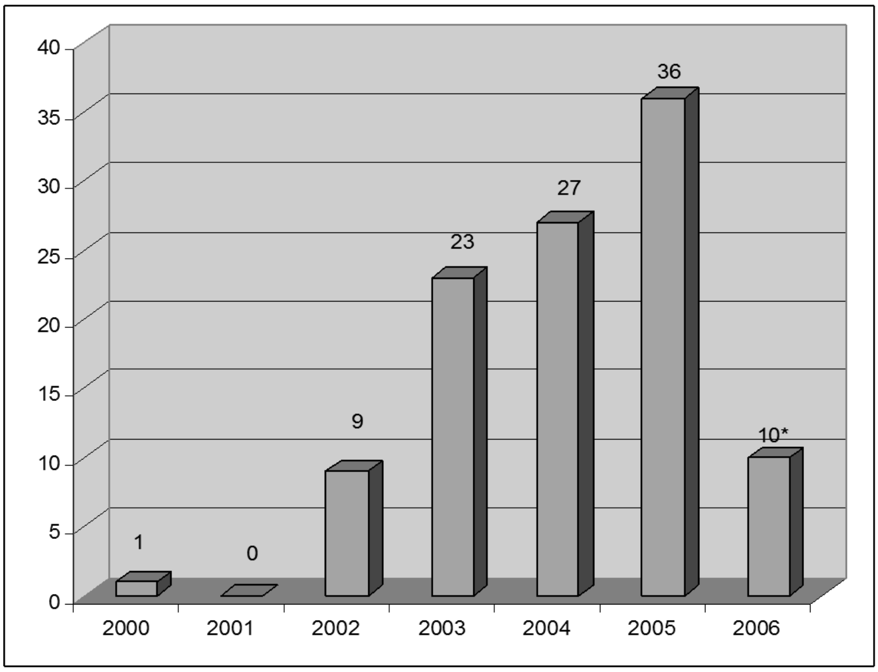
Table 2.20 Contribution of each source for the article selection

Source (total)	Articles	
	Qt.	Freq.
M-business Conferences (28)		
ICMB	18	16.8%
Mobility Roundtable	10	9.3%
M-business Journal (15)		
IJMC	15	14%
IS and e-business Conferences (58)		
ICIS	3	2.8%
HICSS	15	14%
ECIS	6	5.6%
PACIS	6	5.6%
ACIS	3	2.8%
ICEB	3	2.8%
Bled eConference	8	7.5%
AMCIS	14	13.1%
IS and e-business Journals (5)		
ISR	0	-
IJEC	0	-
CACM	2	1.9 %
MISQ	1	0.9%
IJEB	0	-
JAIS	0	-
JMIS	1	0.9%
E-service Journal	0	-
Electronic Markets	0	-
CAIS	0	-
ECRA	1	0.9%
Total	106	100%

The absolute contribution from ICMB, IJMC, HICSS and AMCIS is notable. Also due to the novelty of the subject, only five papers have been found published in general IS and e-business journals. Similar to the general m-business literature, approximately

12 percent of the papers acknowledged to be research in progress. In addition, it is clear that research on user acceptance of mobile technologies is an emerging topic that has attracted the interest of a number of researchers. Figure 2.13 presents an overview of the growth of this research niche.

Figure 2.13 Number of publications per year



* From January to June 2006

In order to guide the in-depth analysis of the research literature on user acceptance of mobile technologies, the following questions were posed:

- What was the principal focus of research? (e.g., consumers, business applications or m-business in general)
- What was the purpose of the study?
- What types of technologies/applications were studied?
- Was primary data collection carried out?
- What research methods were used?
- What models, theories of technology acceptance were used?
- What were the key contributions of the study?

To answer these questions, the 106 selected articles were carefully categorized and then analysed in detail.

In order to identify the research focus in relation to the target group, each article was classified into one of the following categories: consumer, business, and general. As expected, most of the articles (76.6%) focused on consumers. The tendency to focus on consumers in this research niche (acceptance/adoption) is significantly higher than the one found in the general m-business literature (see section 2.3.1) - where 55.7 percent of the papers focused on consumer applications. Most of the few studies on mobile applications for businesses focused on the healthcare industry.

Table 2.21 presents a characterization of each category and the distribution of articles across them.

Table 2.21 Research Focus

Category	Definition	Qt.	Freq.
Consumer	Consumer applications, consumer behaviour, acceptance of consumer focused mobile/wireless technologies	82	76.6%
Business	Business applications, organizational impact, acceptance of mobile/wireless technology by employees and businesses	21	19.6%
General	General issues about acceptance of m-business applications and technologies, broad and unspecified focus	3	2.8%
Total		106	100%

While the analysis above indicates that a large proportion of m-business adoption research has been focused on consumer issues, practitioner research published by Forester Research points out that the international market for business applications of mobile technology - especially business-to-employee applications – is growing twice as fast as the market for consumer applications (Forrester Research 2005).

It was found some diversity of the purpose (goal, aim, objective) of the study stated each article. As presented on Table 2.22, the study of “user acceptance” and “technology adoption” corresponded to almost 80 percent of the papers included in this review. In both cases, the terms were mostly used to indicate the purpose to understand individuals’ intention to use a mobile technology. However, usually the authors that employed the term “user acceptance” had their focus on the user *per se*, while the ones that used “technology adoption” often had their primary focus on the technology. In addition, studies aiming to profile users, usage as well as drivers and inhibitors composed 16 percent of the sample. It is remarkable that despite the popularity of

Rogers (1995) Diffusion of Innovation theory among 106 papers, only one article had as its purpose "investigate the diffusion of mobile technologies".

Table 2.22 Purpose of the study

Purpose	Qt. cit.	Freq.
User Acceptance	47	43.9%
Technology Adoption	37	34.6%
Profile use and users	8	7.5%
Drivers & inhibitors	8	7.5%
Apply TA theory	3	2.8%
Use qualitative methods	1	0.9%
Profile organizations	1	0.9%
Diffusion	1	0.9%
Total.	106	100%

Researchers have also studied user acceptance of a wide range of mobile technologies and applications. Based on the purpose (goal, aim, objective) stated in each article, the classification presented in Table 2.23 was developed.

Table 2.23 Technology/Application

Topic	Qt.	Freq.		Topic (cont)	Qt.	Freq.
M-commerce	19	17.8%		WiFi	3	2.8%
Services	16	15.0%		Marketing	3	2.8%
Internet	16	15.0%		Interface	2	1.9%
Payment	9	8.4%		DSS	2	1.9%
Healthcare	7	6.5%		Parking	1	0.9%
Mobile IS	6	5.6%		Bluetooth	1	0.9%
SMS	4	3.7%		Agriculture	1	0.9%
Devices	4	3.7%		Auction	1	0.9%
Banking	3	2.8%		Entertainment	1	0.9%
3G	3	2.8%		Push-2-talk	1	0.9%
Enterprise	3	2.8%		**Total.**	**106**	**100%**

As expected, the most frequent topic was m-commerce (17.8%), usually approached from a consumer perspective. Typically this topic was approached in a very broad manner without focusing on a specific type of application. Services and mobile/wireless access to the Internet also emerged as popular topics (15%). Among the 21 papers published about business applications, seven focused on wireless applications in healthcare and only three investigated mobile enterprise applications such as field force automation and job dispatch.

In order to investigate whether the m-business adoption literature also lacks empirical investigation, it was verified if the researchers had carried out primary data collection. Primary data collection is understood as data gathered directly by the authors of the publication - not from secondary sources (e.g. case studies based on information collected from secondary sources such as websites and practitioner reports were considered as secondary data collection). Differently from the general m-business literature (where only 41.7 percent presented primary data collection), a substantial proportion of studies (78.5%) on mobile technology adoption were based on primary data collection. This result shows that academia has taken a more empirical research approach in this research niche.

In order to identify the research methods or research approaches used in the sample, all articles were classified according to the method or approach stated in each article (Yin 1984; Benbasat, Goldstein et al. 1987; Kaplan and Duchon 1988). Table 2.24 presents the distribution found in the sample. Also, with the intention of determining whether there has been a longitudinal variation in the research methods deployed, an independence test between year of publication and research method was carried out. It did not reveal a significant relationship between these two variables.

Table 2.24 Research Methods

Method	Qt. cit.	Freq.
Survey	61	57.0%
Conceptual (“thought piece”)	9	8.4%
Case study	8	7.5%
Interviews	7	6.5%
Literature review	7	6.5%
Experiment	6	5.6%
Mix methods	6	5.6%
Focus group	2	1.9%
Total	106	100%

Perhaps due to the influence of the robust, empirically-based body of knowledge on technology adoption, the number of conceptual analyses found in the sample was limited and survey was the most common research method used by the authors (57%). Most surveys were administered to large samples of consumers through the Internet – with an average sample of 828 participants. Surveys among university students were common.

It is also interesting to note that only 18 percent of the empirical papers were based on qualitative methods and that approximately 25 percent of the case studies were based on secondary data collection. In addition, it was found that the average sample used for qualitative studies with primary data collection was 30 participants.

The next step was to identify the foundation theories and models on technology adoption used by the authors (Table 2.25).

Table 2.25 Reference models/theories

Model/Theories	Freq.
TAM	51.4%
Ad Hoc theories/models	25.2%
Other theories/models	22.4%
DoI	20.6%
TRA	11.2%
TPB	9.3%
UTAUT	7.5%
Total	106 papers

Among the five theories/models reviewed in section 2.4 (TRA, TAM, TPB, DoI and UTAUT) TAM was undoubtedly the most popular, appearing in more than half of the papers. It was interesting to observe that almost a quarter of the papers used *Ad Hoc* models - these papers were mostly originated from Europe and often did not acknowledge the existent IS literature on technology adoption. In addition, 22.4 percent of the papers used theories/models such as Goodhue and Thompson's (1995) Technology Task Fit (TTF) and Hofstede's (1984) Cultural Dimensions. Often these theories/models were combined with TAM in order to create hybrid models (Hofstede 1984). It was surprising to see UTAUT being combined with TAM – since TAM is one of the eight models used to create UTAUT. Overall, 63 percent of the papers used only one theory/model, 26 percent used two, 8 percent used three and only 2 percent used four theories/models. Table 2.26 presents the distribution and the intersections of theories/models found in the sample.

Table 2.26 Intersection of theories/models

Models/ Theories	TAM	DoI	TRA	TPB	UTAUT	Other	Ad Hoc	Total
TAM	21	9	7	2	3	13	0	55
DoI	-	10	1	1	1	0	0	22
TRA	-	-	0	1	0	0	0	9
TPB	-	-	-	2	0	0	0	6
UTAUT	-	-	-	-	1	1	0	6
Other	-	-	-	-	-	6	0	20
Ad Hoc	-	-	-	-	-	-	27	27

The next step was to identify in the literature other specific factors that are claimed to influence the adoption of mobile technologies - in addition to the factors found in TRA, TAM, TPB, DoI and UTAUT. Overall 36 additional factors were identified among the 106 papers analyzed and clustered into seven categories (Table 2.27).

Since almost 80 percent of the papers focused on the adoption of mobile consumer applications, factors regarding consumer trust, cost (willingness to pay) and personal attributes were commonly suggested as possible drivers for consumers to adopt mobile technologies. It is also important to acknowledge that models like TAM and UTAUT - which have their origins analyzing the adoption of technologies in the workplace - are commonly applied in consumer focused studies without careful considerations regarding the distinct nature and use of hedonic systems (Van der Heijden 2004).

As expected, some authors suggested that factors concerning the nature of mobile technologies as well as user mobility (temporal, spatial and contextual factors) would influence user acceptance of mobile technologies (Amberg, Hirschmeier et al. 2004; Han, Mustonen et al. 2004; Yang and Stafford 2005; Kargin and Basoglu 2006; Mallat, Rossi et al. 2006; Pagani 2006; Zmijewska and Lawrence 2006). However, most of the factors proposed by the authors are in an initial (conceptual) stage or have not been thoroughly developed or validated.

Table 2.27 Factors influencing user acceptance of mobile technologies

Factors Attributed	Category
Battery life Connectivity Ubiquity Translucent Menu Technology Maturity Portability	Technology (6)
Infrastructure Supporting factors Organizational social context	External Factors (3)
Perceived costs Perceived financial resources Perceived internal/external resources Perceived value Monetary value	Cost (5)
Trust Perceived credibility Perceived risk Privacy	Trust (4)
Identification Mobility context Task Localization Location dependency Time dependency Fragmentation of working space Fragmentation of working time Perceived mobility	Temporal, Spatial and Contextual Factors (9)
Perceptions of mass media Perceived self expressiveness Enjoyment Culture Personal innovativeness in the domain of the technology Personal characteristics	Personal attributes (Consumer) (6)
Near term usefulness Long term usefulness New possibilities	Other (3)

Finally, an analysis of the main contributions of each article was conducted. Many authors clearly highlighted the main contributions of their articles; however, in a number of cases (19), due to the lack of information given by the authors, this classification required a reviewer judgment. Table 2.28 presents the findings. Extended models were the most common contribution found among the articles reviewed. Despite a strong empirical orientation of this research niche, “insights” were found to be the main contribution of almost 19 percent (20) of their articles. Also it is interesting to observe that only 3.7 percent of the papers offered new constructs.

Table 2.28 Primary Contribution

Contribution	Qt.	Freq.
Extended model	21	19.6%
Insights	20	18.7%
Hybrid model	17	15.9%
New Model	15	14.0%
Profile	9	8.4%
Framework	9	8.4%
Future research	6	5.6%
Constructs	4	3.7%
Drivers/inhibitors	4	3.7%
Qualitative method	1	0.9%
Total	106	100%

This section has attempted to provide a general picture of the main characteristics of past and current research into the adoption of mobile technologies. The categorization and statistical analysis of the salient academic literature in this field suggests that mobile business researchers should begin to focus their efforts in the following areas:

- *Research into business and organizational applications*. Current research is heavily focused on consumer issues, despite evidence suggesting that business and enterprise applications are the biggest growth area. While consumer-oriented research is useful, more research into user acceptance of mobile technologies in the workplace is needed to bridge the gap between theory and practice.
- *Theory development.* While other theories have been applied to the adoption of mobile technologies, it does not yet have theory of its own. A solid theoretical foundation exploring the nature of mobile information systems as well as user mobility are necessary in order to develop a better understanding of the factors that influence the acceptance of such systems.

Above all, the findings described above support the development of an empirical study on the acceptance of mobile information systems in the workplace.

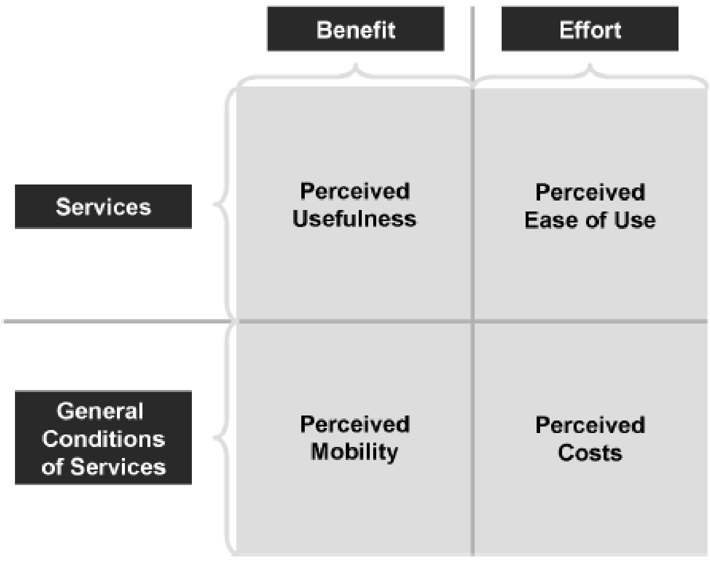
2.5.2 Mobility and the adoption of mobile information systems

As presented in the section above, a large proportion of studies on mobile technology adoption have failed to acknowledge and investigate the most significant feature of mobile information systems: mobility. This section aims to explore in-depth some of the few studies that have incorporated mobility as a determining factor for user adoption.

2.5.2.1 Compass Acceptance Model

Amberg et al. (2004) suggest that most technology acceptance models are not suitable for analysing and evaluating user acceptance of mobile services. In order to fill this gap they developed the Compass Acceptance Model (CAM) (Amberg, Hirschmeier et al. 2004). In a quite different approach from the traditional acceptance models (e.g. TAM and DoI), the structure of the CAM is based on a balanced scorecard that contains a set of independently measurable user acceptance criteria. The CAM consists of four complementary orthogonal categories – Benefits, Efforts, (similar to usefulness and ease of use from TAM), Services (product-specific aspects) and General Conditions of Services (environmental factors) - and four dimensions: Perceived Usefulness, Perceived Ease of Use, Perceived Mobility and Perceived Costs (Figure 2.14):

Figure 2.14 Dimensions of the compass acceptance model



Source: Amberg el al. 2004 p.253

The four dimensions presented in the figure above emphasize the assessment of a service by the end-user's subjective point of view. The first two dimensions *Perceived Usefulness* and *Perceived Ease of Use* can be found in the TAM (Davis, Bagozzi et al. 1989). However, the authors' point out that while TAM focuses mainly on the characteristics of a service itself; the CAM also incorporates the environmental conditions of a service. Therefore, indicators measuring *Perceived Usefulness* in the CAM could be perceived information quality and quantity or conformity of expectations while indicators measuring *Perceived Ease of Use* could be the ease of configuration or first log-in, overall handling and menu navigation.

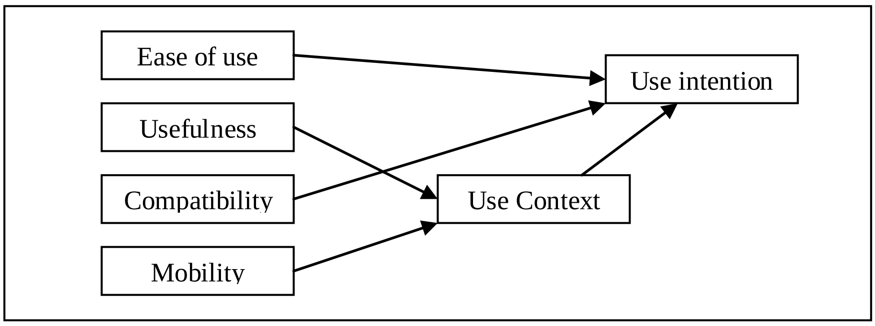
The combination of *Benefits* and *General Conditions of Services* categories led the authors to develop a dimension called *Perceived Mobility*. Indicators measuring this dimension might be network coverage, accessibility and technological infrastructure. Finally, the *Perceived Costs* dimension is formed by the categories *Efforts* and *General Conditions of Services*. In this case, cost transparency, data security and health risks could be considered as appropriate indicators.

The application of the CAM was undertaken using a fictitious example of mobile TV services in trains. After demonstrating the application and surveying 170 people, the model was able to generate, in a holistic way, a few insights regarding user types and behaviour patterns as well as strengths and weaknesses of the service. However, the model was not able to predict the individual intention to use the technology. In addition the *Perceived Mobility* dimension was mostly focused on technological issues such as battery life and network coverage – not incorporating spatial, temporal or contextual issues regarding mobility.

2.5.2.2 mTicketing Acceptance Model

The model proposed by Mallat et al. (2006; 2009) uses TAM and DoI (Davis, Bagozzi et al. 1989; Rogers 1995) as its theoretical background and was created to study the acceptance of mobile ticketing services in the public transportation system in Helsinki, Finland (Figure 2.15).

Figure 2.15 mTicketing Acceptance Model



Source: Mallat et al. (2006), p.7

The authors also identified in the current literature an extensive application of TAM and DoI (see Section 2.5.1). In addition, they indicated that previous studies have found *Ease of Use* and *Usefulness* (TAM) together with *Compatibility* (DoI) to be the most common determinants of user acceptance of mobile services. Consequently, those three items were added to the model.

Mallat et al. (2006; 2009) also perceived mobility to be the most significant feature of mobile technology. They define mobility as the ability to access services ubiquitously, on the move, and through wireless networks and various devices, such as, PDAs and mobile phones. Concomitantly, they use the term mobility to express the benefits generated by time and place independent computing such as service access. On the other hand, *Use Context* was treated as a separate construct representing the specific circumstantial conditions that users meet when they move and use mobile services in different places at different times.

While the items from TAM and DoI are well established, it was necessary to develop the items and measurements of “use context” as well as “mobility”. The basis for the development of “use situation” and “mobility” was related studies found in the literature and findings of a customer survey of mobile ticketing service users previously carried by the Helsinki Public Transport. Each of these items received face and content validation and were added to the final the instrument.

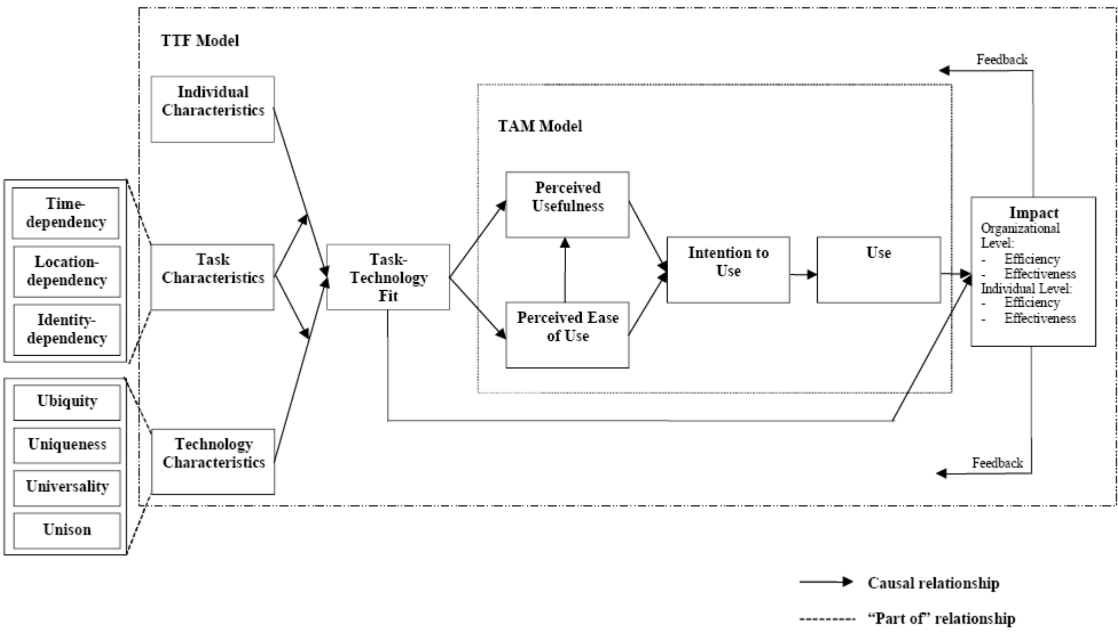
Overall, Mallat et al. (2006; 2009) make some interesting contributions to the study of user acceptance of mobile technologies by complementing traditional technology acceptance models with two constructs that are specific related to the nature of mobile technologies – even though some of the items do not seem to be fully suitable to capture each phenomenon. However these constructs cannot be generalized to a wide range of mobile applications since they were developed to study one specific consumer oriented application as well as one specific task (buy tickets for public transportation).

2.5.2.3 Technology Impact Model

Junglas and Watson (2003) conceptualized the technology impact model (TIM) based on a model by Dishaw and Strong (1999) that combines TAM (Davis, Bagozzi et al. 1989) with TTF (Goodhue and Thompson 1995) and the concept of ultimate commerce (u-commerce).

U-commerce can be defined as "the use of ubiquitous networks to support personalized and uninterrupted communications and transactions between a firm and its various stakeholders to provide a level of value over, above, and beyond traditional commerce" (Watson, Pitt et al. 2002). U-commerce is based on four theoretical constructs, *Ubiquity* - an ultimate form of Reachability, Accessibility and Portability; *Uniqueness* - an ultimate form of Localization, Identification and Portability; *Universality* - an ultimate merge of Mobile Networks and Mobile Devices; and *Unison* - an ultimate merge of Mobile Applications and Data Synchronization (Junglas and Watson 2006). Overall, the notion of u-commerce can be understood, to a certain extent, as a form of unbounded m-commerce (see bounded mobility in section 2.3.2) where the vision of anytime, any-place and any-device would become a reality. Figure 2.16 presents the conceptual technology impact model (TIM).

Figure 2.16 Technology Impact Model

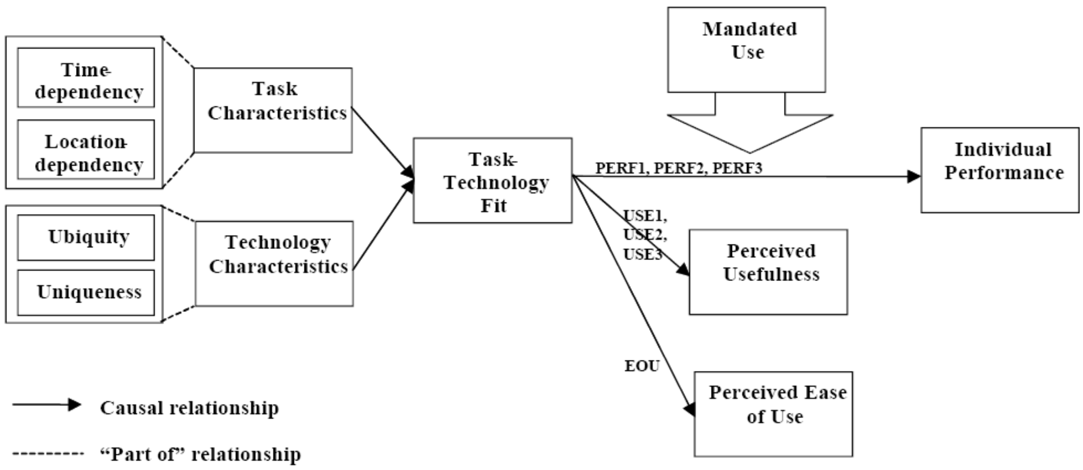


Source: Junglas and Watson 2003 p. 419

TAM and TTF focus on different aspects of user acceptance and use different lenses to explain information system utilization (Dishaw and Strong 1999; Venkatesh, Morris et al. 2003; Pagani 2006; Yuan and Zheng 2006; Junglas 2007; Yuan and Zheng 2009). TAM explains IS usage through beliefs and perceptions a user has of an information system, neglecting that people may use an information system whether they like it or not. On the other hand, TTF, explains IS usage through expected performance increase, neglecting which kind of beliefs or perceptions a user has of an information system (Junglas and Watson 2003). Dishaw and Strong (1999) point out that TTF could be more effective than TAM for predicting use in work-related tasks and a combination of these two models into one extended model can produce better-quality results. In addition, it is important to tailor TTF and TAM to the specific characteristics of mobile information systems (Gebauer, Shaw et al. 2004; Mallat, Rossi et al. 2006; Pagani 2006; Goodhue 2007; Junglas 2007; Junglas, Abraham et al. 2008; Junglas, Abraham et al. 2009).

In order to empirically test the TIM, Junglas and Watson (2003) created task scenarios with different levels of technology-task-fit (under-fit, ideal-fit and over-fit). In addition, they reduced the conceptual model (Figure 2.17) focusing on what they believed to be the most prevalent features of mobile IS: time and location-dependent tasks as well as technology ubiquity and uniqueness. A total of 117 university students participated in their experiment.

Figure 2.17 Simplified Technology Impact Model



Source: Junglas and Watson (2003), p. 420

Junglas and Watson (2003) concluded that location-based services are perceived to be very useful only for location-dependent tasks. Therefore, for tasks that are not location dependent, such as writing e-mail, location-based technologies do not make a difference in usefulness perceptions. In addition, perceptions regarding ease of use do not significantly differed on user groups with over-fit or ideal fit. However, they point out that situations with under-fit conditions tend to devalue the perceptions of ease of use significantly while user perceptions do not considerably differ in ideal-fit and over-fit conditions.

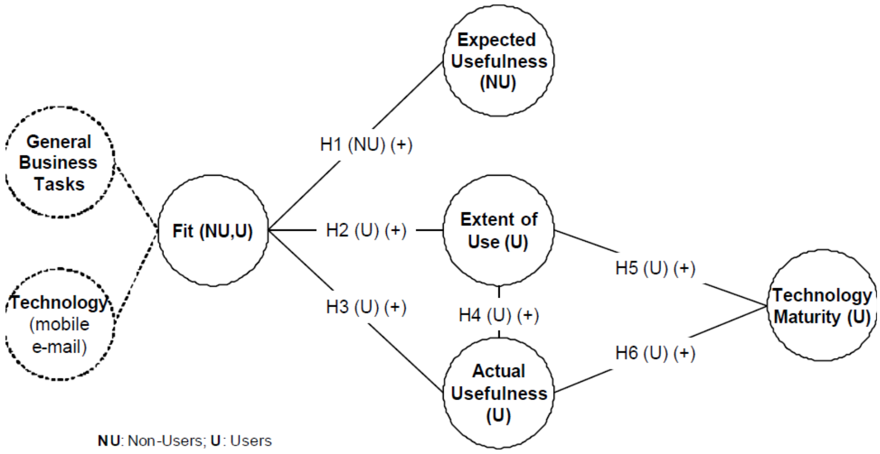
The authors also make an interesting point by saying that the development of ubiquitous information systems will lead the IS community to rethink and revisit the fundamentals of IS - since the majority of theories in this field were developed based on geographically centred information systems. Hoehle and Scornavacca (2008) agreed with this point stating that well-established constructs of the IS literature may need to be revised and adapted for use “under mobile conditions”.

Junglas and Watson (2003) made some interesting contributions to the study of user acceptance of mobile technologies by combining two traditional models (TAM and TTF) and adding factors specifically related to mobile technologies. However, their study failed to develop and operationalize a measurement for any of the proposed temporospatial characteristics of task – specifically time-dependence and location-dependence. In addition, their findings are based on an experiment and the foundation of their work is based on a quite futuristic view of mobile information systems (u-commerce) which does not reflect the reality of most systems currently being deployed all over the world. It is important to develop a model of user acceptance of mobile technologies based on current systems – understanding the present is a key for predicting the future.

2.5.2.4 Mobile Task-Technology-Fit

Gebauer et al (2008) also developed a model that combined key elements of TTF (Goodhue and Thompson 1995) and TAM (Davis 1989) aiming to explain and predict the success of mobile information systems. Their focus was on users and non-users of mobile e-mail (Figure 2.18).

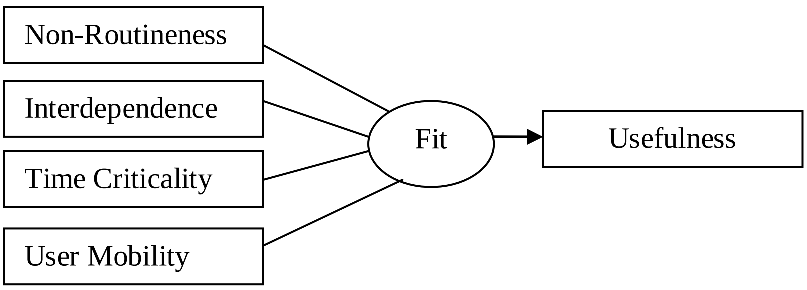
Figure 2.18 Mobile Technology-Task-Fit



Source: Gebauer et al (2007), p. 11

Fit was conceptualized as the presumed need for mobile e-mail, and measured as a second order formative construct that includes the task-characteristics such as *non-routineness, interdependence, time-criticality, and user mobility* (Figure 2.19)

Figure 2.19 Task Characteristics



Source: Adapted from Gebauer et al (2007), p. 34.

Task *non-routineness* refers to structure, repetitiveness and novelty of a task. Tasks of high non-routineness tend to be characterized by a high number of exceptions, poor predictability, and low levels of analysability and programmability (Gebauer, Shaw et al. 2007). In regards to *task interdependence,* the authors adopted Fry and Slocum's (1984) definition (the exchange of output between segments within a subunit and with other organizational units). The authors suggested that *task interdependence* affects the pattern of communication needs of workers and her/his requirements for technological support, in particular with communication technology. On the other hand, time-criticality was related to the degree of urgency that a task needs to be performed. Finally, user mobility was developed from a geographical point of view. It measured the frequency and absolute distance travelled by users.

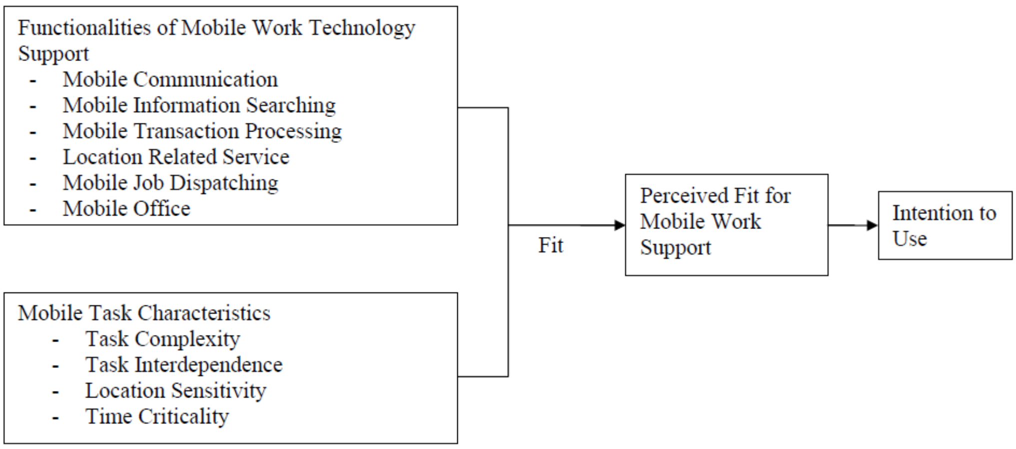
The authors found support for the suggested link between fit of mobile e-mail and user tasks - indicating correspondence between the researcher-determined need for mobile e-mail and the perceptions of users. The results for the fit construct incorporating tasks characteristics helps to shed some light on the antecedents of user perceived usefulness and consequently provides an important link between the theory of task-technology fit and the technology adoption model.

On the other hand, the authors did not find empirical support for the user mobility construct. They concluded that user-mobility may be more complex and multi-faceted than what they have captured and that there is a clear need to advance the measurement of user mobility.

2.5.2.5 Mobile Task Model

Zheng (2007) developed a comprehensive analysis of common tasks undertaken by mobile workers and tested a theoretical model that also combined aspects of TTF (Goodhue and Thompson 1995) and TAM (Davis 1989) (Figure 2.20).

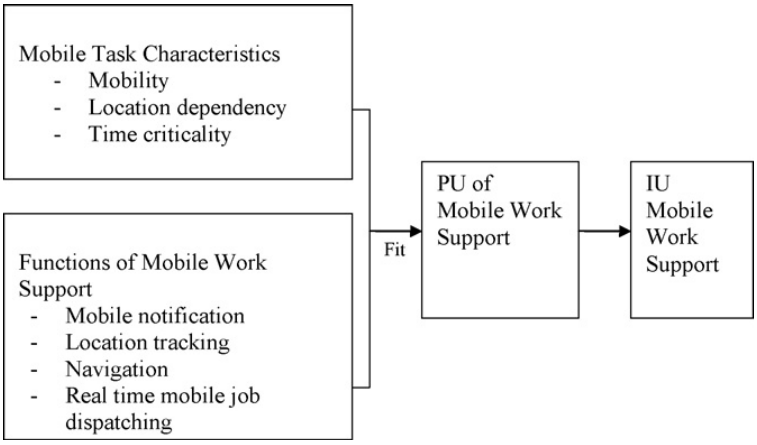
Figure 2.20 Mobile Task Model - Original



Source: Zheng (2007), p. 54.

It is important to notice that Zheng’s (2007) work was developed as a part of his doctoral thesis and that Yuan et. al. (2010) presented a summarized and more polished version of Zheng’s (2007) original model (Figure 2.21) focusing on characteristics and functionalities exclusively related to mobile work. The authors point out that although “mobile communication” was perceived as most useful by all mobile workers in the original study, it did not correlate to any of the task characteristics. As a result, the reduced model contained only four mobile work support functions: mobile notification, location tracking, navigation, and real-time mobile job dispatching. In addition, contextual characteristics of work such as task complexity (routine) and task interdependence were discarded – remaining only temporospatial characteristics of work - mobility (location variety), location dependence and time-criticality.

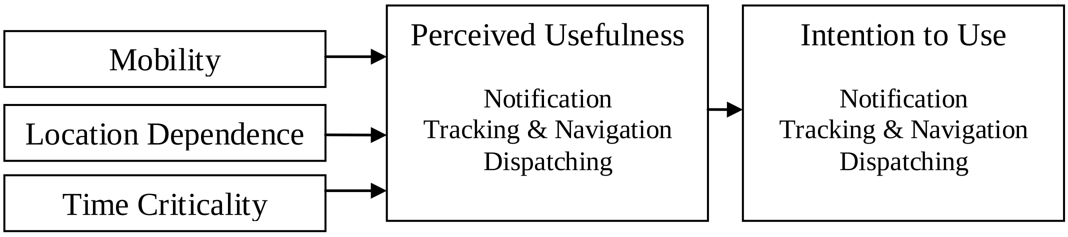
Figure 2.21 Mobile Task Model - Reduced



Source: Yuan et al (2010), p. 2.

The authors suggest that *user mobility* is an important variable to distinguish mobile from stationary workers and it could be measured by the frequency that a person is away from his/her standard office. On the other hand, *location dependency* was defined in quite a peculiar manner: as the degree that location-related information is required to perform the task. Based on Gebauer et al.'s (2007), the authors incorporated *time-criticality* to their model. However they suggest two dimensions to time-criticality: flexibility and urgency. Flexibility captures the degree of rigidity in time structuring for task completion while urgency refers to the importance with which a task must be performed promptly. In addition Yuan et al. (2010) defined fit as the congruence between task characteristics and the functionality of the technology that improves work performance. In other words, they identified important aspects of the task requirements and assessed whether the tool met each of them. As a result, they used "Perceived Usefulness" (PU) as a direct measurement of fit and as a antecedent of ''Intention to Use'' (IU) (Davis 1989; Dishaw and Strong 1999) for each support tool - mobile notification, location tracking, navigation, and real-time mobile job dispatching (Figure 2.22).

Figure 2.22 Mobile Task Model - Tested



Source: Adapted from Yuan et al (2010), p. 8.

The findings suggest that the perceived usefulness of mobile notification and job dispatching were positively related to user mobility. In addition, location tracking and navigation were only perceived to be useful in situations that location-related information was required. Finally, mobile notification and location tracking were perceived to be more useful in time critical situations.

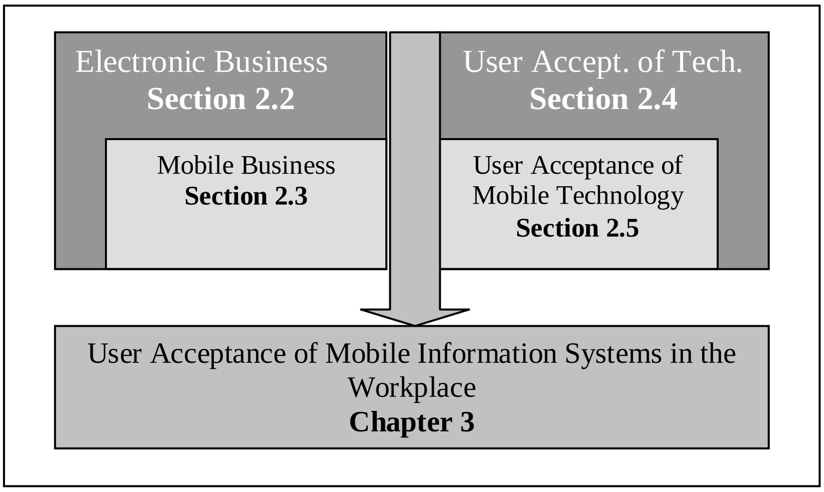
Overall, Yuan et al. (2010) successfully identified temporospatial characteristics of tasks related to mobile work and empirically tested an initial set of indicators to measure these new constructs. However, as acknowledged by the authors, the steps taken to develop and validate the instrument were not as rigorous as they could have been. It would have helped if they had established instrument validation in a large-scale pilot study first, and then conducted a full-scale survey with a much larger sample. While their work provide a good stepping-stone to future research; there is no doubt that much effort should be allocated to improve the reliability and validity of mobility-related constructs.

2.6 Chapter Summary

The literature review presented in this chapter had the purpose of establishing the theoretical foundations of this research. Since little is known about user acceptance of mobile information systems in the workplace, it was necessary to review relevant literature in electronic business, mobile business, user acceptance of technology and user acceptance of mobile technology.

As outlined on Figure 2.27, Section 2.2 explored the theoretical foundations of e-business as well as the evolution of this field of enquiry. Section 2.3 presented a comprehensive review of the m-business literature, identifying and discussing gaps as well as key concepts. Section 2.4 presented a review of the IS literature on user acceptance of technology. Section 2.5 combined the previous sections reviewing current research on user acceptance of mobile technologies.

Figure 2.27 Map of Literature Review



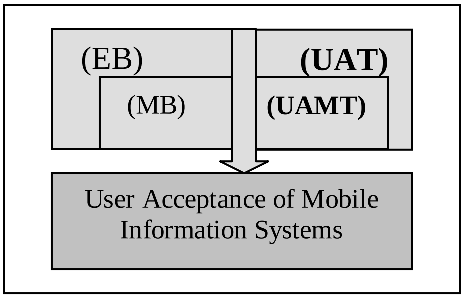
This literature review allowed us to achieve the first two objectives set in Chapter 1 (explore and understand the key attributes, capabilities and limitations of mobile information systems in the workplace; and explore and understand theories of user acceptance of technology at the individual level). In addition, the identification of a number of theoretical concepts that are fundamental for the development of a conceptual model of user acceptance of mobile information systems in the workplace.

Chapter 3 presents the conceptual model based on this literature review.

3 Conceptual Model and Research Hypotheses

3.1 Introduction

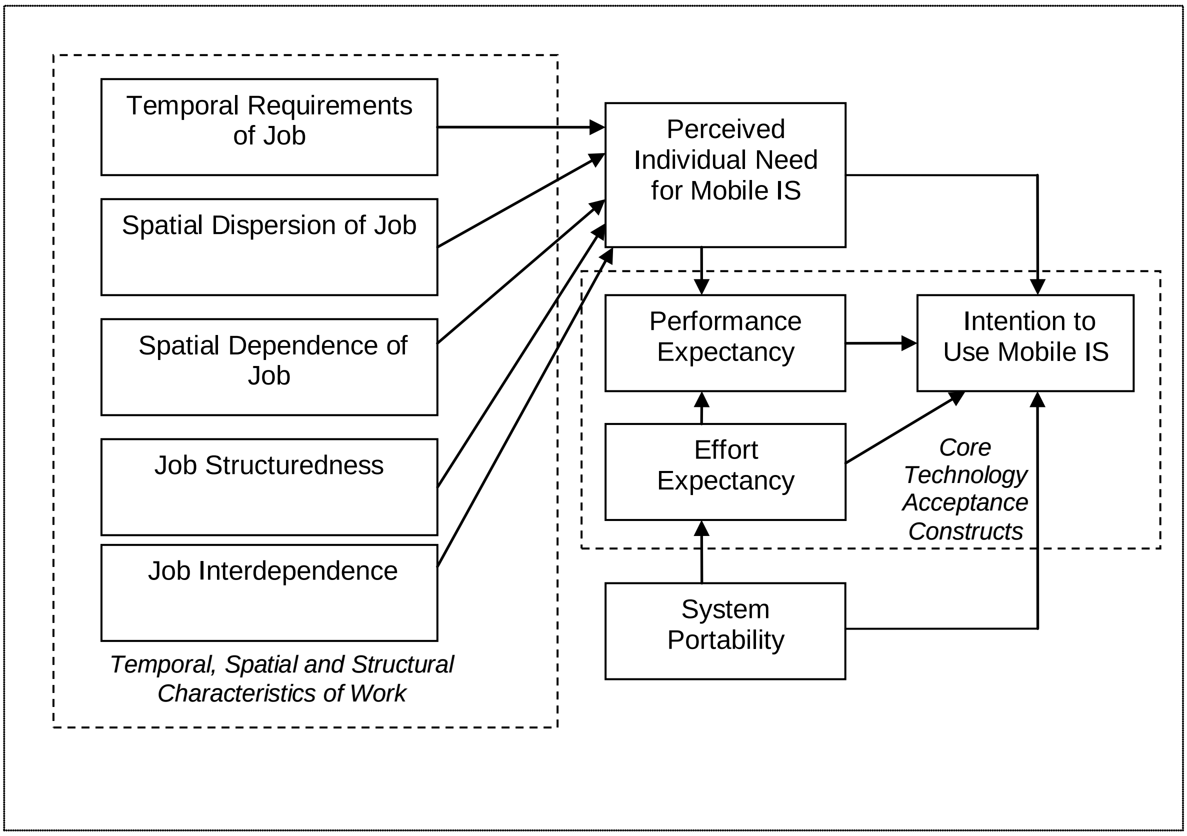
This chapter describes the development of the conceptual research model and research hypotheses that were be used to guide this investigation. Initially, the research model is presented. Then, the research question presented in Chapter 1 is revisited. This is followed by an in-depth discussion of each construct as well as the development of the research hypotheses.



3.2 Research Model

As demonstrated in Chapter 2, much of the literature on user acceptance of mobile technologies is oriented towards consumer applications and fails to provide a tangible and solid theoretical foundation that takes in to consideration the specificities of mobile technologies as well as individual needs of mobile information systems users in the workplace. It was also identified that most of the literature on user acceptance of mobile technology relies heavily on well-known IS theories and models that were developed assuming a “stationary condition” – e.g. Davis’ (1989) Technology Acceptance Model and Rogers’ (1995) Diffusion of Innovation Theory (Zmijewska and Lawrence 2006; Lawrence and Er 2007; Ngai and Gunasekaran 2007; Hoehle and Scornavacca 2008; Scornavacca and Huff 2008; Mallat, Rossi et al. 2009). The research model shown in Figure 3.1 was developed following three steps: 1) thorough literature review, 2) identification of a set of factors that determine the intention to use mobile IS, 3) consideration of conceptual links between these variables and statements of the proposed relationships between the model variables in the form of research hypotheses.

Figure 3.1 Research Model



The model is composed by four key elements: 1) the construct of Perceived Individual Need for Mobile Information System (PINMIS) which is the central point of this research and is explained in depth in the section below; 2) Temporal, Spatial and Structural Characteristics of Work, which is proposed to influence PINMIS and is composed by five key elements: Temporal Requirements of the Job, Spatial Dispersion of the Job, Spatial Dependence of Job, Job Structuredness and Job Interdependence; 3) Core Technology Acceptance Constructs; and 4) System Portability which aims to capture the idiosyncrasies eminent to mobile devices. Due to abundant evidence from previous research, this study does not intend to further test the linkage between Intention to Use and Use Behavior (Fishbein and Ajzen 1975; Davis 1989; Ajzen 1991; Dishaw and Strong 1999; Venkatesh, Morris et al. 2003; Van der Heijden 2004; Venkatesh, Davis et al. 2007) .

Based on this, before developing the hypotheses let us revisit and further develop the initial research question that guided this study.

3.3 Research Question Revisited

The initial research question ***"What factors influence acceptance of mobile information systems in the workplace at the individual level?"*** guided the literature review as well as the development of the conceptual model of user acceptance of mobile technologies in the workplace (e.g. sales force automation (SFA), field force automation (FFA) and mobile office applications (MOA)) (Barnes and Scornavacca 2005).

Based on the conceptual model (Figure 3.1) and the focus on mobile information systems in the workplace, the following research sub-questions are examined in the empirical phases of this study:

I) *To what extent do the temporal, spatial and structural characteristics of the portfolio of tasks performed by users of mobile information systems in the workplace influence their Perceived Individual Need for Mobile IS?*

II) *To what extent does Perceived Individual Need for Mobile IS influence Performance Expectancy and Intention to use Mobile IS?*

III) *To what extent does System Portability influence Effort Expectancy and Intention to use Mobile IS?*

By answering these questions, this research will contribute to the existing body of knowledge of user acceptance of mobile technologies.

3.4 Variables and Research Hypothesis

In this section the research model is further developed. The model considers the role of each variable and its reference to the literature. Then, the expected relationships between variables are stated in the form of research hypotheses.

3.4.1 Perceived Individual Need for Mobile Information Systems

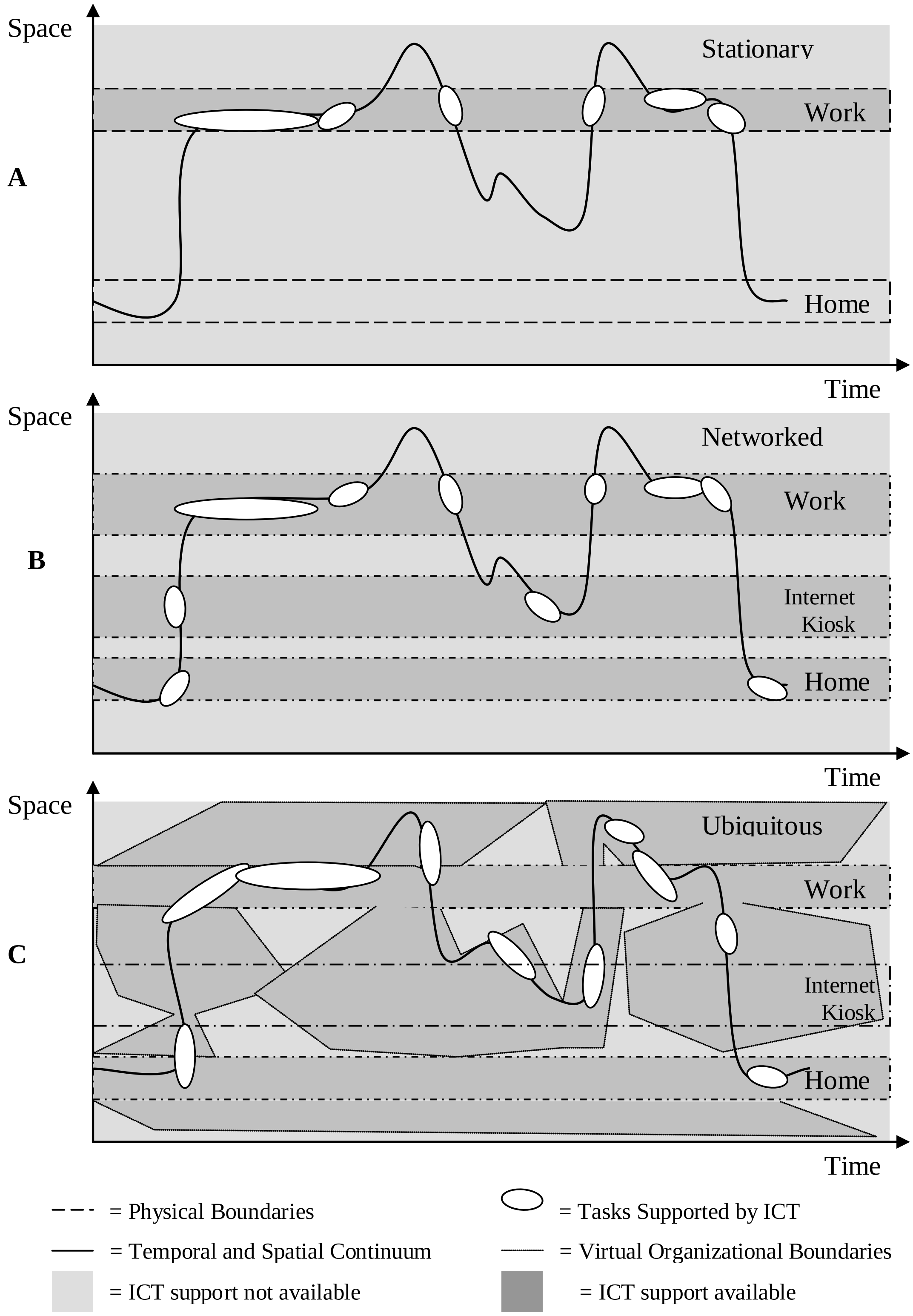
In order to understand Perceived Individual Need for Mobile Information Systems (PINMIS) it is important to recognize the increasing temporospatial availability of ICT in the context of work (Figure 3.2). The two perpendicular axes represent time and space, while the sinuous line represents the movement of an individual in the temporospatial continuum. The light grey areas represent locations in time and space where ICT support[4] is not available, while the dark grey areas represent places where ICT support is available. The area bounded by large dashed lines represents physical boundaries (in this example "home", "work" and "internet kiosk" are used) while the dotted line around the dark grey area represents the organizational virtual boundary – delimitating areas where the organization's information systems can be accessed and ICT assisted tasks can be accomplished. Finally, the white elliptical areas represent individual work-related tasks that require the support of ICT.

In order to illustrate the evolution of ICT, Figure 3.2 also shows three distinct stages: Figure 3.2 (A) represents a "stationary stage" where individuals could only accomplish work-related tasks with assistance of ICT within the boundaries of the workplace. Figure 3.2 (B) represents the introduction of wired "network" capabilities and the creation of a virtual boundary of the organization that merged with the existent physical boundaries – allowing the user to accomplish work-related tasks with the assistance of ICT either from "work", "home" or an "Internet kiosk" (in this example). Finally, Figure 3.2 (C) represents the introduction of mobile technologies which substantially increases the reach of the virtual organizational boundaries.

In each evolutionary stage, there is an increment of temporospatial availability of ICT support – notice the increment of the dark grey area (Figure 3.2). In the "stationary" stage, the ability to have the support of ICT to undertake tasks was quite limited and confined to the boundaries of the workplace. On the other hand, in the "networked" stage, workers had to search for some physical location (in this example represented by the Internet kiosk) where ICT support was available to assist them accomplishing tasks beyond the physical boundaries of the organization. While in the "ubiquitous" stage, workers are challenged to avoid areas (represented in light grey) where ICT support is not available (e.g. by the lack of network coverage in a building basement). Perhaps the few light grey areas remaining in Figure 3.2 (C) should be coloured in black and called as "black holes" to better illustrate the absence of the ability to undertake ICT supported tasks.

[4]ICT support is understood as the provision of information and communication technology to assist an individual to accomplish a task.

Figure 3.2 The evolution of temporal and spatial availability of ICT



Above all, as shown in the example above, the development of mobile technologies made possible the availability of ICT support to workers at locations and during periods of time which they would normally not be able to be assisted by any ICT – due to the boundaries of traditional stationary information systems (Basole 2005; Zheng and Yuan 2007; Yuan, Archer et al. 2010).

As illustrated in the literature review (see section 2.3.2.5), the issues surrounding IS mobility have not been explored systematically in information systems research and are perceived to be complex and multidimensional (Chatterjee and Sarker 2007; Tilson 2007; Gebauer and Tang 2008; Hoehle and Scornavacca 2008; Junglas, Abraham et al. 2009; Yuan, Archer et al. 2010). Previous attempts to understand and characterize aspects of user mobility in the context of mobile IS have not been successful and most have been restricted to a geographic point of view, establishing a clear need to improve the operationalization of a latent construct that helps to explain the adoption and use of mobile IS (Mylonopoulos and Doukidis 2003; Junglas and Watson 2006; Gebauer, Shaw et al. 2007; Gebauer and Tang 2008; Junglas, Abraham et al. 2008; Junglas, Abraham et al. 2009; Mallat, Rossi et al. 2009).

While most IS researchers have focused on individuals' perceptions of geographical mobility to develop constructs that attempted to explain Intention to Use Mobile IS (Mallat, Rossi et al. 2006; Gebauer, Shaw et al. 2007; Yuan, Archer et al. 2010), environmental and cognitive psychologists have taken a different approach focusing on capturing individuals' mobility behaviour via their perceptions of mobility related consequences of their personal circumstances - in other words, perceptions of their individual mobility needs (Haustein and Hunecke 2007; Hunecke, Haustein et al. 2007). The main advantage of the simpler, direct approach taken by the psychologists is that it avoids the misleading notion that individual mobility is effectively measured by distance (Petter, Straub et al. 2007; Gebauer and Tang 2008). As a result, it seems that adapting the approach used by environmental and cognitive psychologists to the context of mobile IS could produce a construct that successfully captures individual need for mobile IS and helps to explain user acceptance of this type of system.

Perceived Individual Need for Mobile Information Systems can be understood as *the degree to which an individual perceives that they need a mobile information system to support their existing work practices* (Kakihara and Sørensen 2002; Lee and Sawyer 2002; Kakihara and Sørensen 2003; Pica and Kakihara 2003; Jarvenpaa, Lang et al. 2004; Payne, Jones et al. 2004; Pica, Sørensen et al. 2004; Junglas and Watson 2006; Mallat, Rossi et al. 2006; Pagani 2006; Zmijewska and Lawrence 2006; Chatterjee and Sarker 2007; Gebauer, Shaw et al. 2007; Haustein and Hunecke 2007; Hunecke, Haustein et al. 2007; Tilson 2007; Gebauer and Tang 2008; Junglas, Abraham et al. 2009; Yuan, Archer et al. 2010). It is important to notice that perceived individual need for mobile IS differs from compatibility (Moore and Benbasat 1991; Rogers 1995) and from fit (Goodhue and Thompson 1995) . A person can perceive that a technology is compatible and has a good fit with their work practices and still may not feel the need for the technology. In addition, the concept of "perceived need" has been successfully incorporated into the theory of planned behaviour by health psychologists (Paisley and Sparks 1998; Payne, Jones et al. 2004). The development of items and measurements for this construct is explained in the next chapter. The next section describes the precursors of PINMIS.

3.4.2 Temporal, Spatial and Structural Characteristics of Work

According to the literature, the degree to which an individual perceives that they need a mobile information system to support their existing work practices is likely to be influenced by the spatial, temporal and structural characteristics of their daily portfolio of tasks, or in simple terms, their work (Balasubramanian, Peterson et al. 2002; Lee and Sawyer 2002; Pica, Sørensen et al. 2004; Prasopoulou, Pouloudi et al. 2006; Towers 2006; Chatterjee and Sarker 2007; Gebauer, Shaw et al. 2007; Haustein and Hunecke 2007; Junglas 2007; Tilson 2007; Zheng 2007; Zheng and Yuan 2007; Yuan and Zheng 2009; Yuan, Archer et al. 2010). Therefore, this research proposes to explore in what way temporal, spatial and structural characteristics of individuals' daily portfolio of tasks influences the *Perceived Individual Need for Mobile Information Systems*.

As demonstrated in the literature review, previous studies, especially from the task-technology fit (TTF) research stream, provided a good conceptual basis to identify spatial, temporal and structural characteristics of business tasks in the context of IS research (Goodhue and Thompson 1995; Dishaw and Strong 1999; Junglas and Watson 2003; Gebauer, Shaw et al. 2004; Pagani 2006; Yuan and Zheng 2006; Gebauer, Shaw et al. 2007; Junglas 2007; Zheng 2007; Yuan, Archer et al. 2010). In this study, it is believed that spatial, temporal and structural characteristics of task identified in previous studies are also valid for characterizing individuals portfolio of work tasks (Lee and Liebenau 2000; Lee and Sawyer 2002; Yuan and Zheng 2006). In addition, asking individuals to reflect on their daily portfolio of tasks instead of a single task allows them to think about their mobile IS needs in relation to their usual movement in the temporal and spatial continuum (as illustrated in Figure 3.2).

Five characteristics emerged from the literature: Temporal Requirements of the Job, Spatial Dispersion of the Job, Spatial Dependence of Job, Job Structuredness and Job Interdependence (Goodhue 1995; Junglas and Watson 2003; Gebauer and Tang 2007; Zheng 2007; Zheng and Yuan 2007; Gebauer and Tang 2008; Yuan, Archer et al. 2010).

Time-criticality was the only temporal characteristic of work tasks that emerged from the literature and refers to urgency and the perceived importance of time in task performance (Gebauer, Shaw et al. 2007; Yuan, Archer et al. 2010). In this study, the concept of *time-criticality* is broadened and explicitly linked to a work task requirements context. As a result, **Temporal Requirements of the Job** (TRJ) is defined as *the degree to which individuals perceive they are required to conform to temporal boundaries in order to perform their portfolio of work tasks* (Zerubavel 1981; Lee and Liebenau 2000; Abraham 2004; Gebauer, Shaw et al. 2007; O'Leary and Cummings 2007; Zheng 2007; Yuan, Archer et al. 2010). Recent research in mobile information systems has established that people use mobile IS to help them achieve communication immediacy, manage time and respond to urgency (Rodina, Zeimpekis et al. 2003; Barnes 2004; Scornavacca, Prasad et al. 2006; Hoehle and Scornavacca 2008; Yuan and Zheng 2009). In addition *time –criticality* has been identified a contributing factor for positive perceptions of fit and usefulness of mobile IS (Gebauer, Shaw et al. 2007; Gebauer and Tang 2007; Zheng 2007; Junglas, Abraham et al. 2008; Yuan, Archer et al. 2010). As a result, hypothesis 1 is formulated:

H1: Temporal Requirements of Job positively influences Perceived Individual Need for Mobile Information Systems.

Spatial contextualization has been often characterized as a crucial value proposition - enabling the provision of geographically specific value-added services - as well as one of the most distinct characteristics of mobile IS (Zhang and Yuan 2002; Barnes 2003; Jarvenpaa, Lang et al. 2003; Rodina, Zeimpekis et al. 2003; Pica, Sørensen et al. 2004; Junglas and Watson 2006; Hoehle and Scornavacca 2008; Mallat, Rossi et al. 2009). While spatial contextualization has been widely discussed and, to a certain extent, overvalued in the literature, little attention has been given to the spatial characteristics of tasks.

Gebauer, Shaw et al (2007) operationalized a construct, which they called *user mobility,* based on individuals' travel frequency and travel distance. However their attempt was ineffective since the need for mobile IS is not necessarily related to the frequency that a person is away from his or her standard office or distance travelled. Similarly, Zheng (2007) identified *location variety* as a relevant spatial characteristic of work tasks which distinguishes mobile from stationary work (in Yuan et al. (2010) this variable was renamed *mobility*). If the goal is to measure how spatially disperse is one's portfolio of work tasks, **Spatial Dispersion of Job** (SDJ) appears to be a more direct taxonomy than *location variety.* SDJ is understood as *the degree to which individuals perceive they are required to move to distinct locations in order to perform their portfolio of work tasks* (Kakihara and Sørensen 2003; Innes, Barnes et al. 2005; Zheng 2007; Gebauer and Tang 2008; Yuan, Archer et al. 2010). In accordance with previous research, Spatial Dispersion of Job is expected to have a positive influence on the *Perceived Individual Need for Mobile Information Systems* (Barnes 2003; Kakihara and Sørensen 2003; Junglas 2007; Zheng 2007; Yuan, Archer et al. 2010). As a result, hypothesis 2 is formulated:

H2: Spatial Dispersion of Job positively influences Perceived Individual Need for Mobile Information Systems.

Another spatial characteristic of task identified by Zheng (2007) was *location dependence* which was defined as the extent to which dynamic location-related information is required to perform a task. However a further analysis of this construct revealed that Zheng's (2007) *location dependence* is not related to spatial dependence of task or individuals. Rather, it relates to individuals' <u>need to obtain location-related information</u> in order to perform their portfolio of tasks. Junglas and Watson (2003) developed the concept of *location dependence* in a more direct manner: the extent to which location is an import aspect to complete a determined task. The authors suggested that *location dependence* is an important characteristic of task and that location-dependent tasks influence individuals' perceptions towards mobile IS. As a result, for the purposes of this research, *location dependence* has been modified to capture spatial dependence of work tasks. **Spatial Dependence of Job** (SDPJ) is defined as the *degree to which individuals perceive that location requirements is a critical element to performing their portfolio of work tasks* (Junglas and Watson 2003; Scornavacca, Prasad et al. 2006; Mallat, Rossi et al. 2009). According the literature, Spatial Dependence of Job is expected to have a positive influence on PINMIS (Barnes 2003; Hoehle and Scornavacca 2008; Junglas, Abraham et al. 2009).

H3: Spatial Dependence of Job positively influences Perceived Individual Need for Mobile Information Systems.

Pica, Sorensen et al. (2004) suggest that the use of a mobile IS by an individual cannot be analysed without contextualizing and relating it to the structure of work tasks that the system is supporting. They found that individuals' interactions with mobile IS supporting structured tasks are likely to have a repetitive character in regards to information access. On the other hand, users' interactions with mobile IS supporting unstructured work are mostly related to ad-hoc information access for problem resolution. The structural characteristics of work tasks have been have been approached by a series of studies in IS (Goodhue 1995; Goodhue and Thompson 1995; Gebauer, Shaw et al. 2004; Karimi, Somers et al. 2004; Yuan and Zheng 2006; Gebauer, Shaw et al. 2007; Zheng 2007; Gebauer and Tang 2008; Yuan and Zheng 2009). In the context of mobile IS, Gebauer, Shaw et al (2007) identified non-routineness and task-interdependence as relevant tasks characteristics that are frequently undertaken by users of this type of system. Similarly, Zheng (2007) suggests that tasks are usually analysed in terms of task complexity and task interdependence.

Based on previous management literature (e.g. Simon, 1960; Mintzberg, 1973) Gebauer, Shaw et al (2007) suggest that task non-routineness captures structural dimensions of task such as repetitiveness and predictability. Usually individuals on higher levels of the organizational hierarchy tend to have non-routine tasks as a major part of their portfolio of tasks (Withey, Daft et al. 1983; Pica, Sørensen et al. 2004; Zheng 2007; Gebauer and Tang 2008; Yuan and Zheng 2009). Perrow (1967) suggests that the degree of routine and non-routine tasks in an individual portfolio of tasks is a product of two elements: task variety and task analysability. Task variety is related to the frequency of unexpected and novel events that occur in work process (exceptions), while task analysability refers to the degree of programmability of the task. Zheng (2007) contrary to Withey et al (1983) findings suggested that these two dimensions might tend to be highly correlated in practice and that it could be combined into a single dimension: task complexity.

While the literature is convergent in pointing out that routineness (or the lack of it) is an important structural characteristic of work, the operationalization of the construct has been quite divergent, using distinct sets of items. If the goal is to measure task repetitiveness and predictability, **Job Structuredness** (JS) seems to be a better nomenclature than routineness. Therefore, for the purposes of this study, Job Structuredness is defined as *the degree to which individuals perceive that their portfolio of work tasks is repetitive and programmable*. Based on previous studies, it is expected that Job Structuredness will have a negative effect on PINMIS (Pica and Kakihara 2003; Zheng 2007; Gebauer and Tang 2008).

H4: Job Structuredness negatively influences Perceived Individual Need for Mobile Information System.

Task interdependency is commonly referred as the exchange of outputs between segments within a subunit and with other organizational units (Thompson 1967; Fry and Slocum 1984; Pearce and Gregersen 1991; Pearce, Sommer et al. 1992; Goodhue and Thompson 1995; Gebauer, Shaw et al. 2007; Gebauer and Tang 2007). Thompson's (1967) approach to interdependence underpins most of the current literature on task interdependence. Interdependence among work tasks can be fostered by individuals sharing and using common resources (pooling); by working in series, where the output from one person becomes input to another (sequential), and/or by individuals feeding their work back and forth among themselves (reciprocal) (Thompson 1967; Kumar and van Dissel 1996; Sharma and Yetton 2003; Yuan and Zheng 2006; Sharma and Yetton 2007). Pearce and Gregersen (1991) viewed task interdependence as two separate factors: reciprocal interdependence and independence. Pearce et al (1992), on the other hand, presented three distinct factors for interdependence: depend on others, others' dependence and reciprocal dependence. Interestingly, Zheng (2007) adapted Pearce et al's (1992) work on interdependence in one single construct – task interdependence, and Gebauer and Tang (2007) considered it as a sub-dimension of task difficulty.

In this study, **Job Interdependence (JI)** is defined as *the degree to which individuals perceive that they are required to exchange information with others in order to perform their portfolio of work tasks* (Thompson 1967; Fry and Slocum 1984; Gebauer, Shaw et al. 2007; Zheng 2007). Highly interdependent tasks involve extensive interaction among individuals, the transmission of new information during the process of interaction as well as coordination between activities (Kumar and van Dissel 1996; Lee and Sawyer 2002; Lyytinen and Yoo 2002; Yuan and Zheng 2006). The literature postulates that mobile IS provide a high level of support to interdependent tasks (Barnes, Scornavacca et al. 2006; Chatterjee and Sarker 2007; Gebauer, Shaw et al. 2007; Gebauer and Tang 2007; Tilson 2007). Therefore, it is expected that

H5: Job Interdependence positively influences Perceived Individual Need for Mobile Information Systems.

Having outlined the constructs related to temporal, spatial and structural characteristics of work and its relationships to the PINMIS construct, the next sub-section discusses the variables related to technology acceptance theory.

3.4.3 Technology Acceptance Theories

As observed in the literature review, there is a strong evidence that PINMIS should be considered as a possible determinant of user acceptance of mobile information systems (Paisley and Sparks 1998; Amberg, Hirschmeier et al. 2004; Han, Mustonen et al. 2004; Payne, Jones et al. 2004; Yang and Stafford 2005; Kargin and Basoglu 2006; Mallat, Rossi et al. 2006; Pagani 2006; Zmijewska and Lawrence 2006; Hunecke, Haustein et al. 2007).

In the attempt to integrate PINMIS and technology acceptance theories, it would be appropriate to use key constructs from the Unified Theory of Acceptance and Use of Technology (UTAUT). The UTAUT synthesizes well what is known about technology adoption (Venkatesh, Morris et al. 2003; Zmijewska and Lawrence 2006; Venkatesh, Davis et al. 2007). However, since UTAUT has been widely tested and validated, it is not necessary to test the all the constructs in the model presented on section 2.4.1.5 (Venkatesh, Morris et al. 2003). Research efforts should be focused on developing and empirically validating the PINMIS construct and testing its relationship with two key variables of UTAUT: Intention to Use and Performance Expectancy (Figure 3.1).

Intention to Use Mobile IS (IU) is defined as *a measure of the strength of one's intention to use Mobile IS* (Fishbein and Ajzen 1975). Despite some concerns about intention models not predicting actual behaviour (Straub and Burton-Jones 2007), a significant body of research has found support for the predictive validity of behavioural intention including intention to use IS (Fishbein and Ajzen 1975; Davis 1989; Ajzen 1991; Dishaw and Strong 1999; Venkatesh, Morris et al. 2003; Van der Heijden 2004; Venkatesh, Davis et al. 2007). Therefore, this study does not intend to further test the linkage between intention and actual usage.

As previously discussed, environmental and cognitive psychologists have successfully demonstrated that mobility requirements influences behavioural intention (Ajzen 1991; Haustein and Hunecke 2007; Hunecke, Haustein et al. 2007). As a consequence it is appropriate to postulate that the degree to which an individual perceives that they needs a mobile information system to support their existing work practices will have a direct positive effect on Intention to use Mobile IS.

H6a: Perceived Individual Need for Mobile Information Systems positively influences Intention to use Mobile IS.

Performance Expectancy (PE) is defined as *the degree to which an individual believes that using the system will help him or her to attain gains in job performance* (Venkatesh, Morris et al. 2003). As described in detail in the literature review, the construct combines items from well-established technology acceptance constructs such as Perceived Usefulness (Davis 1989; Davis, Bagozzi et al. 1989) Relative Advantage (Moore and Benbasat 1991) and Outcome Expectations (Compeau and Higgins 1995; Compeau, Higgins et al. 1999). Of the five models used to develop the UTAUT the performance expectancy construct within each individual model was the strongest predictor of intention and remained significant at all points of measurement in both voluntary and mandatory settings, consistent with previous model tests (Venkatesh, Morris et al. 2003).

Benbasat and Barki (2007) point out that after almost two decades of research investigating TAM and its many variants such as UTAUT, little is known about the antecedents of its belief constructs. As a result, study after study has reiterated the importance of Performance Expectancy, with very little research effort going into investigating what actually makes a system useful.

There have been quite a few attempts in the mobile IS to find precursors of Performance Expectancy (Junglas and Watson 2006; Pagani 2006; Zheng 2007; Gebauer and Tang 2008; Mallat, Rossi et al. 2009). For example, Zheng (2007) considered that that perceived usefulness was a valid measurement of task-technology-fit and was directly influenced by task characteristics. The authors did not take in consideration that TAM and TTF focus on different aspects of user acceptance and use different lenses to explain information system utilization (Dishaw and Strong 1999). TAM attempts to explain IS usage through beliefs and perceptions a user has toward an information system. On the other hand, TTF attempts to explain IS usage through expected performance increase, neglecting the beliefs or perceptions a user has toward an information system (Junglas and Watson 2003; Gribbins, Subramaniam et al. 2006). Gebauer, Shaw et al (2007) also attempted to find precursors of Performance Expectancy in the context of mobile IS. Instead of directly measuring the need for mobile IS, they believed it could be represented as a second order fit construct determined by variations of task characteristics. It appears that developing a direct measure for perceived individual need would be a better and more direct approach (Baggozi 1993; Petter, Straub et al. 2007). In addition, it is vital to notice that while PINMIS aims to capture the perceived requirements of an individual, Performance Expectancy captures the expected consequences attributed to the use of a technology (Venkatesh, Morris et al. 2003; Hunecke, Haustein et al. 2007). Therefore, hypothesis 6b is formulated posing that that PINMIS will influence individuals’ expectations of attaining gains in job performance (Venkatesh, Morris et al. 2003; Haustein and Hunecke 2007; Gebauer and Tang 2008).

H6b: Perceived Individual Need for Mobile Information Systems positively influences Performance Expectancy.

It is well-known in the general IS and mobile IS literatures that performance expectancy has a positive influence on intention to use (Jarvenpaa, Lang et al. 2003; Mylonopoulos and Doukidis 2003; Venkatesh, Morris et al. 2003; Scornavacca, Barnes et al. 2006; Venkatesh, Davis et al. 2007; Gebauer and Tang 2008; Hoehle and Scornavacca 2008; Scornavacca and Huff 2008; Mallat, Rossi et al. 2009). As a result, the following hypothesis is proposed:

H7: Performance Expectancy positively influences Intention to Use Mobile IS.

In the UTAUT model, **Effort Expectancy** (EE) is defined as *the degree of ease associated with the use the system* (Venkatesh, Morris et al. 2003). This construct is a result of an amalgamation of Perceived Ease of Use (Davis 1989; Davis, Bagozzi et al. 1989) and Ease of Use (Moore and Benbasat 1991). One interesting observation noticed from the literature is that effort-oriented constructs have been found to be more salient in the early stages of adoption (Davis, Bagozzi et al. 1989; Venkatesh and Davis 2000; Venkatesh, Morris et al. 2003). Benbasat and Barki (2007) point out that there is extensive evidence in the literature that Performance Expectancy is a very influential belief and that Effort Expectancy is an antecedent of Performance Expectancy and an important determinant of use in its own right. The positive effect of Effort Expectancy on Intention to Use technology has also been described in a number of studies (Venkatesh, Morris et al. 2003; Venkatesh, Davis et al. 2007; Scornavacca and Huff 2008; Mallat, Rossi et al. 2009). Therefore, the following hypotheses are proposed:

H8a: Effort Expectancy positively influences Performance Expectancy.

H8b: Effort Expectancy positively influences Intention to Use Mobile IS.

Having outlined the PINMIS construct and its relationships to technology acceptance theory, the next sub-section discusses the System Portability Construct.

3.4.4 System Portability

While the Effort Expectancy construct captures known usability issues of mobile IS such as small screens and complicated navigation and input methods (Lee and Benbasat 2003; Krogstie, Lyytinen et al. 2004; Scornavacca, Prasad et al. 2006; Gebauer and Ginsburg 2009), it does not seem to fully capture the idiosyncrasies of mobile technologies such as portability (Scornavacca and Huff 2008; Urbaczewski and Koivisto 2008; Gebauer and Ginsburg 2009). As a result, it is necessary to develop a construct that captures individuals' perceptions of System Portability. This construct should help us understand users' Effort Expectancy "under mobile conditions".

The term 'mobile IS' usually implies portability of the device (Kakihara and Sørensen 2002; Kalakota and Robinson 2002; Lee and Benbasat 2003; Basole 2004; Jarvenpaa, Lang et al. 2004; Lee and Benbasat 2004; Lee and Benbasat 2005; Hoehle and Scornavacca 2008). Junglas and Watson (2003; 2006) suggest that portability comprises the physical aspects of mobile devices, while Gebauer and Ginsburg (2009) found that form factors associated to portability (size, weight and sturdiness) were perceived relevant to individuals' perceptions of ease of use of mobile devices. Participants in a study by Hoehle and Scornavacca (2008) felt that mobile IS must be small and lightweight to remain "portable" and that portability was the only characteristic unique to mobile IS. In addition to hardware portability, it is also important to consider software portability, for example, to what extent the Microsoft Outlook has been well adapted to use on your mobile device (Barnes 2003; Junglas and Watson 2003; Basole 2004; Hoehle and Scornavacca 2008). Therefore, **System Portability** (SP) is defined as *the degree of ease associated with transporting the mobile information system*.

Notice that 'transporting the mobile information system' incorporates two aspects of portability abovementioned: 1) hardware portability (carrying hardware from place to place) and 2) software portability (adapting software to mobile device).

As mentioned early in this section, device portability has been perceived to influence users' perceptions of effort involved using a mobile IS (Hoehle and Scornavacca 2008; Mallat, Rossi et al. 2009). As a result, System Portability is expected to have a positive effect on Effort Expectancy (Venkatesh, Morris et al. 2003; Prasopoulou, Pouloudi et al. 2006; Benbasat and Barki 2007; Lucas, Swanson et al. 2007; Venkatesh, Davis et al. 2007; Scornavacca and Huff 2008; Urbaczewski and Koivisto 2008; Chatterjee, Chakraborty et al. 2009). As a result, hypothesis H9a is formulated.

H9a: System Portability positively influences Effort Expectancy.

An important concern of this research is to understand the degree to which existing theories that explain information system use are applicable to mobile information systems. This is particularly important in regards to portability because it may shed light on the contingency of the IT artefact and how it relates to users' intention to use (Benbasat and Barki 2007; Straub and Burton-Jones 2007). Similarly to Effort Expectancy, System Portability is expected to influence users' intention to use mobile IS. It is believed that if the mobile device is 'easy to carry', users are more likely to have the intention use it (Hoehle and Scornavacca 2008; Chatterjee, Chakraborty et al. 2009; Gebauer and Ginsburg 2009; Mallat, Rossi et al. 2009). As a result, the last hypothesis of this study is elaborated:

H9b: System Portability positively influences Intention to Use Mobile IS.

The next section presents the chapter summary.

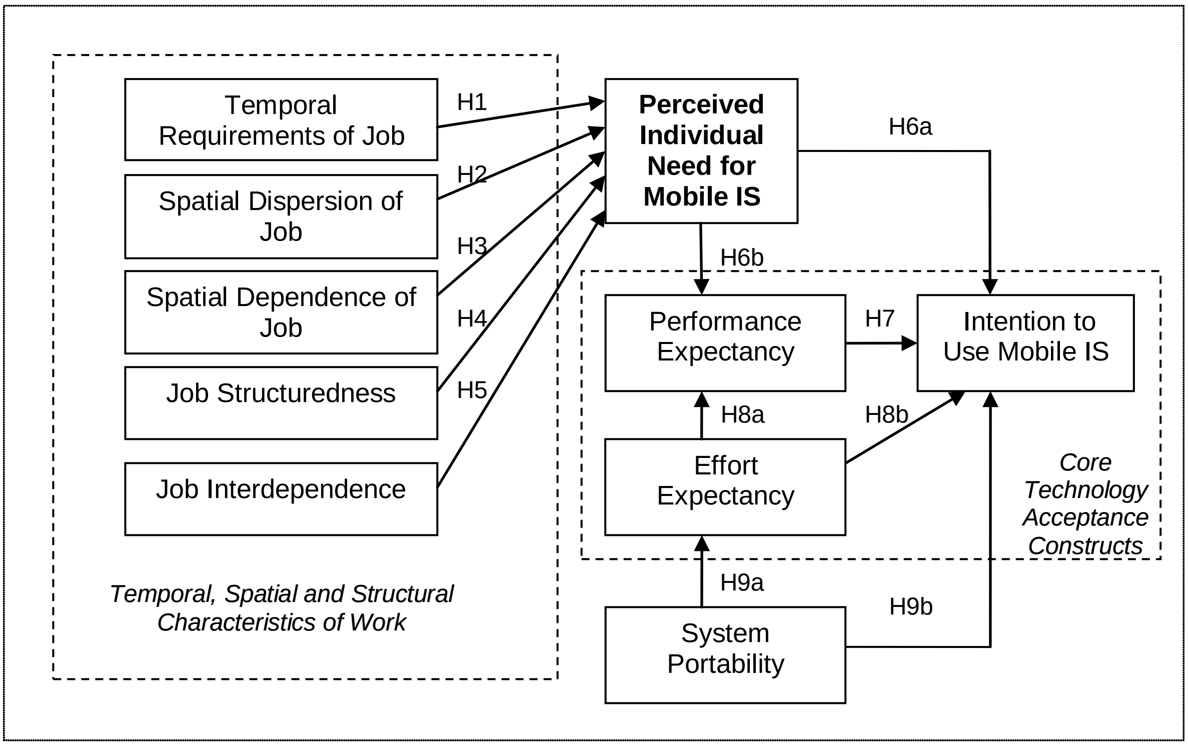
3.5 Chapter Summary

This chapter outlined the development of the research model that guides this investigation. Initially, the research model was briefly introduced (Figure 3.1). Then, the research question originally presented in Chapter 1was revisited and further developed. This was followed by an in-depth discussion of each construct (summarized below - Table 3.1) as well as the development of the associated research hypotheses (summarized below on Figure 3.3).

Table 3.1 Key constructs used in the research model

Construct	Definition	Key References
Perceived Individual Need for Mobile Information Systems		
Perceived Individual Need for Mobile Information Systems (PINMIS)	The degree to which an individual perceives that they need a mobile information system to support their existent work practices.	(Paisley and Sparks 1998; Kakihara and Sørensen 2002; Lee and Sawyer 2002; Kakihara and Sørensen 2003; Pica and Kakihara 2003; Jarvenpaa, Lang et al. 2004; Payne, Jones et al. 2004; Pica, Sørensen et al. 2004; Junglas and Watson 2006; Mallat, Rossi et al. 2006; Pagani 2006; Chatterjee and Sarker 2007; Gebauer, Shaw et al. 2007; Haustein and Hunecke 2007; Hunecke, Haustein et al. 2007; Tilson 2007; Wyse 2007; Gebauer and Tang 2008; Junglas, Abraham et al. 2009)
Temporal, Spatial and Structural Characteristics of Work		
Temporal Requirements of Job (TRJ)	The degree to which individuals perceive they are required to conform to temporal boundaries in order to perform their portfolio of work tasks.	(Zerubavel 1981; Lee and Liebenau 2000; Abraham 2004; Gebauer, Shaw et al. 2007; O'Leary and Cummings 2007; Zheng 2007; Yuan, Archer et al. 2010)
Spatial Dispersion of Job (SDJ).	The degree to which individuals perceive they are required to move to distinct locations in order to perform their portfolio of work tasks.	(Kakihara and Sørensen 2003; Innes, Barnes et al. 2005; Zheng 2007; Gebauer and Tang 2008; Yuan, Archer et al. 2010)
Spatial Dependence of Job (SDPJ)	The degree to which individuals perceive that location requirements is a critical element to performing their portfolio of work tasks.	(Junglas and Watson 2003; Scornavacca, Prasad et al. 2006; Mallat, Rossi et al. 2009)
Job Structuredness (JS)	The degree to which individuals perceive that their portfolio of work tasks is repetitive and programmable.	(Mintzberg 1973; Withey, Daft et al. 1983; Goodhue 1995; Goodhue and Thompson 1995; Gebauer, Shaw et al. 2007; Zheng 2007)
Job Interdependence (JI)	The degree to which individuals perceive that they are required to exchange information with others in order to perform their portfolio of work tasks.	(Thompson 1967; Fry and Slocum 1984; Gebauer, Shaw et al. 2007; Zheng 2007)
Technology Acceptance Theory		
Performance Expectancy (PE)	The degree to which an individual believes that using the system will help him or her to attain gains in job performance.	(Davis 1989; Davis, Bagozzi et al. 1989) (Moore and Benbasat 1991) (Compeau and Higgins 1995; Compeau, Higgins et al. 1999; Venkatesh, Morris et al. 2003)
Effort Expectancy (EE)	The degree of ease associated with the use of the system.	(Davis 1989; Davis, Bagozzi et al. 1989; Venkatesh, Morris et al. 2003)
Intention to Use Mobile IS (IU)	A measure of the strength of one's intention to use mobile IS.	(Fishbein and Ajzen 1975; Davis 1989; Davis, Bagozzi et al. 1989; Ajzen 1991; Venkatesh, Morris et al. 2003)
System Portability		
System Portability (SP)	The degree of ease associated with transporting the mobile information system.	(Junglas and Watson 2003; Lee and Benbasat 2003; Hoehle and Scornavacca 2008; Scornavacca and Huff 2008; Gebauer and Ginsburg 2009)

Figure 3.3 Research Model and associated hypotheses



Summary of Hypotheses:

H1: *Temporal Requirements of Job positively influences Perceived Individual Need for Mobile Information Systems.*

H2: *Spatial Dispersion of Job positively influences Perceived Individual Need for Mobile Information Systems.*

H3: *Spatial Dependence of Job positively influences Perceived Individual Need for Mobile Information Systems.*

H4: *Job Structuredness negatively influences Perceived Individual Need for Mobile Information System.*

H5: *Job Interdependence positively influences Perceived Individual Need for Mobile Information Systems.*

H6a: *Perceived Individual Need for Mobile Information Systems positively influences Intention to use Mobile IS.*

H6b: *Perceived Individual Need for Mobile Information Systems positively influences Performance Expectancy.*

H7: *Performance Expectancy positively influences Intention to Use Mobile IS.*

H8a*: Effort Expectancy positively influences Performance Expectancy.*

H8b: *Effort Expectancy positively influences Intention to Use Mobile IS.*

H9a: *System Portability positively influences Effort Expectancy.*

H9b: *System Portability positively influences Intention to Use Mobile IS.*

4 Research Design and Methodology

4.1 Introduction

Following the development of the conceptual model and the establishment of the research hypotheses, this chapter outlines the methodological considerations that support this study. The research design provides a general framework for the research effort while the initial research question provides an early direction for the research design. The research design is mostly concerned with the logical analysis of the problem instead of the logistics of data collection. It helps the researcher to be assured that the data that will be collected will actually be measuring what it is supposed to measure (De Vaus 2001; Straub, Gefen et al. 2005). Initially, this chapter identifies the selected research paradigm and the philosophical approach undertaken. This is followed by the research outline and a discussion of key methodological considerations undertaken in this study.

4.2 Research Paradigm

Research can be generally defined as an activity that contributes to the understanding of a phenomenon (Lakatos 1978; Kuhn 1996). Any research project consists of several underlying assumptions about what constitutes 'valid' research and which research methods are appropriate(Myers 1997). In general, social research has the purpose of exploring, describing and/or explaining a phenomenon (Babbie 1990; Hirschheim 1991; Babbie and Wagenaar 1992; Myers 1997; Creswell 2003). Each purpose has different implications in regards to the adoption of a research approach as well as in the different aspects of the research design (Babbie and Wagenaar 1992; Benbasat and Weber 1996). As illustrated by the research model in Chapter 3, the current research has the purpose of explaining a phenomenon (Babbie and Wagenaar 1992; Straub, Boudreau et al. 2004).

According to Chen and Hirschheim (2004), positivist research still dominates 81% of published empirical research in the field of Information Systems. Particularly North-American journals, rather than its European counterparts, tend to predominantly publish positivist, quantitative, cross-sectional and survey oriented research. Orlikowski and Baroudi (1991, p. 5) described the nature of positivist studies as follows:

"Positivist studies are premised on the existence of a priori fixed relationships within phenomena which are typically investigated with structured instrumentation. Such studies serve primarily to test theory, in an attempt to increase predictive understand of phenomena."

Therefore, this research adopts a positivist epistemology since it: (1) assumes that reality is objectively given and can be described by measurable properties which are independent of the observer; (2) examines causal relationships; and (3) attempts to test theory, in an attempt to increase the predictive understanding of phenomena (Orlikowski and Baroudi 1991; Babbie and Wagenaar 1992; Myers 1997; Mingers 2003).

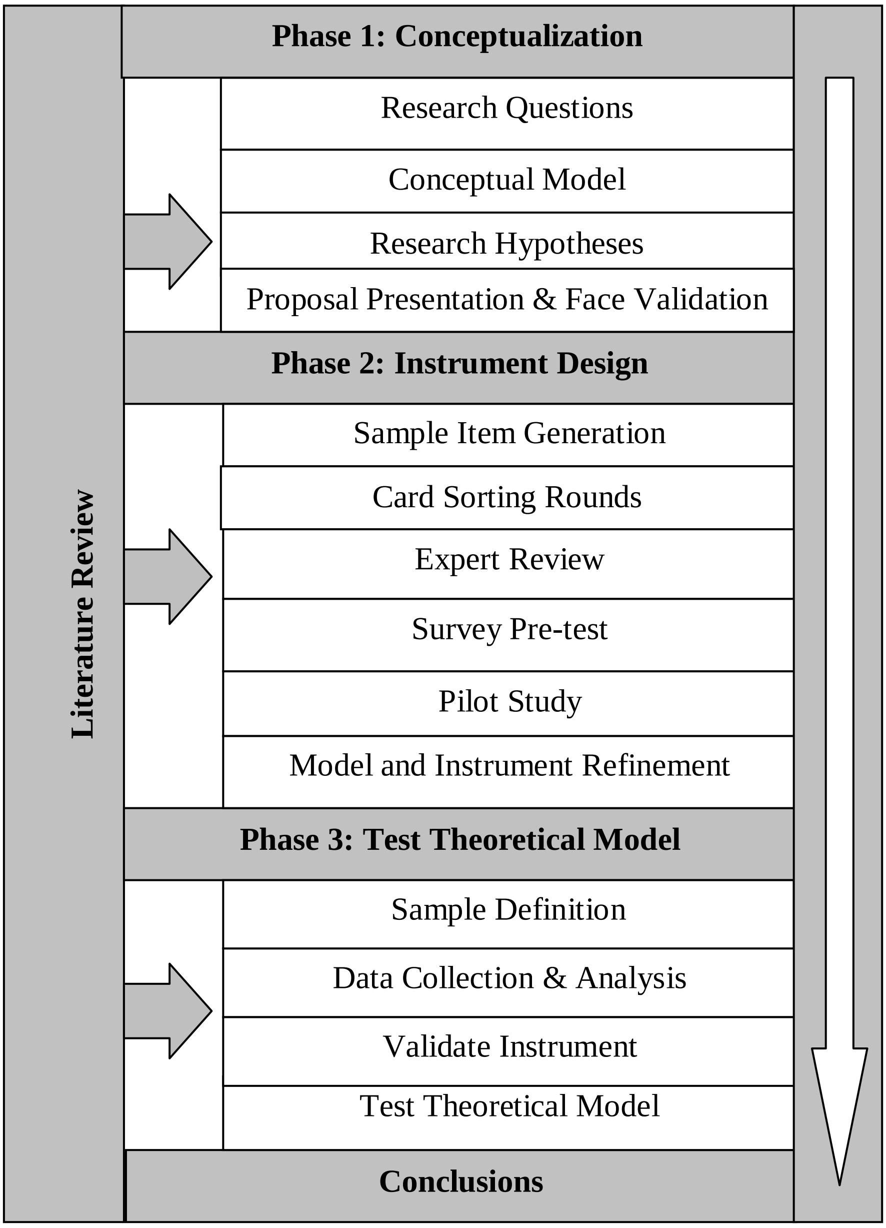
4.3 Research Outline and Methodological Considerations

The research outline is a schematic form, which facilitates the viability of the research, helping the researcher to have a logical order to the work. Pinsonneault and Kraemer (1993) considered that the research outline is a strategy used to answer the research questions and to test the hypotheses which stimulated the research. Figure 4.1 presents the research outline that guided this work.

As shown in the figure below, the research was divided into three phases. The first phase consisted of the development of the research model and hypotheses (already discussed in Chapters 1, 2 and 3). The second phase is constituted by the development of the research instrument (this is described thoroughly in Chapter 5). The third is composed the test of the theoretical model which is presented in detail in Chapter 6.

Before initiating the second phase of the research certain precautionary steps were taken: first, a formal research proposal was presented to School of Information Management; subsequently the face validity of the conceptual model was scrutinized by pool of specialists (two senior professors and three managers of the mobile business branch of large telecommunications company (Creswell 2003).

Figure 4.1 Research Outline



4.3.1 Methodological Approach

Due to the explanatory nature of this work as well as the positivist epistemology adopted here, a quantitative methodology has been selected to support the development of the remaining phases (Benbasat, Goldstein et al. 1987; Straub 1989; Straub, Boudreau et al. 2004; Straub, Gefen et al. 2005). In addition, a quantitative approach can provide statistical evidence from a large sample regarding construct validity and reliability (Babbie 1990; Pinsonneault and Kraemer 1993; Hair, Anderson et al. 1995; Straub, Gefen et al. 2005).

Quantitative research methods include surveys, laboratory experiments, and numerical techniques such as mathematical modelling (Myers 1997; Straub, Gefen et al. 2005).

Straub, Gefen et al. (2005) define quantitative positivist research as a set of methods and techniques that allow IS researchers to answer their research questions. According to the authors, there are two cornerstones in this approach to research: 1) emphasis on quantitative data, and 2) emphasis on positivist philosophy. Quantitative methods and techniques tend to specialize in quantities (using numbers to represent values and levels of theoretical constructs and concepts). In addition, the interpretation of the numbers is viewed as strong scientific evidence of how a phenomenon works. Statistical tools and packages are an essential element of analysis. This emphasis on numerical analysis is also key to the second cornerstone, positivism, which defines a scientific theory as one that can be falsified.

Perhaps the main advantages of using a quantitative research approach is that it yields large amounts of data, it provides statistical evidence in terms of reliability and validity as well as produce findings which are normally generalizable to the whole population (Kaplan and Duchon 1988; Attewell and Rule 1991; Straub, Gefen et al. 2005). Due to its nature it normally requires fewer resources per respondent than most qualitative research methods (Kaplan and Duchon 1988; Babbie 1990; Mingers 2001). In addition it can increase the predictive understanding of a phenomenon by objectively assessing it as well as providing a greater degree of reliability than most qualitative research methods (Babbie 1990; Attewell and Rule 1991; Pinsonneault and Kraemer 1993; Mingers 2001). This research approach is expected to produce replicable results no matter who conducts the research (Attewell and Rule 1991; Straub, Gefen et al. 2005).

On the other hand, there is also a negative side to quantitative research methods (Kaplan and Duchon 1988). First, the researcher is usually absent when the research instrument is completed, having almost no opportunity for clarification of ambiguous aspects. Second, the amount of control which the researcher can exercise is limited in comparison to qualitative research methods (Myers 1997). Third, it often produces a relatively lower level of response/participation than most qualitative research approaches (Mingers 2001). Fourth, little insight is usually gained about the social context, causes and the process behind the phenomena under study (Babbie 1990; Babbie and Wagenaar 1992; Mingers 2001).

4.3.2 The Use of Surveys in IS Research

There is a long and rich tradition in IS research on the use of surveys as a data collection technique to validate and test theories (Pinsonneault and Kraemer 1993; Straub, Gefen et al. 2005). Survey research in IS can be defined as studies that collect data systematically from more than a few entities and perform statistical analysis of data (Lucas 1991). Surveys provide a method of systematizing the collection of information about characteristics, actions, or opinions of a large group of people (Pinsonneault and Kraemer 1993). According to Pinsonneault and Kraemer (1993), surveys are particularly appropriate when:

1) the research goal describes the incidence or prevalence of a phenomenon, or is expected to be predictive about a particular outcome;

2) control of the dependent variables and independent variables is not desired;

3) the phenomena of interest must be studied in their natural setting;

4) the events under consideration are either current or have occurred in the recent past (Pinsonneault and Kraemer 1993).

The use of surveys is particularly important in this case since it enables the examination of causal relationships between variables through substantial amounts of data to test the theoretical model (Babbie 1990; Straub, Gefen et al. 2005). There are, of course, possible issues with the use of surveys, ranging from frame bias and non-response bias to measurement problems (Pinsonneault and Kraemer 1993; Straub, Gefen et al. 2005). However, these issues can be overcome by a carefully designed and comprehensively tested instrument, based on high quality sampling and sufficient responses (Hair, Anderson et al. 1995; Straub, Boudreau et al. 2004; Evans and Mathur 2005; Straub, Gefen et al. 2005). These issues are addressed in detail in Chapters 5 and 6.

4.3.2.1 Electronic Surveys

The data collection process was carried out using a web based survey (or e-survey) (Babbie 1990; Dillman 2000; Scornavacca, Becker et al. 2004; Evans and Mathur 2005; Straub, Gefen et al. 2005). Scornavacca, Becker et al. (2003), point out that a web based survey involves a self-administered questionnaire (without the presence of an interviewer) delivered via a standard web browser. Responses are transferred electronically to a server through a network, typically the Internet. The questionnaire is typically based on electronic text, and may use graphics, audio and hypertext links to provide a richer survey experience (Simsek and Veiga 2001). Typically, respondents are provided with a survey invitation and web address via e-mail. E-surveys have numerous benefits over traditional methods (Klassen and Jacobs 2001; Scornavacca, Becker et al. 2004; Goeritz 2006). One of the chief advantages is the low cost of administration, due to the "peopleless, paperless" mode of data collection (Clayton and Werking 1988). There are, for example, no costs associated with paper, printing, envelopes, stamps, and related administrative work, or for data entry and editing. In addition, the cost per interview falls rapidly with the number of responses and also enables extremely large samples, which may help to reduce sampling variance (Clayton and Werking 1988; Boyer, Olson et al. 2002; Scornavacca, Becker et al. 2004). Other benefits include the much shorter times involved in administering e-surveys, no need for data re-entry (potentially reducing mistakes due to typos and interpretation of the respondent's handwriting), and the ability to do customized e-mail follow-ups (Simsek and Veiga 2000; Simsek and Veiga 2001; Holland, Smith et al. 2010).

On the other hand, e-surveys provide some important challenges for researchers such as low response rate, non-response bias, and assuring the quality of the sampling frame (Dillman 2000; Scornavacca, Becker et al. 2004).

In the specific case of this research, the electronic medium was considered the most appropriate channel to reach a large sample (>200) of people using mobile IS for work purposes (Klassen and Jacobs 2001; Shannon, Johnson et al. 2002; Goeritz 2006). A large sample normally provides stronger external validity and allow the examination of the relationships hypothesized (Pinsonneault and Kraemer 1993). Sample size is an important issue for research based on quantitative methods since and inadequate sample size can present serious problems in the data analysis and hypotheses testing stage, particularly where regression techniques are used (Hair, Anderson et al. 1995; Boudreau, Gefen et al. 2001; Straub, Gefen et al. 2005)

4.3.3 Data Collection and Analysis

As mentioned in the introduction, this chapter focuses on key considerations in regards to the design of the research. While this also theoretically includes the actual process of data collection and analysis, details of each of these aspects will be dealt with in Chapters 5 and 6.

Based on Hair, Anderson et al. (1995) decision tree for choosing the most appropriate method for analysing quantitative data, the data set in this study was be analysed using multiple regression and Structural Equation Modelling (Hair, Anderson et al. 1995; Gefen, Straub et al. 2000; Straub, Gefen et al. 2005; Fang, Chan et al. 2006). Regression can be useful way to test and explore relationships between different constructs. They are a set of statistical techniques that allows the researcher to investigate the relationships between one dependent variable and several independent variables (Gefen, Straub et al. 2000). In addition, regression techniques can be applied to a data set in which independent variables are correlated with each another and/or with the dependent variable (Hair, Anderson et al. 1995).

Structural Equation Modelling (SEM) allows the researcher to assess the overall fit of a model as well as test the structural model all together (Chin 1998; Gefen, Straub et al. 2000). SEM evaluates an entire hypothesized multivariate model, including the hypothesized structural linkages among variables, and between each variable and its respective measures (Bagozzi and Baumgartner 1994). SEM is a family of multivariate statistical techniques used to examine direct and indirect relationships between one or more independent latent variables and one or more dependent latent variables (Gefen, Straub et al. 2000). SEM can be seen as a flexible modelling tool for conducting many multivariate statistical analyses, including regression analysis, path analysis, factor analysis, canonical correlation analysis, and growth curve modelling (Cheung and Chan 2004)

Usually structural equation modelling consists of two processes: 1) analysis of the measurement model and 2) analysis of the structural model. The measurement model specifies how the latent variables or the hypothetical constructs are measured in terms of the observed variables, and it describes the measurement properties, such as the validities and reliabilities of the observed variables. The structural model, on the other hand, specifies causal relationships among latent variables and describes causal effects as well as the level of unexplained variance (Chin 1998; Gefen, Straub et al. 2000).

Overall, SEM provides some advantages in comparison to path analysis and multiple regression (Bagozzi and Baumgartner 1994; Chin 1998; Gefen, Straub et al. 2000). SEM assesses the degree of imperfection in the measurement of underlying constructs, while regression and path analyses do not distinguish between less than perfect measurement of variables and non-random, unexplained variance (Chin 1998). In addition, path analysis assumes that underlying constructs and the scales used to measure them are identical, whereas with SEM, the reliabilities of each of the latent variables considered in the analysis can be assessed. Furthermore, SEM allows for modelling of the unexplained variance taking into account the structural equations (Bagozzi and Baumgartner 1994). Finally, SEM offers measures of overall fit that can provide a summary evaluation of complex models (Gefen, Straub et al. 2000; Cheung and Chan 2004).

There are two main approaches within structural equation modelling: component based approach such as Partial Least Square (PLS) and covariance based approach such as LISREL (Marcoulides, Chin et al. 2009; Qureshi and Compeau 2009; Wetzels, Odekerken-Schroeder et al. 2009). PLS has some advantages over LISREL, such as allowing a smaller sample size and requiring no assumptions about the distributions of the variables (Chin 1998; Esposito Vinzi, Chin et al. 2010). Also, PLS can be effective in situations where the theoretical underpinning of the study is at an early stage (Fornell and Bookstein 1982; Chin 1998). PLS was considered an appropriate method to test the research model for at least two reasons. First, there is broad agreement among scholars that PLS is well suited for exploratory research and theory development (in contrast to theory testing), which is the case in the current research study (Qureshi and Compeau 2009). Second, PLS has the potential to provide acceptable statistical power in particular for large-effect models and for non-normal data (Chin, Gopal et al. 1997).

4.4 Chapter Summary

This chapter presented the research outline and discussed some important decisions in regards to the methodology used to support this study. First, the selection of a positivist epistemology was discussed. This was followed by the presentation of the research outline and key methodological considerations such as the use of quantitative methods and electronic surveys. Methodological issues regarding the instrument development as well as testing the theoretical model are discussed in detail in the following chapters.

5 Instrument Development

5.1 Introduction

Following the clarification of the methodological positioning taken in this research, this chapter outlines the development of the research instrument. In order to minimize measurement error, it is important to rigorously develop a reliable and valid research instrument (Churchill 1979; Straub 1989; Moore and Benbasat 1991; Hinkin 1998).

According to Gefen, Straub et al. (2000), content validity, construct validity, and reliability are some of the essential evaluation criteria for instrument development.

Content validity is a qualitative evaluation of the extent to which the measures of a construct actually capture its real nature. Content validity of an instrument is normally established through a pre-test which helps to eliminate measurement error caused by poorly worded or ambiguous questions or instructions, ensuring that all questions are appropriate and understood (Gefen, Straub et al. 2000).

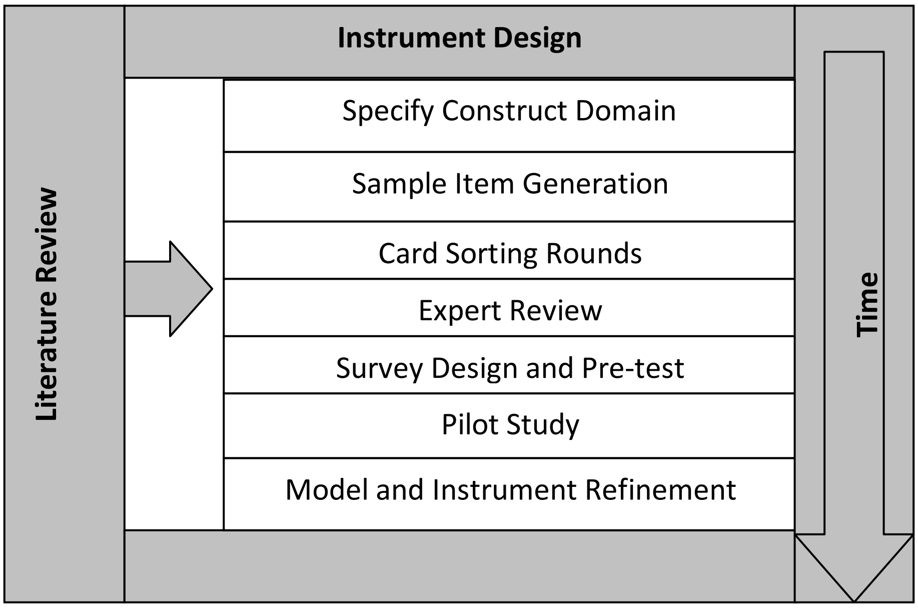
Construct validity assesses whether the measures chosen are true measures of the constructs describing the event or if they are simply artefacts of the methodology per se (Cronbach 1971; Gefen, Straub et al. 2000). If constructs are valid, one can expect quite high correlations between measures of the same construct using different measurement items, and low correlations between measures of constructs that are expected to differ (Campbell and Fiske 1959; Hair, Anderson et al. 1995). In this chapter both convergent and discriminant construct validity will be established (Campbell and Fiske 1959; Straub 1989).

Convergent validity is the degree to which two or more attempts to measure the same concept are in agreement and it can be evaluated through confirmatory factor analysis (Baggozi 1993). Meanwhile, discriminant validity is the degree to which items theorized to reflect the construct differ from those that are not believed to make up the construct (Straub 1989). Discriminant validity is commonly demonstrated using confirmatory factor analysis (Adams, Nelson et al. 1992; Baggozi 1993).

Finally, reliability analyses the extent to which measurements are repeatable (Straub 1989; Straub, Boudreau et al. 2004). The reliability of a multi-item measure can be estimated by Cronbach's alpha (α) and Composite Reliability (CR) (Cronbach 1971; Fornell and Bookstein 1982; Field 2009).

The present instrument development process was based on guidelines suggested in the literature (Churchill 1979; Davis 1989; Moore and Benbasat 1991; Hinkin 1998). Figure 5.1 illustrates the steps which were followed:

Figure 5.1 Instrument Design Process



The first step in the instrument development process usually consists of specifying the domain of constructs. The researcher must clarify the definition of the construct, indicating what is included and what is excluded in that given domain (Churchill 1979; Moore and Benbasat 1991; Hinkin 1998). This stage has been already discussed in the development of the research model in Chapter 3.

The remaining stages will be described in the subsequent sections. Section 5.2 describes the development of items. Section 5.3 explains the card sorting and expert review procedures. Section 5.4 describes the survey design and pre-test phase. Section 5.5 portraits the pilot study and refinement of the scales. Finally Section 5.6 presents a revised research model and items. Section 5.7 presents a short summary of this chapter.

5.2 Development of Items

A key objective of the item development procedure is to ensure content validity (Moore and Benbasat 1991). According to Hinkin (1998), the key to successful item generation is the existence of a well articulated theoretical foundation that indicates the content domain for the measure. The researcher should aim to develop items that will result in measures that sample the theoretical domain of interest to demonstrate content validity. Statements should be simple and as short as possible, and the language used should be familiar to the target population. Also, each item should address a single issue (Hinkin 1998).

Based on Moore and Benbasat's (1991) item creation procedure, the following steps were followed:

Step 1 – Examine the literature for existant scales

Step 2 – Analyse reliability of measurements

Step 3 – Analyse and categorize all items – verifying applicability to research

Step 4 – Add items for constructs where all dimensions were not covered

Step 5 – Revise items - uniform and clarity of wording, adapt to agreement scale

Step 6 - Re-evaluate items, revise wording, and eliminate ambiguous and redundant items

One way of achieving a low measurement error when generating a sample of items is to draw items from existing, already validated scales (Churchill 1979). As a result, initially all relevant items identified in the literature were analysed and categorized according to the various constructs which they were originally intended to address. This generated an initial item pool for each of construct. Then, items considered inappropriate for this particular research context were eliminated (Moore and Benbasat 1991).

In the specific case of this research, the items drawn from the three constructs in the model that came from technology acceptance theory (Performance Expectancy, Effort Expectancy and Intention to Use) and did not require any further development. However, most of the existing scales found in the literature for measuring temporospatial and structural characteristics of work as well as need for mobile IS required further development since it presented in many instances poor fit with construct definitions and/or inadequate levels of validity and reliability.

An important issue to be avoided in instrument development is construct misspecification (Chin 1998) . Researchers must pay careful attention to the directional relationship between the construct and measures (Straub, Boudreau et al. 2004). In this research, all new constructs were carefully developed as reflective variables, ensuring that each variable presented a common latent factor structure with reflective indicators and showing that changes in the underlying latent construct are reflected by changes in the indicators (Freeze and Raschke 2007).

According to Hinkin (1998) there is no fixed rule guiding how many items a construct should have. However he suggests that half of the items created are expected to be retained for use in the final scale. Therefore, as a safeguard, if the goal is to retain four to six items per construct, the initial pool of items for a new construct should have at least eight-twelve items. For example, Moore and Benbasat's (1991) study, which is widely used as a guideline in IS research, suggests beginning with at least 10 items per construct. However their initial pool of 94 items averaged 13.4 items per construct, ranging from 6 to 18 items per construct. Irrespectively to the actual number of items in each construct, is it vital to assure in this stage that the domain of each construct is adequately sampled (Chin, Gopal et al. 1997; Straub, Boudreau et al. 2004).

In addition, some items were also modified to produce a statement to which the respondent was asked to indicate a degree of agreement in a seven-point Likert scale ranging from "strongly disagree" to "strongly agree" (Hair, Anderson et al. 1995; Hinkin 1998; Field 2009). Finally each item was re-evaluated before going to the next stage (Moore and Benbasat 1991; Straub, Boudreau et al. 2004).

The following subsections describe in detail the development of items for each specific construct.

5.2.1 Perceived Individual Need for Mobile Information Systems

Perceived individual need for mobile information systems (PINMIS) is defined as *the degree to which an individual perceives that they need a mobile information system to support their existing work practices*.

As discussed in Chapters 2 and 3, most of previous attempts to understand and characterize aspects of user mobility in the context of mobile IS have been unsuccessful and restricted to a geographic point of view (Mylonopoulos and Doukidis 2003; Junglas and Watson 2006; Gebauer, Shaw et al. 2007; Gebauer and Tang 2008; Junglas, Abraham et al. 2008; Junglas, Abraham et al. 2009; Mallat, Rossi et al. 2009). Individuals' perceptions of geographical mobility do not seem to explain Performance

Expectations or Intentions to Use Mobile IS (Mallat, Rossi et al. 2006; Gebauer, Shaw et al. 2007; Yuan, Archer et al. 2010).

On the other hand, environmental and cognitive psychologists captured individuals' mobility behaviour through perceptions of their individual mobility needs (Haustein and Hunecke 2007; Hunecke, Haustein et al. 2007). The main advantage of the simpler, direct approach taken by the psychologists is that it avoids the misleading notion that individual mobility is effectively measured by distance (Gebauer and Tang 2008).

As discussed in the previous chapters, Haustein and Hunecke (2007) defined the construct Perceived Mobility Necessities as people's perceptions of mobility-related consequences of their personal living circumstances. It was successfully incorporated to the theory of planned behaviour (TPB) in order to explain travel mode choice. The Perceived Mobility Necessities construct was initially operationalized with four items (Table 5.1).

Table 5.1 Perceived Mobility Necessities Items

Construct	Items	Scale
Perceived Mobility Necessities (Haustein and Hunecke 2007) ά= 0.85	To meet my obligations, I often have to be mobile	**5-point scale** Anchors: (1) totally disagree, (5) totally agree
	Familiar and job-related obligations force me to be more often mobile than I want to be	**5-point scale** Anchors: (1) totally disagree, (5) totally agree
	The organization of my everyday life requires a high level of Mobility	**5-point scale** Anchors: (1) totally disagree, (5) totally agree
	I have to be mobile all the time to meet my obligations	**5-point scale** Anchors: (1) totally disagree, (5) totally agree

The top two items in the table above were excluded in the final set of items: one, exhibited strong right skewness and the other reduced internal consistency. The bottom two items performed well and were integrated in the survey (Hunecke, Haustein et al. 2007). This same two-item scale was also used by and Haustein and Hunecke (2007) and exhibited a Cronbach's ά = 0.84.

The concept of "perceived need" has been successfully incorporated into the theory of planned behaviour (TPB) also by health psychologists (Paisley and Sparks 1998; Payne, Jones et al. 2004). Paisley and Sparks (1998), studying fat intake on individuals' diets, incorporated measures of perceived need within the TPB. Since attitude is typically measured using a series of semantic differential scales reflecting the outcomes of performing behaviour, and since perceived need is not necessarily reflected in these scales in any systematic way, perceived need was found to have an independent predictive effect on intentions and expectations within the framework of the TPB. In this case perceived need (to reduce fat intake) was measured by a single question "*Do you feel that you need to reduce your fat intake.. .*" on a 5-point scale ranging from 'no, need to increase', 'not at all', 'slightly', 'a great deal', to 'a very great deal'. However the authors point out that it is likely that a seven-point scale used would be more appropriate than the five-point scale, since it would allow a greater distribution in responses. In addition they suggest that alternative operationalizations of perceived need be developed in the future, including multi-item measures, and that such measures would represent a positive development in examining the role of this construct.

Payne, Jones et al. (2004) investigated the determinants of healthy eating adapting Paisley and Sparks (1998) perceived need measure to a 7-point scale. They found that perceived need significantly contributed to the prediction of healthy eating intention but not to exercise intention. They also mention that, to date, there has been only limited research examining perceived need, mostly focused on food consumption. Therefore, the application of perceived need across multiple behaviours is particularly important, especially as the importance of individual variables within the TPB may be highly dependent on the behaviour being studied (Payne, Jones et al. 2004). In addition, they suggest that further research must more carefully conceptualize and operationalize perceived need using a multi-item measure.

Table 5.2 PINMIS Aspects and References

Aspect	References
Need for ICT support while 'on the go'	(Kakihara and Sørensen 2002; Lee and Sawyer 2002; Kakihara and Sørensen 2003; Jarvenpaa, Lang et al. 2004; Junglas and Watson 2006; Mallat, Rossi et al. 2006; Pagani 2006; Gebauer, Shaw et al. 2007; Gebauer and Tang 2008; Yuan, Archer et al. 2010)
Need for ICT support while away from stationary ICT	(Pica and Kakihara 2003; Pica, Sørensen et al. 2004; Chatterjee and Sarker 2007; Tilson 2007; Junglas, Abraham et al. 2009)
Need to use or rely on mobile IS in order to perform work	(Payne, Jones et al. 2004; Pica, Sørensen et al. 2004; Chatterjee and Sarker 2007; Haustein and Hunecke 2007; Hunecke, Haustein et al. 2007; Tilson 2007; Gebauer and Tang 2008; Junglas, Abraham et al. 2009; Yuan, Archer et al. 2010)

In the present research, the approach used by environmental and health psychologists is adapted to the context of mobile IS, so as to produce a construct that successfully captures individual need for mobile IS and helps to explain user acceptance of this type of system.

In IS research, the concept of perceived need appears in the early literature in the form of perceived informational needs. However, to the best of the researcher's knowledge, no latent variable was operationalized (Alloway and Quillard 1983; Martin 1983).

Table 5.3 Perceived Need for Mobile IS Items

Code	Item	Origin
PINMIS 01	My everyday work tasks require a high level of support by the Mobile Information System.	Derived from Haustein and Hunecke (2007)
PINMIS 02	My job frequently requires me to rely on the Mobile Information System.	New item
PINMIS 03	My everyday work tasks require me to frequently need the support of the Mobile Information System.	Derived from Haustein and Hunecke (2007)
PINMIS 04	My everyday work tasks require me to frequently use the Mobile Information System.	New item
PINMIS 05	I frequently have to use the Mobile Information System in order to meet my work obligations.	Derived from Haustein and Hunecke (2007)
PINMIS 06	I cannot perform most of my work tasks without the support of the Mobile Information System.	New item
PINMIS 07	I frequently need to perform information technology supported tasks where the Mobile Information System is the only information technology available.	New item
PINMIS 08	I frequently need to perform information technology supported tasks where a PC (laptop or desktop) is not available.	Derived from Paisley and Sparks (1998)
PINMIS 09	I frequently need to use the Mobile Information System where a PC (laptop or desktop) is not available.	New item
PINMIS 10	I frequently need to use the Mobile Information System in order to stay connected with my organization while 'on the go'.	Derived from Paisley and Sparks (1998)
PINMIS 11	I frequently need to send, receive and retrieve information via the Mobile Information System while away from a PC (laptop or desktop).	New item
PINMIS 12	I am expected to use the Mobile Information System all the time in order to meet my work obligations.	New item
PINMIS 13	I frequently need to have access to information via the Mobile Information System while 'on the go' in order to meet my work obligations.	Derived from Haustein and Hunecke (2007)
PINMIS 14	I frequently need to send information to others via the Mobile Information System while 'on the go' in order to meet my work obligations.	Derived from Haustein and Hunecke (2007)

The item creation process for PINMIS was based on Moore and Benbasat's (1991) item creation procedure. Drawing from the literature review (Chapter 2) and the PINMIS concept discussion (Chapter 3), the scales were designed to capture three distinct aspects of Perceived individuals needs for mobile IS. These aspects and their literature references are given in Table 5.2.

All PINMIS items were developed utilizing a seven-point Likert scale ranging from "strongly disagree" to "strongly agree". The initial set of items is shown above in Table 5.3.

5.2.2 Temporal, Spatial and Structural Characteristics of Work

As discussed during the development of the conceptual model, five key characteristics emerged from the literature in regards to temporospatial and structural characteristic: Temporal requirements of the job, spatial dispersion of the job, spatial dependence of job, job structuredness and job interdependence. The following sub-section describes the development of measurements for each of those variables.

5.2.2.1 Temporal Requirements of Job (TRJ)

Temporal requirements of job (TRJ) *is defined as the degree to which individuals perceive they are required to conform to temporal boundaries in order to perform their portfolio of work tasks*. In this study, the measurement of TRJ derives from previous work on *time-criticality* (Zerubavel 1981; Lee and Liebenau 2000; Abraham 2004; Prasopoulou, Pouloudi et al. 2006; Gebauer, Shaw et al. 2007; O'Leary and Cummings 2007; Zheng 2007; Yuan, Archer et al. 2010). However, as discussed in the following paragraph, this concept has been broadened in order to unambiguously relate to a work task requirements context.

Based on Lee and Liebenau's (2000) work on the aspects of temporality and Zheng's (2007) dimensions of time-criticality, Temporal Requirements of Job is measured through three aspects: time-window, punctuality, and urgency of task. Time-window (also termed duration) refers to the amount of time spent to complete a task or activity. Punctuality refers to the extent to which tasks must be performed on time (Zerubavel 1981; Lee and Liebenau 2000; O'Leary and Cummings 2007). Finally urgency relates to the importance with which a task needs to be performed promptly (Lee and Liebenau 2000; Zheng 2007; Gebauer and Tang 2008; Junglas, Abraham et al. 2008; Junglas, Abraham et al. 2009). Table 5.4, presents the original set of items used by Zheng (2007) to measure time criticality.

Table 5.4 Time-Criticality according to Zheng (2007)

Construct	Items	Scale
Time-Criticality (Zheng 2007) AVE:0.56 CR: 0.86 ά: 0.80	What is the time urgency for you to start or finish your typical task?	**7-point scale** Anchors: (1)Take it easy, (2) Allow delays, (3) Allow a little delay, (4) At normal speed, (5) Better done sooner, (6) Immediate, (7) In a hurry
	It is very important for you to start your task on time	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
	It is very important for you to complete your task on time	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
	It is very important for you to start your task as soon as possible	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
	It is very important for you to complete your task as soon as possible	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree

Some other studies in the mobile IS domain attempted to measure time-criticality, however, only focusing on a single aspect: urgency (Table 5.5). Gebauer, Shaw et al. (2007) used time criticality as part of a second order mobile fit construct, while Gebauer and Tang (2008) used it as a sub-dimension of task difficulty.

Table 5.5 Items from Time-Criticality

Construct	Items	Scale
Time Criticality (Gebauer et al. 2007) CR=.871 AVE=.71.	Dealing with emergency situations is part of my job	**7-point scale** Anchors: 1) never (7) Always
	My job requires immediate decisions	**7-point scale** Anchors: 1) never (7) Always
Time Criticality (Gebauer and Tang, 2008)	My job frequently requires that I make immediate decisions and actions.	**7-point scale** Anchors: (1) strongly disagree (7) strongly agree
	Emergency Situations and 'fire drills' occur often in my job	**7-point scale** Anchors: (1) strongly disagree (7) strongly agree

In addition, Mallat et al (2009) developed one item in their mobility construct that aimed to measure temporal independence (*Purchasing mobile tickets is independent of* *time.* Perhaps, this item suggests that TRJ could also include an indicator of temporal freedom (measuring the extent to which an individual perceive to be free to choose when they perform their portfolio of tasks).

Again, the six-step item creation procedure based on Moore and Benbasat's (1991) was followed. All TRJ items were adapted or developed to be used with a seven-point Likert scale ranging from "strongly disagree" to "strongly agree". Table 5.6 present the TRJ items initially used in this research and each item's origins.

Table 5.6 Temporal Requirements of Job – Initial Items

Code	Item	Origin
TRJ 01	My work tasks frequently require that I make immediate decisions.	Adapted from Gebauer and Tang (2008) and Gebauer et al. (2007).
TRJ 02	My work tasks frequently require that I take immediate actions.	Adapted from Gebauer and Tang (2008)
TRJ 03	Emergency Situations frequently occur in my job.	Adapted from Gebauer and Tang (2008) and Gebauer et al. (2007).
TRJ 04	I frequently perform urgent work tasks.	Derived from Zheng (2007). Original item had a quite convoluted phrasing and scale as well as a weak loading (0.4)
TRJ 05	My job frequently requires that I start tasks on time.	Adapted from Zheng (2007)
TRJ 06	My job frequently requires that I complete tasks on time.	Adapted from Zheng (2007)
TRJ 07	My job frequently requires that I start tasks as soon as possible.	Adapted from Zheng (2007)
TRJ 08	My job frequently requires that I complete tasks as soon as possible.	Adapted from Zheng (2007)
TRJ 09	I can perform most of my work tasks independently of time.	Derived from Mallat (2009)
TRJ 10	Time is a critical element of my job.	New item
TRJ 11	I frequently need to perform work tasks in a hurry.	New item

The eleven items above seem to provide a good coverage of the three aspects of TRJ construct. Urgency is captured by TRJ01, TRJ02, TRJ03, TRJ04, TRJ11 and partially by TRJ07 and TRJ08. Punctuality is captured by TRJ10, TRJ5, TRJ6. Duration is captured by TRJ12 and partially captured by TRJ7, TRJ8 and TRJ10. Finally temporal freedom is captured by TRJ09.

5.2.2.2 Spatial Dispersion of the Job (SDJ).

Spatial dispersion of the job (SDJ) is defined as the degree to which individuals perceive they are required to move to distinct locations in order to perform their work tasks (Kakihara and Sørensen 2003; Innes, Barnes et al. 2005; Zheng 2007; Gebauer and Tang 2008; Junglas, Abraham et al. 2008; Yuan, Archer et al. 2010). The development of the SDJ measure is based on Zheng's (2007) location variety construct and Gebauer and Tan's (2008) user mobility construct. Table 5.7 presents the original items used by Zheng (2007) and Gebauer and Tan (2008).

Table 5.7 Items related to Spatial Dispersion of Job

Construct	Items	Scale
Location Variety (Zheng 2007) AVE 0.77 CR 0.87, ά 0.70	To what extent do you work at various locations?	**7-point scale** Anchors: (1) Always the same locations, (4) Some at the same location, but some at different new locations, (7) Always at different locations
	To what extent is your job limited to a specific location?	**7-point scale** Anchors: (1) At one specific location, (4) At several alternative locations, (7) Any place
	To what extent do you have the freedom of choosing a place to perform your work?	**7-point scale** Anchors: (1) Not at all (4) Moderately (7) To a great extent
User Mobility (Gebauer and Tan 2008)	I frequently perform my job outside of a standard office environment	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
	I frequently work away from an office environment for long periods of time, days or weeks	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
	I am frequently in places that are very far away from my office due to international or cross-country travel.	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree

Zheng (2007) initially conceptualised location variety as a sub-dimension of location sensitivity. However during the initial validation process the items for Location Variety loaded on a single construct. Later the item referring to freedom was excluded due to low loading. The same construct and measures were used by Yuan et al. (2010), relabelled "mobility". While Location Variety aims to measure the extent to which individuals perceive that <u>a task</u> is performed in different locations, SDJ focuses on how much <u>individuals</u> perceive the need to <u>move</u> to different locations while working. In addition, the scales used by Zheng (2007) are idiosyncratic (Urbaczewski and Koivisto 2008).

Gebauer and Tan (2008) operationalized “user mobility” with statements about the extent to which a user performed work in a “nonstandard” office environment. The construct was modelled as a formative construct based on the assumption that the indicators are not necessarily correlated and measure different aspects of the latent variable (Freeze and Raschke 2007). While User Mobility provides an initial step in measuring spatial dispersion, Gebauer and Tan (2008) acknowledge that the measure may be incomplete, as it focused primarily on travel.

Yuan el al. (2010) suggest that mobility could have three distinct dimensions. The first dimension is location variety, which refers to the array of locations in which work is undertaken. The second is Location Specificity, which measures whether an individual’s portfolio of work tasks is limited to a specific location or could be performed at any location. The third dimension, Location Flexibility, refers to the degree individuals perceive themselves to be free to choose the location where they perform their portfolio of tasks. While the first and second dimensions seem appropriate to measure spatial dispersion of job, the third dimension appears to be much closely related to spatial dependence (see next subsection).

Table 5.8 presents the items initially used in this research to operationalize SDJ. Again, all SDJ items were adapted or developed to be used with a seven-point Likert scale ranging from “strongly disagree” to “strongly agree”.

Table 5.8 Spatial Dispersion of Job Items

Code	Item	Origin
SDJ 01	My job generally requires me to perform my work tasks at the same location.	Derived from Zheng (2007)
SDJ 02	My job generally requires me to perform my work tasks at different locations.	Derived from Zheng (2007)
SDJ 03	My work tasks frequently require me to stay in the same specific location.	Derived from Zheng (2007)
SDJ 04	My work tasks frequently make me go to a variety of locations.	Derived from Zheng (2007)
SDJ 05	My job generally requires me to work in new locations.	Derived from Zheng (2007)
SDJ 06	My job seldom requires me to change the location where I perform my work tasks.	Derived from Zheng (2007)
SDJ 07	My job generally requires me to work in locations I know well.	New item

Items such as SDJ01 and SDJ02 were created to capture stationarity (or in other words, the lack of spatial variety). Consequently, during data analysis these items were reverse coded. The inclusion of reverse-coded items also serves to reduce response set bias (Hinkin 1998). In addition, while it is acknowledged that six SDJ items derive from the two items of Location Variety proposed by Zheng (2007), it is also important to point out that the new SDJ items differ substantially from the original Location Variety measurements.

5.2.2.3 Spatial Dependence of Job (SDPJ)

Spatial dependence of job (SDPJ) *is defined as the degree to which individuals perceive that location is a critical element to performing their portfolio of work tasks* (Junglas and Watson 2003; Scornavacca, Prasad et al. 2006; Mallat, Rossi et al. 2009).

Junglas and Watson (2003) understood *location dependence* as the extent to which location is an important aspect to complete a determined task. However the authors did not operationalize measures for the construct. Zheng's (2007) *location dependence* did not relate to spatial dependence of task or individuals. Rather, it related to individuals' need to obtain location-related information (self-location, other people's location, equipment location, and travel directions). As a result Zheng's (2007) Location Dependence items cannot be considered when aiming to develop measures for Spatial Dependence of Job (see table 5.9 for details).

Table 5.9 Spatial Dependence of Job (Zheng 2007)

Construct	Items	Scale
Location Dependence (Zheng 2007) AVE 0.59 CR 0.85, ά 0.77	To what extent is performing your work dependent on information about your current location?	**7-point scale** Anchors: (1) Not at all, (4) moderately, (7) to a great extent
	To what extent is performing your work dependent on information about other people's (such as co-workers or customers) locations?	**7-point scale** Anchors: (1) Not at all, (4) moderately, (7) to a great extent
	To what extent is performing your work dependent on information about the location of things or equipments that are related to your work?	**7-point scale** Anchors: (1) Not at all, (4) moderately, (7) to a great extent
	To what extent is performing your work dependent on information about travel or navigation guides to the destination?	**7-point scale** Anchors: (1) Not at all (4) Moderately (7) To a great extent

On the other hand, Mallat et al (2009) developed one item in their mobility construct that aimed to measure spatial independence (*Purchasing mobile tickets is independent* *of place)* which can be used in the development of a measure for SDPJ. The initial pool of items presented below (Table 5.10) was composed by two underlying aspects: spatial dependence and spatial freedom. All SDPJ items were developed to be used with a seven-point Likert scale ranging from “strongly disagree” to “strongly agree”.

Table 5.10 Temporal Requirements of Job Items

Code	Item	Origin
SDPJ 01	I can perform most of my work tasks independently of location.	Adapted from Mallat et al (2009)
SDPJ 02	Location is a critical element of my job.	New Item
SDPJ 03	My location is frequently an important factor for performing my work tasks.	New Item
SDPJ 04	I perform most of my work task wherever I want.	Derived from Zheng (2007) Location Variety construct
SDPJ 05	My job requires me to perform my work tasks at specific locations.	New Item
SDPJ 06	It is important to be in the ‘right place’ when performing my work tasks.	New Item
SDPJ 07	My location is frequently irrelevant to perform my work tasks.	New Item
SDPJ 08	I have the freedom to choose where I perform my work tasks.	Derived from Zheng (2007) Location Variety construct

Items SDJP 01, 04, 07 and 08 were reverse coded during data analysis.

5.2.2.4 Job Structuredness (JS)

Job structuredness (JS) *is understood as the degree to which individuals perceive that their portfolio of work tasks is repetitive and programmable* (Mintzberg 1973; Withey, Daft et al. 1983; Goodhue 1995; Goodhue and Thompson 1995; Gebauer, Shaw et al. 2007; Zheng 2007). The measurement of structural characteristics of work tasks such as repetition, routine, programmability and complexity have been operationalized in a number of studies (Goodhue 1995; Goodhue and Thompson 1995; Gebauer, Shaw et al. 2004; Karimi, Somers et al. 2004; Yuan and Zheng 2006; Gebauer, Shaw et al. 2007; Zheng 2007; Gebauer and Tang 2008; Chatterjee, Chakraborty et al. 2009; Yuan and Zheng 2009). While the literature is convergent in pointing out that repetition and programmability as essential structural characteristic of work, the operationalization of the constructs have been quite divergent.

According to Perrow (1967), the degree of structure in an individual portfolio of work tasks has two dimensions: task variety and task analysability. Task variety measures the frequency of unexpected and novel events that occur in work process, while task analysability captures the degree of programmability of the portfolio of task. Zheng (2007), drawing on previous research conducted by Withey et al (1983), suggested that task variety and analysability are highly correlated in practice and that they could be combined into a single dimension: task complexity. The work developed by Withey et al (1983) combined a few prominent scales of task exceptions and analysability found in the literature (e.g. Daft and Macintosh (1981), Van de Ven and Delbecq (1974) and Van de Ven and Ferry (1980)).

In another study, Gebauer and Tang (2008) measured non-routineness as a sub-dimension of task difficulty. Similarly, Goodhue and Thompson (1995) characterized non-routineness (defined there as the lack of analysable search behaviour) as a dimension of task characteristics. Gebauer, Shaw et al (2007) searched the support management literature (e.g., Mintzberg, 1979) to operationalize a non-routineness construct so as to capture structural dimensions of tasks, such as repetitiveness and predictability. Table 5.11 summarize the items found related to Job Structuredness.

Table 5.11 Items related to Job Structuredness

Construct	Items	Scale
Task Complexity (Zheng 2007) Based on Withey et al (1983) AVE 0.65 CR 0.90, ά 0.86	Your work is repetitive	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
	There is a clearly known way to do the major types of your work	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
	You can rely on established procedures	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
	Your work is routine	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
	There is an understandable sequence of steps that can be followed in doing your work	**7-point scale** Anchors: (1) strongly disagree (4) Neutral (7) strongly agree
non-routiness Gebauer et al (2007) based on Mintzberg (1979)	I initiate and lead projects to improve my organization	**7-point scale** Anchors: (1) never (7) Always
	I allocate resources, including budget and staff	**7-point scale** Anchors: (1) never (7) Always
non-routiness Gebauer and Tang (2008)	I process information from many different sources	**7-point scale** Anchors: (1) strongly disagree (7) strongly agree
non-routine tasks Goodhue and	I frequently deal with ill-defined business problems	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree

Thompson (1995)	I frequently deal with Ad-hoc, non-routine business problems	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	Frequently the business problems I work involve answering questions that have never been asked in quite that form before	**5-point scale** Anchors: (1) strongly disagree (7) strongly agree
Construct	**Items**	**Scale**
Task exceptions (Withey et al 1983)	How many of these tasks are the same from day-to-day? (very few... most of them).	**5-point scale** Anchors: (1) very few (5) most of them
	To what extent would you say your work is routine?	**5-point scale** Anchors: (1) to a small extent (5) to a great extent
	People in this unit do about the same job in the same way most of the time.	**5-point scale** Anchors: (1) to a small extent (5) to a great extent
	Basically, unit members perform repetitive activities in doing their jobs.	**5-point scale** Anchors: (1) to a small extent (5) to a great extent
	How repetitious are your duties?	**5-point scale** Anchors: (1) very little (5) very much
Task Analysability (Withey et al 1983)	To what extent is there a clearly known way to do the major types of work you normally encounter?	**5-point scale** Anchors: (1) to a small extent (5) to a great extent
	To what extent is there a clearly defined body of knowledge of subject matter which can guide you in doing your work?	**5-point scale** Anchors: (1) to a small extent (5) to a great extent
	To what extent is there an understandable sequence of steps that can be followed in doing your work?	**5-point scale** Anchors: (1) to a small extent (5) to a great extent
	To do your work, to what extent can you actually rely on established procedures and practices?	**5-point scale** Anchors: (1) to a small extent (5) to a great extent
	To what extent is there an understandable sequence of steps that can be followed in carrying out your work?	**5-point scale** Anchors: (1) to a small extent (5) to a great extent

In order to develop a measurement for Job Structuredness, the procedure suggested by Moore and Benbasat's (1991) was deployed. The objective here was to select and adapt items that would specifically measure task repetitiveness and programmability in order to assure that each item reflected the definition of the construct. All JS items were adapted or developed to be used with a seven-point Likert scale ranging from "strongly disagree" to "strongly agree". Table 5.12 present the JS items initially used in this research and their origins.

Table 5.12 Job Structuredness Items

Code	Item	Origin
JS 01	Most of my work tasks are repetitive.	Adapted from Van de Ven and Dalbecq (1974) Withey et al (1983) and Zheng (2007)
JS 02	There is a clearly known way to do the major types of tasks in my job.	Adapted from Van de Ven and Ferry (1980); Withey et al (1983) and Zheng (2007).
JS 03	I can rely on established procedures and practices to perform my work tasks.	Adapted from Daft and Macintosh (1981); Withey et al (1983) and Zheng (2007).
JS 04	Most of my work tasks are routine.	Adapted from Van de Ven and Dalbecq (1974); Daft and Macintosh (1981); Withey et al (1983) and Zheng (2007)
JS 05	There is an understandable sequence of steps that can be followed in doing my job.	Adapted from Van de Ven and Dalbecq (1974); Withey et al (1983) and Zheng (2007)
JS 06	I frequently deal with ill-defined business problems.	Adapted from Goodhue and Thompson (1995)
JS 07	I frequently deal with ad-hoc business problems.	Adapted from Goodhue and Thompson (1995)
JS 08	I frequently deal with non-routine business problems.	Adapted from Goodhue and Thompson (1995)
JS 09	Most of the time my job requires me to perform the same work tasks in the same way.	Adapted from Van de Ven and Dalbecq (1974); Daft and Macintosh (1981); Withey et al (1983) and Zheng (2007)

Please note that items JS 06, 07 and 08 were reverse coded during data analysis.

5.2.2.5 Job Interdependence (JI)

Job interdependence (JS) *is defined as the degree to which individuals perceive that they are required to exchange information with others in order to perform their portfolio of work tasks* (Thompson 1967; Fry and Slocum 1984; Sharma and Yetton 2003; Gebauer, Shaw et al. 2007; Zheng 2007).

No measures were found in the literature of job interdependence explicitly focused on <u>information</u> exchange among workers. The existing scales of task interdependence commonly focus on the exchange of <u>outputs</u> between segments within a subunit and with other organizational units (Thompson 1967; Fry and Slocum 1984; Pearce and Gregersen 1991; Pearce, Sommer et al. 1992; Goodhue and Thompson 1995; Kumar and van Dissel 1996; Gebauer, Shaw et al. 2007; Gebauer and Tang 2007).

Pearce and Gregersen (1991) found that task interdependence could be modelled as two separate factors: reciprocal interdependence and independence. Pearce et al (1992), on the other hand, presented three distinct factors for interdependence: depend on others, others' dependence and reciprocal dependence. In the context of IS research Pearce et al’s (1992) scales have been successfully used by Sharma and Yetton (2003; 2007).

In addition, in relation to mobile workers, Zheng (2007) adapted Pearce et al’s (1992) work on interdependence in one single construct labelled task interdependence. On the other hand, Gebauer and Tang (2008) considered interdependence as a sub-dimension of task difficulty. Finally, Goodhue and Thompson (1995) characterized interdependence (with other organizational units) as a dimension of task characteristics. Table 5.13 summarizes items found related to Job Interdependence.

Table 5.13 Items related to Job Interdependence

Construct	Items	Scale
Reciprocal Interdependence Pearce and Gregersen (1991)	I work closely with others in doing my work.	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	I frequently must coordinate my efforts with others.	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	My own performance is dependent on receiving accurate information from others.	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	The way I perform my job has a significant impact on others.	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	My work requires me to consult with others fairly frequently.	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
Independence Pearce and Gregersen (1991)	I work fairly independently of others in my work.	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	I can plan my own work with little need to coordinate with others.	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	I rarely have to obtain information from others to complete my work.	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
Depend on others Pearce et al (1992)	I work fairly independently of others in my work (N).	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	I can plan my own work with little need to coordinate with others	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	I rarely have to obtain information from others to complete my work	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree

	My own work is relatively unaffected by the performance of other individuals or departments	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	I frequently must coordinate my efforts with others	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	My own performance is dependent on receiving accurate information from others	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
Others' Dependence Pearce et al (1992)	I am frequently interrupted by others' request for information	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	In my job I am frequently called on to provide information and advice	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	The way I perform my job has a significant impact on others	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
Reciprocal Interdependence Pearce et al (1992)	My job involves working closely with others in producing a team effort	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	I get together with other team members so we can set our job objectives together	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	I work closely with others in doing my work	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	My job consists of providing timely and accurate information to others	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
Interdependence Gebauer et al (2007) Based on Mintzberg (1979)	To perform my job, I interact closely with others	**7-point scale** Anchors: (1) never (7) Always
	To perform my job, I process information from many sources	**7-point scale** Anchors: (1) never (7) Always
Interdependence Gebauer and Tang (2008)	My job is independent with the jobs of other individuals and organizational units	**7-point scale** Anchors: (1) strongly disagree (7) strongly agree
	I interact close with and rely on the work of others	**7-point scale** Anchors: (1) strongly disagree (7) strongly agree
Interdependence Goodhue and Thompson (1995)	The business problems I deal with frequently involve more than one business function	**5-point scale** Anchors: (1) strongly disagree (5) strongly agree
	The problems I deal with frequently involve more than one business function	**5-point scale** Anchors: (1) strongly disagree (7) strongly agree

In order to develop a measurement for Job Interdependence for the present study, it was necessary to select and adapt items from the table above specifically focused on individuals' requirements to exchange information with others. Table 5.14 present the JI items initially used in this research and their origins.

Table 5.14 Temporal Requirements of Job Items

Code	Item	Origin
JI 01	My work tasks frequently can be performed independently of others.	Adapted from Pearce and Gregersen (1991)
JI 02	My work tasks frequently can be planned with little need to coordinate with others.	Adapted from Pearce and Gregersen (1991)
JI 03	My work tasks frequently require me to coordinate efforts with others (customers, co-workers, supervisors)	Adapted from Pearce and Gregersen (1991)
JI 04	I frequently need to obtain information from others to in order to complete my work tasks.	Adapted from Pearce and Gregersen (1991)
JI 05	My job is independent of the jobs of other individuals and organizational units.	Adapted from Gebauer and Tang (2008)
JI 06	I interact closely with and rely on the work of others.	Adapted from Gebauer and Tang (2008)
JI 07	The business problems I deal with frequently involve more than one person or business function.	Adapted from Goodhue and Thompson (1995)
JI 08	I frequently need to exchange information with others in order to perform my work tasks.	New item - created specifically to capture need to exchange information
JI 09	My own performance is dependent on receiving accurate information from others.	Adapted from Pearce and Gregersen (1991)
JI 10	My work tasks frequently require me to consult with others.	Pearce and Gregersen (1991)
JI 11	My job frequently requires me to provide accurate information to others.	Adapted from Pearce et al (1992)

The JI items are also based on a seven-point Likert scale ranging from "strongly disagree" to "strongly agree". Items JI 01, 02 and 05 were reverse coded during data analysis.

5.2.3 Technology Acceptance Theories

As described in Chapter 3, this study aims to integrate PINMIS and technology acceptance theories by using three key constructs from the Unified Theory of Acceptance and Use of Technology (UTAUT): Performance Expectancy, Effort

Expectancy and Intention to Use (Venkatesh, Morris et al. 2003). The UTAUT has already been explored in-depth in Chapter 2 – section 2.4.1.5. Since the goal here is not to further test or validate the UTAUT constructs, in this research, these concepts and their measures are adopted with minor modifications in order to suite the study context. Consistent with the original UTAUT scale, a seven-point Likert scale ranging from “strongly disagree” to “strongly agree” was used for all technology adoption items.

5.2.3.1 Performance Expectancy (PE)

Performance Expectancy (PE) *is defined as the degree to which an individual believes that using the system will help him or her attain gains in job performance* (Venkatesh, Morris et al. 2003). As presented in Table 5.15, this construct is a result of the combination of Perceived Usefulness (Davis 1989; Davis, Bagozzi et al. 1989) Relative Advantage (Moore and Benbasat 1991) and Outcome Expectations (Compeau and Higgins 1995; Compeau, Higgins et al. 1999)

Table 5.15 Origin of Performance Expectancy Items

Construct	Items	Origin
Performance Expectancy	I would find the system useful in my job.	Perceived Usefulness (Davis 1989; Davis, Bagozzi et al. 1989)
	Using the system enables me to accomplish tasks more quickly.	Relative Advantage (Moore and Benbasat 1991)
	Using the system increases my productivity	Relative Advantage (Moore and Benbasat 1991)
	If I use the system, I will increase my chances of getting a raise.	Outcome Expectations (Compeau and Higgins 1995; Compeau, Higgins et al. 1999)

The measurement of Performance Expectancy is independent from the nature of the systems (stationary or mobile), requiring minimum change to the wording of its items (Junglas 2007; Mallat, Rossi et al. 2009; Yuan, Archer et al. 2010). Table 5.16 lists the items used in the current study, with the appropriate wording modifications to fit with the context of mobile IS.

Table 5.16 Performance Expectancy Items

Code	Item
PE 01	I find the mobile information system useful in my job.
PE 02	Using the mobile information system enables me to accomplish tasks more quickly.
PE 03	Using the mobile information system increases my productivity.
PE 04	If I use the mobile information system, I will increase my chances of getting a raise.

5.2.3.2 Effort Expectancy (EE)

Effort Expectancy (EE) *is defined as the degree of ease associated with the use of the system* (Venkatesh, Morris et al. 2003). This construct incorporate items from Perceived Ease of Use (Davis 1989; Davis, Bagozzi et al. 1989) and Ease of Use (Moore and Benbasat 1991) (Table 5.17)

Table 5.17 Origin of Effort Expectancy Items

Construct	Items	Origin
Effort Expectancy	My interaction with the system would be clear and understandable.	Perceived Ease of Use (Davis 1989; Davis, Bagozzi et al. 1989)
	It would be easy for me to become skillful at using the system.	Perceived Ease of Use (Davis 1989; Davis, Bagozzi et al. 1989)
	I would find the system easy to use.	Perceived Ease of Use (Davis 1989; Davis, Bagozzi et al. 1989)
	Learning to operate the system is easy for me.	Ease of Use (Moore and Benbasat 1991)

It is interesting to observe that the four reflective indicators of the Effort Expectancy construct (clear and understandable, easy to become skilful, easy to use and easy to learn) are equally applicable to stationary as well as mobile IS (Jarvenpaa, Lang et al. 2003; Mylonopoulos and Doukidis 2003; Gebauer, Shaw et al. 2007; Hoehle and Scornavacca 2008; Scornavacca and Huff 2008). Table 5.18 lists the items used for Effort Expectancy in the current study.

Table 5.18 Performance Expectancy Items

Code	Item
EE 01	My interaction with the mobile information system would be clear and understandable.
EE 02	It is easy for me to become skilful at using the mobile information system.
EE 03	I find the mobile information system easy to use.
EE 04	Learning to operate the mobile information system is easy for me.

5.2.3.3 Intention to Use Mobile IS

Finally, *Intention to Use Mobile IS* (IU) *is defined as the strength of one's intention to use Mobile IS* (Fishbein and Ajzen 1975). It is the Behavioural Intention to use the System construct used by Venkatesh et al. (2003), with minor modifications to fit the context of this study. Table 5.19 presents a list of items used by Venkatesh et. al. (2003).

Table 5.19 Origin of Intention to Use the System Items

Construct	Items	Origin
Behavioural Intention to Use the System	I intend to use the system in the next <n> months.	Behavioural intention (Davis 1989; Davis, Bagozzi et al. 1989; Ajzen 1991)
	I predict I would use the system in the next <n> months.	Behavioural intention (Davis 1989; Davis, Bagozzi et al. 1989; Ajzen 1991)
	I plan to use the system in the next <n> months.	Behavioural intention (Davis 1989; Davis, Bagozzi et al. 1989; Ajzen 1991)

Table 20 lists the items used Intention to Use Mobile IS.

Table 5.20 Items of Intention to use mobile IS

Code	Item
IU 01	I intend to the use mobile information system in the next 6 months.
IU 02	I predict I would use the mobile information system in the next 6 months.
IU 03	I plan to use the mobile information system in the next 6 months.

5.2.4 System Portability

System portability (SP) *is defined as the degree of ease associated with transporting the mobile information system* (Junglas and Watson 2003; Lee and Benbasat 2003; Hoehle and Scornavacca 2008; Scornavacca and Huff 2008; Gebauer and Ginsburg 2009).

It is interesting to observe that in the UTAUT model the scales of performance expectancy and effort expectancy are commonly applicable to 'stationary' as well as 'mobile' IS. However, while effort expectancy captures known usability issues of mobile IS such as small screens and cumbersome input methods, it does not account for effort expectancy related to technology portability. A measure of system portability is required which will incorporate users' effort expectancy "under mobile conditions" (Hoehle and Scornavacca 2008; Gebauer and Ginsburg 2009; Mallat, Rossi et al. 2009).

Incorporating an indicator of portability (e.g. 'easy to carry') into the effort expectancy would result in the construct becoming a formative composite variable instead of a reflective latent variable (Freeze and Raschke 2007; Petter, Straub et al. 2007). As a result, system portability was modelled as an independent reflective variable and is expected to have a positive effect on effort expectancy(Chatterjee, Chakraborty et al. 2009).

While portability has been widely discussed in the literature as a key characteristic unique to mobile IS, to the best of the researcher's knowledge, no actual measurement of individuals' perception of system portability has been developed to date (Hoehle and Scornavacca 2008; Chatterjee, Chakraborty et al. 2009; Junglas, Abraham et al. 2009).

Three possible aspects for the construct emerged from the literature: physical properties of the device – such things as size, weight and sturdiness (Junglas and Watson 2006; Gebauer and Ginsburg 2009); 'easy to carry', which relates to the perceptions of effort associated in carrying the device around most of the time (Hoehle and Scornavacca 2008; Chatterjee, Chakraborty et al. 2009; Junglas, Abraham et al. 2009); and software adaptation, which concerns how well applications have been adapted for use on mobile devices (Barnes 2003; Basole 2004).

All SP items were developed to be measured using a seven-point Likert scale ranging from "strongly disagree" to "strongly agree". Table 5.21 present the SP items initially used in this research and the origins of each item in the literature.

Table 5.21 System Portability Items

Code	Item	Origin
SP 01	I find the Mobile Information System device easy to carry.	(Hoehle and Scornavacca 2008; Chatterjee, Chakraborty et al. 2009; Junglas, Abraham et al. 2009)
SP 02	I find the Mobile Information System device easy to take with me while 'on the go'.	(Hoehle and Scornavacca 2008; Chatterjee, Chakraborty et al. 2009; Junglas, Abraham et al. 2009)
SP 03	The Mobile Information System device is very heavy.	(Junglas and Watson 2006; Gebauer and Ginsburg 2009)
SP 04	The Mobile Information System device is very fragile.	(Junglas and Watson 2006; Gebauer and Ginsburg 2009)
SP 05	The Mobile Information System device is very big.	(Junglas and Watson 2006; Gebauer and Ginsburg 2009)
SP 06	The Mobile Information System is very portable.	(Hoehle and Scornavacca 2008; Chatterjee, Chakraborty et al. 2009; Junglas, Abraham et al. 2009)
SP 07	The mobile versions of applications I normally use on my PC provide very limited functionalities.	(Barnes 2003; Basole 2004)
SP 08	The mobile versions of applications I normally use on my PC have been well adapted for use on the mobile device.	(Barnes 2003; Basole 2004)
SP 09	I find the Mobile Information System is portable without being limited.	(Barnes 2003; Basole 2004)

Overall, the initial basket of questionnaire items included 80 items: Perceived Individual Need for Mobile Information Systems (PINMIS) 14 items, Temporal Requirements of Job (TRJ) 11 items, Spatial Dispersion of Job (SDJ) 7 items, Spatial Dependence of Job (SDPJ) 8 items, Job Structuredness (JS) 9 items, Job Interdependence (JI) 11 items, Performance Expectancy (PE) 4 items, Effort Expectancy (EE) 4 items, Intention to Use Mobile IS (IU) 3 items, and System Portability (SP) 11 items. The next section describes the card sorting and expert panel procedures which were used to develop the research instrument.

5.3 Card Sorting and Expert Panel

Once the initial pool of 80 items was generated, the next step was to conduct two rounds of a card sorting procedure, and an expert panel evaluation. In order to minimize a possible cognitive overburden of the participants the 11 items from the three UTAUT constructs (PE, EE, IU) were not included in this process. It was assumed that these constructs are well validated and research efforts should be focused on the development of the remaining constructs (Venkatesh, Morris et al. 2003; Venkatesh, Davis et al. 2007).

According to Moore and Benbasat (1991), this stage of the instrument development process has two key goals: first, assessment the construct validity of the scales being developed, and second, identification of particular items which still may be ambiguous.

The use of card sorting techniques is extremely common in disciplines such as design and information architecture (Robertson 2001). In the IS tradition, the work of Davis (1989) and Moore and Benbasat (1991) has popularized the card-sorting technique as a means of accessing content validity, and it is considered an appropriate approach for initially assessing the correspondence between candidates items and the definitions of the constructs they are intending to measure. In the card sorting procedure, convergence or divergence of items within categories can serve as an indicator of construct validity. For example, if an item is consistently placed in the same construct category, then it can be considered to demonstrate convergent validity with the related construct, and discriminant validity with the others (Moore and Benbasat 1991).

There are two distinct approaches for deploying the card sorting technique in the literature: opened and closed. An open (or exploratory) card sorting procedure basically consists of asking the participants to sort the various items into categories and then create labels for the categories they have created. This process helps the researcher to verify if the definitions obtained are aligned with the original scale's intent. In addition, if the number of categories created by the judges as well as the labels and items assigned to them are consistent, then scales based on these categories also demonstrate a good degree of convergent and discriminant validity (Moore and Benbasat 1991). A closed (or confirmatory) card sorting consists of asking participants to sort the items into pre-established construct categories. This procedure helps to reduce the cognitive burden associated with the tasks of creating groups and labelling categories.

Following Moore and Benbasat (1991), a sequential two-round procedure was adopted which consisted of an initial open round followed by a closed round. Four judges were used in each round. The judges were selected using a convenience sample; the key criterion for being a judge was that the person had to have a mobile device that they used for work purposes. Card sorting was conducted with one judge at a time following a protocol (shown in Appendix 1).

5.3.1 Card Sorting - Open Round

The first set of judges included two males and two females, of varying backgrounds and age groups (e.g. a 60+ senior academic, a 50+ carrier advisor, a 30+ bank manager, and a 20+ system analyst). This range of backgrounds and technical expertise was chosen to ensure that a wide range of perceptions would be included in the analysis.

Each of the 69 items was printed on an index card. Each card was assigned a random number on that back that helped in identifying the items and was later used in the inter-rater score analysis. Prior to sorting the cards, judges received a copy of the protocol, a set of instructions involving three tasks: card sorting, labelling categories and pointing out ambiguous, repeated or indeterminate items (Appendix 1). This set of instructions had been previously tested with two separate individuals to ensure comprehensiveness and comprehensibility. Judges were instructed to ask any questions they might have about the process and to keep in mind that there were no ‘right’ or ‘wrong' answers in the exercise. They were also instructed that statements within each group must relate more to one another than they do to statements in other categories, and that some statements may appear to be similar to one another, but their task was to try to determine the primary underlying idea that each statement reflects.

A practice round of 11 items related to individuals’ eating habits was used to insure that the participants understood the process. Five items were related to meat intake, four to vegetable intake and two deliberately constructed to be ambiguous and not fitting any category (these items are shown in Appendix 1). Judges were then asked to accomplish the three tasks stated in the instructions using the practice cards. Running a practice round with simple items was an extremely valuable process. It helped to clarify any issues related to the instructions, it also ensured that the judges understood the concept of sorting items based on an underlying construct (Moore and Benbasat 1991).

Once the practice run was completed, the 69 cards were then shuffled into random order and presented to the judges. The judges were reminded that there was no pre-determined number of categories, the number of cards in each category was not necessarily uniform and could vary significantly, and that it was acceptable to change their minds and re-sort the cards during the process.

Individually, each judge followed the instructions and sorted the cards into categories, labelled each category, and pointed out any unclear items. It took approximately 40 to 50 minutes per judge to complete the sorting procedure.

5.3.1.1 Results Open Round

There are a number of ways to calculate the level of agreement among ratings of multiple judges (Randolph 2008). In this research the following measures were used: Raw Percentage Agreement, Cohen's Kappa (Cohen 1960), Fixed Marginal Multi-rater Kappa (Siegel and Castellan 1988), and Items Placement Score (Moore and Benbasat 1991).

Cohen's Kappa is defined as the proportion of agreement after chance agreement is removed (Cohen 1960). In this case, the Kappa scores are calculated for each pair of judges and the results are averaged to create an overall score. Although there is no general rule-of-thumb regarding Cohen's Kappa results, Moore and Benbasat (1991) suggest that scores greater than 0.65 are acceptable. In the case of Raw Percent Agreement, Hinkin (1998) suggests that 0.75 or higher is acceptable. Table 5.22 presents the results.

Table 5.22 Inter-judge agreement

Paired Judges	Raw Agreement	Cohen's Kappa	Notes on Kappa Scores
1&2	0.913	0.895	95% confidence interval: 0.815- 0.975
1&3	0.927	0.913	95% confidence interval: 0.839 - 0.986
1&4	0.942	0.930	95% confidence interval: 0.864 - 0.997
2&3	0.957	0.948	95% confidence interval: 0.889 -1.006
2&4	0.971	0.965	95% confidence interval: 0.917 - 1.013
3&4	0.986	0.982	95% confidence interval: 0.948 -1.017
Average	**0.949**	**0.939**	

The results in the table above are highly acceptable, indicating that there was substantial agreement among judges (Moore and Benbasat 1991). In addition, the Marginal Multi-rater Kappa resulted in 0.938, further validating the results above (Siegel and Castellan 1988).

Following Moore and Benbasat's (1991) procedure, the overall Items Placement Score was calculated (Table 5.23). The diagonal entries indicate the number of items placed within the same underlying construct. On the other hand, the scattered off-diagonal numbers indicate some disagreement or inconsistency in the placement of items. Overall, 97.4% of the placement converged suggesting a good level of reliability of the classification scheme.

Table 5.23 Items Placement Score – open round

Target Category	Actual Categories							
	JI	SDJ+ SDPJ	PINMIS	JS	SP	TRJ	TOTAL	%HITS
JI	43			1			44	97.73%
SDJ+SDPJ		60					60	100.00%
PINMIS	2		51		3		56	91.07%
JS				36			36	100.00%
SP					36		36	100.00%
TRJ				1		43	44	97.73%
Total of items placement	276	Hits	269	Overall hit ratio	97.46%	69 cards, 4 judges)		

Although, the convergence among judges was exceptionally high for an open round, all four judges created six groups instead of the expected seven categories. They did not distinguish Spatial Dispersion of Job and Spatial Dependence of Job, considering both a single construct related to location. As a result, it unclear whether these are two separate constructs or a single construct with two sub-dimensions. Table 5.24 illustrates the results of the labelling exercise.

Table 5.24 Labels Provided by Judges

Original Category	Label Judge 1	Label Judge 2	Label Judge 3	Label Judge 4
JI	Job- dependence on others	Collaboration	Collaboration	Autonomy
SDJ+SDPJ	Job - Importance of location	Location (critical)	Location	Location
PINMIS	Job -dependence on mobility	Necessities	Why I need to use Mobile IS	Tool Requirements
JS	Job-type of tasks	Task Characteristic	Task Characteristic	Job Task
SP	Mobile Device	Device Characteristics	Characteristics of Mobile IS	Mobile IS Portability
TRJ	Job - Importance of time	Time	Time	Time Management

In most cases, the labels and definitions provided by the judges matched very closely those of the underlying theoretical constructs, providing a degree of confidence in the appropriateness of the scales.

Besides establishing content validity of the new scales, the card sorting procedure has the objective of reducing the number of items and clarifying possible ambiguity. In this round, items were deleted based on the following criteria: a) items considered ambiguous, repeated, confusing or indeterminate; b) items with a low placement score (Moore and Benbasat 1991). In addition some items presented some minor issues and were rephrased or put into 'quarantine' for further observation in the next round. Table 5.25 lists the items that were dropped or modified in this round.

Table 5.25 Items deleted or modified on round one

Code	Item	Action	Reason
SDJ 07	My job generally requires me to work in locations I know well.	Deleted	Ambiguous. "I know well" was seen as not relevant.
PINMIS 07	I frequently need to perform information technology supported tasks where the Mobile Information System is the only information technology available.	Deleted	Unclear – judges perceived it was related to system characteristic or system availability instead of need for mobile IS.
PINMIS 08	I frequently need to perform information technology supported tasks where a PC (laptop or desktop) is not available.	Deleted	Unclear – judges perceived it was related to PC availability instead of need for mobile IS.
PINMIS 09	I frequently need to use the Mobile Information System where a PC (laptop or desktop) is not available.	Deleted	Unclear – judges perceived it was related to PC availability instead of need for mobile IS.
PINMIS 10	I frequently need to use the Mobile Information System in order to stay connected with my organization while 'on the go'.	Quarantined	May be overlaps with interdependence. Perhaps it captures need to communicate.
PINMIS 11	I frequently need to send, receive and retrieve information via the Mobile Information System while away from a PC (laptop or desktop).	Rephrased	"while away from a PC" confused the judges. Item rephrased "I frequently need to send, receive and retrieve information via the Mobile Information System in order to meet my work obligations"
PINMIS 12	I am expected to use Mobile Information System all the time in order to meet my work obligations.	Deleted	Seems to capture compulsory use instead of need – two judges found it odd.
PINMIS 14	I frequently need to send information to others via the Mobile Information System while 'on the go' in order to meet my work obligations.	Deleted	Overlapped with Job Interdependence. Perhaps it focuses on need to communicate.
JI 07	The business problems I deal with frequently involve more than one person or business function.	Deleted	Overlapped with Job Structuredness
JS 06	I frequently deal with ill-defined business problems.	Deleted	Ambiguous – judges found the statement confusing.

In total eight items were dropped. The PINMIS construct had by far the highest number of issues: 5 items deleted, 1 rephrased and 1 quarantined. Items such as PINMIS07, PINMIS08 and PINMIS09 were considered to be focused on IT availability instead of need for mobile IS to support work tasks. On the other hand PINMIS10, PINMIS12 and PINMIS14 were considered to overlap some of the temporospatial and structural characteristics of work.

All the remaining 61items passed to the next round of card sorting

5.3.2 Card Sorting - Closed Round

The second group of judges was composed of three males and one female. It also incorporated different backgrounds and age groups (e.g. a 60+ senior academic, a 40+ liaison officer, a 30+ project manager, and a 20+ tutor). The sessions followed a similar protocol used during the open round. However, in this closed round the participants were asked to complete only two tasks: card sorting and pointing out problematic items. In addition to the white cards containing the items, participants received a blue pile containing the name and definitions of six different categories regarding individual perceptions of the factors that influence user acceptance of mobile information systems in the workplace. They were asked to read the statements in the cards and sort them into the six categories printed in the blue cards. In addition, they were requested to place ambiguous (fitting multiple categories) or indeterminate (fitting no category) items in the “unclear bin”. It took approximately 30-40 minutes to complete each session.

Following the recommendations obtained in the first round, Spatial Dependence of Job and Spatial Dispersion of Job were combined into a single category. This was labelled Location Requirements of Job and defined as the degree individuals perceive they are required to comply with spatial boundaries in order to perform their portfolio of work tasks. Since the possibility of having only one construct related to spatial characteristic still was under evaluation, the item labels were kept in their original form (SDJ and SDPJ) to facilitate further investigation.

5.3.2.1 Results Closed Round

In this round the level of agreement among judges was also verified using Raw Percentage Agreement, Cohen's Kappa (Table 5.26), Fixed Marginal Multi-rater Kappa (Siegel and Castellan 1988), and Items Placement Score (Table 5.27).

Table 5.26 Inter-judge agreement

Paired Judges	Raw Agreement	Cohen's Kappa	Notes on Kappa Scores
1&2	0.902	0.883	95% confidence interval: 0.793 -0.972
1&3	0.869	0.844	95% confidence interval: 0.743- 0.945
1&4	0.885	0.863	95% confidence interval: 0.768- 0.959
2&3	0.967	0.962	95% confidence interval: 0.910 - 1.014
2&4	0.934	0.921	95% confidence interval: 0.847 - 0.996
3&4	0.902	0.883	95% confidence interval: 0.794- 0.972
Average	**0.910**	**0.893**	

The results in this round also indicated a substantial level of agreement among judges (Moore and Benbasat 1991). In addition, the Marginal Multi-rater Kappa resulted in 0.892. This is consistent with the first round and above the suggested cutoff point (Siegel and Castellan 1988). Table 5.27 present the results for Items Placement Score (Moore and Benbasat 1991).

Table 5.27 Items Placement Score – closed round

	Actual Categories								
Target Category	JI	SDJ+ SDPJ	PIN MIS	JS	SP	TRJ	Unclear	Total	% HITS
JI	39						1	40	97.50%
SDJ+SDPJ		56						56	100%
PINMIS			35		1			36	97.22%
JS			1	30			1	32	93.75%
SP					31		5	36	86.11%
TRJ	1		1	1		39	2	44	88.64%
Total of items placement		244	Hits	230	Overall hit ratio	94.26 %	(61 cards, 4 judges)		

An initial examination of the off-diagonal placement matrix above suggested that some items from the system portability construct were unclear. However, a further detailed investigation of the placement revealed that one specific judge found all items related to physical attributes of the device (SP3-5) confusing. Therefore those items were retained for further testing.

Consistent with the first round, items were removed or modified following the previously established criteria. Table 5.28 lists the items that were dropped or modified in this round.

Table 5.28 Items deleted or modified on round two

Code	Item	Action	Reason
TRJ 03	Emergency Situations frequently occur in my job.	Deleted	Unclear - may fit two categories – regarding time and job structure
JS 07	I frequently deal with ad-hoc business problems.	Quarantined	The term ‘ad-hoc’ was not clear to a couple of judges
PINMIS 10	I frequently need to use the Mobile Information System in order to stay connected with my organization while ‘on the go’.	Deleted	Quarantined on round 1. Round 2 judges found the item ambiguous.
SP 04	The Mobile Information System device is very fragile.	Rephrased	Rephrased with a positive statement "The Mobile Information System device is very robust."

The number of issues found in the second card sorting round was reasonably low. Only two items were removed. All the remaining 59 items where then taken to the next stage and scrutinised by an expert panel.

5.3.3 Expert Panel

The card sorting rounds provided an initial indication of construct convergent validity, discriminant validity and to a certain extent content validity (Cronbach 1971; Straub 1989; Straub, Boudreau et al. 2004). According to Straub (1989), it is highly advisable to conduct several rounds of instrument pretesting with different groups of expert judges or panels in order to establish content validity. According to Boudreau et al. (2001) approximately 23% of IS research articles examine content validity during the instrument validation phase. The goal here is to verify whether the constructs are likely to be real and reliable; and that the instrument is likely measuring the right content, covering in a representative manner all the ways that the content of a given construct could be measured.

The panel members were selected based on their individual expertise in questionnaire design and survey deployment. The expert panel was composed of two IS professors, one marketing professor, one library studies academic and a senior mobile product marketing manager from a major telecommunication company. Each expert received via e-mail a file containing a copy of the research mode and several tables. Each table presented a construct label, its definition and a list of candidate items. They were requested to analyse the material and provide feedback: was the content was clear, did the proposed grouping of the items seem logical, and was the instrument measuring the right content? Feedback was received during a one-hour meeting with each expert.

There were no major issues regarding the *Perceived Need for Mobile IS* construct. It was suggested to insert the words "*and consult*" on PINMIS 11 in order to make it more comprehensive. The item was modified accordingly:

PINMIS 11: I frequently need to send, receive, retrieve <u>and consult</u> information via a Mobile Information System in order to meet my work obligations.

Regarding the *Temporal Requirements of Job* construct, two items were perceived as unclear. The term "time" on TRJ09 (*I can perform most of my work tasks independently of <u>time</u>*) and TRJ10 (*<u>Time</u> is a critical element of my job*) was considered vague and that it could be interpreted in many different ways by the respondents (e.g. time interval, urgency, deadlines, or actual 'clock time'). As a result, seven new candidate items were generated and scrutinised by the panel, as shown in Table 5.29:

Table 5.29 New Candidate Items for TRJ

Item	Statement
A	I perform my work tasks whenever I want.
B	I have the freedom to choose when I perform most of my work tasks.
C	My job frequently requires me to perform my work tasks at the 'right time'.
D	My job frequently requires me to perform my work tasks at specific times.
E	How much time I spend in each work task is important for my job.
F	My job requires me to meet deadlines.
G	My job requires me to follow a schedule.

After consultation with the panel members, candidate item A was substituted for TRJ 09. The panel found that the concepts in the new item were very clear and tapped well into the dimension of temporal freedom. Similarly, candidate item C was selected to substitute TRJ 10. It was suggested the term 'right time' would not create confusion and would capture well the need for individuals to comply with temporal boundaries while performing their portfolio of tasks. In addition it was suggested that candidate item E be incorporated into the questionnaire. The item was considered to have a good fit with the construct and was able to capture issues regarding temporal boundaries of job, especially time-window. Therefore, candidate item E was added as TRJ 12.

With regards to *Spatial Dispersion of Job* as well as *Spatial Dependence of Job* it was recommended by most of the experts to keep them as two separate constructs since they actually measure different phenomena. It is possible that the two constructs converged in the card sorting round due to the large number of items related to location. Further statistical testing (discussed in the next section) will help clarifying this issue.

There were no major issues regarding the items from SDJ and SDPJ. Only SDJ 04 was modified from "My work tasks frequently <u>make me go</u> to a variety of locations" to "My work tasks frequently <u>require me to</u> go to a variety of locations" in order to improve its phrasing.

Job Struturedness also did not require any modifications. On the other hand, a few items from *Job Interdependence* had to be modified. First, in item JI 05 the word "generally" was added in order to improve its ability to capturing variance. Also "and" was substituted by "or." As a result, JI 05 changed to the following: "*My job is <u>generally</u> independent of the jobs of other individuals <u>or</u> organizational units*". Second, the word "accurate" on JI 09 (*My own performance is frequently is dependent on receiving <u>accurate</u> information from others*) and JI 11 (*My job frequently requires me to provide <u>accurate</u> information to others*) was removed. Given the purpose of the construct, there was no need to qualify the type of information individuals were sending or receiving. Item JI 06 *(I interact <u>closely with</u> and <u>rely on</u> the work of others*) was found to be a 'double-barrel' item, tapping two distinct issues. The item was then split into two new items JI 6a (*My job frequently requires me <u>to interact closely</u> with others)* and JI 6b (*My job frequently requires me to <u>rely on</u> the work of others*).

Finally, regarding the *System Portability* construct item SP 09 (*I find the Mobile Information System is portable without being limited*) was removed due to ambiguity of the trade-off present in the statement. In addition item SP 07 was reworded to improve clarity "*Mobile applications provide very limited functionally in comparison to applications on a PC.*"

Overall, the expert panel was a valuable step in the development of the questionnaire. The rich and insightful ideas provided by the panel allowed the researcher to further improve the content validity of the constructs and to fine-tune some of the items. The set of items resulting from the card sorting and expert panel rounds is available in Appendix 3 (instrument pre-test).

5.4 Questionnaire Design and Survey Pre-test

As discussed in Chapter 4 (section 4.3.2.1), the data collection process in this study was carried out using web-based surveys. Therefore, once the scales were finalized, the next stage of the instrument design involved the development of the online questionnaire (Simsek and Veiga 2001). An important goal in survey design is to design the survey in such a way as to reduce non-response rate (Hair, Anderson et al. 1995; Dillman 2000; Scornavacca, Becker et al. 2004). There are a number of reasons respondents may not participate in surveys, including personal interest, time constraints, questionnaire complexity, length and lack of visual appeal (Goeritz 2006). In order to potentially increase participation in the survey, the survey response process was streamlined as much as possible. Meticulous attention was paid to the survey lay-out, flow and wording (Evans and Mathur 2005; Holland, Smith et al. 2010). The online survey questionnaire was structured as follows (for the questionnaire used in the pre-test see Appendix 3, for the final questionnaire used in the pilot study see Appendix 4):

A) Pre-survey
   a. Consent
   b. Screening Question
B) Survey Questionnaire
   a. Introduction
   b. Part 1 - Questions Related to Nature of Work
   c. Part 2 – Questions Related to PINMIS
   d. Part 3 – Questions Related to Mobile IS
   e. Part 4 – Questions Related to Mobile Device
   f. Part 5 – Demographics
C) Post Survey
   a. Thank you note
   b. Link to enter prize draw

The pre-survey section contained information about participation consent in accordance to the requirements of the Human Ethics Committee (HEC) of Victoria University of Wellington. Information regarding the goal and focus of the research, participation criteria, confidentiality, anonymity and voluntariness was highlighted on that page. Also, information regarding incentives was emphasized by offering respondents a summary of the completed study and the opportunity to enter a prize draw

(Simsek and Veiga 2001; Goeritz 2006). In addition, a screening question was posed in order to assure the respondents were currently using a mobile device enabled with data access for work purposes. If a person answered “no” to the screening question, a thank you note was displayed explaining that they did not meet the criteria for participating in the study. Answering “yes” gave access to the survey.

The introduction to the survey questionnaire was designed to clarify key terms such as “mobile IS” and to emphasize that the focus of the research was the use of mobile data applications, not voice communications. This was followed by the Part 1 (Questions Related to Nature of Work) containing the items from TRJ, SDJ, SDPJ, JS and JI. Part 2 focused on the PINMIS construct and part 3 contained items from PE, EE, IU and SP. Part 4 contained questions related to individuals’ mobile devices such as device brand, operator, employer’s subsidy and application availability. Although not required for the analysis of this research, these data would serve to further inform the researcher concerning key characteristics of the sample and enrich the interpretation of the data, adding insights into aspects pertaining patterns of mobile IS usage. Finally, Part 5 collected demographic information (age, gender, and occupation).

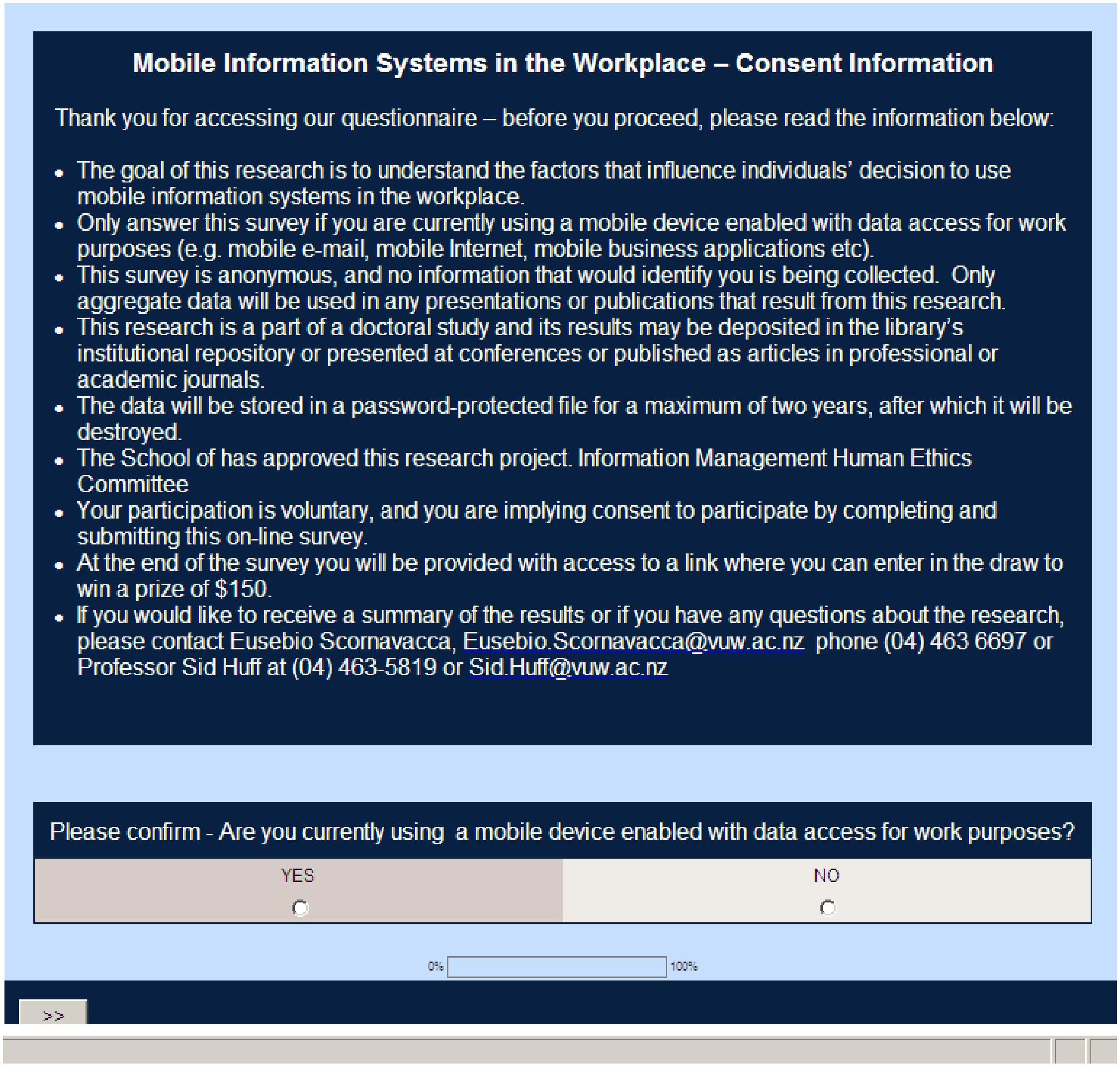
The post-survey section contained a thank you note for completing the survey and provided a link for respondents enter in the prize draw. Including the prize draw link in the thank you note ensured that only individuals that completed the survey were able to enter the draw. In addition, using a separate link and database to store e-mail addresses and names for the prize draw ensured that individuals’ anonymity was protected.

At this point the first pre-test was conducted. Pre-tests are conducted in an attempt to assess that the mechanics of compiling the questionnaire are adequate (Moore and Benbasat 1991; Hinkin 1998; Field 2009). Five people currently using mobile IS for work purposes from distinct organizations were asked to pre-test the questionnaire: one professor, one estate department manager, two bank employees and a project manager. Participants were asked to complete the instrument and then comment on matters such as clarity, length, wording, flow, and timing (Babbie 1990; Simsek and Veiga 2001).

On average each participant took between 15 and 20 minutes to complete the survey. Their feedback provided a few suggestions on how to improve the wording of the instructions as well as the sequence in which some questions were presented. These suggestions were taken into consideration and small changes were made to the questionnaire. No major issues were reported in relation to the construct items.

The next step was to upload the survey instrument to the online survey software provider (www.qualtrics.com). A few interactions with the vendor were necessary in order to ensure the system was meeting necessary performance requirements. For example, a new 'back button' was created allowing users to navigate between sections. Also, some issues regarding the implementation of the screening questions were resolved. In addition, some valuable features were enabled: ballot box stuffing prevention (each person can take the survey only once), 'save and continue' capability (allowing respondents who did not complete the survey to go back and continue from the point they left), and missing question alert (avoiding the issue of missing data). Figure 5.2 illustrates the first page of the online questionnaire.

Figure 5.2 Online Questionnaire



Mobile Information Systems in the Workplace – Consent Information

Thank you for accessing our questionnaire – before you proceed, please read the information below:

- The goal of this research is to understand the factors that influence individuals' decision to use mobile information systems in the workplace.
- Only answer this survey if you are currently using a mobile device enabled with data access for work purposes (e.g. mobile e-mail, mobile Internet, mobile business applications etc).
- This survey is anonymous, and no information that would identify you is being collected. Only aggregate data will be used in any presentations or publications that result from this research.
- This research is a part of a doctoral study and its results may be deposited in the library's institutional repository or presented at conferences or published as articles in professional or academic journals.
- The data will be stored in a password-protected file for a maximum of two years, after which it will be destroyed.
- The School of has approved this research project. Information Management Human Ethics Committee
- Your participation is voluntary, and you are implying consent to participate by completing and submitting this on-line survey.
- At the end of the survey you will be provided with access to a link where you can enter in the draw to win a prize of $150.
- If you would like to receive a summary of the results or if you have any questions about the research, please contact Eusebio Scornavacca, Eusebio.Scornavacca@vuw.ac.nz phone (04) 463 6697 or Professor Sid Huff at (04) 463-5819 or Sid.Huff@vuw.ac.nz

Please confirm - Are you currently using a mobile device enabled with data access for work purposes?

YES	NO
○	○

0% 100%

>>

Once the survey system was up and running, a sample of 25 mobile IS users, employees from a university and a major telecommunication provider, were asked to test the system. Different browsers (Internet Explorer, Firefox, Google Chrome) were used during the test. In addition, a test of the data collection and conversion (to SPSS) process was carried out.

Participants were also asked to report on content clarity as well as any issues they may have encountered with the system when answering the survey. Based on the feedback, a few spelling errors were corrected. In addition, a question from Part 4 on the use of mobile applications was rephrased. In Part 5 a demographic question related to industry was added.

In addition, some issues related to the lay-out of the question regarding the availability and frequency of use of mobile applications were raised (Part 4). A couple of options were developed (e.g. using a side by side matrix or splitting the question in two parts - availability and frequency) and sent back to the participants for consultation. Even though the survey system does not allow a dynamic second column (e.g. only displaying second column items for applications indicated as 'available' in the 1st column) when using use a side by side matrix, this option was considered easier to complete and more user friendly.

Overall, doing the pre-test using a sample representative of the actual population of interest was extremely beneficial for improving content validity, fine-tuning the questionnaire layout as well as testing the usability and reliability of the online instrument (Hinkin 1998; Scornavacca, Becker et al. 2004). The finalized questionnaire used in the pilot is available in Appendix 4.

5.5 Pilot Study

The next stage of the instrument development process comprised a "full-scale" pilot study (Moore and Benbasat 1991; Pinsonneault and Kraemer 1993; Hinkin 1998; Straub, Boudreau et al. 2004). The primary aim of this stage is to test the reliability of the various scales (Cronbach 1971; Hair, Anderson et al. 1995; Field 2009). In order to achieve this goal, the questionnaire should be presented to a sample whose background is similar to the target population of the final study (in this case, individuals using mobile IS for work purposes (Hinkin 1998).

Before the pilot study was initiated, an application containing the survey instrument was submitted and approved by the Human Ethics Committee (HEC) of the School of Information Management, Victoria University of Wellington (Appendix 2).

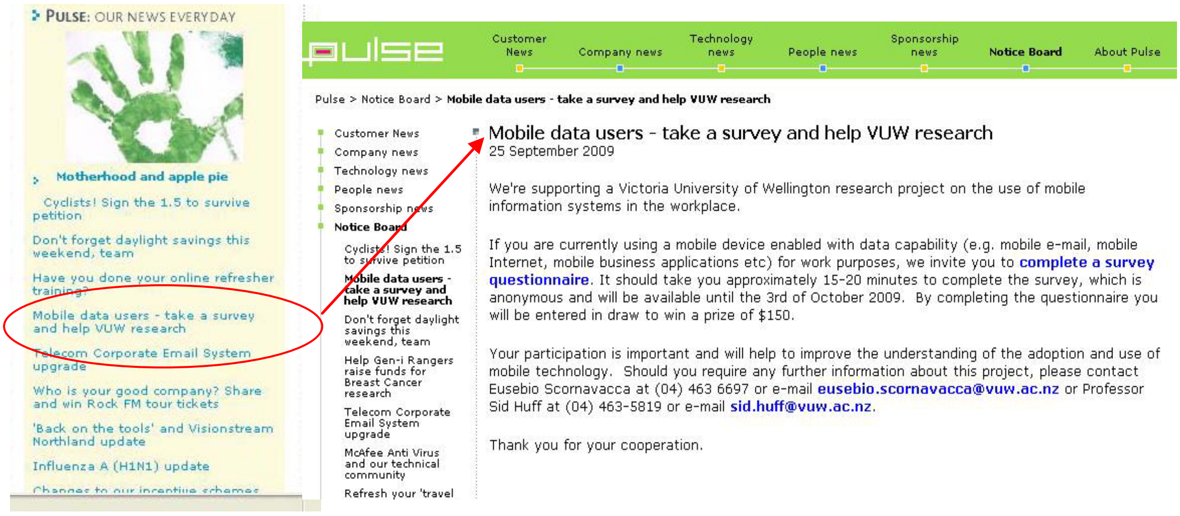
The pilot study was then conducted among employees of a large telecommunications provider in New Zealand. This organizational setting was considered appropriate to pilot test the instrument since it offered a combination of a large number of employees using mobile IS as well as a wide range of portfolios of work tasks (e.g. sales people, network maintenance, human resources, advertising, IT consultants etc) (Pinsonneault and Kraemer 1993; Hinkin 1998; Simsek and Veiga 2000; Goeritz 2006).

The survey instrument was made available on-line and a note with a link to the questionnaire was posted in the electronic notice board available in the telecommunication company's staff portal (Figure 5.3). Therefore, only people from the telecommunications company were able to see the note. In the message it was highlighted that only people using mobile devices enabled with data access for work purposes were invited to participate.

According to Goeritz (2006) material incentives can increase the odds of a person completing a Web survey up to 19% and it may increase the absolute response rate on average by 2.8% over offering no incentives. On the other hand, there is a risk that people may fill in 'random' data to get to the end of the survey quickly in order to be eligible for an incentive. This issue can be easily overcome by controlling the time participants take to complete the survey and excluding those that completed in a period of time significantly below average. As a result, it was offered to the participants a summary of the completed study and the opportunity to enter a prize draw of $150 in gift vouchers (Simsek and Veiga 2001; Goeritz 2006).

The survey was available online for 9 days (including six working days). In total 446 people accessed the questionnaire website. Even though the survey invitation clearly targeted mobile data users, 81 individuals (18%) accessed the survey and answered 'NO' to the screening question. After careful examination of the dataset in a spreadsheet, it was found that 128 individuals abandoned the survey at some stage and did not produce a complete data set. In addition, six sets were excluded because they were fully completed in less than 10 minutes. As a result, a total 234 useful responses were taken further (52% of the total web page hits).

Figure 5.3 Pilot Study Invitation



According to Hinkin (1998), there has been substantial debate over the suitable sample size that is needed to appropriately conduct tests of statistical significance. As the sample size increases, the likelihood of attaining statistical significance also increases (Field 2009). The advantage of a large sample is that it can produce stable estimates of the standard errors to assure that factor loadings are accurate reflections of the true population values (Hair, Anderson et al. 1995).

In order to determine the adequacy of a sample size, the specific statistical methods used to analyse the data must be taken in consideration (Field 2009). For example, in the literature recommendations for item-to-response ratios in exploratory and confirmatory factor analysis ranged from 1:4 to 1:10 (Hair, Anderson et al. 1995; Hinkin 1998; Field 2009). On the other hand, some researchers have found that in most cases, a sample size of 150-200 observations should be sufficient to obtain an accurate solution in factor analysis as long as inter-item correlations are reasonably strong (Hoelter 1983; Guadagnoli and Velicer 1988). In the case of Partial Least Squares, Chin (1998) suggests a minimum sample size of ten times the number of structural paths leading into a construct.   As a result, the sample of 234 respondents fulfil the criteria outlined above and was considered adequate for the purposes of the pilot study.

5.5.1 Pilot Results: Respondent Profile

The sample was mostly composed of males (67.1%) and the average age was 36 years old (28% were younger than 30, 42% were between 30 and 40, and 30% were 40 or older). Over 80% worked for the parent telecommunications company and 18% for the subsidiary IT consultancy firm. A large variety of occupations were included in the sample: public relations manager, solicitor, business analyst, economist, IT consultant and network manager among many others. Overall, based on discussions with the liaison officer and HR department of the parent company, it seems the survey captured a representative sample of the population using mobile IS at the company.

Interestingly, 67% of the respondents perceived that it was not compulsory for them to use a mobile information system in their job. Almost 90% of them had the cost of mobile data access paid by the employer. On average, they had been using their current mobile device for approximately 13 months. In addition, respondents reported that they spent on average 45 minutes per day using their mobile device for voice communications. The device manufacturers' market share in the sample is presented on Table 5.30.

Table 5.30 Devices used by the pilot sample

Device Manufacturer	Percent
Nokia	24.2%
HTC	20.7%
Sony Ericsson	14.5%
RIM/Blackberry	11.0%
Palm	9.7%
Apple/iPhone	8.8%
Samsung	6.6%
Sanyo	0.9%
Other	3.1%
Don't Know	0.4%
TOTAL	100%

Approximately 99% of the respondents indicated that mobile internet, calendar, contacts, texting (SMS), and mobile e-mail were applications available in their devices. Around 60% indicated that their devices included GPS and office application such as spreadsheets and word processors. On the other hand, only 20% reported corporate applications such as sales force automation and CRM. Table 5.31 illustrates the availability and frequency of use of the mobile applications.

Table 5.31 Use of applications by the pilot sample

Application	Available	Frequency of Use					
		Never	Rarely	Sometimes	Quite Often	Very Often	TOTAL
Contacts	99.6%	0.5%	0.9%	8.3%	14.8%	75.6%	100%
Mobile e-mail	99.6%	2.3%	5.5%	7.4%	12.9%	71.9%	100%
Calendar	99.6%	0.9%	3.2%	6.0%	20.6%	69.3%	100%
Texting (SMS)	99.1%	1.9%	1.4%	3.7%	23.4%	69.6%	100%
Mobile Internet	98.2%	0.9%	8.3%	24.0%	26.3%	40.6%	100%
MMS	72.9%	31.6%	22.3%	25.4%	7.8%	13.0%	100%
GPS and Navigation	58.6%	33.9%	19.0%	25.3%	14.4%	7.5%	100%
Spreadsheet	64.3%	30.2%	27.9%	24.0%	11.2%	6.7%	100%
Word Processing	64.2%	30.5%	28.3%	24.3%	10.2%	6.8%	100%
E-reader	67.0%	26.1%	22.2%	34.1%	11.9%	5.7%	100%
Presentations	59.9%	34.3%	33.7%	20.1%	5.9%	5.9%	100%
Other Corporate App	26.6%	63.8%	3.4%	10.1%	16.1%	6.7%	100%
Sales Force App	9.5%	90.2%	2.1%	2.1%	1.4%	4.2%	100%
Mobile Chat	8.0%	57.0%	19.8%	12.8%	7.0%	3.5%	100%
CRM Application	8.0%	89.9%	1.5%	2.9%	2.2%	3.6%	100%
Field Force App	5.8%	96.4%	1.5%	0.7%	0.0%	1.5%	100%

It is interesting to observe that contacts, mobile e-mail and calendar were the most frequently used applications among respondents. In addition, mobile internet still was also frequently used by the participants in comparison to the remaining applications.

5.5.2 Verifying Data Characteristics

During the data collection process the survey system automatically verified whether the data sets were complete, and alerted users if any questions were left unanswered. As a result, all 234 data sets that passed the first screening were complete and there was no need to carry out a missing data analysis (Hair, Anderson et al. 1995; Carver 2005; Field 2009).

Since some statistical tests assume normal data distributions, normality is an important issue to be examined during data analysis (Field 2009). Normality of the data is usually verified using the Kolmogorov-Smirnov and Shapiro-Wilk tests as well as by calculating skewness and kurtosis ratings (Hair, Anderson et al. 1995; Field 2009). Skewness is a measure of the asymmetry of a distribution while Kurtosis measures the degree to which scores cluster in the tails of a distribution (Hair, Anderson et al. 1995;

Field 2009). Most authors consider that a data set is normally distributed if the skewness and kurtosis ratings are within the +2 to -2 range; while some others indicate that +3 to -3 for kurtosis still is acceptable (Hair, Anderson et al. 1995; Carver 2005; Tabachnick and Fidell 2007; Field 2009). While scores outside of this range may have the potential to restrict the data analysis and subsequent interpretation of results, it is known that for samples (200+) this risk is reduced (Tabachnick and Fidell 2007).

The results of the Kolmogorov-Smirnov and Shapiro-Wilk tests, together with the skewness and kurtosis ratings indicated that the data was not normally distributed. Over 50% of the items presented skewness and kurtosis above the recommended thresholds (Carver 2005).

In some cases, it is recommended to try to normalize data through transformation procedures (Hair, Anderson et al. 1995). Although data transformation procedures to normalize the data may facilitate data analysis in some cases, it can restrict and alter subsequent interpretation of the results and therefore should not be conducted unnecessarily (Hair, Anderson et al. 1995).

After careful consideration, it was decided to proceed without attempting to normalize data. First, analysis with PLS is not constrained by the need of normally distributed variables. Second, during confirmatory factor analysis, non-parametric Spearman correlations were used instead of Pearson correlations. Third, after further examination (presented in the section below) the data of the sample were found adequate for exploratory factor analysis (Chin 1998; Gefen, Straub et al. 2000; Gefen and Straub 2005; Field 2009).

Another important issue to consider is non-response bias (Field 2009). Two sub-samples were created based on the order of questionnaire completion. The first included the first 50 people that responded the survey, while the second consisted of the last 50 respondents (Churchill 1979). Early and late respondents were compared using a two-tailed t-test at 5% significance level (Field 2009). Out of the 71 measurement items, only four (TRJ09, SDJ05, JS05 and EE03) presented some degree of statistical difference between the two groups. There were no significant differences with respect to respondent profile. The overall results comparing the two sub-groups indicate that there is not evidence of any substantial differences among them in order to raise significant concerns regarding non-response bias in the pilot study (Hair, Anderson et al. 1995; Field 2009).

Finally, as with all self-reported data, the issue of potential for common method biases was investigated (Podsakoff, Podsakoff et al. 2003; Liang, Saraf et al. 2007; Brannick, Chan et al. 2010). To that end a Harman one-factor test was conducted (Podsakoff, Podsakoff et al. 2003). Results from this test showed that 16 factors were present and the most covariance explained by one factor was 20%, indicating that common method biases are not a likely contaminant of our results (Liang, Saraf et al. 2007; Brannick, Chan et al. 2010).

5.5.3 First Reliability Assessment

Reliability measures the degree of correlation between items within an individual construct (Straub, Boudreau et al. 2004). Straub (1989) points out that reliability refers to the extent to which the respondent can answer the same questions or close approximations in the same way each time, in order words, it evaluates consistency and accuracy. While reliability may be calculated in a number of ways, the most commonly accepted measure in field studies is internal consistency reliability using Cronbach's α (Cronbach 1971; Hinkin 1998). In the specific case of IS research, nearly all IS researchers prefer internal consistency statistics for reliability testing (Straub, Boudreau et al. 2004). The generally agreed upon lower limit for Cronbach's alpha is 0.7 but it may lowered to 0.6 in exploratory research (Straub 1989; Hair, Anderson et al. 1995; Carver 2005). While low Cronbach's α (lower than 0.60) may indicate poor construct definition or a multidimensional construct, a very high Cronbach's α (above 0.95) may suggest the presence of common methods bias (Straub, Boudreau et al. 2004).

Cronbach's α was calculated using SPSS 16 and a $0.7 < \alpha > 0.95$ threshold was adopted. Table 5.32 presents the summary of the initial reliability test.

In the table below, Cronbach's α = 0.84;0.89, for example, represent the initial and final alpha scores. All final Cronbach's α scores resulted within the expected range (Moore and Benbasat 1991). However, eleven items were pinpointed for possible exclusion because they presented a correlation below the .40 threshold: TRJ 09, SDPJ 05, JS 08, JI 01, JI 02, JI 05, SP 04, SP 07, SP08 and PE 04. A detailed analysis and discussion regarding the exclusion of each individual item will be presented later in this chapter.

Table 5.32 First Reliability Assessment

Item	Item-Total Correlation	Cronbach's α if Item Deleted
TRJ –11 items - Cronbach's α= 0.843; 0.901		
TRJ1	.625	.820
TRJ2	.683	.816
TRJ4	.584	.824
TRJ5	.657	.820
TRJ6	.542	.829
TRJ7	.651	.819
TRJ8	.668	.818
TRJ9_rc	*-.240*	*.901*
TRJ10	.622	.821
TRJ11	.677	.816
TRJ12	.665	.817
JS – 8 items - Cronbach's α= 0.891; 0.923		
JS1	.735	.870
JS2	.763	.867
JS3	.784	.865
JS4	.754	.868
JS5	.754	.868
JS7_rc	*.297*	*.905*
JS8_rc (2)	*(.362) .441*	*(.923) .896*
JS9	.753	.868
PINMIS – 8 items - Cronbach's α= 0.950; .950		
PINMIS1	.861	.941
PINMIS2	.841	.942
PINMIS3	.876	.940
PINMIS4	.862	.941
PINMIS5	.846	.942
PINMIS6	.661	.954
PINMIS11	.819	.944
PINMIS13	.781	.946
PE– 4 items - Cronbach's α= 0.756; 0.883		
PE1	.611	.677
PE2	.730	.598
PE3	.732	.605
PE4	*.266*	*.883*
EE – 4 items - Cronbach's α= 0.908; 0.908		
EE1	.740	.899
EE2	.812	.874
EE3	.866	.854
EE4	.753	.895

Item	Item-Total Correlation	Cronbach's α if Item Deleted
SDJ – 6 items - Cronbach's α= 0.785; 0.785		
SDJ1_rc	.536	.752
SDJ2	.596	.737
SDJ3_rc	.541	.751
SDJ4	.613	.733
SDJ5	.521	.755
SDJ6_rc	.402	.783
SDPJ – 8 items - Cronbach's α= 0.811; 0.822		
SDPJ1_rc	.589	.781
SDPJ2	.594	.779
SDPJ3	.623	.775
SDPJ4_rc	.485	.795
SDPJ5	*.307*	*.822*
SDPJ6	.563	.784
SDPJ7_rc	.573	.783
SDPJ8_rc	.494	.794
JI – 11 items - Cronbach's α= 0.844; 0.890		
JI1_rc	*.293*	*.854*
JI2_rc (3)	*(.399) .566*	*(.890) .829*
JI3	.588	.826
JI4	.691	.821
JI5_rc (2)	*(.343) .390*	*(.871).848*
JI6a	.671	.820
JI6b	.595	.824
JI8	.671	.823
JI9	.480	.834
JI10	.709	.821
JI11	.495	.834
SP – 8 items - Cronbach's α= 0.715; 0.818		
SP1	.534	.666
SP2	.622	.654
SP3_rc	.550	.653
SP4	*.186*	*.735*
SP5_rc	.464	.674
SP6	.618	.652
SP7_rc (2)	*(.286) .290*	*(.749) .716*
SP8 (3)	*(.102).180*	*(.818) .735*
IU – 3 items - Cronbach's α= 0.927; 0.927		
IU1	.806	.928
IU2	.923	.833
IU3	.825	.913

Notes: "rc" denotes reverse coded items; bold items presented low correlation; "(2) or (3)" specifies the item was excluded on the second or third round of reliability tests

5.5.4 Exploratory Factor Analysis

The next step to refine the measurements involves exploratory factor analysis (EFA) (Straub 1989; Moore and Benbasat 1991; Hinkin 1998; Hinkin and Tracey 1999; Straub, Boudreau et al. 2004). EFA is a widely utilized and broadly applied statistical technique in the social sciences (Costello and Osborne 2005). Conway and Huffcutt (2003) point out that EFA can be used for data reduction by simply taking a fairly large set of variables and reducing them to a smaller, more manageable number while retaining as much of the original variance as possible. However, EFA is a complex procedure with few absolute guidelines and many options (Costello and Osborne 2005). The EFA procedures described here were computed using SPSS 16.

There are many issues confronting users of EFA such as determining the suitability of the data for factor analysis, deciding the factor extraction method, choosing the number of factors to retain, and selecting the method for rotating factors.

Determining the suitability of the data for factor analysis can be achieved by analyzing the sample size in relation to number of variables, examining the intercorrelations of the entire correlation matrix, using Bartlett's Test of Sphericity, and using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Field 2009). It was already discussed and determined in section 5.5 that the sample size of 234 respondents in this pilot can be considered adequate as it fell within recommended guidelines for EFA (Tabachnick and Fidell 2007). The result of Bartlett's Test of Sphericity should be below the 0.05 significance level to indicate that sufficient correlations exist among the items. On the other hand, the Kaiser-Meyer-Olkin test measures the sampling adequacy, which should be greater than 0.5 for a satisfactory factor analysis to proceed (Hair, Anderson et al. 1995; Field 2009).

As shown on Table 5.33, the KMO measure for this sample is acceptable and close to ideal (0.85) and the significance level of the Bartlett's Test (0.00) indicates that the overall intercorrelations assumptions are met.

Table 5.33 KMO and Bartlett's Test

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.85
Bartlett's Test of Sphericity	
Approx. Chi-Square	12250.206
df	2485
Sig.	.000

Once the data were considered appropriate for conducting EFA, the next issue to be dealt with was deciding the factor extraction method. There are several factor analysis extraction methods to choose from, and information on the relative strengths and weaknesses of each technique is scarce, often only available in obscure references (Costello and Osborne 2005). Most extraction methods can be classified as either a common factor model or as a components model. According to Conway and Huffcutt (2003), the purpose of common factor models such as maximum likelihood and principal axis factoring is to understand the latent variables that account for the observed relationships among measured variables. On the other hand the goal of components models such as Principal Component Analysis (PCA) is simply to reduce the number of variables by creating linear combinations that retain as much of the original measures' variance as possible. Since the goal of the EFA is to refine the measures and reduce the number of items, PCA was chosen as the most appropriate method of extraction.

The next issue is deciding the number of factors to extract. In the literature, there is no agreement concerning the most appropriate way to determine the number of factors to be extracted in an EFA (Conway and Huffcutt 2003; Hayton, Allen et al. 2004). Some of the methods available include Kaiser's "eigenvalues greater than one" rule, scree plot tests, parallel analysis and a priori theory (Field 2009). It is recommended that researchers not rely on a single method, rather, use a combination of techniques to determine the number of factors to be extracted (Costello and Osborne 2005).

Kaiser's "eigenvalues greater than one" rule is the default setting in most software packages and coincidently the most commonly used technique to determine number of components in an EFA (Conway and Huffcutt 2003). For the pilot data set, analysis of the eigenvalues and total variance explained suggested a total of 16 components (Table 5.34). This result is supported by the literature where ample research shows that the commonly used eigenvalues greater than one rule tends to produce a larger number of factors (Conway and Huffcutt 2003). However, despite the high number of factors suggested by this method, it is desirable to report the PCA results using the eigenvalues greater than one rule in order to produce a benchmark with the existing literature (Field 2009).

The literature points out that for PCA, parallel analysis can be generally the most accurate way to determine the number of factors (Conway and Huffcutt 2003; Hayton, Allen et al. 2004; Costello and Osborne 2005). The basic rationale for parallel analysis is that nontrivial components from real data with a valid underlying factor structure should have larger eigenvalues than parallel components derived from random data having the same sample size and number of variables (Hayton, Allen et al. 2004). Parallel analysis was conducted according to Hayton, Allen et al (2004) based on 71 variables, 234 respondents and 100 interactions. The comparison between the actual eigenvalues from the PCA and the criterion values from the parallel analysis is shown in Table 5.34.

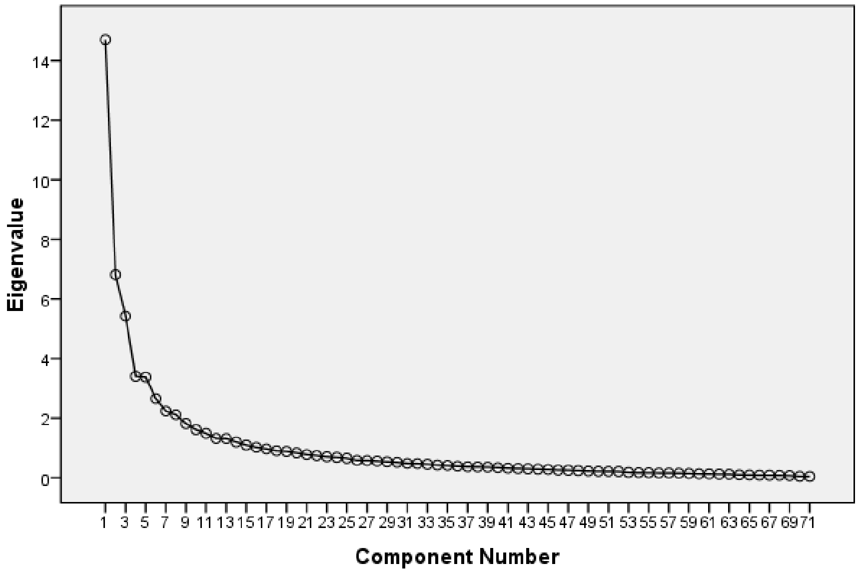
Table 5.34 Parallel Analysis

Factor	Eigenvalue PCA	Random Eigenvalue Parallel Analysis
1	14.70	2.31
2	6.81	2.18
3	5.42	2.10
4	3.40	2.03
5	3.37	1.96
6	2.65	1.91
7	2.24	1.85
8	2.11	1.81
9	1.81	1.76
10	1.61	1.71
11	1.490	1.67
12	1.320	1.58
13	1.316	1.55
14	1.199	1.51
15	1.096	1.47
16	1.020	1.44
. .	. .	. .

This test suggests a smaller number of factors than the previous test. Based on the results of parallel analysis, nine factors would be retained.

The next procedure was to deploy Cattell's scree plot test (Hair, Anderson et al. 1995). It consists of plotting a graph containing the eigenvalues of the factors and trying to identify a point on the curve where the smooth decrease of eigenvalues appearing to level off towards the right side of the plot (Hair, Anderson et al. 1995). Due to the proximity of the points in the plotted curve the result of this test was a bit inconclusive, perhaps 8 or 9 items should be retained (Figure 5.4).

Figure 5.4 Scree Plot



Another method for determining the number of factors is based on a priori theory (Hair, Anderson et al. 1995; Conway and Huffcutt 2003). Given the lack of convergence among the techniques described above and the risk of including factors without sufficient theoretical justification, the a priori theory approach would argue for extracting the number of factors (ten) initially hypothesized in Chapter 3.

Finally, the method of rotation needs to be selected. The goal of rotation is to simplify and clarify the data structure (Carver 2005). There are two categories of rotation. Orthogonal rotations produce factors that are uncorrelated, while oblique methods allow the factors to correlate (Field 2009). Varimax rotation (orthogonal) is by far the most common method of rotation described in the literature since it produces a clearer and simpler structure in a single matrix which is easier to interpret (Costello and Osborne 2005). However, using orthogonal rotation may result in a loss of valuable information if the factors are correlated. In that case, oblique rotations such as direct oblimin, quartimin, and promax should theoretically render a more accurate solution (Conway and Huffcutt 2003). The downside is that oblique rotation output is more complex than orthogonal rotation output (Field 2009). Direct oblimin is the most popular oblique rotation and the results are displayed in two matrices (pattern and structure).

Field (2009) suggests that orthogonal and oblique rotations should be conducted jointly in order to evaluate which produces a clearer and simpler factor structure. In this research, Field’s (2009) suggestion to carry out both orthogonal varimax rotation and oblique direct oblimin rotation is adopted.

The final step before running an EFA is to define the parameters for item deletion. Aligned with the current IS literature, this study considered significant for EFA purposes a factor component loadings of 0.60 or higher and factor cross-loadings lower than 0.4 (Straub, Boudreau et al. 2004; Field 2009).

In summary, the following factor extraction rules were implemented:

- Factor extraction method: Principal Component Analysis
- Number of factors to retain: Eingenvalue>1 and 10 hypothesized factors
- Rotation method: Varimax and Oblimin Direct
- Factor loading threshold: 0.6
- Crossloading Threshold: 0.4

Given the investigative nature of EFA, in addition to different rotation and factor retention criteria, it was decided to run three different EFA analyses: 1) containing all 71 items; 2) excluding the 11 items pinpointed in the preliminary reliability analysis (60 items); and 3) dividing the model into two sub-sets (left and right) in order to observe items loadings with a simpler structure and smaller set of factors. The ‘left’ side of the model includes the temporospatial and structural characteristics of work factors (TRJ, SDJ, LD, RT, IN) and PINMIS. The ‘right’ side of the model includes PINMIS, SP, EE, PE and IU. Table 5.35 presents a summary of the parameters used during EFA.

Table 5.35 Summary of Parameters used during EFA

Rotation	Number of Items	Factors Retained	Output
Varimax	71 items	Eigenvalue>1	Rotated Component Matrix
		10 hypothesized factors	
	60 items	Eigenvalue>1	
		10 hypothesized factors	
	Left Side	Eigenvalue>1	
	Right Side	Eigenvalue>1	
Oblimin Direct	71 items	Eigenvalue>1	Pattern and Structure Matrices
		10 hypothesized factors	
	60 items	Eigenvalue>1	
		10 hypothesized factors	

This process involved at least ten PCA solutions resulting in more than 14 component matrices which produced rich raw material for analysis and decision making in regards to measurement purification (Field 2009). The discussion of the results of this series of PCAs is presented individually for each construct (see Table 5.36 for PINMIS). Due to limitations of space, only the initial rotated component matrix (varimax, eigenvalue>1, 71 items) as well as the pattern and structure matrices (oblimin, 10 fixed factors, 71 items) have been included in Appendix 5. The other matrices can be made available upon request. Overall, the varimax rotation using a fixed number of factors seemed to produce better solutions with a clearer factor structure.

Table 5.36 EFA results for PINMIS

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	10	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
PINMIS1		P	P	P	P	P	P	P	P	P	P	P	P	P	P	keep
PINMIS2		P	P	P	P	P	P	P	P	P	P	P	P	P	P	keep
PINMIS3		P	P	P	P	P	P	P	P	P	P	P	P	P	P	keep
PINMIS4		P	P	P	P	P	P	P	P	P	P	P	P	P	P	keep
PINMIS5		P	P	P	P	P	P	P	CL-IU(.47)	P	CL-IU(.43)	P	CL-IU(.49)	P	CL-IU(.45)	keep
PINMIS6		P	P	P	P	P	P	P	P	P	P	P	P	P	P	keep
PINMIS11		P	P	P	P	P	P	P	CL-IU(.53)	P	CL-IU(.48)	P	CL-IU(.55)	P	CL-IU(.48)	keep
PINMIS13		P	P	P	P	P	P	P	CL-IU(.40)	P	P	P	CL-IU(.42)	P	CL-IU(.41), SDJ(.42)	keep

The table above presents the results for the PINMIS construct. "**P**" indicates that the item passed the requirements, loading in the theoretical construct with loadings higher than 0.6 and crossloadings lower than 0.4. All items that presented issues are shadowed. "**CL**" specifies a crossloading over 0 .4. For example, "CL- IU (.48)" refers to a crossloading with IU of 0.48.

Overall, the PIMIS construct performed well, especially with varimax rotations, most items loading between 0.7-0.9. However in the solutions using varimax PE 02 and 03 tended to cluster with PINMIS with loadings of 0.5 and crossloading with IU with scores of 0.4. A discussion about the issues found with PE is presented later in this section.

PINMIS 05, 11, 13 crossloaded with IU in the structure solutions from oblimin rotations. It was decided not to eliminate these items at this moment since, in the solutions in which that crossloading was detected, the items consistently loaded in the PIMINS construct with scores around 0.8. In addition in the structure matrices from oblimin rotations IU seemed to cluster with weaker loading of PE 01, 02 and 03.

Table 5.37 presents the results for TRJ. It uses the same legend used in the table above. “L (.x)” indicates a weak loading (below 0.6) and the number between brackets indicates the actual loading. In cases where the loading was slightly above 0.6 are indicated by P (.60). “**F**” indicates the items loaded into a non-specified component (“rubbish”). For example “F16 (.60)” indicates the items loaded into the 16th component of the solution with a loading of 0.6. Finally “X” in the α column indicates the item presented reliability issues.

Table 5.37 EFA results for TRJ

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	10	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
TRJ1		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
TRJ2		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
TRJ4		L (.59)	P (.61)	L (.59)	P (.60)	P (.60)	N/A	L (.52)	P	L (.59)	P	L (.54)	P	L (.54)	P	drop
TRJ5		P (.63)	P	P	P	P (.60)	N/A	F15 (.55)	F15 (.68)	P	P	L (.51)	P	P	P	drop
TRJ6		F16 (.56)	L (.57)	L (.55)	L (.57)	F9 (.60)	N/A	F15 (.67)	F15 (.75)	L (.54)	P (.61)	F11 (.40)	L (.55)	L (.54)	P (.62)	drop
TRJ7		P	P	P	P	P	N/A	L (.58)	P	P	P	P	P	P	P	keep
TRJ8		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
TRJ9rc	X	F11 (.51)	F9 (59)	N/A	N/A	N/A	N/A	F10 (.46)	F10 (.51)	F10 (.58)	F10 (.61)	N/A	N/A	N/A	N/A	drop
TRJ10		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
TRJ11		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
TRJ12		P	P	P	P	P	N/A	L (.56)	P	P	P	P	P	P	P	keep

Four items were pinpointed for exclusion. TRJ 04 (*I frequently perform urgent work tasks*) did not seem to work well, presenting weak loadings across the board. TRJ 05 (*My job frequently requires that I start tasks on time*) and TRJ 06 (*My job frequently requires that I complete tasks on time*) also presented a weak loading or loaded separately. Perhaps the term “on time” allowed divergent interpretations. TR 09 (*I* *perform most of my work tasks whenever I want*) evidenced weak loading and poor reliability, probably because it refers to temporal freedom.

Table 5.38 EFA results for SDJ

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	10	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
SDJ1rc		Pb	SDPJ (.41)	Pb	L (.54)	Pb	N/A	Pb	Pb	La (.36)	La (.43)	F11 (.66)	Pb	Lb (.48)	Lb (.50)	Stat
SDJ2		Pa	P	Pa	P	Pa	N/A	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Disp
SDJ3rc		Pb	SDPJ (.52)	Pb	L (.52)	Pb	N/A	Pb	Pb	SDPJ (.84)	SDPJ (.56)	F11 (.58)	Pb	Lb (.58)	Lb (.50)	Stat
SDJ4		Pa	P	Pa	P	Pa	N/A	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Disp
SDJ5		Pa	P	Pa	P	Pa	N/A	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Pa	Disp
SDJ6rc		F16 (.55)	PINMIS (.38)	La (.39)	L (.42)	L a(.42)	N/A	F10 (.39)	La (.38)	PINMIS (.32)	PINMIS (.39)	SDPJ (.46)	La (.46)	Lb (.51)	Lb (.50)	Stat

Table 5.38 presents the results for SDJ. In this case the construct clustered in two separate factors (indicated by 'a' and 'b' in the table above). SDJ 01(*My job generally requires me to perform my work tasks at the same location*), SDJ 03 (*My work tasks frequently require me to stay in the same specific location*) and SDJ 06 (*My job seldom requires me to change the location where I perform my work tasks*) refer to 'lack of location variety'. It was expected that these items (reverse coded) would cluster with items referring to "location variety", which did not occur. Consequently it was decided to split 'spatial dispersion of job' into two factors: 'dispersion,' containing items SDJ02, 04 and 05, and a new variable (perhaps called 'stationarity') composed of SDJ 01, 03 and 06 -- which no longer need to be reverse coded.

Table 5.39 EFA results for SDPJ

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	10	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
SDPJ1rc		P (.60)	L (.56)	L (.57)	Pa (.60)	P (.60)	N/A	L (.52)	L (.58)	P (.60)	P (.62)	La (.46)	La (.58)	P	P	drop
SDPJ2		P	P	Pb	Pb	Pb	N/A	P	P	P	P	Pb	Pb	P	P	Dep
SDPJ3		P	P	Pb	Pb	Pb	N/A	P	P	P	P	Pb	Pb	P	P	Dep
SDPJ4rc		F14 (.40)	F9 (.63)	Pa	Pa	Pa	N/A	F10 (.55)	F10 (.62)	F10 (.54)	F10 (.61)	Pa	Pa	L (.57)	P (.61)	Free
SDPJ5	X	F12 (.60)	L (.49)	N/A	N/A	N/A	N/A	F11 (.64),	F12 (.65)	L (.49)	L (.51)	N/A	N/A	N/A	N/A	drop
SDPJ6		P	P	Pb	Pb	Pb	N/A	P	P	P	P	Pb	Pb	P	P	Dep
SDPJ7rc		L (.56) F13 (.43)	F9 (.53)	Pa	Pa	Pa	N/A	F10 (.61)	F10 (.40)	L (.55)	L (.58)	Pa	Pa	P	P	Free
SDPJ8rc		L (.36)	F9 (.43)	Pa (.63)	Pa (.62)	Pa	N/A	F10 (.32)	F10 (.62)	L (.40)	L (.48)	La (.57)	Pa	L (.56)	P (.62)	Free

Similarly to SDJ, the SDPJ construct tended to cluster into two separate factors (Table 5.39). Items related to spatial freedom/independence (reverse coded) (SDPJ 01, 04, 07 and 08) did not cluster with the remaining items from SDPJ related to spatial dependence. Therefore it was decided that spatial freedom and spatial dependence should be further explored as two separate constructs. In addition, SDPJ 01 (*I can perform most of my work tasks independently of location*) should be watched closely due to borderline loadings and SDPJ 05 (My *job generally requires me to perform my work tasks at specific locations*) should possibly be excluded due to weak loading and poor reliability.

Table 5.40 EFA results for JS

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	10	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
JS1		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JS2		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JS3		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JS4		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JS5		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JS7rc	X	F11 (.74)	F9 (.42)	N/A	N/A	N/A	N/A	F16 (.78)	F16 (.81)	F10 (.42)	F10 (.40)	N/A	N/A	N/A	N/A	drop
JS8rc	X	F11 (.65)	F9 (.47)	N/A	N/A	N/A	N/A	F16 (.61)	F16 (.72)	F10 (.39)	F10 (.46)	N/A	N/A	N/A	N/A	drop
JS9		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep

As illustrated on Table 5.40, Job Structuredness performed well with the exception of JS 07 (*I frequently deal with ill-defined business problems*) and JS 08 (*I frequently deal with ad-hoc business problems*). These two items were originally borrowed from “non-routineness” from Goodhue and Thompson (1995) and presented weak loadings and poor reliability.

Table 5.41 EFA results for JI

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	e>1	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
JI1rc	X	F10 (.67)	JS (.33)	N/A	N/A	N/A	N/A	F11 (.69)	F11 (.71)	JS (.30)	JS (.35)	N/A	N/A	N/A	N/A	drop
JI2rc	X	F10 (.75)	L (.47)	N/A	N/A	N/A	N/A	F11 (.74)	F11 (.81)	L (.44)	L (.51)	N/A	N/A	N/A	N/A	drop
JI3		L (.56)	P	P	P	P	N/A	L (.44)	P	P	P	P	P	P	P	keep
JI4		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JI5rc	X	F10 (.61)	F9(.48)	N/A	N/A	N/A	N/A	F11 (.59)	F11 (.53)	F10 (.40)	F10 (.46)	N/A	N/A	N/A	N/A	drop
JI6a		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JI6b		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JI8		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JI9		P (.63)	P (.62)	P (.60)	P (.62)	P (.62)	N/A	P	P	P	P	L (.56)	P (.63)	P	P	keep
JI10		P	P	P	P	P	N/A	P	P	P	P	P	P	P	P	keep
JI11		L (.52)	L (.55)	L (.57)	L (.55)	L (.58)	N/A	L (.44)	L (.57)	L (.52)	P (.61)	L (.54)	P (.63)	L (.52)	P (.61)	drop

Table 5.41 presents the results for Job Interdependence. It seems that independence (reverse coded) does not correlate to INTERdependence. JI 01(*Most of my work tasks frequently can be performed independently of others*) JI 02 (*Most of my work tasks frequently can be planned with little need to coordinate with others*), and JI 05(*My job is generally independent of the jobs of other individuals or organizational units*) presented weak loadings in addition to poor reliability scores. JI 11(*Most of my work*

tasks frequently require me to provide information to others) also did not perform well with weak loadings across the board.

Table 5.42 EFA results for SP

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	e>1	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
SP1		P	P	P	P	N/A	Pa	P	P	P	P	Pa	Pa	P	P	keep
SP2		P	P	P	P	N/A	Pa	P	P	P	P	Pa	Pa	P	P	keep
SP3rc		P	P	F12 (.75)	P	N/A	F5 (.74)	L (.58)	P	P	P	Pb	Pb	P	P	test
SP4	X	F13 (.66)	L (.32)	N/A	N/A	N/A	N/A	F10 (.51)	F10 (.49)	F10 (.35)	F10 (.32)	N/A	N/A	N/A	N/A	drop
SP5rc		P	P	F12 (.76)	P	N/A	F5 (.75)	L (.53)	P	P	P	Pb	Pb	P	P	test
SP6		P	P	P	P	N/A	P	P	P	P	P	Pa	Pa	P	P	keep
SP7rc	X	F15 (.79)	L (.38)	N/A	N/A	N/A	N/A	F10 (.79)	F10 (.80)	L (.38)	L (.39)	N/A	N/A	N/A	N/A	drop
SP8	X	F14 (.59)	JS (.29)	N/A	N/A	N/A	N/A	F13 (.55)	F13 (.58)	IU (.27)	RT (.29)	N/A	N/A	N/A	N/A	drop

The SP items referring to portability (SP 01, 02, 06) performed very well (Table 5.42). On the other hand, software portability did not surface as a sub-dimension of system portability. Items SP 07 (*Mobile applications provide very limited functionalities in comparison to applications on a PC*) and SP08 (*The mobile applications also available on PCs have been well adapted for use on mobile devices*) did not pass the reliability tests and presented weak loadings throughout the PCA. In addition, with regards to physical aspects of mobile devices, the term "robust" (on SP 04), suggested by Gebauer and Ginsburg (2009), did not produce positive results. The terms "big" (SP 05) and "heavy" (SP 03) produced slightly better results, but they loaded separately from the other SP items in some solutions, suggesting the need to further investigate them.

Table 5.43 EFA results for PE

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	e>1	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
PE1		IU (.58) PN (.41)	IU (.54), PN(.41)	IU (.60)	IU (.59)	N/A	IU (.69)	IU (.56)	IU (.77)	IU (.52)	IU (.70)	IU (.58)	IU (.79)	IU (.57)	IU(.78)	keep
PE2		PN (.55), IU (.42)	PN (.58),IU(.45)	PN(.57);IU(.45)	PN (.57);IU (.45)	N/A	IU (.59)	IU (.40)	PN (.61), IU(.61)	PN (.46)	IU (.63)	IU (.44)	IU (.69)	PN (.46), IU (.43)	PN (.63), IU(.63)	keep
PE3		PN (51), IU (.44)	PN (.55), IU(.43)	PN(.52); IU(.47)	PN (.52); IU (47)	N/A	IU (.53)	IU (.41)	IU (.66)	PN (.42)	IU (.61)	IU (.44)	IU (.63)	IU (.43)	IU (.68)	keep
PE4	X	F14 (.59)	PN (.35)	N/A	N/A	N/A	F5 (.61)	F13 (.65)	F13 (.62)	PN (.32)	PN (.34)	N/A	N/A	N/A	N/A	keep

Surprisingly PE was the construct that presented the most issues (Table 5.43). Item PE 04 (*If I use the mobile information system, I will increase my chances of getting a raise*) presented a low reliability score, quite weak loadings and did not cluster with other PE items. The item originated from the variable 'outcome expectations' (Compeau and Higgins 1995; Compeau et al 1999) and has been mostly tested in North American settings. Perhaps this item does not perform well in New Zealand where immediate financial reward on short-term performance (such as bonus and tips) is not a part of the remuneration culture. Items PE 01, 02 and 03 did not load as a PE construct and its loadings were spread between IU and PIMNIS. An additional PCA (varimax, eignevalue>1) was run of the right side of the model without PINMIS and SP, just containing the UTAUT constructs (PE, EE and IU). The PE items still did not load on its own factor, clustering instead with UI. Perhaps this indicates these three constructs from the UTAUT do not perform well (as a subset) without the rest of the components of the original model (Venkatesh, Morris et al. 2003). Even though the goal of this research does not include a detailed examination of the UTAUT constructs, an interesting proposition would be to incorporate the original TAM constructs (ease of use and perceived usefulness) into the main study and examine their performance, as compared to their UTAUT counterparts, in conjunction to PINMIS and SP.

Table 5.44 EFA results for EE

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	e>1	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
EE1		P	P	P	P	N/A	P	P	P	P	P	P	P	P	P	keep
EE2		P	P	P	P	N/A	P	P	P	P	P	P	P	P	P	keep
EE3		P	P	P	P	N/A	P	P	P	P	P	P	P	P	P	keep
EE4		P	P	P	P	N/A	P	P	P	P	P	P	P	P	P	keep

Table 5.44 presents the results for EE. All items performed well across the various EFA analyses. In addition, the items from IU also performed well, however the construct tended to 'drag' PE 01, 02 and 03 with loadings of 0.4-0.5 into the same factor (Table.5.45). This will be further investigated in the main study with addition of the original TAM items.

Table 5.45 EFA results for IU

Item	α	Varimax						Oblimin								Res.
		71 items		60 items		left side	right side	71 items				60 items				
		e>1	10	e>1	10	e>1	e>1	eigen>1		10 factors		eigen>1		10 factors		
								Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	Pat.	Struc.	
IU1		P	P	P	P	N/A	P	P	P	P	P	P	P	P	P	keep
IU2		P	P	P	P	N/A	P	P	P	P	P	P	P	P	P	keep
IU3		P	P	P	P	N/A	P	P	P	P	P	P	P	P	P	keep

The EFA was a long process which revealed some interesting results. The recommendations which emerged from this procedure will be analysed in the next section alongside other measure refinement techniques in order to produce a final set of items for the main study.

5.5.5 Confirmatory Factor Analysis

There is no clear direction in the literature whether researchers should or should not combine exploratory and confirmatory factor analyses (Hinkin 1998; Conway and Huffcutt 2003; Gefen and Straub 2005). Conway & Huffcutt (2003) point out that researchers should carefully consider whether EFA is appropriate in first place (e.g., whether there is a clear expectation about the factor pattern) and suggest that, if that is the case, then confirmatory factor analysis (CFA) probably provides a better approach for existing instruments since it takes sampling error into account more effectively than EFA does. Since the current research aims to develop new constructs and also used existing items, using both, EFA and CFA, was considered appropriate.

Differently from EFA, in CFA the expected pattern of loadings of the measurement items on the latent constructs are clearly determined by the model (Gefen and Straub 2005). Structural equation modelling tools such as LISREL and PLS are used for CFA and the establishment of factorial validity (Chin 1998; Gefen, Straub et al. 2000).

In PLS, factor validity is examined through convergent validity and discriminant validity (Gefen and Straub 2005). Convergent validity refers to the extent to which two different measures of the same concept or construct agree (Baggozi 1993). In other words, convergent validity is shown when each measurement item correlates strongly with its assumed theoretical construct by loading with a significant t-value on its latent construct.

On the other hand, discriminant validity verifies whether participants have responded to questions on two supposedly distinct constructs in such a similar manner that there is no empirical evidence that two different things are actually being measured (Straub 1989). Gefen and Straub (2005) state that discriminant validity is shown when two things happen:

a) the correlation of the latent variable scores with the measurement items show an appropriate pattern of loadings, one in which the measurement items load highly on their theoretically assigned construct and not highly on other factors; and

b) an appropriate analysis of average variance extracted (AVE) is carried out. The AVE measures the variance captured by a latent construct. Constructs with AVE values less than 0.50 are candidates for deletion since they do not add much in the way of explanatory value.

The first step in conducting the CFA is to load the measurement model into the SEM software. In this case, PLS-Graph 3.0 was the tool used and two models were uploaded. The first model was based in the original research model and contained the 71 items used in the pilot study; and the second model was a refined version following the results of the EFA presented perviously.

The next step was to evaluate the loadings for all of the measurement items according to their specific constructs. Item loadings represent the correlation coefficients between the indicator and the construct. In the literature, there are not universally established thresholds for item loadings in PLS. However, many authors suggest that loadings greater than 0.60 are acceptable when new items or scales being developed. Loadings above 0.70 are considered ideal (Straub, Boudreau et al. 2004; Marcoulides, Chin et al. 2009). As a result, items loading lower than 0.60 were eliminated. The results of the two models were compared and a converged measurement model (1st refinement) was elaborated. The CFA was repeated and a refined measurement model was generated (2nd refinement). Discriminant and convergent validities were assessed for the final set of items. Reliability was estimated by Cronbach's α and by composite reliability (CR) scores with a threshold of 0.70 (Cronbach 1971; Fornell and Bookstein 1982; Field 2009).

Finally, the items remaining in the second refinement were also submitted to a new EFA exercise (column EFA II). The results of this process will be presented individually for each construct. Table 5.46 show the results for PINMIS.

Table 5.46 CFA results for PINMIS

Item	α	EFA I	PLS		Analysis	PLS		EFA II	Final
			Original	PCA		1st refine	2nd refine		
PINMIS1		keep	0.89	0.89	keep	0.89	0.89	0.88	keep
PINMIS2		keep	0.87	0.87	keep	0.87	0.87	0.83	keep
PINMIS3		keep	0.90	0.90	keep	0.90	0.90	0.87	keep
PINMIS4		keep	0.90	0.90	keep	0.90	0.90	0.85	keep
PINMIS5		keep	0.90	0.90	keep	0.90	0.90	0.80	keep
PINMIS6		keep	0.71	0.71	keep	0.71	0.71	0.72	keep
PINMIS11		keep	0.88	0.88	keep	0.88	0.88	0.78	keep
PINMIS13		keep	0.85	0.85	keep	0.85	0.84	0.73	keep

The items measuring the PINMIS construct presented excellent results in all respects (CR= 0.959, AVE =0.747, α=0.950). The original construct and the eight associated items did not require any modifications.

Table 5.47 CFA results for TRJ

Item	α	EFA I	PLS		Analysis	PLS		EFA II	Final
			Original	PCA		1st refine	2nd refine		
TRJ1		keep	0.77	0.80	keep	0.78	0.79	0.71	keep
TRJ2		keep	0.80	0.83	keep	0.81	0.81	0.75	keep
TRJ4		drop	0.73	N/A	keep	0.74	0.76	0.62	keep
TRJ5		drop	0.69	N/A	keep	0.68	N/A	N/A	drop
TRJ6		drop	0.60	N/A	drop	N/A	N/A	N/A	drop
TRJ7		keep	0.69	0.71	keep	0.69	0.68	0.72	keep
TRJ8		keep	0.68	0.71	keep	0.69	0.69	0.75	keep
TRJ9rc	X	drop	-0.37	N/A	drop	N/A	N/A	N/A	drop
TRJ10		keep	0.72	0.75	keep	0.73	0.73	0.70	keep
TRJ11		keep	0.78	0.81	keep	0.80	0.82	0.76	keep
TRJ12		keep	0.71	0.71	keep	0.72	0.71	0.72	keep

TRJ 09 (I perform most of my work tasks whenever I want) was originally developed to capture temporal independence, while TRJ 05 (My job frequently requires that I start tasks on time) and TRJ 06 (My job frequently requires that I complete tasks on time) aimed to capture punctuality. The three items did not seem to contribute much to the construct and were eliminated (Table 5.47). The remaining eight items, mostly referring to urgency and duration performed well and were taken to the next phase (CR = 0.911, AVE = 0.562, α=0.890).

Table 5.48 CFA results for SDJ

Item	α	EFA I	PLS		Analysis	PLS		EFA II	Final
			Original	PCA		1st refine	2nd refine		
SDJ1rc		Statio	0.57	N/A	Statio	0.80	0.80	0.84	Statio
SDJ2		Disp	0.80	0.85	Disp	0.85	0.85	0.72	Disp
SDJ3rc		Statio	0.57	N/A	Statio	0.80	0.80	0.81	Statio
SDJ4		Disp	0.82	0.88	Disp	0.88	0.88	0.78	Disp
SDJ5		Disp	0.77	0.87	Disp	0.80	0.87	0.84	Disp
SDJ6rc	Y	Statio	0.57	N/A	Statio	0.88	0.80	0.50	Statio

In the analysis of the original model SDJ 01, 03 and 06 presented weak loadings (Table 5.48). However, instead of eliminating these items, the modification of splitting SDJ into two constructs, established during the EFA, was followed. Stationarity appears works well as a separate variable with no need to reverse code the items. While the new stationarity factor performed well (CR= 0.841 , AVE = 0.638, α=0.741), the load for SDJ06 (*My job seldom requires me to change the location where I perform my* *work tasks*) in the new PCA solution was low and it also presented some marginal reliability issues.

The original SDJ construct remained with SDJ 02, 04 and 05 and presented a Composite Reliability of 0.901, AVE of 0.753 and Cronbach's α of 0.836.

Table 5.49 CFA results for SDPJ

Item	α	EFA I	PLS		Analysis	PLS		EFA II	Final
			Original	PCA		1st refine	2nd refine		
SDPJ1rc		drop	0.74	N/A	Freedom	0.74	0.74	0.72	keep
SDPJ2		Dep	0.367	0.89	Depend.	-0.92	N/A	N/A	drop
SDPJ3		Dep	0.38	0.89	Depend.	-0.52	N/A	N/A	drop
SDPJ4rc		Free	0.85	N/A	Freedom	0.85	0.85	0.72	keep
SDPJ5	X	drop	0.22	N/A	drop	N/A	N/A	N/A	drop
SDPJ6		Dep	0.36	0.89	Depend.	-0.23	N/A	N/A	drop
SDPJ7rc		Free	0.74	N/A	Freedom	0.74	0.74	0.80	keep
SDPJ8rc		Free	0.81	N/A	Freedom	0.81	0.81	0.69	keep

The initial pool of items developed in this study for SDPJ was composed of two subsets: spatial dependence and spatial independence/freedom. Items of independence/freedom were reverse coded in order to measure spatial dependence. However, the initial results of the EFA suggested that reverse coded spatial independence/freedom did not represent spatial dependence (Table 5.49). Similar to the case of SDJ, the existence of two separate constructs was revealed: spatial dependence (SDPJ 02, 03 and 05) and spatial freedom (SDPJ 01, 04, 07 and 08). Further tests on PLS showed that most items from Spatial Dependence of Job (SDPJ 03 and 06) fail to pass basic requirements and were dropped. On the other hand, Spatial Freedom presented better loadings and presented a composite reliability of 0.866 , AVE of 0.618 and α=0.797. Consequently, items SDPJ 01, 04, 07 and 08 will be taken to the next stage redefined as Spatial Freedom of Job.

Table 5.50 CFA results for JS

Item	α	EFA I	PLS		Analysis	PLS		EFA II		Final
			Original	PCA		1st refine	2nd refine			
JS1		keep	0.39	-0.56	JS	-0.58	a 0.85	0.82	N/A	Exception
JS2		keep	0.32	-0.11	JS	-0.14	b 0.81	N/A	0.88	Analysab
JS3		keep	0.25	0.01	JS	-0.02	b 0.97	N/A	0.92	Analysab
JS4		keep	0.38	-0.71	JS	-0.73	a 0.97	0.85	N/A	Exception
JS5		keep	0.27	-0.01	JS	-0.05	b 0.91	N/A	0.88	Analysab
JS7rc	X	drop	0.85	N/A	non RT	0.88	c 0.87	N/A	N/A	drop
JS8rc	X	drop	0.94	N/A	non RT	0.95	c 0.95	N/A	N/A	drop
JS9		keep	0.36	-0.55	JS	-0.58	a 0.87	0.83	N/A	Exception

Interestingly, the results of the initial CFA for JS were almost the opposite from the EFA (Table 5.50). In this sense, it was illuminating to run the entire model on PLS without discarding any items. JS 07 and 08 initially presented reliability problems and poor performance in the EFA, but with PLS they evidenced substantially higher loadings than their counterparts. Since JS 07 and 08 were originally developed by Goodhue and Thompson (1995) to measure non-routines and do not seem to adequately be capturing some aspects of *job structuredness*, it was decided that both items should be excluded.

Despite the fact that JS loaded as one factor in the PCA, further analysis using CFA showed that (JS 02, 03 and 05) and (JS 01, 04 and 09) work well as two separate constructs (namely, task exceptions (CR = 0.928 , AVE = 0.812, α=.907) and task analysability (CR=0.924 , AVE = 0.803, α=0.886). These findings are reflected in the literature. Perrow (1967) and Withey et al (1983) argued that the degree of routine in an individual portfolio of tasks is a product of task exceptions and task analysability, while Zheng (2007) suggested that these two aspects are highly correlated and could be combined into a single aspect. Job Structuredness needs to be further explored during the main study.

Table 5.51 CFA Results for JI

Item	α	EFA I	PLS		Analysis	PLS		EFA II	Final
			Original	PCA		1st refine	2nd refine		
JI1rc	X	drop	0.08	0.08	Independ.	0.91	N/A	N/A	drop
JI2rc	X	drop	0.37	0.37	Independ.	0.47	N/A	N/A	drop
JI3		keep	0.69	0.69	keep	0.67	N/A	N/A	drop
JI4		keep	0.82	0.82	keep	0.82	0.82	0.83	keep
JI5rc	X	drop	0.21	0.21	Independ.	0.65	N/A	N/A	drop
JI6a		keep	0.86	0.86	keep	0.86	0.88	0.81	keep
JI6b		keep	0.73	0.73	keep	0.76	0.78	0.73	keep
JI8		keep	0.86	0.86	keep	0.86	0.88	0.84	keep
JI9		keep	0.62	0.62	keep	0.63	N/A	N/A	drop
JI10		keep	0.86	0.86	keep	0.86	0.87	0.82	keep
JI11		drop	0.63	0.63	drop	N/A	N/A	N/A	drop

The EFA revealed that, contrary to initial expectations based on Zheng (2007), items measuring Job Independence, when reverse coded, did not seem to capture the degree of Job Interdependence (see Table 5.51). The CFA confirmed this finding, that Job Independence and Job Interdependence are two separate constructs. Since the goal in this study is to measure information interdependence, items JI 01, 02 , 05 and 11 were excluded from further analysis. An additional reliability assessment indicated that JI01 and 09 should also be removed. From the 11 initial items, 5 moved forward to the next stage. JS presented CR = 0.927, AVE = 0.717 and α=0.891.

Table 5.52 CFA Results for SP

Item	α	EFA I	PLS Original	PLS PCA	Analysis	PLS 1st refine	PLS 2nd refine	EFA II	Final
SP1	Y	keep	0.73	0.76	keep	0.76	0.76	0.72	keep
SP2		keep	0.85	0.93	keep	0.93	0.93	0.85	keep
SP3rc		test	0.66	N/A	drop	N/A	N/A	N/A	drop
SP4	X	drop	0.31	N/A	drop	N/A	N/A	N/A	drop
SP5rc		test	0.58	N/A	drop	N/A	N/A	N/A	drop
SP6		keep	0.84	0.91	keep	0.91	0.91	0.87	keep
SP7rc	X	drop	0.38	N/A	drop	N/A	N/A	N/A	drop
SP8	X	drop	0.33	N/A	drop	N/A	N/A	N/A	drop

System portability was intended to incorporate three aspects: physical properties, ‘easy to carry’, and software adaptation. The findings from the initial EFA are further validated by the CFA (Table 5.52). Physical properties and software adaptation do not seem to reflect portability. Only the three items that reflected the notion of “easy to carry” were retained (CR = 0.902 , AVE = 0.755 α=0.833).

Table 5.53 CFA Results for PE

Item	α	EFA I	PLS Original	PLS PCA	Analysis	PLS 1st refine	PLS 2nd refine	EFA II	Final
PE1		keep	0.87	0.89	keep	0.89	0.89	IU (.61)	keep
PE2		keep	0.89	0.89	keep	0.89	0.89	PN (.53)	keep
PE3		keep	0.92	0.93	keep	0.93	0.93	PN (.49)	keep
PE4	xy	test	0.36	N/A	test	N/A	N/A	JS e (.50)	test

The loadings for PE 01, 02 and 03 are close to the results published in the original UTAUT article (Venkatesh, Morris et al. 2003). However PE04, again, presented issues, perhaps reinforcing the notion discussed previously that the item may be not adequate for use in surveys in Australasia (Table.5.53). As a result, it was decided to incorporate the original TAM constructs (Perceived Ease of Use and Perceived Usefulness) into the main study and to determine whether they perform better or worse than their UTAUT counterparts. Having excluded PE04, the PE construct obtained the following results: CR =0.928, AVE = 0.812 and α=0.883.

Table 5.54 CFA Results for EE

Item	α	EFA I	PLS Original	PLS PCA	Analysis	PLS 1st refine	PLS 2nd refine	EFA II	Final
EE1		keep	0.87	0.87	keep	0.87	0.87	0.78	keep
EE2		keep	0.88	0.87	keep	0.87	0.87	0.88	keep
EE3		keep	0.92	0.92	keep	0.92	0.92	0.91	keep
EE4		keep	0.87	0.87	keep	0.87	0.87	0.81	keep

Effort expectancy (Table 5.54 - CR= 0.935, AVE =0.781, α=0.908) and intention to use the system (Table 5.55 - CR = 0.953, AVE = 0.872, α=0.927) did not present any issues and were carried forward to the next round. The loadings found in the pilot study for these items were similar to those described in the original UTAUT study (Venkatesh, Morris et al. 2003).

Table 5.55 CFA Results for IU

Item	α	EFA I	PLS		Analysis	PLS		EFA II	Final
			Original	PCA		1st refine	2nd refine		
IU1		keep	0.92	0.92	keep	0.92	0.92	0.79	keep
IU2		keep	0.97	0.97	keep	0.97	0.97	0.85	keep
IU3		keep	0.91	0.91	keep	0.91	0.91	0.82	keep

Discriminant validity was confirmed by an AVE analysis presented below on Table 5.56. Gefen and Straub (2005) suggest that, as a rule of thumb, the square root of the AVE of each construct should be 'much larger' than the correlation of the specific construct with any of the other constructs in the model and should be at least 0.50. However, the interpretation of 'much larger' still is an open question in the literature.

Table 5.56 Discriminant Validity Results

	SDJ	TRJ	Free.	JI	PINMIS	SP	PE	EE	IU	Stat.	JS-excep	JS-analy
SDJ	0.87											
TRJ	0.30	0.75										
Free.	0.35	0.21	0.79									
JI	0.26	0.29	0.15	0.85								
PINMIS	0.44	0.44	0.39	0.32	0.86							
SP	0.14	0.32	0.06	0.32	0.18	0.87						
PE	0.38	0.37	0.41	0.40	0.67	0.35	0.90					
EE	0.14	0.23	0.26	0.27	0.27	0.33	0.45	0.88				
IU	0.26	0.31	0.29	0.41	0.45	0.34	0.70	0.37	0.93			
Stat.	-0.38	0.07	-0.26	-0.13	-0.31	-0.04	-0.35	-0.08	-0.23	0.80		
JS-excep	-0.25	0.00	-0.18	-0.14	-0.07	-0.06	-0.25	-0.07	-0.24	0.40	0.90	
JS-analy	-0.07	0.12	-0.09	-0.01	0.06	0.00	-0.15	-0.02	-0.12	0.28	0.72	0.90

Note: AVE root is shown in the diagonal.

The square root of the AVE of each construct was well beyond the 0.50 threshold and was considerably larger than the correlation of the specific construct with any of the other constructs. As expected, the two new dimensions of Job Structuredness (exceptions and analysability) would have a stronger correlation in comparison to the remaining pair of constructs in the model. Also reinforcing some of the early results on the EFA, the correlation between PE and IU was higher than expectations based on the literature.

Final convergent validity and reliability scores are presented on Table 5.57

Table 5.57 Convergent Validity and Reliability Results

Item	Loading	Std error	t-stat.	Sig
PINMIS (8 items)				
CR= 0.959 , AVE = 0.747, α=0.950				
PINMIS1	0.8896	0.0175	50.91	p<0.001
PINMIS2	0.8724	0.0272	32.02	p<0.001
PINMIS3	0.9034	0.0180	50.27	p<0.001
PINMIS4	0.8980	0.0339	26.50	p<0.001
PINMIS5	0.8995	0.0142	63.18	p<0.001
PINMIS6	0.7062	0.0414	17.05	p<0.001
PINMIS11	0.8837	0.0182	48.46	p<0.001
PINMIS13	0.8446	0.0251	33.59	p<0.001
Stationarity from SDJ (3 items)				
CR= 0.841 , AVE = 0.638, α=0.741				
SDJ1	0.8013	0.0628	12.76	p<0.001
SDJ3	0.7956	0.0686	11.59	p<0.001
SDJ6	0.7984	0.0634	12.59	p<0.001
Spatial Dispersion - SDJ (3 items)				
CR= 0.901 , AVE = 0.753 , α=0.836				
SDJ2	0.8457	0.0254	33.25	p<0.001
SDJ4	0.8837	0.0239	36.95	p<0.001
SDJ5	0.8737	0.0227	38.52	p<0.001
Job Structuredness /Exceptions (3 items)				
CR =0.924 , AVE = 0.803, α=0.886				
JS1	0.8486	0.1560	5.43	p<0.001
JS4	0.9669	0.1535	6.30	p<0.001
JS9	0.8687	0.1813	4.79	p<0.001
Job Structuredness/Analyzability (3 items)				
CR = 0.928 , AVE = 0.812, α=.907				
JS2	0.8095	0.2337	3.46	p<0.001
JS3	0.9748	0.1908	5.10	p<0.001
JS5	0.9114	0.1793	5.08	p<0.001
Job Interdependence (5 items)				
CR = 0.927 , AVE = 0.717, α=0.891				
JI4	0.8230	0.0538	15.30	p<0.001
JI6a	0.8771	0.0269	32.63	p<0.001
JI6b	0.7784	0.0390	19.97	p<0.001
JI8	0.8811	0.0439	20.08	p<0.001
JI10	0.8707	0.0420	20.74	p<0.001

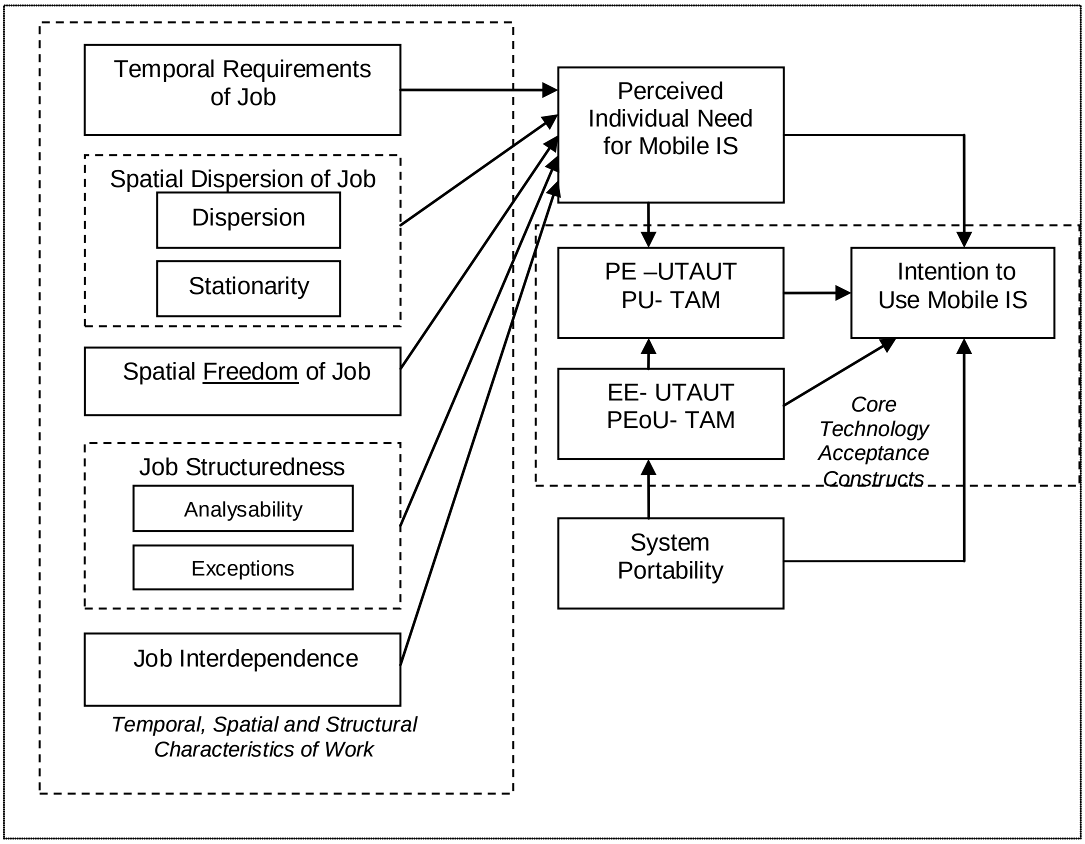
Item	Loading	Std error	t-stat.	sig
Temporal Requirements of Job (8 items)				
CR= 0.911, AVE = 0.562, α=0.890				
TRJ1	0.7930	0.0296	26.76	p<0.001
TRJ2	0.8120	0.0268	30.34	p<0.001
TRJ4	0.7610	0.0385	19.77	p<0.001
TRJ7	0.6760	0.0542	12.47	p<0.001
TRJ8	0.6857	0.0692	9.90	p<0.001
TRJ10	0.7267	0.0454	15.99	p<0.001
TRJ11	0.8182	0.0283	28.87	p<0.001
TRJ12	0.7087	0.0590	12.01	p<0.001
Spatial Freedom from SDPJ (4 items)				
CR = 0.866 , AVE = 0.618, α=0.797				
SDPJ1	0.7375	0.0540	13.64	p<0.001
SDPJ4	0.8500	0.0307	27.72	p<0.001
SDPJ7	0.7393	0.0641	11.53	p<0.001
SDPJ8	0.8129	0.0317	25.62	p<0.001
System Portability SP (3 items)				
CR= 0.902 , AVE = 0.755 α=0.833				
SP1	0.7592	0.0730	10.39	p<0.001
SP2	0.9303	0.0129	72.26	p<0.001
SP6	0.9081	0.0236	38.53	p<0.001
Performance Expectance PE (3 items)				
CR = 0.928 , AVE = 0.812 α=0.883				
PE1	0.8881	0.0292	30.36	p<0.001
PE2	0.8891	0.0234	38.00	p<0.001
PE3	0.9255	0.0128	72.32	p<0.001
Effort Expectance EE(4 items)				
CR = 0.935 , AVE =0.781, α=0.908)				
EE1	0.8681	0.0253	34.27	p<0.001
EE2	0.8748	0.0403	21.68	p<0.001
EE3	0.9183	0.0154	59.58	p<0.001
EE4	0.8736	0.0226	38.64	p<0.001
Intention to Use IU (3 items)				
CR = 0.953 , AVE = 0.872, α=0.927)				
IU1	0.9201	0.0221	41.56	p<0.001
IU2	0.9666	0.0104	92.87	p<0.001
IU3	0.9135	0.0387	23.63	p<0.001

The results are very positive. All items loadings are greater than 0.7 and significant at the p<0.001. In addition CR and α scores were also above the threshold of 0.7.

5.6 Revised Research Model and Items

The measurement refinement procedure reduced the number of items used in the questionnaire from 71 to 50 (approximately 30%). It also generated some insight in regards to the theoretical model. Figure 5.5 presents a revised research model.

Figure 5.5 Revised Research Model



Most of the changes occurred in the variables measuring spatial and structural characteristics of work. *Spatial dependence of job* (SDPJ) was replaced by s*patial freedom of job* (SFJ) which is interpreted as *the degree to which individuals perceive to be free of spatial requirements when performing their portfolio of work tasks*.

Spatial dispersion of job was split into two categories. *Dispersion* which refers to the degree to which individuals perceive they are required to move to distinct locations in order to perform their portfolio of work tasks. In contrast, *stationarity* refers to the degree to which individuals perceive they are required to stay in the same usual place in order to perform their portfolio of work tasks.

After individual discussions with a four senior IS researchers, it was decided to add and rephrase a couple of the items in order to better represent these new aspects (Hinkin

1998). The new or modified items received face validation from the senior academics and later were subjected to the main study pre-test phase.

Dispersion remained with SDJ 02, 04, 06 and gained one new item (SDJ 07 - *My job requires me to frequently perform my work tasks in many locations*). In the case of stationarity, SDJ 01 and 03 remained unchanged. SDJ 06 was simplified to "*My job hardly ever requires me to change the location where I work*" aiming to improve its reliability scores. Two new items were added SDJ 09 "*My job requires me to work every day in the same place*" and SDJ 10 "*My job requires me to always work in a single location*".

Job structuredness was also split in two dimensions: *task exceptions* and *task analysability (Withey, Daft et al. 1983)*. While *task exceptions* aims to capture the degree to which individuals perceive that their portfolio of work tasks is repetitive, *task analysability* has the objective of measuring the degree to which individuals perceive that their portfolio of work tasks is programmable. Exceptions received one new item (JS10) "*most of the time my job requires me to perform repetitive activities*".

Other constructs such as PINMIS, TRJ, SP, JI were not changed at this stage.

Regarding the technology acceptance constructs, intention to use underwent a minor change. Instead of "in the next 6 months…." The wording is changed to "in the next 12 months…". The purpose of this change is to increase variance in the responses. In addition, as discussed in the previous section, five items from the original PU and PEoU constructs from TAM were added to the pool in order to enable a comparison of performance against its UTAUT counterparts (PE and EE respectively) (Venkatesh, Morris et al. 2003). Table 5.58 presents the newly added items.

Table 5.58 Items from TAM

Code	Item
PU1	Using the mobile information system improves my job performance.
PU2	Using the mobile information system enhances my effectiveness on the job.
PU3	Using the mobile information system makes it easier to do my job.
PEoU1	I find it easy to get the mobile information system to do what I want it to do.
PEoU2	I find the mobile information system is flexible to interact with.

Perceived usefulness will include PE01, 02, 03 plus PU01, 02 and 03, while perceived ease of use will include EE01, 02, 03, 04 plus PEoU01, 02 (Davis 1989; Davis, Bagozzi et al. 1989).

5.7 Chapter Summary

This chapter outlines the development of the research instrument. Section 5.2 described the development of the initial pool of items used in this research. This was followed by section 5.3 that explained the initial measurement purification procedures with the card sorting and expert review rounds. Section 5.4 describes the survey design and pre-test phase while section 5.5 portrayed the pilot study and refinement of the scales via EFA and CFA. Finally section 5.6 presents the revised research model. In the next chapter the main study is described.

Table 5.59 presents a summary of the measurement items refined during the pilot study.

Table 5.59 Summary of Measurement Items

Temporal Requirements of Job	
Code	**Item**
TRJ1	My job frequently requires that I make immediate decisions.
TRJ2	My job frequently requires that I take immediate actions.
TRJ4	I frequently perform urgent work tasks.
TRJ7	My job frequently requires that I start tasks as soon as possible.
TRJ8	My job frequently requires that I complete tasks as soon as possible.
TRJ10	My job frequently requires me to perform my work tasks at the right time.
TRJ11	I frequently need to perform work tasks in a hurry.
TRJ12	How much time I spend on each work task is important for my job.
TRJ5 (drop)	My job frequently requires that I start tasks on time.
TRJ6 (drop)	My job frequently requires that I complete tasks on time.
TRJ9 (drop)	I perform most of my work tasks whenever I want.
Spatial Dispersion of Job	
Code	**Item**
SDJ1	My job generally requires me to perform my work tasks at the same location.
SDJ2	My job generally requires me to perform my work tasks at different locations.
SDJ3	My work tasks frequently require me to stay in the same specific location.
SDJ4	My work tasks frequently require me to go to a variety of locations.
SDJ5	My work tasks frequently require me to work in new locations.
SDJ6	My job seldom requires me to change the location where I perform my work tasks.
	Spatial Dependence of Job
Code	**Item**
SDPJ1	I can perform most of my work tasks independently of location.
SDPJ4	I perform most of my work tasks wherever I want.
SDPJ7	My location is frequently irrelevant to perform my work tasks.
SDPJ8	I have the freedom to choose where I perform most of my work tasks.
SDPJ2(drop)	Location is a critical element of my job.
SDPJ3(drop)	My location is frequently an important factor for performing my work tasks.
SDPJ5(drop)	My job generally requires me to perform my work tasks at specific locations.
SDPJ6(drop)	It is important to be in the right place when performing my work tasks.

	Job Structuredness
Code	**Item**
JS1	Most of my work tasks are repetitive.
JS2	There is a clearly known way to do the major types of tasks in my job.
JS3	I can rely on established procedures and practices to perform most of my work tasks.
JS4	Most of my work tasks are routine.
JS5	There is an understandable sequence of steps that can be followed in doing my job.
JS9	Most of the time my job requires me to perform the same work tasks in the same way.
JS7 (drop)	I frequently deal with ad-hoc business problems.
JS8 (drop)	I frequently deal with non-routine business problems.
	Job Interdependence
Code	**Item**
JI4	My job frequently requires me to obtain information from others in order to complete my work tasks.
JI6a	My job frequently requires me to interact closely with others.
JI6b	My job frequently requires me to rely on the work of others.
JI8	My job frequently requires me to exchange information with others in order to perform my work tasks.
JI10	My job frequently requires me to consult with others.
JI1 (drop)	Most of my work tasks frequently can be performed independently of others.
JI2 (drop)	Most of my work tasks frequently can be planned with little need to coordinate with others.
JI3 (drop)	Most of my work tasks frequently require me to coordinate efforts with others (customers, co-workers, supervisors)
JI5 (drop)	My job is generally independent of the jobs of other individuals or organizational units.
JI9 (drop)	My own performance is frequently dependent on receiving information from others.
JI11 (drop)	Most of my work tasks frequently require me to provide information to others.
Perceived Need for Mobile Information Systems	
Code	**Item**
PINMIS1	My everyday work tasks require a high level of support by a Mobile Information System.
PINMIS2	My everyday work tasks require me to rely on a Mobile Information System.
PINMIS3	My everyday work tasks require me to frequently need the support of a Mobile Information System.
PINMIS4	My everyday work tasks require me to frequently use a Mobile Information System.
PINMIS5	I frequently have to use a Mobile Information System in order to meet my work obligations.
PINMIS6	I cannot perform most of my work tasks without the support of a Mobile Information System.
PINMIS11	I frequently need to send, receive, retrieve and consult information via a Mobile Information System in order to meet my work obligations.
PINMIS13	I frequently need to have access to information via a Mobile Information System while on the go in order to meet my work obligations.

System Portability	
Code	**Item**
SP1	I find that the Mobile Information System device is easy to carry.
SP2	I find that the Mobile Information System device is easy to take with me while on the go.
SP6	I find that the Mobile Information System device is very portable.
SP3 (drop)	I find that the Mobile Information System device is very heavy.
SP4 (drop)	I find that the Mobile Information System device is very robust.
SP5 (drop)	I find that the Mobile Information System device is very big.
SP7 (drop)	Mobile applications provide very limited functionalities in comparison to applications on a PC.
SP8 (drop)	The mobile applications also available on PCs have been well adapted for use on mobile devices.

Performance Expectancy	
Code	**Item**
PE1	I find the Mobile Information System useful in my job.
PE2	Using the Mobile Information System enables me to accomplish tasks more quickly.
PE3	Using the Mobile Information System increases my productivity.
PE4	If I use the Mobile Information System, I will increase my chances of getting a raise.

Effort Expectancy	
Code	**Item**
EE1	My interaction with the Mobile Information System is clear and understandable.
EE2	It is easy for me to become skilful at using the Mobile Information System.
EE3	I find the Mobile Information System easy to use.
EE4	Learning to operate the Mobile Information System is easy for me.

Intention to Use Mobile IS	
Code	**Item**
IU1	In the next SIX months I intend to use Mobile Information System.
IU2	In the next SIX months I predict I would use the Mobile Information System.
IU3	In the next SIX months I plan to use the Mobile Information System.

6 Theoretical Model Test

6.1 Introduction

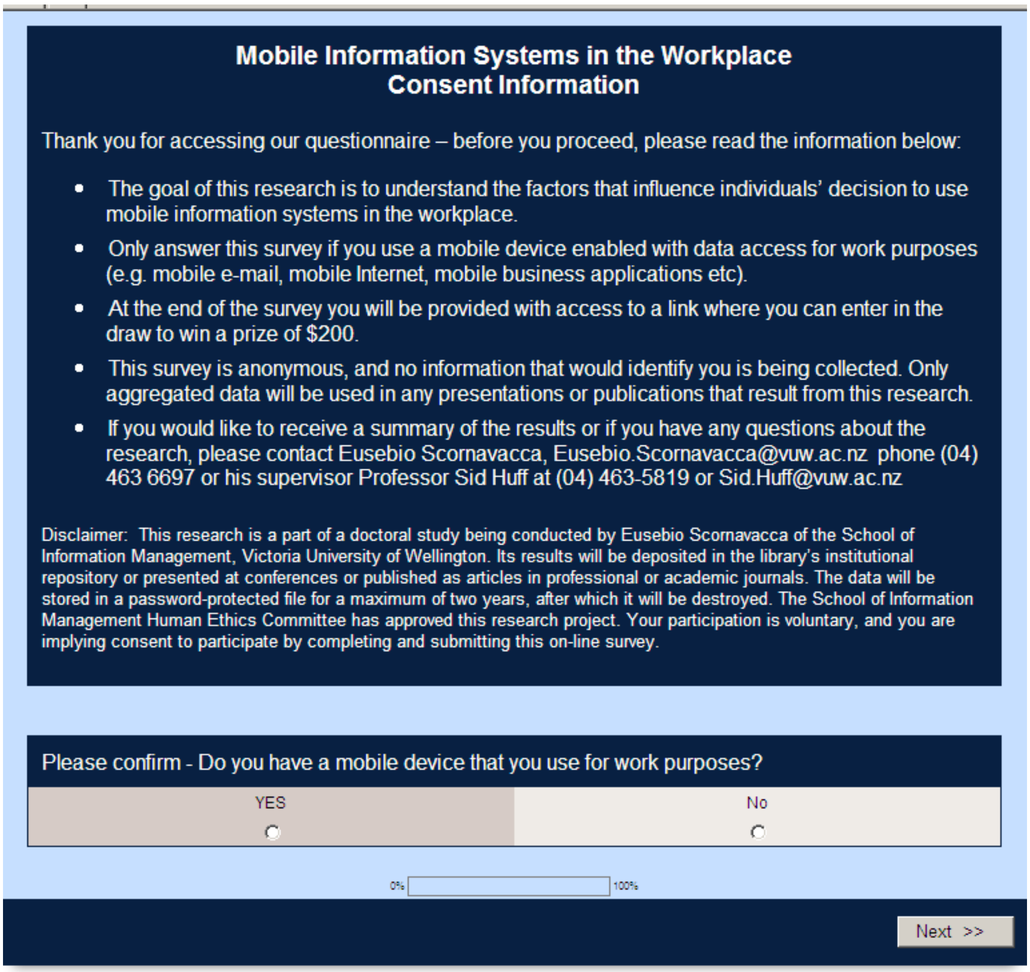
Once the pilot study was concluded and the instrument was fully developed, the next step was to test the theoretical model using a large scale survey. Therefore, the purpose of the chapter is to describe the results of the main survey as well as to test the conceptual research model and associated hypotheses. First, the details surrounding the main survey are presented. This is followed by an in-depth data analysis of the results and the actual evaluation of the research model.

6.2 Questionnaire Refinement

Before the main study was initiated, an application containing the revised survey instrument was submitted and approved by the Human Ethics Committee (HEC) of the School of Information Management, Victoria University of Wellington. The finalized questionnaire used in the main study is available in Appendix 2.

Based on the feedback received during the pilot study, the questionnaire layout received a few minor modifications so as to reduce the non-response rate (Hair, Anderson et al. 1995; Scornavacca, Becker et al. 2004). For example, the consent information page was reduced to only five bullet points and a disclaimer paragraph was added at the bottom (Figure 6.1). In addition, in order to increase clarity, the original screening question (are you currently using a mobile device enabled with data access for work purposes?) was split into two short questions: 1) “Do you have a mobile device that you use for work purposes?” and 2) “Is your mobile device enabled with data services (e.g. mobile e-mail, mobile Internet, mobile business applications etc)?”. As a result, the survey system was then set up to only give access to the survey to people that answered “yes” to both questions.

Figure 6.1 New Questionnaire Layout



At this point the survey instrument was pre-tested using a convenience sample representing the population of interest (Field 2009). A total of 24 mobile IS users from four distinct organisations (a university, a bank, an IT firm and a telecommunication provider) participated in the exercise (Moore and Benbasat 1991; Hinkin 1998; Field 2009). Just as in the pilot study, participants were asked to report on content clarity, wording, flow, length as well as any issues they encountered with the system when answering the survey (Babbie 1990; Simsek and Veiga 2001). Based on the feedback received, some spelling errors were corrected and, in order to improve the questionnaire's flow, the questions about system portability were moved from Part 3 (perceptions towards mobile IS) to Part 4 (your mobile device) of the questionnaire. The finalized questionnaire used in the main study is presented on Appendix 6.

6.3 Data Collection Procedure and Sample Adequacy

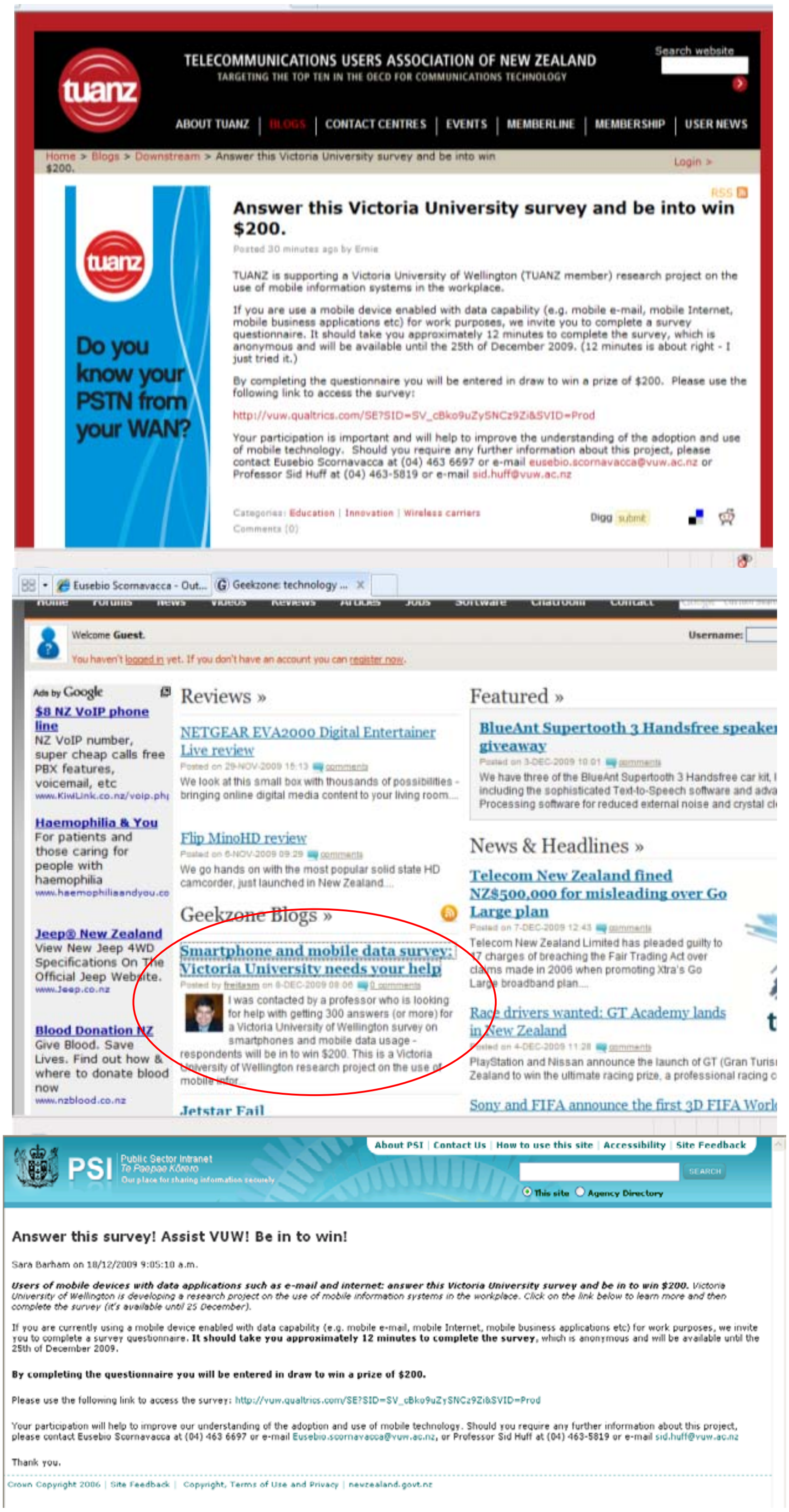
As discussed during Chapters 4 and 5, the population of interest in this research comprises people using mobile IS for work purposes in New Zealand and the data collection technique deployed was web-based survey questionnaire (Dillman 2000).

The goal in this stage was to gather a large sample (>200) of mobile IS users working for an extensive number of organizations from private and public sectors and possessing a wide range of portfolios of work tasks (e.g. consultants, managers, sales people, technicians, field workers etc) (Pinsonneault and Kraemer 1993; Hinkin 1998; Simsek and Veiga 2000; Klassen and Jacobs 2001; Shannon, Johnson et al. 2002; Goeritz 2006). Invitations with a link to the questionnaire were strategically posted in the following websites (Figure 6.2):

- Telecommunication Users Association of New Zealand (www.tuanz.org.nz).
    - TUANZ is a not-for-profit membership association comprised of more than 450 organizations predominately with a strong dependency on telecommunications technology.
- Geekzone (www.geekzone.co.nz)
    - Geekzone is New Zealand's largest technology website and publishes news, articles and reviews as well as hosting some of the busiest technology discussion forums in the country.
- NZICT Group (www.ict.org.nz)
    - The NZICT Group is an industry association that represents New Zealand’s Information and Communication Technologies industry.
- PSI – Public Sector Intranet (www.psi.govt.nz)

The PSI is a portal for New Zealand public servants to share information and resources.

Figure 6.2 Survey Invitation on TUANZ, Geekzone and PSI websites



In the message posted in the websites, it was highlighted that only people using mobile devices enabled with data access for work purposes were invited to participate. As in the pilot study, a summary of the completed study was offered to the participants, along with the opportunity to enter a prize draw of $200 in gift vouchers (Simsek and Veiga 2001; Goeritz 2006).

On the 8th of December 2009, the survey was made available online and remained accessible for 16 days. In total, 578 people accessed the questionnaire website. Even though the survey invitations were clearly targeted at mobile data users, 93 individuals (16%) accessed the survey and failed to pass the screening questions. As a result, a total of 485 people accessed the actual survey questionnaire (84% of total hits).

The initial analysis of the dataset found that 170 individuals (35% of the people granted access to the questionnaire) abandoned the survey at some stage and did not produce a complete set of responses. It was interesting to observe that from these 170 people, 91 (54%) stopped at introduction and did not actually answer any questions. Another 67 (39%) abandoned survey during part 1, only five (3%) abandoned survey in part 2, another four participants (2.5%) abandoned survey in part 3 and just three people did not complete all the demographic information. In addition, nine surveys were excluded because they were fully completed in less than 8 minutes. As a result, 309 (53% hits, 64% granted questionnaire access) usable response sets were taken to further analysis. The response rate obtained is within the normal parameters described in the current e-survey literature (Dillman 2000; Boyer, Olson et al. 2002; Scornavacca, Becker et al. 2004; Holland, Smith et al. 2010).

The sample size obtained was considered adequate since it fulfils the criteria for conducting exploratory and confirmatory factor analysis (item-to-response ratios above from 1:5; >200) previously discussed in Chapter 5 (Hair, Anderson et al. 1995; Hinkin 1998; Field 2009). In addition, the sample size is also suitable for performing analysis using Partial Least Squares, wherein a minimum sample size of ten times the number of structural paths leading into a construct is required. In the specific case of this research would result into a minimum sample of 50 respondents (Chin 1998; Marcoulides, Chin et al. 2009). Further considerations about the sample are presented in during the analysis of the results.

The next section presents the data analysis and results of the survey.

6.4 Data Analysis and Results

This section presents the data analysis and results of the main study. First, the respondents' profile is presented. This is followed by an analysis of the characteristics of the data set. Then, it describes the exploratory and confirmatory factor analyses procedures as well as the assessment of the measurement model. Finally the section is concluded with the evaluation of the structural model and associated hypotheses.

6.4.1 Profile of Respondents

The sample was largely composed of males (81.2%) and the majority (62.3%) were aged between 30 and 49 years old. A wide range of occupations and organizations were represented in the sample. Mostly respondents were either in a managerial or highly technical/skilled position such as manager, director, supervisor, CEO, CIO, network architect, engineer, consultant, lawyer, accountant, business analyst and so forth. The respondents worked in information technology firms (23.3%), government (22.7%), telecommunication providers (17.5%), professional services providers (8.4%), education (4.5%), and finance companies (3.2%) among many other organisations. Approximately 55% of the sample used Vodafone as their telecommunication service provider; 35% used Telecom, and 8% used TelstraClear. The device manufacturers' market share in the sample is presented in Table 6.1 and indicates the predominance of Apple's iPhone and Blackberry devices among business users.

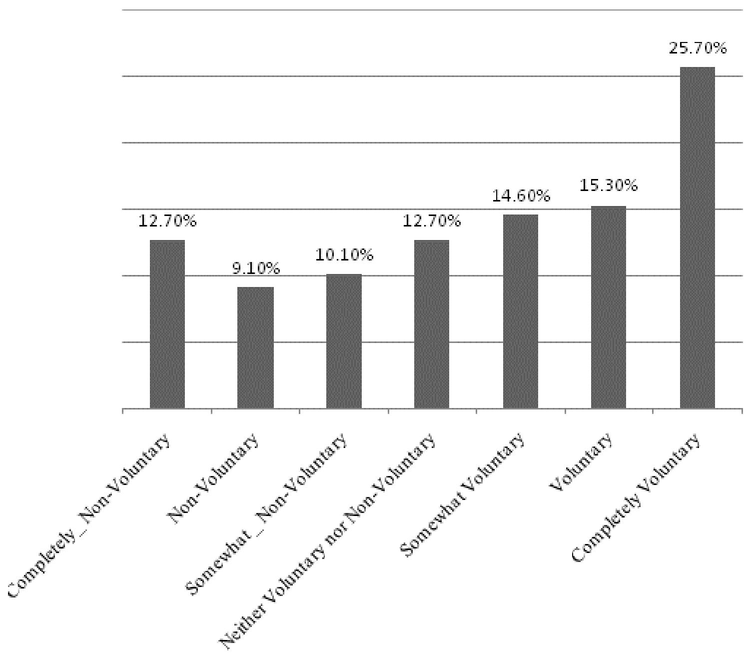
Table 6.1 Handheld devices used by the sample

Device Manufacturer	Percent
Apple/iPhone	28.2%
RIM/Blackberry	23.6%
HTC	14.9%
Nokia	14.2%
Unsure	4.5%
Other	14.6%
TOTAL	100%

While 77.7 % of the respondents had the cost of the mobile device paid by their employer, 72.8% had data access fully paid by the company (13.3% were partially paid by the employer and 13.9% paid for data access themselves). On average, they had been using their current mobile device for approximately 16 months and spent 30 minutes per day using their mobile device for voice communications. In addition, as illustrated on

Figure 6.3, a statistically significantly higher number of participants indicated that the use of mobile IS in their jobs is voluntary rather than compulsory (Chi-square = 85.18, df = 2, 1-p = >99.99%. (Venkatesh, Morris et al. 2003).

Figure 6.3 Voluntariness of the use of mobile IS



Almost every respondent (99%) indicated that applications such as mobile internet, calendar, contacts, texting (SMS), and mobile e-mail were available in their devices. Around 80% indicated that their devices included office applications such as spreadsheets, PDF readers and word processors. Also 70% acknowledged GPS and mobile chat capabilities. On the other hand, 29% reported the availability of some sort of corporate application such as sales force automation, field force automation or CRM. Table 6.2 illustrates the availability and frequency of use of the mobile applications.

Table 6.2 Use of applications by the sample

Application	Available	Frequency of Use					
		Never	Rarely	Sometimes	Quite Often	Very Often	TOTAL
Mobile e-mail	99.0%	0.5%	0.9%	8.3%	14.8%	75.6%	100%
Contacts	99.7%	2.3%	5.5%	7.4%	12.9%	71.9%	100%
Calendar	99.3%	0.9%	3.2%	6.0%	20.6%	69.3%	100%
Texting (SMS)	98.3%	1.9%	1.4%	3.7%	23.4%	69.6%	100%
Mobile Internet	97.9%	0.9%	8.3%	24.0%	26.3%	40.6%	100%
GPS and Navigation	70.6%	31.6%	22.3%	25.4%	7.8%	13.0%	100%
E-reader	82.0%	33.9%	19.0%	25.3%	14.4%	7.5%	100%
MMS	85.9%	30.2%	27.9%	24.0%	11.2%	6.7%	100%
Word Processing	76.8%	30.5%	28.3%	24.3%	10.2%	6.8%	100%
Mobile Chat	69.7%	26.1%	22.2%	34.1%	11.9%	5.7%	100%
Other Corporate App	26.4%	34.3%	33.7%	20.1%	5.9%	5.9%	100%
Spreadsheet	75.8%	63.8%	3.4%	10.1%	16.1%	6.7%	100%
Presentations	68.6%	90.2%	2.1%	2.1%	1.4%	4.2%	100%
Field Force App	10.7%	57.0%	19.8%	12.8%	7.0%	3.5%	100%
CRM Application	14.1%	89.9%	1.5%	2.9%	2.2%	3.6%	100%
Sales Force App	13.3%	96.4%	1.5%	0.7%	0.0%	1.5%	100%

As was found in the pilot study, mobile e-mail contacts, calendar and text messages were the most frequently used applications among respondents. An additional analysis using an independence test was carried out comparing device brand and application usage. It was found that iPhone users reported a statistically significantly higher frequency of use of mobile internet while Blackberry users indicated a statistically significantly lower frequency of use of this application. In addition, the use of e-mail was statistically significantly lower among Nokia users.

One additional step was taken in order to assure sample quality. The respondent profile presented above was submitted to the scrutiny of two mobile product marketing managers of a large telecommunication company. In their opinion, the characteristics of the respondents in the sample are representative of the actual population using mobile IS for work purposes in New Zealand

6.4.2 Verifying Data Characteristics

The survey system automatically verified whether the questionnaire sections were complete, and alerted users if any questions were left unanswered. Respondents were required to complete a section before moving on to the next section (Podsakoff, Podsakoff et al. 2003). As a result, there was no need to carry out a missing data analysis since the 309 data sets that passed the initial data screening were all complete (Hair, Anderson et al. 1995; Carver 2005; Field 2009).

Normality of the data was verified using the Kolmogorov-Smirnov and Shapiro-Wilk tests as well as by calculating skewness and kurtosis values (Hair, Anderson et al. 1995; Field 2009). The results indicated that the data was not normally distributed. Approximately 40% of the items presented skewness and kurtosis above the recommended thresholds of -3 and 3 (Carver 2005). As discussed in detail in the previous chapter, data transformation procedures to normalize the data should not be conducted unnecessarily (Hair, Anderson et al. 1995). Since the data of the sample was found adequate for exploratory factor analysis (details presented in the section below) and PLS is not constrained by normality requirements, it was decided to proceed with the analysis without attempting to transform data (Chin 1998; Gefen, Straub et al. 2000; Gefen and Straub 2005; Field 2009).

The next step was to verify if the sample presented non-response bias (Field 2009). Two sub-samples were created based on the order of questionnaire completion. The first group included the first 60 people who responded the survey, while the second consisted of the last 60 respondents (Churchill 1979). The two groups were compared using a two-tailed t-test at 5% significance level (Field 2009). Out if the 59 measurement items only four (JI10, EE03, EE04 and SP01) presented some degree of statistical difference between the two groups. There were no significant differences with respect to respondent profile. The overall results comparing the two sub-groups indicate that there is no evidence of substantial differences among them in order to raise significant concerns regarding non-response bias in the sample (Hair, Anderson et al. 1995; Field 2009).

Finally, potential for common method biases was investigated (Podsakoff, Podsakoff et al. 2003; Liang, Saraf et al. 2007; Brannick, Chan et al. 2010). The results of a Harman one-factor test (Podsakoff, Podsakoff et al. 2003) showed that 10 factors were present and the most covariance explained by one factor is 26%, indicating that common method biases are not a likely contaminant of our results (Liang, Saraf et al. 2007; Brannick, Chan et al. 2010).

6.4.3 Exploratory Factor Analysis

The next step of the data analysis involved exploratory factor analysis (EFA) (Straub 1989; Moore and Benbasat 1991; Hinkin 1998; Hinkin and Tracey 1999; Straub, Boudreau et al. 2004). As shown on Table 6.3, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is acceptable and close to ideal (0.91) and the significance level of the Bartlett's Test (0.00) indicates that the overall intercorrelations assumptions are met (Field 2009). In addition, the sample size in relation to the number of variables is within the recommended guidelines for EFA as previously discussed in section 5.5 (Tabachnick and Fidell 2007). As a result, the data set was considered appropriate for conducting EFA (Hair, Anderson et al. 1995; Field 2009).

Table 6.3 KMO and Bartlett's Test

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.910
Bartlett's Test of Sphericity	
Approx. Chi-Square	16711.132
df	1711
Sig.	.000

In line with the discussion in the previous chapter, the following factor extraction rules were implemented (Conway and Huffcutt 2003; Straub, Boudreau et al. 2004; Field 2009):

- Factor extraction method: Principal Component Analysis (PCA)
- Number of factors to retain: Eingenvalue>1 and 10 hypothesized factors
- Rotation method: Varimax and Oblimin Direct
- Factor loading threshold: 0.6
- Crossloading Threshold: 0.4

Additionally, in order to follow up the recommendations from the pilot study, two separate EFA were undertaken: 1) containing the UTAUT constructs (performance expectancy and effort expectancy) and 2) containing the TAM counterparts (perceived usefulness and perceived ease of use). Table 6.4 presents a summary of the parameters used during EFA.

Table 6.4 Summary of Parameters used during EFA

Rotation	Number of Items	Factors Retained	Output
Varimax	UTAUT 55 items	Eigenvalue>1	Rotated Component Matrix
		10 hypothesized factors	
	TAM 59 items	Eigenvalue>1	
		10 hypothesized factors	
Oblimin Direct	UTAUT 55 items	Eigenvalue>1	Pattern and Structure Matrices
		10 hypothesized factors	
	TAM 59 items	Eigenvalue>1	
		10 hypothesized factors	

Interestingly, both methods used to indicate the number of factors to be retained (Eigenvalue>1 and hypothesized factors) converged to 10 factors. An additional parallel analysis was carried out and also indicated the same 10 factors (Hayton, Allen et al. 2004). Overall, both oblimin and varimax rotations produced similar results, however the rotated matrix using varimax rotation seemed to produce better solutions with a clearer factor structure (Field 2009). Due to limitations of space and the convergence of solutions, only the rotated component matrices (PCA, varimax, eigenvalue>1) are presented in this section (Conway and Huffcutt 2003; Straub, Boudreau et al. 2004; Field 2009). Table 6.5 presents the rotated component matrix with the UTAUT constructs while Table 6.6 shows the rotated component matrix with the TAM.

Table 6.5 Rotated Component Matrix - UTAUT

Items	Component									
	1	2	3	4	5	6	7	8	9	10
SDJ02	.839									
SDJ07	.812									
SDJ09_rc	.792									
SDJ01_rc	.787									
SDJ06_rc	.784									
SDJ03_rc	.781									
SDJ04	.776									
SDJ10_rc	.765									
SDJ05	.695									
PJIMIS02		.827								
PJIMIS03		.820								
PJIMIS01		.818								
PJIMIS04		.803								
PJIMIS05		.796								
PJIMIS11		.753								
PJIMIS13		.734								
PJIMIS06		.713								

TRJ02			.806							
TRJ07			.785							
TRJ04			.767							
TRJ01			.747							
TRJ08			.742							
TRJ11			.720							
TRJ10			.702							
TRJ12			.625							
JS09				.866						
JS03				.848						
JS05				.848						
JS04				.833						
JS10				.823						
JS02				.811						
JS01				.770						
JI10					.865					
JI04					.856					
JI08					.843					
JI06a					.797					
JI06b					.794					
EE04						.895				
EE02						.892				
EE03						.864				
EE01						.699				
IU02							.853			
IU03							.840			
IU01							.793			
SFJ04								.856		
SFJ01								.850		
SFJ07								.801		
SFJ08								.722		
SP06									.884	
SP01									.882	
SP02									.861	
PE02										.688
PE03										.679
PE04										.589
PE01							.393			.516

Table 6.6 Rotated Component Matrix - TAM

Items	Component									
	1	2	3	4	5	6	7	8	9	10
SDJ02	.837									
SDJ07	.807									
SDJ09_rc	.792									
SDJ01_rc	.782									
SDJ06_rc	.779									
SDJ03_rc	.776									
SDJ04	.773									
SDJ10_rc	.766									
SDJ05	.691									
PJIMIS02		.808								
PJIMIS03		.806								
PJIMIS01		.803								
PJIMIS05		.789								
PJIMIS04		.778								
PJIMIS11		.746								
PJIMIS13		.723								
PJIMIS06		.712								
TRJ02			.802							
TRJ07			.782							
TRJ04			.766							
TRJ01			.740							
TRJ08			.739							
TRJ11			.720							
TRJ10			.704							
TRJ12			.627							
JS09				.866						
JS03				.849						
JS05				.848						
JS04				.832						
JS10				.822						
JS02				.811						
JS01				.770						
EE03					.874					
PEoU01					.873					
EE02					.856					
EE04					.854					
PEoU02					.768					
EE01					.677					
PU01						.828				
PE03						.815				
PU02						.792				
PE02						.777				
PU03						.670				
PE01						.604				

JI10							.864			
JI04							.852			
JI08							.841			
JI06a							.797			
JI06b							.792			
SFJ04								.855		
SFJ01								.850		
SFJ07								.799		
SFJ08								.722		
SP06									.875	
SP01									.874	
SP02									.854	
IU02										.854
IU03										.839
IU01										.757

Perceived need for mobile IS (PINMIS), *temporal requirements of the job* (TRJ), *job interdependence* (JI), *job structuredness* (JS) and *system portability* (SP) performed well and produced results similar to those found in the pilot study. In addition, the results obtained for the new construct *spatial freedom of job* (SFJ) were also positive. As described on Chapter 5, SFJ was derived from a subset of items of the *spatial dependence of job* (SDPJ) construct (SDPJ 01, 04, 07 and 08). These items aimed to capture spatial independence/freedom and, in this chapter, they have been recorded as SFJ01, 04, 07 and 08.

As originally theorized (though different from the results of the pilot study), *spatial dispersion of job* (SDJ) clustered into a single factor. In the pilot study, SDJ split into two separate factors (which were termed spatial dispersion and stationarity). The reverse coded items measuring 'lack of location variety' (SDJ 01, 03 and 06) did not cluster with the remaining SDJ items referring to "location variety". Perhaps SDJ now loaded into a single factor due to the changes it underwent after the pilot (refinement of the items SDJ 01, 02, 03, 04, 06 as well as the addition of items SDJ 07, 09 and 10).

Regarding the technology acceptance constructs, all items loaded in its respective theoretical constructs (Tables 6.5 – UTAUT and 6.6 - TAM). This is in contrast to the results of the pilot study, when some items from UTAUT's *performance expectancy* (PE) construct loaded on *intention to use* (IU) and PIMNIS. In addition, TAM's *perceived easy of use* (PEoU) and UTAUT's *effort expectancy* (EE) did not present significant differences. IU items loaded strongly in both TAM and UTAUT solutions.

TAM's *perceived usefulness* (PU) seems to produce a better result than its UTAUT counterpart *performance expectancy* (PE). As in the pilot study, the item PE 04 (*If I use the mobile information system, I will increase my chances of getting a raise*) from the PE construct presented weak loadings. This result further supports the idea discussed previously that the PE04 item may be not adequate for use in surveys in Australasia since immediate financial reward on short-term performance is not a part of the local remuneration culture. A further PCA was done excluding PE04 and PE 01, 02 and 03 produced adequate results above the established thresholds.

Overall, the results of the exploratory factor analysis in the main study were extremely encouraging. All items loaded on their respective theoretical constructs, and most items exhibited loadings between 0.7 and 0.9. In addition, this procedure was able to clarify some of the issues raised during the pilot study such as whether to include PE04 in the analysis or split SDJ into two separate constructs. The next section presents the results of the confirmatory factor analysis as well as the evaluation of the measurement model.

6.4.4 Confirmatory Factor Analysis and Evaluation of the Measurement Model

Following the same procedure discussed in Chapter 5, the next step was to perform a confirmatory factor analysis (CFA). Two measurement models were loaded on PLS-Graph 3.0: the first model contained the UTAUT constructs (PE and EE) while the second model used TAM constructs (PU and PEoU) (Venkatesh, Morris et al. 2003). Again, the loadings for all of the measurement items were evaluated using a 0.70 threshold (Straub, Boudreau et al. 2004; Marcoulides, Chin et al. 2009). Convergent validity and reliability scores for PINMIS, SP, JI, JS, SFJ, SDJ and TRJ are presented on Table 6.7. Table 6.8 present results for the technology acceptance constructs (PE, PU, IU, PEoU and PU). A threshold of 0.70 was adopted for the Cronbach's α as well as the composite reliability (CR) scores (Cronbach 1971; Fornell and Bookstein 1982; Field 2009).

Table 6.7 Convergent Validity and Reliability Results for PINMIS, SP, JI, JS, SFJ, SDJ and TRJ.

Item	Loading	Std error	t-stat.	Sig
Perceived Individual Need for Mobile IS (8 items)				
CR= 0.965 , AVE = 0.777, α=0.956				
PINMIS1	0.9125	0.0136	67.00	p<0.001
PINMIS2	0.9280	0.0095	97.36	p<0.001
PINMIS3	0.9067	0.0157	57.65	p<0.001
PINMIS4	0.9138	0.0125	72.82	p<0.001
PINMIS5	0.9044	0.0106	85.29	p<0.001
PINMIS6	0.7351	0.0332	22.11	p<0.001
PINMIS11	0.8817	0.0129	68.26	p<0.001
PINMIS13	0.8415	0.0270	31.19	p<0.001
Spatial Dispersion of Job - SDJ (9 items)				
CR= 0.949 , AVE = 0.675, α=0.939				
SDJ1_rc	0.8200	0.0274	29.95	p<0.001
SDJ3_rc	0.8270	0.0267	31.01	p<0.001
SDJ6_rc	0.8198	0.028	29.30	p<0.001
SDJ9_rc	0.7798	0.0408	19.12	p<0.001
SDJ10_rc	0.7588	0.0304	24.94	p<0.001
SDJ2	0.8777	0.0171	51.28	p<0.001
SDJ4	0.8483	0.0162	52.33	p<0.001
SDJ5	0.7754	0.0255	30.40	p<0.001
SDJ7	0.8801	0.0133	66.05	p<0.001
Job Structuredness JS(7 items)				
CR =0.944 , AVE = 0.708, α=0.932				
JS1	0.8248	0.0469	17.58	p<0.001
JS2	0.7952	0.0883	9.00	p<0.001
JS3	0.8102	0.1079	7.51	p<0.001
JS4	0.8841	0.0661	13.38	p<0.001
JS5	0.8052	0.1102	7.30	p<0.001
JS9	0.8779	0.0881	9.95	p<0.001
JS10	0.8857	0.0747	11.84	p<0.001

Item	Loading	Std error	t-stat.	sig
Temporal Requirements of Job (8 items)				
CR= 0.925, AVE = 0.608, α=0.906*				
TRJ1	0.7874	0.0267	29.51	p<0.001
TRJ2	0.8376	0.0177	47.30	p<0.001
TRJ4	0.8505	0.0148	57.30	p<0.001
TRJ7	0.7505	0.0376	19.96	p<0.001
TRJ8	0.7974	0.0313	25.45	p<0.001
TRJ10	0.7599	0.0328	23.18	p<0.001
TRJ11	0.8282	0.0175	47.22	p<0.001
TRJ12	0.5956	0.0542	10.99	p<0.001
Spatial Freedom of Job - SFJ(4 items)				
CR = 0.901 , AVE = 0.696, α=0.855				
SFJ1	0.8078	0.0392	20.59	p<0.001
SFJ4	0.8906	0.0225	39.58	p<0.001
SFJ7	0.8282	0.0397	20.84	p<0.001
SFJ8	0.8070	0.0417	19.35	p<0.001
System Portability SP (3 items)				
CR= 0.965 , AVE = 0.901 α=0.941				
SP1	0.9411	0.0142	66.34	p<0.001
SP2	0.9571	0.0104	92.03	p<0.001
SP6	0.9494	0.0141	67.44	p<0.001
Job Interdependence JI (5 items)				
CR = 0.934 , AVE = 0.739, α=0.904				
JI4	0.8786	0.0171	51.34	p<0.001
JI6a	0.8489	0.0251	33.81	p<0.001
JI6b	0.8075	0.0293	27.52	p<0.001
JI8	0.8805	0.0207	42.50	p<0.001
JI10	0.8804	0.0177	49.85	p<0.001
*If TRJ12 is removed CR = 0.927, AVE = 0.648 α=0.909				

The results were very encouraging. With the exception of TRJ 12, all items loadings were greater than 0.7 and significant at p<0.001. In addition, CR and α scores were also above the threshold of 0.7 (Straub, Boudreau et al. 2004; Marcoulides, Chin et al. 2009; Esposito Vinzi, Chin et al. 2010). The results of the CFA also indicate that SDJ works well as a single construct and there is no need to split it in two variables (dispersion and stationarity).

Similarly, and contrary to the results of the pilot study, *job structuredness* loaded as one single factor in the EFA as well as the CFA, demonstrating that task exceptions and task analysability are highly correlated dimensions and can be successfully combined into a single dimension (Zheng 2007).

Finally, the revised TRJ construct (without TRJ12) consisted of seven items, with CR = 0.927, AVE = 0.648 and α=0.909.

Table 6.8 Convergent Validity and Reliability Results for Technology Acceptance Constructs

Item	Loading	Std error	t-stat.	sig
Performance Expectancy PE (4 items) UTAUT				
CR = 0.871, AVE = 0.642, α=0.752*				
PE1	0.8553	0.023	37.21	p<0.001
PE2	0.9087	0.0134	67.97	p<0.001
PE3	0.9099	0.0134	68.13	p<0.001
PE4	0.4290	0.0669	6.41	p<0.001
*If PE4 is removed CR = 0.927, AVE = 0.809 α=0.881				
Effort Expectancy EE (4 items) UTAUT				
CR= 0.940 , AVE = 0.796, α=0.915				
EE1	0.8681	0.0253	34.27	p<0.001
EE2	0.8748	0.0403	21.68	p<0.001
EE3	0.9183	0.0154	59.58	p<0.001
EE4	0.8736	0.0226	38.64	p<0.001
Intention to Use IU (3 items)				
CR = 0.956 , AVE = 0.879, α=0.931				
IU1	0.9298	0.0163	57.20	p<0.001
IU2	0.9338	0.0353	26.46	p<0.001
IU3	0.9493	0.0164	57.74	p<0.001

Item	Loading	Std error	t-stat.	sig
Perceived Usefulness PU (6 items) TAM				
CR= 0.953, AVE = 0.770 , α=0.940				
PE1	0.8150	0.0310	26.25	p<0.001
PE2	0.8892	0.0169	52.56	p<0.001
PE3	0.9186	0.0111	82.41	p<0.001
PU1	0.9159	0.0118	77.57	p<0.001
PU2	0.9480	0.0141	64.21	p<0.001
PU3	0.8163	0.0263	31.03	p<0.001
Perceived Ease of Use PEoU (6 items) TAM				
CR = 0.943 , AVE = 0.734, α=0.925				
EE1	0.8091	0.0269	30.03	p<0.001
EE2	0.9087	0.0145	62.48	p<0.001
EE3	0.8965	0.0152	58.96	p<0.001
EE4	0.8838	0.0173	51.16	p<0.001
PEoU1	0.8664	0.024	36.11	p<0.001
PeoU2	0.7674	0.0313	24.52	p<0.001

As expected, PE04 was the only item loading below the established threshold. Therefore, it was decide that PE04 would be excluded from the PE construct in all further analysis. The reduced PE construct (containing only PE 01, 02 and 03) resulted in a CR = 0.927, AVE = 0.809 and α=0.881.

At this point it was opportune to carry out the comparison between TAM and UTAUT constructs proposed in Chapter 5. Consideration was given to not only item loadings, CR, AVE and α scores but also path coefficients, calculated t-values, and variance explained (described in detail in the next section) (Chin, Gopal et al. 1997). Overall, PEoU and EE as well as PU and PE (without PE04) produced almost identical results. It was concluded that it was advantageous to continue using use the UTAUT constructs in this study since they produced similar results with a much smaller set of items than their respective TAM counterparts (Venkatesh, Morris et al. 2003).

Table 6.9 presents a summary of the final set of variables. All constructs exhibited Cronbach's α and CR scores above 0.70 as well as AVE and communality exceeding 0.50 threshold.

Table 6.9 Summary of the Measurement Model Quality – Convergent Validity

Construct	Code	# of items	CR	AVE	Cronb. α	Commun.
Perceived Individual Need for Mobile IS	PINMIS	8	0.965	0.777	0.956	0.774
Temporal Requirements of Job	TRJ	7	0.927	0.648	0.909	0.648
Spatial Dispersion of Job	SDJ	9	0.949	0.675	0.939	0.675
Spatial Freedom of Job	SFJ	4	0.901	0.696	0.855	0.696
Job Structuredness	JS	7	0.944	0.708	0.932	0.708
Job Interdependence	JI	5	0.934	0.739	0.904	0.739
System Portability	SP	3	0.965	0.901	0.941	0.901
Performance Expectancy	PE	3	0.927	0.809	0.881	0.809
Effort Expectancy	EE	4	0.940	0.796	0.915	0.797
Intention to Use	IU	3	0.956	0.879	0.931	0.879

The next step was to confirm discriminant validity by carrying a AVE analysis (Table 6.10) (Chin 1998; Gefen and Straub 2005).

Table 6.10 Discriminant Validity Results

	PINMIS	PE	EE	IU	TRJ	SDJ	SFJ	JI	JS	SP
PINMIS	0.880									
PE	0.618	0.899								
EE	0.332	0.432	0.892							
IU	0.38	0.51	0.429	0.938						
TRJ	0.541	0.425	0.243	0.308	0.805					
SDJ	0.501	0.415	0.221	0.22	0.21	0.822				
SFJ	0.248	0.165	0.169	0.076	0.068	0.341	0.834			
JI	0.313	0.312	0.184	0.262	0.282	0.144	-0.008	0.860		
JS	-0.13	-0.179	-0.117	-0.242	0.03	-0.283	-0.081	-0.179	0.841	
SP	0.268	0.333	0.428	0.433	0.209	0.203	0.128	0.265	-0.149	0.949

Note: The square root of AVE is shown in the diagonal.

As discussed in Chapter 5, as a rule of thumb, the square root of the AVE of each construct should be 'much larger' than the correlation of the specific construct with any of the other constructs in the model and should be at least 0.50 (Gefen and Straub 2005). The square root of the AVE for each construct was well above the 0.50 threshold and was considerably larger than the correlation of the specific construct with any of the other constructs, thus demonstrating discriminate validity.

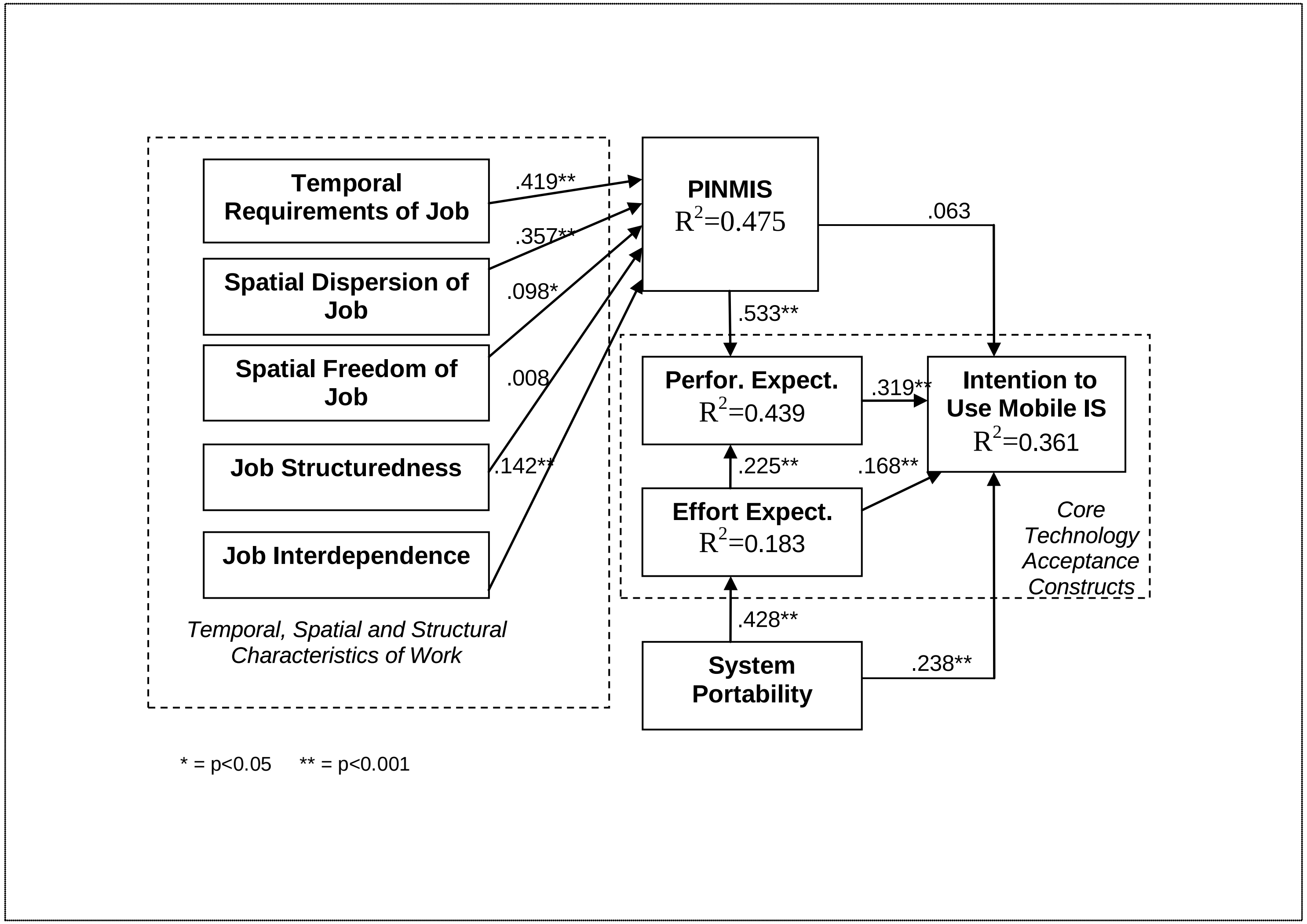
The next section describes the structural model evaluation as well as hypothesis testing.

6.4.5 Structural Model Evaluation and Hypotheses Testing

With the validity of the measures established, the next step was to test the structural portion of the research model (Gefen, Straub et al. 2000; Esposito Vinzi, Chin et al. 2010). The research model was initially conceptualized in detail on Chapter 3 and refined during the pilot study (Chapter 5) as well as the EFA and CFA procedures presented above in this chapter.

PLS analysis emphasises maximising explained variance (R^2) as well as establishing the significance of all path estimates (Chin 1998; Chin 1998). The refined model (Figure 6.4) was created in PLS-Graph 3.0 and path coefficients, t-values as well as variance explained were calculated for each endogenous variable (Marcoulides, Chin et al. 2009; Qureshi and Compeau 2009; Wetzels, Odekerken-Schroeder et al. 2009; Esposito Vinzi, Chin et al. 2010)

Figure 6.4 Structural Model



As illustrated above, the temporal, spatial and structural characteristics of work (TRJ, SDJ, SFJ, JS and JI) explained approximately 48% of the variance in perceived need for mobile IS (PINMIS). Similarly, performance expectancy (PE) had 44% of its variance explained by its antecedents. System portability (SP) explained approximately 18% of the variance in effort expectancy (EE). Overall, the model was able to explain 36% of the variance in intentions to use mobile IS (IU). The R^2 results for the technology acceptance constructs (PE, EE and IU) are comparable to recent findings in the literature (Venkatesh, Morris et al. 2003; Al-Gahtani, Hubona et al. 2007).

Each structural path in the research model represents a hypothesis (Chin 1998). Analysis of the structural model allows us to confirm or disconfirm each hypothesis as well as understand the actual contribution that an independent variable makes in explaining the variance in a dependent variable (Esposito Vinzi, Chin et al. 2010).

The strength and significance of each structural path can be determined in PLS through a bootstrap resampling procedure (Chin, Gopal et al. 1997). In this research bootstrapping was carried out using 309 cases and 1000 samples (Gefen and Straub 2005; Wetzels, Odekerken-Schroeder et al. 2009). The results are shown on Table 6.11.

Table 6.11 Path Coefficients and Significance Levels

	Path Coefficient	Standard Error	t- statistic	Significance level 2-tailed
TRJ-> PINMIS	0.419	0.044	9.417	p<0.001
SDJ -> PINMIS	0.357	0.051	6.960	p<0.001
SFJ-> PINMIS	0.098	0.046	2.146	p<0.05
JS -> PINMIS	-0.008	0.032	0.249	NS
JI -> PINMIS	0.142	0.041	3.455	p<0.001
PINMIS -> IU	0.063	0.048	1.316	NS
PINMIS -> PE	0.533	0.047	11.285	p<0.001
PE -> IU	0.319	0.074	4.303	p<0.001
EE -> PE	0.255	0.065	3.914	p<0.001
EE -> IU	0.168	0.053	3.158	p<0.001
SP -> EE	0.428	0.063	6.836	p<0.001
SP -> IU	0.238	0.052	4.543	p<0.001

The results show that with the exception of job structuredness (JS), all the remaining temporal, spatial and structural characteristics of work presented a significant impact on perceived individual need for mobile IS (PINMIS). As a result, hypothesis 1 was accepted since temporal requirements of job positively influences perceived individual need for mobile IS (TRJ-> PINMIS). Similarly, spatial dispersion of job, spatial freedom of job as well as job interdependence were found to be positively related to perceived individual need for mobile IS - confirming the second (SDJ-> PINMIS), third (SFJ-> PINMIS) and fifth (JI-> PINMIS) hypotheses. On the other hand hypothesis 4 (JS-> PINMIS) was rejected since the causal relationship between job structuredness and perceived individual need for mobile IS was found not significant.

While perceived individual need for mobile IS (PINMIS) is found to be significantly correlated to performance expectancy, it is not significantly associated with intentions to use mobile IS. Therefore hypothesis 6a (PINMIS->UI) is rejected while 6b (PINMIS->PE) is accepted (PINMIS->UI).

Further tests were undertaken to evaluate if PE mediates the relationship between PINMIS and IU (Baron and Kenny 1986). Once paths PINMIS->PE and PE->UI were removed, the path PINMIS->IU presented a significant relationship with a path coefficient of 0.229. Once paths PINMIS->PE and PE->UI are included, path PINMIS->IU presented a non-significant relationship with coefficient of 0.063. It can be concluded that relationship between PINMIS and IU fully is mediated by PE (Baron and Kenny 1986; Esposito Vinzi, Chin et al. 2010).

As expected, performance expectancy and effort expectancy are found to be positively related to intention to use Mobile IS, confirming hypothesis 7 (PE->IU) and hypothesis 8b (EE->PU). Similarly, hypothesis 8a (EE->PE), that effort expectancy positively influences performance expectancy is accepted.

Finally hypotheses 9a (SP->PE) and 9b (SP->IU), that system portability positively influences effort expectancy as well as intention to use mobile IS, are also confirmed.

A summary of the hypotheses tests is present on Table 6.12.

Table 6.12 Summary of Hypothesis Testing

Hypotheses	Result
H1: *Temporal Requirements of Job positively influences Perceived Individual Need for Mobile Information Systems.*	Accepted
H2: *Spatial Dispersion of Job positively influences Perceived Individual Need for Mobile Information Systems.*	Accepted
H3: *Spatial Freedom of Job positively influences Perceived Individual Need for Mobile Information Systems.*	Accepted
H4: *Job Structuredness negatively influences Perceived Individual Need for Mobile Information System.*	Rejected
H5: *Job Interdependence positively influences Perceived Individual Need for Mobile Information Systems.*	Accepted
H6a: *Perceived Individual Need for Mobile Information Systems positively influences Intention to use Mobile IS.*	Rejected
H6b: *Perceived Individual Need for Mobile Information Systems positively influences Performance Expectancy.*	Accepted
H7: *Performance Expectancy positively influences Intention to Use Mobile IS.*	Accepted
H8a*: Effort Expectancy positively influences Performance Expectancy.*	Accepted
H8b*: Effort Expectancy positively influences Intention to Use Mobile IS.*	Accepted
H9a: *System Portability positively influences Effort Expectancy.*	Accepted
H9b: *System Portability positively influences Intention to Use Mobile IS.*	Accepted

6.5 Chapter Summary

This chapter described the results of the main survey, and tested the conceptual research model and associated hypotheses. Section 6.2 described the refinement of the research instrument. This was followed by an explanation of the data collection procedures and a discussion about the adequacy of the sample (Section 6.3). The main section of this Chapter (6.4) presented the data analysis and results. This included the sample profile, EFA, CFA and the tests of the conceptual research model and hypotheses.

Discussion of the findings, conclusions and limitations of the research are presented in the next chapter.

7 Discussion and Conclusions

7.1 Introduction

The purpose of this chapter is to discuss and draw conclusions from the results obtained in this research. To this end, the development and measurement of each variable of the research model, as well as the tests of the relationships between variables, are reviewed. First, the results regarding perceived individual need for mobile IS (PINMIS) are examined. This is followed by an analysis of temporal, spatial and contextual characteristics of work (TRJ, SDJ, SFJ, JS and JI) and their relationship to PINMIS. Then, the technology acceptance constructs are evaluated. Subsequently, the outcomes of system portability are accessed. Then, the research questions and objectives of this study are revisited. Finally, the chapter presents an analysis of the contributions of the research as well as its limitations and suggestions for future research.

7.2 Perceived Individual Need for Mobile Information Systems

The literature review demonstrated that most of previous attempts to understand and characterize aspects of user mobility in the context of mobile IS have been limited to a geospatial point of view and were unsuccessful in predicting performance expectations or intentions to use mobile IS (Mylonopoulos and Doukidis 2003; Junglas and Watson 2006; Gebauer, Shaw et al. 2007; Gebauer and Tang 2008; Junglas, Abraham et al. 2008; Junglas, Abraham et al. 2009; Mallat, Rossi et al. 2009). Simultaneously, it was found that environmental and cognitive psychologists successfully managed to capture individuals' mobility behaviour through perceptions of their individual mobility needs (Haustein and Hunecke 2007; Hunecke, Haustein et al. 2007). It was also found that the concept of "perceived need" has been successfully incorporated by health psychologists into the theory of planned behaviour (TPB) (Paisley and Sparks 1998; Payne, Jones et al. 2004).

As a result, in the present research, the approach used by environmental, cognitive and health psychologists was adapted to the context of mobile IS, so as to operationalize a construct that successfully captures individual need for mobile IS and helps explain user acceptance of this type of system. Accordingly, perceived individual need for mobile information systems has been defined as the degree to which an individual perceives that they need a mobile information system to support their existing work practices.

Drawing from the literature review and the PINMIS conceptualization (Chapter 3), scales were designed to capture three distinct aspects PINMIS: 1) need for ICT support while 'on the go'; 2) need for ICT support while away from stationary ICT; and 3) need to use or rely on mobile IS in order to perform work.

While the items related to the first and third aspects were validated, the items representing the second aspect were dropped during the refinement process (Chapter 5) since they were considered to be focused on IT availability instead of need for mobile IS to support work tasks. From the initial 14 items, 8 items remained in the final set used to estimate PIMNIS. Table 7.1 presents the final set of items used to estimate PINMIS.

Table 7.1 Items used to estimate PINMIS

Code	Item
PINMIS1	My everyday work tasks require a high level of support by a Mobile Information System.
PINMIS2	My everyday work tasks require me to frequently rely on a Mobile Information System.
PINMIS3	My everyday work tasks require me to frequently need the support of a Mobile Information System.
PINMIS4	My everyday work tasks require me to frequently use a Mobile Information System.
PINMIS5	I frequently have to use a Mobile Information System in order to meet my work obligations.
PINMIS6	I cannot perform most of my work tasks without the support of a Mobile Information System.
PINMIS11	I frequently need to send, receive, retrieve and consult information via a Mobile Information System in order to meet my work obligations.
PINMIS13	I frequently need to have access to information via a Mobile Information System while 'on the go' in order to meet my work obligations.

The new construct demonstrated convergent and discriminant validity as well as reliability (CR= 0.965 , AVE = 0.777, α=0.956) (Cronbach 1971; Fornell and Bookstein 1982; Field 2009). It was also confirmed that temporal, spatial and structural characteristics of work are predictors of PINMIS and that PINMIS can be integrated into current technology acceptance theories. Further details regarding the relationships between PINMIS and the remaining variables will be explored in-depth in the following sections.

Overall, this study has shown that IS mobility requirements can be effectively measured by perceived need and that it is a much more reliable and valid approach than measuring IS mobility requirements by geospatial movement (distance travelled) (Gebauer and Tang 2008; Yuan, Archer et al. 2010).

7.3 Temporal, Spatial and Structural Characteristics of Work

The findings from the literature review suggested that the degree to which an individual perceives that they need a mobile information system to support their existing work practices is likely to be influenced by the spatial, temporal and structural characteristics of their work (Balasubramanian, Peterson et al. 2002; Lee and Sawyer 2002; Pica, Sørensen et al. 2004; Prasopoulou, Pouloudi et al. 2006; Towers 2006; Chatterjee and Sarker 2007; Gebauer, Shaw et al. 2007; Haustein and Hunecke 2007; Junglas 2007; Tilson 2007; Zheng 2007; Zheng and Yuan 2007; Yuan and Zheng 2009; Yuan, Archer et al. 2010). The research model conceptualized five key temporospatial and structural characteristics of work: temporal requirements of job, spatial dispersion of job, spatial dependence of job, job structuredness and job interdependence. The following sub-sections discuss the results for each of those variables.

7.3.1 Temporal Requirements of Job (TRJ)

Temporal requirements of job (TRJ) from previous work on time-criticality (Zerubavel 1981; Lee and Liebenau 2000; Abraham 2004; Prasopoulou, Pouloudi et al. 2006; Gebauer, Shaw et al. 2007; O'Leary and Cummings 2007; Zheng 2007; Yuan, Archer et al. 2010). However, in this research the concept has been broadened in order to explicitly relate to the context of job requirements. Therefore, TRJ has been defined as the degree to which individuals perceive they are required to conform to temporal boundaries in order to perform their portfolio of work tasks. The construct was measured through three aspects: time-window, punctuality, and urgency of task. The initial pool of 11 items suffered some rewording during the card sorting and expert panels, one item was deleted and an additional item was generated at that stage. Out of the 11 items used to estimate TRJ in the pilot study only 8 items passed on to the main study. During the main study one last item was dropped. Table 7.2 presents the items used to estimate TRJ.

Table 7.2 Items used to estimate TRJ

Code	Item
TRJ1	My job frequently requires that I make immediate decisions.
TRJ2	My job frequently requires that I take immediate actions.
TRJ4	I frequently perform urgent work tasks.
TRJ7	My job frequently requires that I start tasks as soon as possible.
TRJ8	My job frequently requires that I complete tasks as soon as possible.
TRJ10	My job frequently requires me to perform my work tasks at the right time.
TRJ11	I frequently need to perform work tasks in a hurry.

The TRJ construct with 7 items displayed convergent and discriminant validity as well as reliability (CR= 0.927 , AVE = 0.648, α=0.909) (Cronbach 1971; Fornell and Bookstein 1982; Field 2009). In addition, Hypothesis 1 was confirmed demonstrating that temporal requirements of job positively influences perceived individual need for mobile IS. This result is in line with previous literature which established that people find value in using mobile IS to respond to urgent matters and to help them achieve communication immediacy (Rodina, Zeimpekis et al. 2003; Barnes 2004; Scornavacca, Prasad et al. 2006; Gebauer and Tang 2008; Hoehle and Scornavacca 2008; Gebauer and Ginsburg 2009; Yuan and Zheng 2009; Yuan, Archer et al. 2010)

7.3.2 Spatial Dispersion of the Job (SDJ).

In this research, spatial dispersion of job (SPJ) has been defined as the degree to which individuals perceive they are required to move to distinct locations in order to perform their work tasks. The development of SPJ was based on two constructs found in the literature: Zheng's (2007) location variety construct and Gebauer and Tan's (2008) user mobility construct. While it is acknowledged that 6 initial SDJ items derive from the 2 items of Location Variety proposed by Zheng (2007), it is also important to point out that the new SDJ items differ substantially from the original Location Variety measurements. While Zheng (2007) location variety aimed to measure the extent to which individuals perceive that a task is performed in different locations, SDJ focuses on how much individuals perceive they need to move to different locations while working.

The initial pool of 7 items contained 2 items aimed to capture stationarity (or lack of spatial variety). These two items were reverse coded during data analysis. During the card sorting and expert panels SDJ did not suffer any major changes and one additional item was created. Interestingly, the results of the pilot study indicated that perhaps SDJ could be split in to two variables (spatial dispersion and stationarity) and a couple of items were rephrased and another two were added in order to better represent these two aspects. However, the final study demonstrated that SDJ works well as a single construct. Perhaps the final refinements after the pilot study helped to clarify any cognitive dissonance among the items. The 9 items used to estimate SDJ also demonstrated convergent and discriminant validity as well as reliability (CR= 0.949 , AVE = 0.675, α=0.939) (Cronbach 1971; Fornell and Bookstein 1982; Field 2009). Table 7.3 presents the items used to estimate SDJ.

Table 7.3 Items used to estimate SDJ

Code	Item
SDJ1*	My job requires me to generally perform my work tasks at the same location.
SDJ2	My job requires me to frequently work at different locations.
SDJ3*	My work tasks require me to generally stay in the same specific location.
SDJ4	My work tasks require me to frequently go to a variety of locations.
SDJ5	My work tasks require me to frequently work in new locations.
SDJ6*	My job hardly ever requires me to change the location where I work.
SDJ7	My job requires me to frequently perform my work tasks in many locations.
SDJ9*	My work tasks require me to work every day in the same place.
SDJ10*	My job requires me to always work in a single location.

*=reverse coded during the analysis

Spatial dispersion of job was found to be positively related to perceived individual need for mobile IS (Hypothesis 2). This result is sustained by the literature that suggested that mobile IS offers particular value to individuals that are constantly ‘on the move’ (Zhang and Yuan 2002; Barnes 2003; Jarvenpaa, Lang et al. 2003; Rodina, Zeimpekis et al. 2003; Pica, Sørensen et al. 2004; Junglas and Watson 2006; Hoehle and Scornavacca 2008; Mallat, Rossi et al. 2009).

7.3.3 Spatial Freedom of Job (SFJ)

Spatial freedom of job (SFJ) was initially conceptualized as spatial dependence of job (SDPJ). SDPJ was defined as the degree to which individuals perceive that location is a critical element to performing their portfolio of work tasks. This initial construct, was based on Junglas and Watson (2003) work on location dependence which analysed the extent to which location is an import aspect to complete a determined task.

During the card sorting and expert panels the initial pool of 8 items created for SDPJ did not undergo any major modifications. Similarly to SDJ, the SDPJ construct tended to cluster into two separate factors during the pilot study. Reverse coded items related to spatial freedom/independence did not cluster with the remaining items (all related to spatial dependence). The possible existence of two separate constructs was considered: spatial dependence (SDPJ 02, 03 and 05) and spatial freedom (SDPJ 01, 04, 07 and 08). However furthers tests on PLS revealed that most items from spatial dependence (SDPJ 03 and 06) failed to pass the established thresholds. On the other hand, the items related to spatial freedom presented solid results (CR= 0.866, AVE =0.618 and α=0.797). Consequently, items SDPJ 01, 04, 07 and 08 were taken to the next stage and the construct was renamed spatial freedom of job (SFJ). SFJ has been defined as the degree to which individuals perceive to be free of spatial requirements when performing their portfolio of work tasks. Table 7.4 presents the items used to estimate SFJ.

Table7.4 Items used to estimate SFJ

Code	Item
SFJ1	I can perform most of my work tasks independently of location.
SFJ4	I perform most of my work tasks wherever I want.
SFJ7	My location is frequently irrelevant to the performance of my work tasks.
SFJ8	I have the freedom to choose where I perform most of my work tasks.

The final study demonstrated the validity and reliability of SFJ (CR= 0.901, AVE = 0.696, α=0.855) and confirmed Hypothesis 3 ($p<.05$), that spatial freedom of job positively influences PINMIS. It was interesting to find, during the refinement process of this construct that spatial freedom and independence emerged as two separate entities. In addition, the tests with the items created to measure spatial dependence indicated the construct was neither reliable nor valid. On the other hand, the results of SFJ support previous finding that workers that enjoy freedom to work wherever they want may perceive in a positive manner the advantages of the affordances provided by mobile technologies (Gebauer and Tang 2008; Chatterjee, Chakraborty et al. 2009; Junglas, Abraham et al. 2009; Yuan and Zheng 2009; Yuan, Archer et al. 2010).

7.3.4 Job Structuredness (JS)

The measurement of structural characteristics of work tasks such as repetition, routine, programmability and complexity have been operationalized in a number of studies (Goodhue 1995; Goodhue and Thompson 1995; Gebauer, Shaw et al. 2004;

Karimi, Somers et al. 2004; Yuan and Zheng 2006; Gebauer, Shaw et al. 2007; Zheng 2007; Gebauer and Tang 2008; Chatterjee, Chakraborty et al. 2009; Yuan and Zheng 2009). While the literature is convergent in pointing out that routineness (or the lack of it) is an important structural characteristic of work, the operationalization of the construct has been quite divergent, using distinct sets of items (Van de Ven and Dalbecq 1974; Daft and Macintosh 1981; Withey et al 1983; Zheng 2007 and Gebauer and Tang 2008). In this study job structuredness (JS) has been defined as the degree to which individuals perceive that their portfolio of work tasks is repetitive and programmable.

The 9 items initially selected to estimate JS did not require any changes during the card sorting and expert panel rounds. However during the pilot study the two items borrowed from Goodhue and Thompson (1995) were discarded since they did not cluster with the other items in the construct. In addition, the pilot study also suggested that perhaps JS could be developed as two separate constructs (task exceptions and task analysability). However, during the main study it was demonstrated, as initially suggested by Zheng (2007), that this was not the case and that these two aspects are highly correlated and can be successfully be combined into a single aspect.

The final measurement of job structuredness used 7 items and was proven valid and reliable (CR=0.944, AVE=0.708, α=0.855). Table 7.5 presents the items used to estimate JS.

Table 7.5 Items used to estimate JS

Code	Item
JS1	Most of my work tasks are repetitive.
JS2	There is a clearly known way to do the major types of tasks in my job.
JS3	I can rely on established procedures and practices to perform most of my work tasks.
JS4	Most of my work tasks are routine.
JS5	There is an understandable sequence of steps that can be followed in doing my job.
JS9	Most of the time my job requires me to perform the same work tasks in the same way.
JS10	Most of the time my job requires me to perform repetitive activities.

The influence of job structuredness on PINMIS was found not significant. As a result, Hypothesis 4 was rejected. This result suggests that the perceived need for mobile IS is not influenced by the degree to which a person's portfolio of work tasks is structured. Individuals with unstructured work are most likely to require mobile IS support in order to obtain ad-hoc information access for problem resolution while people with structured jobs are likely use mobile IS for repetitive information access (Pica, Sørensen et al. 2004).

7.3.5 Job Interdependence (JI)

In the managerial literature, the constructs related to task interdependence are normally centred on general exchanges between individuals and/or organizational units (Thompson 1967; Fry and Slocum 1984; Pearce and Gregersen 1991; Pearce, Sommer et al. 1992; Goodhue and Thompson 1995; Kumar and van Dissel 1996; Gebauer, Shaw et al. 2007; Gebauer and Tang 2007). Since no measures of job interdependence explicitly focused on information exchange among workers were found in the literature, it was necessary to select and adapt items from previous studies such as Pearce and Gregersen (1991), Pearce et al (1992), Sharma and Yetton (2003; 2007), Zheng (2007), Gebauer and Tang (2008) and Goodhue and Thompson (1995).

As a result, in this study, job interdependence has been defined as the degree to which individuals perceive that they are required to exchange information with others in order to perform their portfolio of work tasks.

The initial pool of 11 items developed for JI were improved during the card sorting and expert panel exercises. Out of the 11 items used to estimate JI in the pilot study only 5 items passed on to the main study. Contrary to initial expectations based on Zheng (2007), items measuring job independence, when reverse coded, did not capture the degree of job interdependence. Table 7.6 presents the items used to estimate JI.

Table 7.6 Items used to estimate JI

Code	Item
JI4	My job frequently requires me to obtain information from others in order to complete my work tasks.
JI6a	My job frequently requires me to interact closely with others.
JI6b	My job frequently requires me to rely on the work of others.
JI8	My job frequently requires me to exchange information with others in order to perform my work tasks.
JI10	My job frequently requires me to consult with others.

*=reverse coded during the analysis

During the main study JI performed well in terms of validity and reliability (CR= 0.934 , AVE = 0.739, α=0.904). In addition, Hypothesis 5 was accepted, confirming that job interdependence positively influences PINMIS. This result is supported by the literature which postulates that mobile IS provide a high level of support to interdependent work tasks by providing an ubiquitous and interactive channel for information exchanges (Barnes, Scornavacca et al. 2006; Chatterjee and Sarker 2007; Gebauer, Shaw et al. 2007; Gebauer and Tang 2007; Tilson 2007).

Having discussed the results regarding the constructs related to temporal, spatial and structural characteristics of work and its relationships to the PINMIS construct, the next sub-section discusses the variables related to technology acceptance theory.

7.4 Variables from Technology Acceptance Theories

One objective of this study was to integrate PINMIS with technology acceptance theories. To this end, constructs from the Unified Theory of Acceptance and Use of Technology (UTAUT), namely intention to use (IU), performance expectancy (PE) and effort expectancy, were adopted in this research with minor modifications in order to suite the study context (Venkatesh, Morris et al. 2003). Since the goal here was not to further validate the UTAUT, IU, PU and EE were not included in the card sorting and expert panel phase.

7.4.1 Intention to Use Mobile IS (IU)

In this research, intention to use mobile IS (IU) has been defined as a measure of the strength of one's intention to use Mobile IS (Fishbein and Ajzen 1975; Venkatesh, Morris et al. 2003). Based on the results from the pilot study the 3 items from IU underwent a minor change: instead of "in the next 6 months", the wording was changed to "in the next 12 months". The purpose of this change was to increase variance in the responses. During he main study the construct performed well (CR= 0.956 , AVE = 0.879, α=0.931) and the model was able to explain 36% of the variance in intentions to use mobile IS (IU). These results are comparable to previous findings from previous studies (Venkatesh, Morris et al. 2003; Han, Mustonen et al. 2004; Al-Gahtani, Hubona et al. 2007). Table 7.7 presents the items used to estimate IU.

Table 7.7 Items used to estimate IU

Code	Item
IU1	In the next 12 months I intend to use Mobile Information Systems.
IU2	In the next 12 months I predict I will use Mobile Information Systems.
IU3	In the next 12 months I plan to use Mobile Information Systems.

Surprisingly, the direct relationship between PINMIS and Intention to use Mobile IS (IU) proved to be non-significant, consequently Hypothesis 6a was rejected. It was found the effect of PINMIS on IU was mediated by performance expectancy.

7.4.2 Performance Expectancy (PE)

Performance Expectancy (PE) has been defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance (Venkatesh, Morris et al. 2003). The construct combines four items from well-known technology acceptance constructs such as Perceived Usefulness (Davis 1989; Davis, Bagozzi et al. 1989) Relative Advantage (Moore and Benbasat 1991) and Outcome Expectations (Compeau and Higgins 1995; Compeau, Higgins et al. 1999). Table 7.8 presents the items used to estimate PE.

Table 7.8 Items used to estimate PE

Code	Item
PE1	I find Mobile Information Systems useful in my job.
PE2	Using Mobile Information Systems enables me to accomplish tasks more quickly.
PE3	Using Mobile Information Systems increases my productivity.
PE4 (x)	If I use Mobile Information Systems, I will increase my chances of getting a raise.

The results of the pilot study in regards to PE were quite surprising. While the loadings for PE 01, 02 and 03 were close to the results published in the original UTAUT article (Venkatesh, Morris et al. 2003), PE04 presented issues such as low reliability score, weak loadings and did not cluster with other PE items. As a result, it was decided to incorporate the original TAM constructs (perceived ease of use and perceived usefulness) into the main study and to determine whether they perform better or worse than their UTAUT counterparts.

During the main study it was confirmed that item PE 04 from the PE construct presented again weak loadings. It was concluded that the PE04 item may be not adequate for use in surveys in Australasia since immediate financial reward on short-term performance is not a salient part of the local remuneration culture. Once PE04 was excluded, the PE construct produced solid results (CR= 0.927 , AVE = 0.809, α=0.881) which were almost identical to its respective TAM counterpart (PU). It was concluded that it was advantageous to continue using the UTAUT constructs in this study since they produced similar results with a much smaller set of items then the original TAM constructs (Venkatesh, Morris et al. 2003). In addition, PE had 44% of its variance explained by its antecedents in the model.

Hypothesis 6b, postulating that PINMIS positively influences performance expectancy, was accepted. This is an important finding. As Benbasat and Barki (2007) pointed out, after almost twenty years of research investigating user acceptance of technology (via TAM and its many variants), little still is known about the antecedents of the belief constructs such as performance expectancy or perceived usefulness. As a result, study after study has reiterated the importance of PE/PU, with little understanding about what actually makes a system useful (Junglas and Watson 2006; Pagani 2006; Zheng 2007; Gebauer and Tang 2008; Mallat, Rossi et al. 2009). In addition, it is vital to notice that while PINMIS captures the perceived requirements of an individual, performance expectancy captures the expected consequences attributed to the use of a technology (Venkatesh, Morris et al. 2003; Hunecke, Haustein et al. 2007). Therefore, there is a clear cause-consequence relationship between perceived need and perceived performance expectancy (usefulness).

As expected and consistent with the literature, Hypothesis 7 was accepted, confirming that PE positively influences Intention to Use Mobile IS. (Jarvenpaa, Lang et al. 2003; Mylonopoulos and Doukidis 2003; Venkatesh, Morris et al. 2003; Scornavacca, Barnes et al. 2006; Venkatesh, Davis et al. 2007; Gebauer and Tang 2008; Hoehle and Scornavacca 2008; Scornavacca and Huff 2008; Mallat, Rossi et al. 2009).

7.4.3 Effort Expectancy (EE)

Effort expectancy (EE) is a result of a amalgamation of perceived ease of use (Davis 1989; Davis, Bagozzi et al. 1989) and ease of use (Moore and Benbasat 1991). It has been defined as the degree of ease associated with the use the system (Venkatesh, Morris et al. 2003). Table 7.9 presents the items used to estimate EE.

Table 7.9 Items used to estimate EE

Code	Item
EE1	My interaction with Mobile Information Systems is clear and understandable.
EE2	It is easy for me to become skilful at using Mobile Information Systems.
EE3	I find Mobile Information Systems easy to use.
EE4	Learning to operate Mobile Information Systems is easy for me.

The performance of the EE construct during the pilot study as well as the main study met all expectations (CR= 0.940 , AVE = 0.796, α=0.915) (Venkatesh, Morris et al. 2003; Al-Gahtani, Hubona et al. 2007). When comparing EE to its TAM counterpart (Perceived ease of use) it produced almost identical results with the advantage of having fewer items then PEoU (Venkatesh, Morris et al. 2003). As expected and extensively documented in the literature, Hypotheses 8a (EE positively influences PE) and 8b (EE positively influences IU) were accepted (Venkatesh, Morris et al. 2003; Venkatesh, Davis et al. 2007; Scornavacca and Huff 2008; Mallat, Rossi et al. 2009).

Having outlined the results regarding the constructs from technology acceptance theory, the next sub-section discusses the system portability construct.

7.5 System Portability (SP)

Although UTAUT's effort expectancy construct captures known usability issues of mobile IS such as small screens and cumbersome input methods, it does not account for the some of the idiosyncrasies of mobile technologies such as portability (Hoehle and Scornavacca 2008; Gebauer and Ginsburg 2009; Mallat, Rossi et al. 2009). In addition, while portability has been a focal point of the m-business literature, no actual measurement of individuals' perceptions of system portability has been developed prior to this research (Hoehle and Scornavacca 2008; Chatterjee, Chakraborty et al. 2009; Junglas, Abraham et al. 2009).

In this research, system portability (SP) has been defined as the degree of ease associated with transporting the mobile information system. Initially, 9 items were developed incorporating three aspects found in the literature: physical properties of the device, 'easy to carry' and software adaptation (Basole 2004; Hoehle and Scornavacca 2008; Chatterjee, Chakraborty et al. 2009; Gebauer and Ginsburg 2009; Junglas, Abraham et al. 2009). During the card sorting and expert panel exercises some of the items underwent some minor modifications and one item was deleted due to ambiguity. Out of the 7 items used to estimate SP in the pilot study only 3 items (all referring to the 'easy to carry' aspect) were retained to be used in main study. As a result it was concluded that the items from physical properties and software adaptation aspects do not seem to be reflective measures of portability. Table 7.10 presents the items used to estimate SP.

Table 7.10 Items used to estimate SP

Code	Item
SP1	I find my Mobile Information System device easy to carry.
SP2	It is easy for me to take my Mobile Information System device with me while 'on the go'.
SP6	I find that my Mobile Information System device is very portable.

During the main study, the construct performed soundly, demonstrating reliability and validity (CR= 0.965 , AVE = 0.901, α=0.941) . In addition it was found that user's perceptions regarding system portability are positively related to perceptions of effort expectancy as well as intentions to use mobile IS – confirming Hypotheses 9a and 9b. This finding demonstrated that if the mobile device is 'easy to carry', users are more likely to find it easy to use and to actually use it (Hoehle and Scornavacca 2008; Chatterjee, Chakraborty et al. 2009; Gebauer and Ginsburg 2009; Mallat, Rossi et al. 2009). In addition, the validation of system portability is particularly important in regards to technology adoption theories since it sheds some light on the contingency of the mobile artefact in relation to users' beliefs (Benbasat and Barki 2007; Straub and Burton-Jones 2007).

Now that the development and measurement of each variable of the research model as well as the tests of the relationships between variables have been reviewed, the next section revisits the research question and objectives.

7.6 Research Question and Objectives Revisited

The purpose of this study was to develop and validate a model of the factors that influence user acceptance of mobile information systems in the workplace. Consequently, the initial research question that guided this study was:

What factors influence the acceptance of mobile information systems in the workplace at the individual level?

Thus, in order answer this question, three objectives were set in Chapter 1:

To explore and understand the key attributes, capabilities and limitations of mobile information systems in the workplace;

To explore and understand theories of user acceptance of technology at the individual level ;

To develop, and validate a user acceptance model of mobile information systems in the workplace.

The first and second objectives were successfully accomplished by the extended literature review on electronic business, mobile business, user acceptance of technology and user acceptance of mobile technology presented in Chapter 2. The literature review allowed the identification of theoretical concepts that were fundamental for the development of the conceptual model of user acceptance of mobile information systems in the workplace developed in Chapter 3.

In order to achieve the third objective, and answer the research question, three research sub-questions were posed to guide the empirical phase of this study:

To what extent do the temporal, spatial and structural characteristics of the portfolio of tasks performed by users of mobile information systems in the workplace influence their perceived individual need for mobile IS?

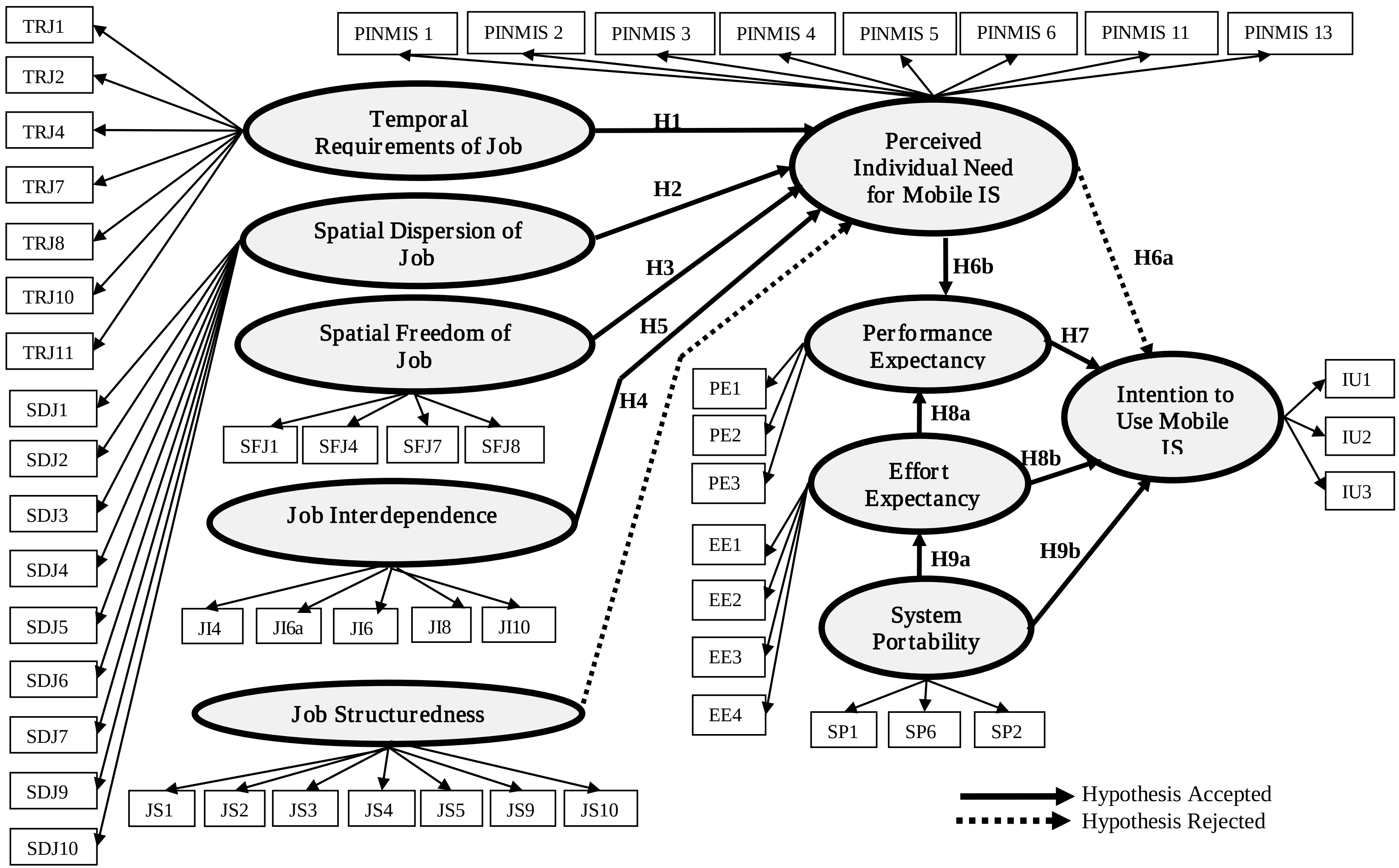
To what extent does perceived individual need for mobile IS influence performance expectancy and intention to use mobile IS?

To what extent does system portability influence effort expectancy and intention to use mobile IS?

The study was able to effectively answer the three questions. Figure 7.1 presents the finalized model including measurement items and research hypotheses. In regards to sub-question 1, it was found that temporal requirements of job, spatial dispersion of job, spatial freedom of job and job interdependence were characteristics of the portfolio of tasks performed by users of mobile information systems in the workplace that have a positive influence their perceived individual need for mobile IS. Concerning sub-question 2, it was concluded that while perceived individual need for mobile IS has a significant influence on performance expectancy, it does not directly influence individuals' intention to use mobile IS. Finally, the empirical test of the model allowed us to answer sub-question 3 by confirming that system portability has a positive influence on effort expectancy as well as intention to use mobile IS.

Through the review of the research objectives and associated research questions it can be concluded that this fulfilled its purpose and successfully developed and validated a model of the factors that influence user acceptance of mobile information systems in the workplace.

Figure 7.1 Final Research Model



7.7 Contributions of the Study

This study embraced one of the new frontiers of the IS discipline: IS mobility. The findings presented here provide contributions to academics as well as practitioners.

7.7.1 Contributions to Theory

While the emergence of mobile technologies has attracted considerable interest among researchers, its theoretical development still is at an early stage. From an academic perspective, the development and validation of a model for user acceptance of mobile IS in the workplace extends the body of knowledge of technology acceptance theories (one of the most mature and explored areas of IS) into the mobile business domain.

Specifically, the validation and measurement of temporospatial and structural characteristics of work enables an understanding of how individuals' relation to time, space and work structure influence their need for the mobile IS artefact. It also provides the foundations for researchers to explore user temporospatial behaviours in the context of information systems.

Perceived individual need for mobile IS was proven to be a much more successful and direct approach to measuring IS mobility requirements than using user geographic mobility (travel distance) (Mallat, Rossi et al. 2006; Gebauer, Shaw et al. 2007; Yuan, Archer et al. 2010).

The development of system portability empirically validates a construct that captures one of the major idiosyncrasies of mobile IS. In addition, it provides a better understanding of how device portability affects perceptions of technology ease of use.

In particular, this research sheds some light onto the antecedents of the belief constructs such as performance expectancy – considered one of the most important gaps in the technology acceptance literature (Benbasat and Barki 2007).

Above all, this research provides a foundation to further research on user acceptance of mobile technologies.

7.7.2 Contributions to Practice

The study provides a better understanding of the characteristics and capabilities of mobile information systems in the workplace as well as the relationship between individuals' characteristics of work and their perceived need for mobile information systems in the workplace. Managers can use the model to clearly identify work portfolios that may benefit the most from the availability of mobile IS support and therefore make better decisions in relation to investments in mobile technologies.

The results of the study can provide guidance to mobile providers when developing, implementing and selling mobile information systems for the workplace. The study provides to mobile technology vendors a better understanding of their target markets needs. For example, new mobile applications could be developed to help users with specific job characteristics such as time urgency, geographical dispersion and information interdependence. It also can help vendors to easily determine what industries and job characteristics may gain the most advantage from the implementation of mobile IS. In addition, the results here can be also used as a marketing tool to demonstrate to prospective buyers the value of mobile IS to employees and their positive perception in relation to performance gains.

7.8 Limitations and Directions for Future Research

The adoption of mobile technologies is a dynamic and continuous process. One of the main limitations of this research is that it used cross-sectional surveys and data collection was carried in only one point of time during pilot and another instance during the main study. Therefore the inference of causality expressed is not as robust as in a longitudinal study. Ideally, a longitudinal study should have been conducted in order capture the of possible changes in the relationships among the variables of the model during the different stages of the technology adoption process (Venkatesh, Morris et al. 2003).

While extensive efforts were taken to review all of the literature related to this study, it is important to acknowledge that it is possible that some articles may have been overlooked in the process. In addition, while it is believed that the dominant factors that influence user acceptance of mobile information systems in the workplace have been identified in this study that could be other factors which did not come to light in the research. Finally, even though a rigorous process of model development, data collection and instrument validation was followed, possible measurement errors cannot be completely ruled out.

A potential methodological limitation of this study concerns the survey recruitment method and the sample used in the study. While efforts were made to gather a large random sample of users of mobile IS for work purposes, it is impossible to guarantee that all respondents met the selection criteria and answered the questions carefully. In addition the sample is limited to the New Zealand context and within that, to individuals associated with the organizations that supported the distribution of the survey instrument. Therefore, the results presented here, while generalizable to these specific circumstances, should not be examined and used out of its context.

Future research should extend the current model, re-examine and further validate the constructs and scales developed in this study, evaluating its applicability in different contexts. In addition, PINMIS and its temporospatial determinants could be adapted for the study on hedonic mobile applications in consumer markets. Finally, it would be also beneficial to explore the antecedents of system portability, examining how the device physical properties influence individuals' perceptions of portability.

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Appendices

Appendix 1 - Card Sorting Protocols

Card sorting Protocol – open round

Introduction:

Thank you for agreeing in participating in this phase of my research.

The goal of this exercise is to develop categories of individual perceptions of the factors that influence the adoption of mobile information systems in the workplace. I will start the session by reading a standard set of instructions for the tasks you are required to perform. I will then answer any questions you might have about this process. Following the Q&A period, you will be asked to complete a practice round of 11 items related to individuals' eating habits. Please keep in mind that this is not a test – it is simply an exercise for the purpose of constructing a survey instrument intended to verify if certain statements group together. There are no 'right' or 'wrong' answers.

The sorting process will be completed individually by you and should take approximately 40 minutes to complete.

Task One – card sorting

One pile of randomly ordered index cards will be given to you. Start the sorting task by reading all the statements in the cards. Each card contains a statement intended to reflect a particular thought regarding individual perceptions of the factors that influence the adoption of mobile information systems in the workplace. You will be asked to sort the cards into categories – there is no pre-determined number of categories and the number of cards in each category is not necessarily uniform and could vary significantly. The statements within each group must relate more to one another than they do to statements in other categories. Many statements may appear to be similar to one another, but you are asked to try to determine the primary underlying idea that each statement reflects.

It is acceptable to change your mind and re-sort the cards during the process. Once you have established your final categories, please review each pile one more time to ensure that all cards are in the 'right' category and that none of the statements fit a different category better. You may access these instructions at anytime during the process.

Task two – labelling

You will be given a blank card. Please write a label and a definition for each category you have created.

Task three – ambiguous, repeated and indeterminate items

Please point out items that you found to be ambiguous, indeterminate (fitting no category) or repeated. Also indicate items that feel that the wording could be improved.

Final Remarks:

Thank you for contributing to this phase of my research.

Please do not discuss this process with other colleagues and students – since they may be also participating in this phase of the research.

Card sorting Protocol – closed

Introduction:

Thank you for agreeing in participating in this phase of my research.

The goal of this exercise is to develop categories of individual perceptions of the factors that influence the adoption of mobile information systems in the workplace. I will start the session by reading a standard set of instructions for the tasks you are required to perform. I will then answer any questions you might have about this process. Following the Q&A period, you will be asked to complete a practice round of 11 items related to individuals' eating habits. Please keep in mind that this is not a test – it is simply an exercise for the purpose of constructing a survey instrument intended to verify if certain statements group together. There are no 'right' or 'wrong' answers.

The sorting process will be completed individually by you and should take approximately 40 minutes to complete.

Task One – card sorting

A blue and a white pile of randomly ordered index cards will be given to you. The blue pile contains the name and definition of six different categories regarding individual perceptions of the factors that influence the adoption of mobile information systems in the workplace. Start the sorting task by reading all the statements in the blue cards and placing them on the table.

Each white card contains a statement intended to reflect a particular thought regarding individual perceptions of the factors that influence the adoption of mobile information systems in the workplace. You will be asked read the statements in the cards and sort them into the six categories printed in the blue cards – the number of cards in each category is not necessarily uniform and could vary significantly. The statements within each group must relate more to one another than they do to statements in other categories. Many statements may appear to be similar to one another, but you are asked to try to determine the primary underlying idea that each statement reflects. Ambiguous or indeterminate (fitting no category) items should be placed in the "unclear" bin.

It is acceptable to change your mind and re-sort the cards during the process. Once you have established your final categories, please review each pile one more time to ensure that all cards are in the 'right' category and that none of the statements fit a different category better. You may access these instructions at anytime during the process.

Task two – improvement

Please point out items that you found to be repeated. Also indicate items that feel that the wording could be improved.

Final Remarks:

Thank you for contributing to this phase of my research.

Please do not discuss this process with other colleagues and students – since they may be also participating in this phase of the research.

Card sorting – trial round cards regarding eating habits

#		Meat intake
1	M	I frequently eat beef.
2	M	I frequently eat fish.
3	M	I frequently eat poultry.
4	M	I frequently eat pork.
5	M	I enjoy eating meat.

#	ref	Vegetable intake
1	V	I frequently eat raw vegetables.
2	V	I frequently eat cooked vegetables.
3	V	I enjoy eating salads.
4	V	I enjoy eating cooked vegetables.

#	ref	Ambiguous/not fitting
1	A	I consider myself to be a vegetarian.
2	A	I frequently drink soft drinks such as coke.

Appendix 2– Human Ethics Approvals

HEC Approval for Pilot Study

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

SIM HUMAN ETHICS COMMITTEE

Comments on Application for Human Ethics Approval

Date: 27th July 2009
Re: Perceived Individual Needs for Mobile Information Systems: an investigation into the factors influencing user acceptance of mobile information systems in the workplace
Principal Researcher: Eusebio Scornavacca
Supervisor (student research): Sid Huff; Hans Lehmann
Ref No: #16819

Your HEC application has been reviewed and the Committee's decision is the following:

Approval Given after Amendments made – Application accepted.
Human Ethics Approval valid until: (Date: *as in application* or *no more than 3 years*)
Thank you for the amendments you have made to your HEC application. These meet the committee's required changes. On behalf of the HEC Chair I am authorised to inform you that you may now proceed with your research. You may begin your data collection immediately but please note that a hard copy of your application signed by both you and your supervisor (or other researchers involved for staff applications) is required within one month to ensure that we have a complete record of the approval of your application. This should be submitted to me at:
School of Information Management
Victoria University of Wellington
Kelburn Campus
Wellington

Wendy Chen
HEC Administrator
SIM Human Ethics Committee

HEC Approval for Main Study

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

SIM HUMAN ETHICS COMMITTEE

Comments on Application for Human Ethics Approval

Date: **18th November 2009**
Re: **Perceived Individual Needs for Mobile Information Systems: an investigation into the factors influencing user acceptance of mobile information systems in the workplace**
Principal Researcher: **Eusebio Scornavacca**
Supervisor (student research): **Sid Huff**
Hans Lehmann

Ref No: **#17114**

Your HEC application has been reviewed and the Committee's decision is the following:

Category 2 - Application approved subject to the following minor change(s).
Human Ethics Approval valid until: (Date: *as in application* or *no more than 3 years*)
The committee requires the change(s) noted below, if these are acceptable you may begin immediately but you will need to send an updated application within one month. If the changes are not acceptable to you, please email me detailing your objections. Note that the updated hard copy of your application needs to be signed by both you and your supervisor and should be submitted to me at:

School of Information Management
Victoria University of Wellington
Kelburn Campus
Wellington

Wendy Chen
HEC Administrator
SIM Human Ethics Committee

Appendix 3 – Instrument Used to in the Pilot Study Pre-test

Mobile Information Systems in the Workplace – Consent Information

Thank you for accessing our questionnaire – before you proceed, please read the information below:

- The goal of this research is to understand the factors that influence individuals' decision to use mobile information systems in the workplace.
- This survey is anonymous, and no information that would identify you is being collected.
- The results of this research may be deposited in the library's institutional repository or presented at conferences or published as articles in professional or academic journals. Only aggregate data will be used in any presentations or publications that results from this research.
- Your participation is voluntary, and you are implying consent to participate by completing and submitting this online survey. It should take you 15-20 minutes to complete the survey.
- The data will be stored in a password-protected file for a maximum of two years, after which it will be destroyed.
- The School of Information Management Human Ethics Committee has approved this research project.
- If you would like to receive a summary of the results or if you have any questions about it, please contact Eusebio Scornavacca, Eusebio.Scornavacca@vuw.ac.nz phone (04) 463 6697 or my supervisor Sid Huff at 463-5819 or e-mail Sid.Huff@vuw.ac.nz

Only answer this survey if you are currently using for work purposes a mobile device enabled with data access.

Continue

Introduction

Mobile technologies are rapidly being adopted by a large number of organizations around the world. The goal of this research is to understand the factors that drive individuals to use mobile information systems in the workplace.

In this research **Mobile Information Systems** is defined as a combination of the mobile device, software and wireless networks. The focus here is on **data communications, processing and storage** – not voice communications. We are interested in mobile computing and the use of data applications such as mobile e-mail, text messages, mobile internet, calendar, contacts and task management, navigation (GPS), multi-media message service (MMS), mobile office applications, sales-force and field-force applications, etc.

When answering the survey please <u>ONLY take in consideration the use of your device for data applications - not voice communications</u>.

- Part 1 –
Nature of Work

The following statements will help us understand your work practices**.**
When answering each item please think of **a typical working day** and the **usual portfolio of tasks** you normally do in order to meet your work obligations.

Please indicate to what extend do you agree with the following statements:

	My job frequently requires that I….	***Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree***
TC1	make immediate *decisions*.	1...2...3...4...5...6...7
TC2	take immediate *actions*.	1...2...3...4...5...6...7
TC5	*start* tasks on time.	1...2...3...4...5...6...7
TC6	*complete* tasks on time.	1...2...3...4...5...6...7
TC7	*start* tasks as soon as possible.	1...2...3...4...5...6...7
TC8	complete tasks as soon as possible.	1...2...3...4...5...6...7

		Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree
TC4	I frequently perform *urgent* work tasks.	1...2...3...4...5...6...7
TC9	I perform most of my work tasks *whenever* I want.	1...2...3...4...5...6...7
TC10	My job frequently requires me to perform my work tasks at the *right time*.	1...2...3...4...5...6...7
TC11	I frequently need to perform work tasks in a *hurry*.	1...2...3...4...5...6...7
TC12	How much time I spend on each work task is important for my job.	1...2...3...4...5...6...7

	My job generally requires me to perform my work tasks….	***Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree***
LV1	at *the same* location.	1...2...3...4...5...6...7
LV2	at *different* locations.	1...2...3...4...5...6...7
LD5	*at specific locations.*	1...2...3...4...5...6...7
	My work tasks frequently require me to...	
LV3	*stay* in the *same specific l*ocation.	1...2...3...4...5...6...7
LV4	*go to* a *variety* of locations.	1...2...3...4...5...6...7
LV5	work in *new* locations.	1...2...3...4...5...6...7
LV6	My job seldom requires me to change the location where I perform my work tasks.	1...2...3...4...5...6...7

Please indicate to what extend do you agree with the following statements:

		Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree
LD1	I can perform most of my work tasks *independently* of *location*.	1...2...3...4...5...6...7
LD2	Location is a *critical element* of my job.	1...2...3...4...5...6...7
LD3	My location is frequently *an important factor* for performing my work tasks.	1...2...3...4...5...6...7
LD4	I perform most of my work tasks *wherever I want*.	1...2...3...4...5...6...7
LD6	It is important to be in the *right place* when performing my work tasks.	1...2...3...4...5...6...7
LD7	My location is frequently *irrelevant* to perform my work tasks.	1...2...3...4...5...6...7
LD8	I have the *freedom to choose* where I perform most of my work tasks.	1...2...3...4...5...6...7

		Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree
RT1	Most of my work tasks are *repetitive*.	1...2...3...4...5...6...7
RT2	There is a *clearly known way* to do the major types of tasks in my job.	1...2...3...4...5...6...7
RT3	I can rely on *established procedures and practices* to perform most of my work tasks.	1...2...3...4...5...6...7
RT5	There is an *understandable sequence of steps* that can be followed in doing my job.	1...2...3...4...5...6...7
RT7	I frequently deal with *ad-hoc* business problems.	1...2...3...4...5...6...7
RT8	I frequently deal with *non-routine* business problems.	1...2...3...4...5...6...7
RT9	Most of the time my job requires me to perform *the same work tasks* in the same way.	1...2...3...4...5...6...7
RT4	Most of my work tasks are *routine*.	1...2...3...4...5...6...7

Please indicate to what extend do you agree with the following statements:

	Most of my work tasks frequently…	*Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree*
IN1	can be performed *independently* of others.	1...2...3...4...5...6...7
IN2	can be *planned* with *little need to coordinate* with others.	1...2...3...4...5...6...7
IN3	require me to *coordinate efforts* with others (customers, co-workers, supervisors)	1...2...3...4...5...6...7
IN11	require me to provide information to others.	1...2...3...4...5...6...7
	My job frequently requires me to….	

IN4	*obtain information* from others in order to *complete* my work tasks.	1...2...3...4...5...6...7
IN8	*exchange* information with others in order to perform my work tasks.	1...2...3...4...5...6...7
IN6a	*interact closely* with others.	1...2...3...4...5...6...7
IN6b	*rely on the work* of others.	1...2...3...4...5...6...7
IN10	*consult* with others.	1...2...3...4...5...6...7

		Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree
IN5	My job is generally *independent* of the jobs of other individuals or organizational units.	1...2...3...4...5...6...7
IN9	My *own* performance is frequently *dependent on receiving* information from others.	1...2...3...4...5...6...7

Part 2 – Perceived Need for Mobile Information Systems

The following statements will help us understand your **needs for Mobile Information Systems**. When answering each item please think of **a typical working day** and your **need for information systems** to support you performing your portfolio of tasks. <u>Please focus on data applications</u> such as mobile e-mail, text messages, mobile internet, calendar, contacts and task management, navigation (GPS), multi-media message service (MMS), mobile office applications, sales-force and field-force applications, telemetry etc. <u>Do not take in consideration the need or use of your device for voice communications</u>.

Please indicate to what extend do you agree with the following statements:

	My everyday work tasks require…..	*Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree*
PN1	a *high level of support* by a Mobile Information System.	1...2...3...4...5...6...7
PN2	me to *rely* on a Mobile Information System.	1...2...3...4...5...6...7
PN4	me to frequently *use* a Mobile Information System.	1...2...3...4...5...6...7
PN3	me to frequently *need the support* of a Mobile Information System.	1...2...3...4...5...6...7
PN11	I frequently need to *send, receive, retrieve and consult* information via a Mobile Information System in order to meet my work obligations.	1...2...3...4...5...6...7
PN5	I frequently *have* to use a Mobile Information System in order to meet my work obligations.	1...2...3...4...5...6...7
PN6	I *cannot perform* most of my work tasks without the support of a Mobile Information System.	1...2...3...4...5...6...7
PN13	I frequently need to have *access to information* via a Mobile Information	1...2...3...4...5...6...7

	System while 'on the go' in order to meet my work obligations.	

CU	Is it *compulsory* for you to use a Mobile Information System in your job?	☐ Yes ☐ No

Part 3 – Perceptions towards Mobile Information Systems

The following statements will help us understand your **perceptions towards the Mobile Information System**. Please focus on data applications and do not take in consideration the use of your device for voice communications.

Please indicate to what extend do you agree with the following statements:

	I find the Mobile Information System device is….	*Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree*
SP1	easy to *carry*.	1...2...3...4...5...6...7
SP3	very *heavy*.	1...2...3...4...5...6...7
SP4	very *robust*.	1...2...3...4...5...6...7
SP5	very *big*.	1...2...3...4...5...6...7
SP6	very *portable*.	1...2...3...4...5...6...7
SP2	easy to *take with me* while 'on the go'.	1...2...3...4...5...6...7
SP7	*Mobile applications* provide very limited functionalities in comparison to applications on a PC.	1...2...3...4...5...6...7
SP8	The *mobile applications* also available on PCs have been well adapted for use on mobile devices.	1...2...3...4...5...6...7

		Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree
PE1	I find the mobile information system useful in my job.	1...2...3...4...5...6...7
PE2	Using the mobile information system enables me to accomplish tasks more quickly.	1...2...3...4...5...6...7
PE3	Using the mobile information system increases my productivity.	1...2...3...4...5...6...7
PE4	If I use the mobile information system, I will increase my chances of getting a raise.	1...2...3...4...5...6...7

Please indicate to what extend do you agree with the following statements:

		Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree
EE1	My interaction with the mobile information system is clear and understandable.	1...2...3...4...5...6...7

EE2	It is easy for me to become skilful at using the mobile information system.	1...2...3...4...5...6...7
EE3	I find the mobile information system easy to use.	1...2...3...4...5...6...7
EE4	Learning to operate the mobile information system is easy for me.	1...2...3...4...5...6...7

		Strongly Disagree 1...2...3...4...5...6...7 Strongly Agree
IU1	I intend to use mobile information system in the next 6 months.	1...2...3...4...5...6...7
IU2	I predict I would use the mobile information system in the next 6 months.	1...2...3...4...5...6...7
IU3	I plan to use the mobile information system in the next 6 months.	1...2...3...4...5...6...7

Part 4 – Your Mobile Device

1- Does your workplace provide you with a mobile device? ☐ Yes ☐ No
2- Does your workplace pay for mobile data access? ☐ Yes ☐ No
3- How long have you been using this device: ___ years ___months ☐ Don't know
4- Type of mobile device you currently use: Operator: ☐ Telecom, ☐ Vodafone, ☐ Telstra, ☐ 2 degrees, ☐ Other, ☐ Don't know Brand:______________________ ☐ Don't know Model: ______________________ ☐ Don't know

5- Please indicate which of the following mobile applications your device is enabled and how often you have used each of them in the last 30 days:

	Enabled	If enable□ indicate frequency of use
Mobile Internet (Web Browser)	☐	Never 1...2...3...4...5...6...7 Always
Mobile e-mail	☐	Never 1...2...3...4...5...6...7 Always
Calendar	☐	Never 1...2...3...4...5...6...7 Always
Contac□s	☐	Never 1...2...3...4...5...6...7 Al□ays
Texting (SMS)	☐	Never 1...2...3...4...5...6...7 Always
Multimedia Messaging (MMS)	☐	Never 1...2...3...4...5...6...7 Always
GPS and Navigation	☐	Never 1...2...3...4...5...6...7 Always
Mobile Chat	☐	Never 1...2...3...4...5...6...7 Always
E-reader□(e.g. acrobat PDF)	☐	Never 1...2...3...4...5...6...7 Always
Spreadsheet (e.g. MS excel)	☐	Never 1...2...3...4...5...6...7 Always
Word Processing (e.g. MS word)	☐	Never 1...2...3...4...5...6...7 Always
Presentati□ns (e.g. MS□PowerPoint)	☐	Never 1...2...3...4...5...6...7 Always
Sales Force Application	☐	Never 1...2...3...4...5...6...7 Always
Field Force Application (job dispatch, tracking)	☐	Never 1...2...3...4...5...6...7 Always
CRM Application	☐	Never 1...2...3...4...5...6...7 Always
Other Corpo□ate Application	☐	Never 1...2...3...4...5...6...7 Always
other:	☐	Never 1...2...3...4...5...6...7 Always

6 - Approximately, how many minutes per day do you use your mobile device for voice communications? ______ minutes per week

Part 5 – Demographic Information

1 - Age: ______ years old.

2 - Gender: ☐ Female ☐ Male

3 - Occupation:

Additional comments:

THANK YOU

Appendix 4 - Finalized Questionnaire Used in the Pilot Study

Consent

Mobile Information Systems in the Workplace – Consent Information

Thank you for accessing our questionnaire – before you proceed, please read the information below:

- The goal of this research is to understand the factors that influence individuals' decision to use mobile information systems in the workplace.
- Only answer this survey if you are currently using a mobile device enabled with data access for work purposes (e.g. mobile e-mail, mobile Internet, mobile business applications etc).
- This survey is anonymous, and no information that would identify you is being collected. Only aggregate data will be used in any presentations or publications that result from this research.
- This research is a part of a doctoral study and its results may be deposited in the library's institutional repository or presented at conferences or published as articles in professional or academic journals.
- The data will be stored in a password-protected file for a maximum of two years, after which it will be destroyed.
- The School of has approved this research project. Information Management Human Ethics Committee
- Your participation is voluntary, and you are implying consent to participate by completing and submitting this on-line survey.
- At the end of the survey you will be provided with access to a link where you can enter in the draw to win a prize of $150.
- If you would like to receive a summary of the results or if you have any questions about the research, please contact Eusebio Scornavacca, Eusebio.Scornavacca@vuw.ac.nz phone (04) 463 6697 or Professor Sid Huff at (04) 463-5819 or Sid.Huff@vuw.ac.nz

Please confirm - Are you currently using a mobile device enabled with data access for work purposes?

YES	NO
○	○

Introduction

Mobile Information Systems in the Workplace

Please read the text below before you start the survey

Mobile technologies are rapidly being adopted by a large number of organizations around the world. The goal of this research is to understand the factors that influence individuals' decision to use mobile information systems in the workplace.

In this research *Mobile Information Systems* are defined as a combination of the mobile device, software and wireless networks. The focus here is on data communications, processing and storage – not voice communications. We are interested in mobile computing and the use of data applications such as mobile e-mail, text messages (SMS), mobile Internet, calendar, contacts, task management, navigation (GPS), multi-media message service (MMS), mobile office applications, sales-force and field-force applications, etc.

When answering the survey please ONLY take in consideration the use of your device for data applications - not voice communications.

Please click on the button below to start the survey

Part 1 - Nature of Work

Part 1 – Nature of Work

The following statements will help us understand your work practices.

When answering each item **please think of a typical working day and the usual portfolio of tasks you normally perform** in order to meet your work obligations.

Please indicate to what extent you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I frequently perform urgent work tasks.	○	○	○	○	○	○	○
I perform most of my work tasks whenever I want.	○	○	○	○	○	○	○
My job frequently requires me to perform my work tasks at the right time.	○	○	○	○	○	○	○
I frequently need to perform work tasks in a hurry.	○	○	○	○	○	○	○
How much time I spend on each work task is important for my job.	○	○	○	○	○	○	○

My job frequently requires that I....	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
make immediate decisions.							
take immediate actions.							
start tasks on time.							
start tasks as soon as possible.							
complete tasks on time.							
complete tasks as soon as possible.							

My job generally requires me to perform my work tasks....	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
at the same location.							
at specific locations.							
at different locations.							

My work tasks frequently require me to...	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
stay in the same specific location.							
go to a variety of locations.							
work in new locations.							

Please indicate to what extent you agree with the following statements:	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
My job seldom requires me to change the location where I perform my work tasks.							
I can perform most of my work tasks independently of location.							

Location is a critical element of my job.	○	○	○	○	○	○	○
My location is frequently an important factor for performing my work tasks.	○	○	○	○	○	○	○
I perform most of my work tasks wherever I want.	○	○	○	○	○	○	○
It is important to be in the right place when performing my work tasks.	○	○	○	○	○	○	○
My location is frequently irrelevant to perform my work tasks.	○	○	○	○	○	○	○
I have the freedom to choose where I perform most of my work tasks.	○	○	○	○	○	○	○

Please indicate to what extent you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Most of my work tasks are repetitive.	○	○	○	○	○	○	○
There is a clearly known way to do the major types of tasks in my job.	○	○	○	○	○	○	○
I can rely on established procedures and practices to perform most of my work tasks.	○	○	○	○	○	○	○
There is an understandable sequence of steps that can be followed in doing my job.	○	○	○	○	○	○	○
I frequently deal with ad-hoc business problems.	○	○	○	○	○	○	○
I frequently deal with non-routine business problems.	○	○	○	○	○	○	○
Most of the time my job requires me to perform the same work tasks in the same way.	○	○	○	○	○	○	○
Most of my work tasks are routine.	○	○	○	○	○	○	○

Most of my work tasks frequently…

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
can be performed independently of others.	○	○	○	○	○	○	○
can be planned with little need to coordinate with others.	○	○	○	○	○	○	○
require me to coordinate efforts with others (customers, co-workers, supervisors)	○	○	○	○	○	○	○
require me to provide information to others.	○	○	○	○	○	○	○

My job frequently requires me to....	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
obtain information from others in order to complete my work tasks.	○	○	○	○	○	○	○
exchange information with others in order to perform my work tasks.	○	○	○	○	○	○	○
interact closely with others.	○	○	○	○	○	○	○
rely on the work of others.	○	○	○	○	○	○	○
consult with others.	○	○	○	○	○	○	○

Please indicate to what extent you agree with the following statements:	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
My job is generally independent of the jobs of other individuals or organizational units.	○	○	○	○	○	○	○
My own performance is frequently dependent on receiving information from others.	○	○	○	○	○	○	○

Part 2 - Perceived Need for Mobile Information Systems

Part 2 – Perceived Need for Mobile Information Systems

The following statements will help us understand your <u>needs for Mobile Information Systems.</u>

When answering each item please think of **a typical working day** and your **need for information systems** to support you performing your portfolio of tasks.

<u>Please focus on data applications</u> such as mobile e-mail, text messages (SMS), mobile Internet, calendar, contacts and task management, navigation (GPS), multi-media message service (MMS), mobile office applications, sales-force and field-force applications, telemetry etc.

<u>Do not take in consideration the need or use of your device for voice communications</u>.

Please indicate to what extent you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I frequently need to send, receive, retrieve and consult information via a Mobile Information System in order to meet my work obligations.							
I frequently have to use a Mobile Information System in order to meet my work obligations.							
I cannot perform most of my work tasks without the support of a Mobile Information System.							
I frequently need to have access to information via a Mobile Information System while 'on the go' in order to meet my work obligations.							

My everyday work tasks require.....

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
a high level of support by a Mobile Information System.							
me to frequently use a Mobile Information System.							
me to rely on a Mobile Information System.							
me to frequently need the support of a Mobile Information System.							

Is it compulsory for you to use a Mobile Information System in your job?

- Yes
- No

Part 3 – Perceptions towards Mobile Information Systems

Part 3 – Perceptions towards Mobile Information Systems

The following statements will help us understand your **perceptions towards the Mobile Information System**. <u>Please focus on data applications and do not take in consideration the</u>

use of your device for voice communications.

Please indicate to what extent you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Mobile applications provide very limited functionalities in comparison to applications on a PC.							
The mobile applications also available on PCs have been well adapted for use on mobile devices.							

I find that the Mobile Information System device is....

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
easy to carry.							
very heavy.							
very robust.							
very big.							
very portable.							
easy to take with me while 'on the go'.							

Please indicate to what extent you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I find the mobile information system useful in my job.							
Using the mobile information system enables me to accomplish tasks more quickly.							
Using the mobile information system increases my productivity.							
If I use the mobile information system, I will increase my chances of getting a raise.							

Please indicate to what extent you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
My interaction with the mobile information system is clear and understandable.	○	○	○	○	○	○	○
It is easy for me to become skilful at using the mobile information system.	○	○	○	○	○	○	○
I find the mobile information system easy to use.	○	○	○	○	○	○	○
Learning to operate the mobile information system is easy for me.	○	○	○	○	○	○	○

In the next SIX months.....

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I intend to use mobile information system.	○	○	○	○	○	○	○
I predict I would use the mobile information system.	○	○	○	○	○	○	○
I plan to use the mobile information system.	○	○	○	○	○	○	○

Part 4 – Your Mobile Device

Part 4 – Your Mobile Device

Please answer the following questions regarding your mobile device.

Does your workplace provide you with a mobile device?

○ Yes

○ No

Does your workplace pay for mobile data access?

○ Yes

○ No

Your Mobile Service Provider is....					
Telecom	Vodafone	TelstraClear	2 Degrees	Other	Don't Know
○	○	○	○	○	○

How long have you been using this device?	
Months	

Type of mobile device you currently use:	
Brand	
Model	

Please indicate which of the following mobile applications are available on your device, and how often you have used each of them in the last 30 days:

	Mobile apps			If available, please indicate frequency of use				
	Available	Not Available	Don't know	Never	Rarely	Sometimes	Quite Often	Very Often
Mobile Internet (Web Browser)	○	○	○	○	○	○	○	○
Mobile e-mail	○	○	○	○	○	○	○	○
Calendar	○	○	○	○	○	○	○	○
Contacts	○	○	○	○	○	○	○	○
Texting (SMS)	○	○	○	○	○	○	○	○
Multimedia Messaging (MMS)	○	○	○	○	○	○	○	○
GPS and Navigation	○	○	○	○	○	○	○	○
Mobile Chat	○	○	○	○	○	○	○	○
E-reader (e.g. acrobat PDF)	○	○	○	○	○	○	○	○
Spreadsheet (e.g. MS excel)	○	○	○	○	○	○	○	○

Word Processing (e.g. MS word)	○	○	○	○	○	○	○	○
Presentations (e.g. MS PowerPoint)	○	○	○	○	○	○	○	○
Sales Force Application	○	○	○	○	○	○	○	○
Field Force Application (job dispatch, tracking)	○	○	○	○	○	○	○	○
CRM Application	○	○	○	○	○	○	○	○
Other Corporate Application	○	○	○	○	○	○	○	○

Approximately, how many minutes per day do you use your mobile device for voice communications?

Minutes per day

Part 5 - Demographic Information

Part 5 – Demographic Information

Gender

○ Female

○ Male

Age

Years old

Occupation

Type of organization you are currently working for (E.g. Bank, IT Company, University, Government Department, Telco, Construction Company, Manufacturer...)

Please use the space below for any additional comments:

Survey Powered By Qualtrics ®

Appendix 5 Results of Principal Components Analysis (Pilot)

Pilot Study - PCA - Varimax - Eigen value >1, 71 items

Rotated Component Matrix[a]

	Component															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PN3	.883															
PN1	.883															
PN4	.859															
PN2	.846															
PN5	.826															
PN11	.799															
PN13	.759															
PN6	.717															
PE2	.550					.424										
PE3	.518					.444										
TC2		.762														
TC11		.747														
TC8		.745														
TC7		.725														
TC12		.703														
TC1		.701														
TC10		.677														
TC5		.637														
TC4		.594														
IN4			.823													
IN8			.817													
IN10			.809													
IN6a			.775													
IN6b			.703													
IN9			.634													
IN3			.561													
IN11			.524													
RT3				.884												
RT2				.845												
RT5				.836												
RT4				.800												
RT9				.795												
RT1				.792												
EE3					.892											

EE2					.880											
EE4					.809											
EE1					.762											
IU2						.837										
IU3						.817										
IU1						.769										
PE1	.407					.578										
LD3							.845									
LD2							.781									
LD6							.779									
LD1_rc							.606									
LD7_rc							.503						.430			
LD8_rc							.360									
SP6								.783								
SP2								.758								
SP1								.718								
SP3_rc								.673								
SP5_rc								.620								
LV5									.803							
LV4									.797							
LV2									.724							
IN2_rc										.758						
IN1_rc										.676						
IN5_rc										.614						
RT7_rc											.749					
RT8_rc											.652					
TC9_rc											.517					
LV1_rc												.774				
LV3_rc												.751				
LD5												-.600				
SP4													-.664			
LD4_rc													.404			
PE4														.593		
SP8														.579		
LV6_rc																
SP7_rc															.790	.
TC6																.525

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 26 iterations.

PCA – all 71 variables – Oblimin – FIXED 10 factors

Pattern Matrix[a]

	Component									
	1	2	3	4	5	6	7	8	9	10
PN1	.877									
PN3	.862									
PN2	.820									
PN4	.818									
PN5	.739									
PN6	.732									
PN11	.713									
PN13	.653									
PE2	.469								-.440	
PE3	.412								-.401	
LV6_rc	.323									
PE4	.320									
RT3		.873								
RT5		.859								
RT2		.855								
RT4		.779								
RT9		.779								
RT1		.773								
IN1_rc		-.299								
IN10			.815							
IN4			.794							
IN8			.792							
IN6a			.780							
IN6b			.749							
IN3			.653							
IN9			.638							
IN11			.524							
IN2_rc			.442							
TC2				-.746						
TC11				-.733						
TC8				-.732						
TC12				-.701						
TC1				-.691						
TC7				-.689						
TC5				-.661						

TC10				-.634						
TC4				-.593						
TC6				-.540						
EE3					-.914					
EE2					-.909					
EE4					-.814					
EE1					-.764					
LD3						.838				
LD2						.785				
LD6						.750				
LD1_rc						.608				
LD7_rc						.555				.443
LD5						.490				
LV3_rc						-.484				
LD8_rc						.406				
LV1_rc						-.367	-.362			
LV4							-.800			
LV5							-.777			
LV2							-.756			
SP6								.735		
SP2								.732		
SP1								.684		
SP3_rc								.683		
SP5_rc								.652		
SP7_rc								.387		
IU2									-.806	
IU3									-.761	
IU1									-.743	
PE1									-.528	
SP8									-.271	
TC9_rc										.578
LD4_rc										.545
RT8_rc		.437								.438
IN5_rc										.409
RT7_rc										.393
SP4										-.335

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 17 iterations.

Structure Matrix

	Component									
	1	2	3	4	5	6	7	8	9	10
PN3	.893									
PN1	.890									
PN2	.860									
PN4	.859									
PN5	.838								-.436	
PN11	.821								-.479	
PN13	.778						-.426			
PN6	.738									
PE2	.633								-.609	
PE3	.615								-.611	
LV6_rc	.390	-.184								
PE4	.344	.248								
RT3		.851								
RT2		.833								
RT5		.828								
RT4		.818								
RT9		.811								
RT1		.784								
IN1_rc		-.346								
SP8		.295								
IN10			.834							
IN8			.826							
IN4			.823							
IN6a			.812							
IN6b			.726							
IN3			.691							
IN9			.635							
IN11			.612	-.401						
IN2_rc			.513							.462
TC2				-.760						
TC11				-.757						
TC8				-.750						
TC7				-.731						
TC12				-.724						
TC1				-.713						
TC5				-.707						

TC10				-.692						
TC4				-.643						
TC6				-.611						
EE3					-.917					
EE2					-.880					
EE4					-.838					
EE1					-.813					
LD3						.798				
LD2						.792				
LD6						.733				
LD1_rc						.626				
LD7_rc						.580				.487
LV3_rc						-.565	-.414			
LD5						.519				
LD8_rc						.482				.401
LV1_rc						-.476	-.432			
LV4							-.834			
LV5							-.801			
LV2							-.800			
SP2								.771		
SP6								.767		
SP3_rc								.730		
SP1								.698		
SP5_rc								.685		
SP7_rc								.391		
IU2									-.870	
IU1									-.843	
IU3									-.816	
PE1	.479								-.707	
TC9_rc										.614
LD4_rc						.422				.610
IN5_rc										.466
RT8_rc		.433								.457
RT7_rc										.404
SP4										-.320

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Appendix 6 - Final Questionnaire Used in the Main Study

Consent

Mobile Information Systems in the Workplace
Consent Information

Thank you for accessing our questionnaire – before you proceed, please read the information below:

- The goal of this research is to understand the factors that influence individuals' decision to use mobile information systems in the workplace.
- Only answer this survey if you use a mobile device enabled with data access for work purposes (e.g. mobile e-mail, mobile Internet, mobile business applications etc).
- At the end of the survey you will be provided with access to a link where you can enter in the draw to win a prize of $200.
- This survey is anonymous, and no information that would identify you is being collected. Only aggregated data will be used in any presentations or publications that result from this research.
- If you would like to receive a summary of the results or if you have any questions about the research, please contact Eusebio Scornavacca, Eusebio.Scornavacca@vuw.ac.nz phone (04) 463 6697 or his supervisor Professor Sid Huff at (04) 463-5819 or Sid.Huff@vuw.ac.nz

Disclaimer: This research is a part of a doctoral study being conducted by Eusebio Scornavacca of the School of Information Management, Victoria University of Wellington. Its results will be deposited in the library's institutional repository or presented at conferences or published as articles in professional or academic journals. The data will be stored in a password-protected file for a maximum of two years, after which it will be destroyed. The School of Information Management Human Ethics Committee has approved this research project. Your participation is voluntary, and you are implying consent to participate by completing and submitting this on-line survey.

Please confirm - Do you have a mobile device that you use for work purposes?

YES	No
○	○

Is your mobile device enabled with data services (for example: mobile e-mail, mobile Internet, mobile business applications etc)?

Yes	No
○	○

Introduction

Mobile Information Systems in the Workplace

Please read the text below before you start the survey

The goal of this research is to understand the factors that influence individuals' decision to use Mobile Information Systems in the workplace.

In this research **Mobile Information Systems** are defined as a combination of the mobile device, software and wireless networks. The focus here is on data communications, processing and storage – not voice communications. We are interested in mobile computing and the use of data applications such as mobile e-mail, text messages (SMS), mobile Internet, calendar, contacts, task management, navigation (GPS), multi-media message service (MMS), mobile office applications, sales-force and field-force applications, etc.

When answering the survey please ONLY take into consideration the use of your device for data applications - not voice communications.

Please click on the button below to start the survey

Part 1 - Nature of Work

Part 1 – Nature of Work

The following statements will help us understand your work practices.

When answering each item **please think of a typical working day** and **the usual portfolio of tasks you normally perform** in order to meet your work obligations.

Please indicate the extent to which you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I frequently need to perform work tasks in a hurry.	○	○	○	○	○	○	○
My job frequently requires me to perform my work tasks at the right time.	○	○	○	○	○	○	○
I frequently perform urgent work tasks.	○	○	○	○	○	○	○

How much time I spend on each work task is important for my job.	○	○	○	○	○	○	○

My job frequently requires that I....

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
...make immediate decisions.	○	○	○	○	○	○	○
...take immediate actions.	○	○	○	○	○	○	○
...start tasks as soon as possible.	○	○	○	○	○	○	○
...complete tasks as soon as possible.	○	○	○	○	○	○	○

My job requires me to.....

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
...generally perform my work tasks at the same location.	○	○	○	○	○	○	○
...frequently work at different locations.	○	○	○	○	○	○	○
...always work in a single location.	○	○	○	○	○	○	○
...frequently perform my work tasks in many locations.	○	○	○	○	○	○	○

My work tasks require me to...

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
...generally stay in the same specific location.	○	○	○	○	○	○	○
...frequently go to a variety of locations.	○	○	○	○	○	○	○
...frequently work in new locations.	○	○	○	○	○	○	○
...work every day in the same place.	○	○	○	○	○	○	○

Please indicate the extent to which you agree with the following statements:

	Strongly		Somewhat	Neither Agree nor	Somewhat		Strongly

	Disagree	Disagree	Disagree	Disagree	Agree	Agree	Agree
My job hardly ever requires me to change the location where I work.	○	○	○	○	○	○	○
I can perform most of my work tasks independently of location.	○	○	○	○	○	○	○
I perform most of my work tasks wherever I want.	○	○	○	○	○	○	○
My location is frequently irrelevant to the performance of my work tasks.	○	○	○	○	○	○	○
I have the freedom to choose where I perform most of my work tasks.	○	○	○	○	○	○	○

Please indicate the extent to which you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Most of my work tasks are repetitive.	○	○	○	○	○	○	○
There is a clearly known way to do the major types of tasks in my job.	○	○	○	○	○	○	○
I can rely on established procedures and practices to perform most of my work tasks.	○	○	○	○	○	○	○
There is an understandable sequence of steps that can be followed in doing my job.	○	○	○	○	○	○	○
Most of the time my job requires me to perform the same work tasks in the same way.	○	○	○	○	○	○	○
Most of my work tasks are routine.	○	○	○	○	○	○	○
Most of the time my job requires me to perform repetitive activities.	○	○	○	○	○	○	○

My job frequently requires me to....

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
...obtain information from others in order to complete my work tasks.	○	○	○	○	○	○	○
...exchange information with others in order to perform my work tasks.	○	○	○	○	○	○	○
...interact closely with others.	○	○	○	○	○	○	○
...rely on the work of others.	○	○	○	○	○	○	○
...consult with others.	○	○	○	○	○	○	○

Part 2 - Perceived Need for Mobile Information Systems

Part 2 - Perceived Need for Mobile Information Systems

The following statements will help us understand your need for Mobile Information Systems.

Notice that we define **Mobile Information Systems** as a combination of the mobile device, software and wireless networks. When answering each item please think of **a typical working day** and your **need for Mobile Information Systems** to support you in performing your portfolio of tasks.

Please focus on data applications such as mobile e-mail, text messages (SMS), mobile Internet, calendar, contacts and task management, navigation (GPS), multi-media message service (MMS), mobile office applications, sales-force and field-force applications, telemetry etc.

Do not take into consideration the need or use of your device for voice communications.

Please indicate the extent to which you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I frequently need to send, receive, retrieve and consult information via a Mobile Information System in order to meet my work obligations.	○	○	○	○	○	○	○
I frequently have to use a Mobile Information System in order to meet my work obligations.	○	○	○	○	○	○	○
I cannot perform most of my work tasks without the support of a Mobile Information System.	○	○	○	○	○	○	○
I frequently need to have access to information via a Mobile Information System while 'on the go' in order to meet my work obligations.	○	○	○	○	○	○	○

My everyday work tasks require.....

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
....me to frequently use a Mobile Information System.	○	○	○	○	○	○	○
....a high level of support by a Mobile Information System.	○	○	○	○	○	○	○
....me to frequently rely on a Mobile							

Information System.	○	○	○	○	○	○	○
....me to frequently need the support of a Mobile Information System.	○	○	○	○	○	○	○

Part 3 – Perceptions towards Mobile Information Systems

Part 3 – Perceptions towards Mobile Information Systems

The following statements will help us understand your **perceptions towards Mobile Information Systems**.
Please focus on data applications and do not take in consideration the use of your device for voice communications.

Using Mobile Information Systems....

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
...enables me to accomplish tasks more quickly.	○	○	○	○	○	○	○
...increases my productivity.	○	○	○	○	○	○	○
...improves my job performance.	○	○	○	○	○	○	○
...enhances my effectiveness on the job.	○	○	○	○	○	○	○
...makes it easier to do my job.	○	○	○	○	○	○	○

Please indicate the extent to which you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I find Mobile Information Systems useful in my job.	○	○	○	○	○	○	○
If I use Mobile Information Systems, I will increase my chances of getting a raise.	○	○	○	○	○	○	○

Please indicate the extent to which you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree

My interaction with Mobile Information Systems is clear and understandable.	○	○	○	○	○	○	○
It is easy for me to become skilful at using Mobile Information Systems.	○	○	○	○	○	○	○
I find Mobile Information Systems easy to use.	○	○	○	○	○	○	○
Learning to operate Mobile Information Systems is easy for me.	○	○	○	○	○	○	○
I find it easy to get Mobile Information Systems to do what I want them to do.	○	○	○	○	○	○	○
I find that Mobile Information Systems are flexible to interact with.	○	○	○	○	○	○	○

In the next 12 months.....

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
...I intend to use Mobile Information Systems.	○	○	○	○	○	○	○
...I predict I will use Mobile Information Systems.	○	○	○	○	○	○	○
...I plan to use Mobile Information Systems.	○	○	○	○	○	○	○

Part 4 – Your Mobile Device

Part 4 – Your Mobile Device

Please answer the following questions regarding your **mobile device**.
In case you have two or more devices, think about the device you use the most for work purposes.

Please indicate the extent to which you agree with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I find my Mobile Information System device easy to carry.	○	○	○	○	○	○	○
It is easy for me to take my Mobile Information System device with me while 'on the go'.	○	○	○	○	○	○	○
I find that my Mobile Information System device is very portable.	○	○	○	○	○	○	○

Does your workplace provide you with a mobile device?

- ○ Yes
- ○ No

Does your workplace pay for mobile data access?

- ○ Fully pays for mobile data access.
- ○ Partially pays for mobile data access.
- ○ Does not pay for mobile data access.

Using a mobile device in your job is.....

Completely_ Non-Voluntary	Non-Voluntary	Somewhat _ Non-Voluntary	Neither Voluntary nor Non-Voluntary	Somewhat Voluntary	Voluntary	Completely Voluntary
○	○	○	○	○	○	○

Your Mobile Service Provider is....

Telecom	Vodafone	TelstraClear	2 Degrees	Other	Don't Know
○	○	○	○	○	○

For how many months have you been using this device?

Number of Months	

Type of mobile device you currently use:
(if you don't know or are not sure about it please write "unsure")

Brand	
Model	

Please indicate which of the following mobile applications are available on your device, and how often you have used each of them in the last 30 days:

	Mobile apps	If available, please indicate frequency of use

	Available	Not Available	Don't know	Never	Rarely	Sometimes	Quite Often	Very Often
Mobile Internet (Web Browser)	○	○	○	○	○	○	○	○
Mobile e-mail	○	○	○	○	○	○	○	○
Calendar	○	○	○	○	○	○	○	○
Contacts	○	○	○	○	○	○	○	○
Texting (SMS)	○	○	○	○	○	○	○	○
Multimedia Messaging (MMS)	○	○	○	○	○	○	○	○
GPS and Navigation	○	○	○	○	○	○	○	○
Mobile Chat	○	○	○	○	○	○	○	○
E-reader (e.g. acrobat PDF)	○	○	○	○	○	○	○	○
Spreadsheet (e.g. MS excel)	○	○	○	○	○	○	○	○
Word Processing (e.g. MS word)	○	○	○	○	○	○	○	○
Presentations (e.g. MS PowerPoint)	○	○	○	○	○	○	○	○
Sales Force Application	○	○	○	○	○	○	○	○
Field Force Application (job dispatch, tracking)	○	○	○	○	○	○	○	○
CRM Application	○	○	○	○	○	○	○	○
Other Corporate Application	○	○	○	○	○	○	○	○

On average, how many minutes per day do you use your mobile device for voice communications?

Number of minutes per day ____________

Part 5 - Demographic Information

Part 5 – Demographic Information

Gender

- ○ Female
- ○ Male

Age (years)

- ○ Less than 20
- ○ 20-29
- ○ 30-39
- ○ 40-49
- ○ 50-59
- ○ 60+

Occupation

Type of organization you are currently working for (E.g. Bank, IT Company, University, Government Department, Telco, Construction Company, Manufacturer...)

Please use the space below for any additional comments:

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