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Adoption of mobile commerce: An exploratory analysis

by

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PREFACE

This report summarizes relevant theory and research on the adoption and use of mobile services. It also presents theories of general ICT adoption relevant to understanding the adoption of mobile services. A model is developed and tested based upon data from a survey of early adopters' use of mobile commerce services. The report is written as part of the project "Electronic Commerce with Mobile Internet Access" funded by Telenor ASA. Project manager of this project is Professor Leif B. Methlie, who also heads the research group on electronic commerce at the Foundation for Research in Economics and Business Administration.

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ABSTRACT

In this report we investigate the behavioral adoption requirements of end-users of mobile commerce services. Even though the approach is exploratory, the purpose of the investigation is to develop and test relevant models explaining end-users' adoption of mobile commerce services. We develop a theoretical model of the adopters' decision to use mobile commerce services, and test different versions of this model on empirical data of early adopters of mobile commerce services. The model may be used as a basis for evaluating the adoption potential of new mobile services by service providers and application developers. The report has two main contributions. First, it presents and reviews relevant literature on ICT adoption research and mobile services research. Based upon this review, we suggest a model of mobile commerce service adoption that integrates findings from domestication research into a model of ICT adoption - the theory of planned behavior. Second, we report the methodology and results of an exploratory study of innovators' adoption of mobile commerce services. This part of the study uses the model introduced above, validates the measurement model, and performs a step-wise analysis of the model's ability to explain the innovators' adoption behavior. The final model is a somewhat modified version of the model suggested from our theoretical review.

The theoretical part of the report concludes that there seemed to be a lack of studies applying traditional ICT-adoption theory to the adoption of mobile services. Instead, domestication research represents the dominating theoretical perspective in studies of mobile service adoption. In this part of the report, we attempt to unify findings in adoption and domestication research by integrating domestication research findings into a traditional model of ICT adoption. Our approach starts with a set of well established models of ICT adoption, and

modifies and extends these models integrating important findings of domestication research. Of these models, the technology acceptance model (TAM), the theory of reasoned action (TRA), and the theory of planned behavior (TPB) are used as the underlying models for the extensions and modifications. The result of these theoretical analyses is a modified version of the decomposed theory of planned behavior.

In the empirical part of the project, we analyze and discuss three propositions related to the model introduced above:

- Mobile services are adopted for reasons and in contexts that makes it necessary to extend the TAM model into a theory of planned behavior to explain their adoption.
- The theory of planned behavior should be modified to incorporate the most relevant findings in domestication research explaining the adoption and use of mobile services.
- The basic concepts of the theory of planned behavior should however be applied and measured similarly when studying both the adoption of traditional Internet services and mobile services.

To investigate these propositions, a survey was conducted of early adopters of mobile commerce services. The subjects were recruited from discussion forums and mailing lists of users and developers of mobile Internet services. A total of 232 subjects participated in the survey. The innovativeness of the subjects was measured and both this measure and the demographic characteristics of the subjects were typical of innovators and early adopters. The data from the survey was generally analyzed applying structural equations modeling.

The results of these analyses showed that our measures - generally based upon traditional measures of adoption research - were highly reliable, and that they could also be defended theoretically. This finding supported the third proposition indicating a reasonable validity of our measurement model. Thus, the model was suitable for further confirmatory analyses.

In the analyses performed to investigate the other two propositions, we found support for a need to extend the TAM model with behavioral control. We found less support for extending the model with subjective norm elements, but when extending the model with both subjective norm and behavioral control, the subjective norm part also contributed to good fit and improved explanatory power. When extending the TAM model, the explained variance in intention to use mobile commerce services increased from 30% to 49%. Thus, we conclude that the TAM model should be extended, at least with behavioral control to explain a significant part of the variance in intentions to use mobile services.

We also found support for a relationship between external influence and perceived usefulness indicating that there were some expectancy-related issues that should be modeled when studying mobile services. Further, we found support for a relationship between the determinants of subjective norm and a relationship between subjective norm and attitudes towards use. Finally, self control was found to indirectly influence intention to use mobile services through an effect on subjective norm. Even though our propositions were investigated qualitatively, these findings generally also supported the first and second proposition.

The model developed in this report may be used as a basis for evaluating the adoption potential of new services. However, it is most applicable for evaluating services that are mainly adopted for functional reasons. In addition, the model has only been validated on innovative subjects and thus, it is most

applicable when investigating the adoption potential of new services among early adopters. Further research is needed to identify the most important determinants of the explanatory concepts used in our model. Further research is also needed to extend the model to other mobile services than mobile commerce services and other end-users than early adopters. We will extend our research in these directions in new studies of mobile service adoption in 2002.

1. INTRODUCTION

End-user services in 3G networks are developed using more complex service models than those of previous wireless networks. Examples of such services are channel integrating, network mediating and mobile commerce end-user services. To obtain widespread adoption of these services, a set of requirements should be met. These requirements are technological, business strategic and behavioral (Frambach, 1993, 1998, Pedersen, 2001). First, complex services require an integration of network technologies, network services, content services and supplementary services. Such integration is often obtained using open interfaces between technology- and service platforms. Second, widespread adoption on the demand side requires widespread adoption of these technology- and service platforms among application developers and service providers. To meet these business strategic requirements, the business models of value chain players should balance the need for maintaining transaction control, obtaining network effects, and maintaining a close relationship between shared revenues and the end-user's valuation of the added value provided by each player. Finally, end-users specify a set of demand-side requirements that the services should meet. These requirements are behavioral, and will vary across end-users, contexts and roles. To understand these requirements, analyses of the context specific behavior of end-users should be conducted. These *behavioral demand-side adoption requirements* are focused in this report. We study end-users in the context of mobile commerce using a model derived from combining two context dependent adoption perspectives; the perspectives of the end-user as a technology user and as a network member.

The report is organized in six sections. In this section, we introduce the problem of describing and explaining end-users' behavioral adoption requirements when adopting complex mobile services such as mobile

commerce services. In section 2, we introduce the theoretical perspectives applied to study end-user adoption of ICT in general and mobile services in particular. We focus on studies in adoption and domestication research, and review relevant research in these two "schools of thought". Section 2 ends with the development of an adoption model integrating domestication research findings into a traditional adoption model - the decomposed theory of planned behavior. We also present some rather general and exploratory propositions on the usefulness and validity of this model. In section 3, we present an exploratory study investigating some of these propositions. In particular, we use the study to validate the measures of the model and study the relevance of the proposed model relationships. The results of this exploratory study are presented in section 4, and in section 5, we conclude and discuss both the results of our theoretical and empirical research efforts.

1.1 Problem and purpose

Understanding behavioral adoption requirements is important to both researchers and industry players. For researchers, an important issue is how mobile end-user services differ from traditional ICT-services in ways that affect their adoption. For example, the personalization, location specificity and ubiquity of these services are suggested as important characteristics making their adoption different from other ICT-services (e.g. Rask and Dholakia, 2001). However, this report is more concerned with understanding the adoption requirements of end-users from the perspective of industry players. Large investments have been made in 3G networks both to obtain licenses and to deploy the networks themselves. In addition, further investments will be made in service development, marketing and distribution. It is assumed that because the ARPU resulting from traditional services like voice will decline, sufficient revenue to defend these investments must be generated from new services like

social network mediation and mobile commerce services. Thus, the most important research questions when viewed from the perspective of industry players are: What services of this kind are likely to be adopted by end-users; how does the end-user decide to adopt these services; and what influences that adoption decision. Of these questions, the last two are focused in this study. It is also likely that by investigating these questions it will eventually also be possible to suggest what kinds of services are likely to be adopted.

The purpose of this study is threefold. First, we intend to present and review relevant literature on general ICT-adoption and literature on mobile service adoption that are relevant to understand the adoption of more complex end-user services likely to be introduced in 3G networks. Second, we intend to develop a model of end-user adoption integrating the most relevant findings of the literature review. To develop a valid and relevant model, both theoretical concepts and measures should be well founded. Thus, the theoretical review is used to secure sufficient validity of theoretical concepts. In addition, the measures of the model are validated empirically. Finally, we want to perform a preliminary and exploratory investigation using the model to see if it can improve our understanding of the adoption decisions of early adopters of mobile commerce services. To obtain this, an exploratory analysis of the usefulness of our theoretical and measurement models is conducted.

1.2 Approach

Generally, studies of ICT adoption takes one of three possible approaches, a diffusion approach, an adoption approach or a domestication approach. *Diffusion* researchers typically describe the aggregate adoption process a posteriori as an S-shaped function of time that may be used to categorize adopters of different kinds (see Mahajan, Muller and Bass, 1990). Rogers

(1995) tries to explain the observed adoption behavior using characteristics of the technology being introduced. He also describes the diffusion process as consisting of four elements; an innovation or new technology, a social system, the communication channels of the social system, and time. Of these elements, Rogers (1995) focuses on the innovation, the social system and the communication channels when explaining the observed adoption behavior. *Adoption* researchers typically describe and explain the adoption decision of individual end-users applying different cognitive and social theories of decision making. Three models stand out as the most widely applied - the technology acceptance model (TAM) originally proposed by Davis (1989), the theory of reasoned action (TRA) originally proposed by Fishbein and Ajzen (1975), and the extension of TRA into a theory of planned behavior (TPB) originally proposed by Ajzen (1985). Several hundred studies may be found applying one of these three theories to explain end-users' adoption and acceptance of different kinds of ICT-systems and applications (see Venkatesh and Davis, 2000). *Domestication* research typically studies the adoption and use of technology in everyday life (see Silverstone and Hirsch, 1992). Examples of technologies studied are fixed telephony (see Fisher, 1988), television (Silverstone and Haddon, 1996a) and personal computers (Silverstone and Haddon, 1996b). The perspective is dominated by sociologist researchers and consequently, descriptive studies often characterize the adoption and use of technologies by demographic variables such as education, age and gender. However, the main focus of domestication research is on the societal consequences of the domestication of technology; that is the process in which the use of technology becomes integrated into our everyday life. In this report, an adoption approach is used. However, research in diffusion and in particular domestication research is reviewed and integrated into a model of mobile service adoption.

Taking an adoption approach means focusing the end-user as a technology user. In Pedersen (2001) we stressed that this is only one of three important approaches to the end-user that is relevant when studying the adoption of mobile commerce services. Equally important is treating the end-user as a social network member and a consumer. The social network issues are carefully integrated in our model of end-user adoption using findings from domestication research. Examples of such findings are the importance of external and interpersonal influence in the formation of subjective norms. Consequently, some of the most relevant issues in approaching the end-user as a social network member are integrated into the model developed in this report. The consumer perspective on the end-user is implicitly considered because we empirically study the adoption of mobile commerce services organized along a consumer life cycle model. Thus, the end-user approach in this report primarily combines the technology user and social network member approaches. Other sub-projects of the research group in electronic commerce focus more directly on explicitly applying a consumer approach (Pedersen, Methlie and Thorbjørnsen, 2001).

2. THEORY

Two areas of research may be combined when approaching mobile end-user service adoption. First, mobile services are services provided using information and communication technology. Consequently, theories of the adoption of ICT and ICT-based services are relevant to understanding the adoption of mobile end-user services. Second, the adoption and use of mobile services and mobile phones have been studied in anthropology and sociology as a social phenomena and object of study. It has also been studied by telecom researchers when trying to segment and understand the market of mobile end-users, and it has been studied by informatics researchers trying to develop services and interfaces of good usability. Consequently, the theories and models applied in this area of telecom research are also relevant when trying to understand end-user adoption. We first present the traditional theories and models applied when studying ICT adoption and acceptance. We then turn to the specific research conducted by telecom researchers, and categorize the contributions found in this area. Finally, we combine the two perspectives in a TPB-model of individual end-user adoption modified and applied specifically to the adoption of mobile end-user services like mobile commerce services.

2.1 Technology diffusion, adoption and acceptance theory

When studying adoption at the aggregate level, the way innovations are communicated in groups and in society are more important than the decision of each individual to adopt an innovation. Thus, diffusion models are used in aggregate adoption studies. Another issue in these studies is how different groups of users adopt an innovation and what characterize these groups - not the individual members of the groups. At the individual level, the individual's decision process or adoption process is studied and modeled. Some of these adoption models treat the adoption process as a rational decision process, while

other treat it as a process controlled by both individual cognitive and affective elements as well as by external norms and behavioral constraints on making rational decisions.

2.1.1 Aggregate level theories and models

The classic diffusion study typically contrasts the technology requirements of different user categories to *describe* the adoption process a posteriori. Several aggregate mechanisms are proposed to explain the observed diffusion process. In marketing, the Bass model (see Mahajan, Muller and Bass, 1990) focuses on how information is communicated in media and interpersonally, and how the two mechanisms of communication result in the S-shaped aggregate adoption rate often observed in studies of innovation diffusion. Discontinuous models have also been applied to explain the shifts in adoption rates found for some technologies (e.g. Loch & Huberman, 1999). Similar models have also been applied in economics to explain the aggregate diffusion process observed (see Baptista, 1999).

Rogers (1995) goes beyond aggregate adoption process description, and tries to *explain* the observed adoption by characteristics of the technology being introduced. While most of the models mentioned above are mainly concerned with describing the diffusion process over time, Rogers (1995) focuses on the innovation, the social system and the communication channels. Regarding the innovation or technology being adopted, he mentions relative advantage, compatibility, complexity, trialability and observability as the most important characteristics of a technology explaining why it is being adopted. These are all supply side characteristics presumed to influence usefulness and user friendliness. Some studies have also adapted these supply side determinants in studies of individual end-user adoption (e.g. Ruyter et al., 2000).

On the demand side, explanatory variables are not identified at the individual adopter level. Instead, diffusion theory focuses on describing aggregates of individual users and on categorizing groups of adopters, such as e.g. early adopters, early majority users and late adopters. Diffusion theory also applies more traditional demographic variables to characterize aggregates of individual adopters. For example, early adopters are typically found among the better educated and younger (Dickerson and Gentry, 1983). Many of the studies following this tradition actually suggest the categorization of end-users into adopter categories and the corresponding analysis of the demographic, socioeconomic and personality characteristics of these groups as explanatory models of adoption (e.g. Atkin et al., 1998). In this way, diffusion theory characterizes the social system by categorizing users and the demographic and socioeconomic groups of it. In addition, diffusion theory also focuses on the communication channels of social systems. Traditionally, the communication channels are similar to the channels assumed in the Bass model mentioned above - mass media and interpersonal communication channels. The Bass model (Mahajan et al., 1990), or variants of it, may be considered as the communication channel model component of the theory of diffusion as proposed by Rogers (1995), even though some marketing researchers may object to such a conclusion (Wright and Charlett, 1995).

2.1.2 Individual level theories and models

While some of the concepts used by Rogers (1995) may be interpreted at the individual level (see Ruyter et al., 2000), the theories in section 2.1.1 have mainly been used to explain the adoption of technology in larger groups of individuals. Individual level adoption has been studied applying various cognitive and social theories of decision making, but three models stand out as the most widely applied - the technology acceptance model (TAM) originally

proposed by Davis (1989), the theory of reasoned action (TRA) originally proposed by Fishbein and Ajzen (1975), and the extension of TRA into a theory of planned behavior (TPB) originally proposed by Ajzen (1985).

The technology acceptance model (Davis, 1989, Davis et al., 1989) focuses on the attitudinal explanations of intention to use a specific technology or service. It includes five concepts - perceived user friendliness, perceived usefulness, attitudes towards use, intention to use and actual use. The TAM-model has been used by several researchers to explain the attitudes and behaviors of information system users. Although the model is mainly applied to explaining the adoption of technology within organizations, the constructs of the model are meant to be fairly general (Doll, Hendrickson and Deng, 1998). Davis, Bagozzi and Warshaw (1989) described the variables of the model as universal to different types of computer systems and user populations. The model may also be applied to explain individuals' attitudes to using web-sites (e.g. Lederer et al., 2000; Lin and Lu, 2000).

Perceived usefulness 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). User friendliness is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). Attitude towards using the system is defined as "the degree of evaluative affect that an individual associate with using the target system in his job" (Davis et al., 1989, p. 476). Doll et al. (1998, p. 847) have modified these definitions somewhat. They argue that information systems will be useful in general if they "contribute to accomplishing the end-user's purpose". Another perspective to the "usefulness" construct is that an information system is useful "to which a potential adopter views the innovation as offering value over alternative ways of performing the same task" (Agarwal and Prasad, 1999, p.

365). Both these modifications indicate that the model is suitable for studying different kinds of information systems, including systems that are not directly related to job situations. For example, a study by Jung and Butler (2000) found that useful information and user friendliness were among the most important variables for successful web site design in the tourism industry. Consequently, the technology acceptance model is considered relevant in studying the acceptance, adoption and use of a wide range of ICT-based services, including electronic commerce services (e.g. Jiang, et al., 2000). Thus, it is somewhat surprising that we have only found one minor study applying TAM to the adoption of mobile telephone services (Kwon and Chidambaram, 2000).

The TAM-model has been both extended and modified. The typical extension is in the development of antecedents and determinants of perceived user friendliness and perceived usefulness. While the determinants of perceived user friendliness are believed to be rather general and have been given much attention (e.g. Venkatesh and Davis, 1996), the determinants of perceived usefulness are service-dependent and have been given less attention (Venkatesh and Davis, 2000). The second extension is by introducing social determinants of use or intended use. Some have introduced these concepts as determinants of perceived usefulness (Venkatesh and Davis, 2000), while others have criticized the model for not incorporating such issues at all (Bhattacharjee, 2000). The third extension is the introduction of behavioral control and user resources as an issue in the TAM model (e.g. Mathieson et al., 2001). Both these extensions are treated in the presentations of TRA and TPB below. The typical modification of TAM is in the exclusion of some of the concepts of the model (e.g. intention to use - Nysveen, Pedersen and Thorbjørnsen, 2000) or the suggestion that causal relationships should be altered in some way (e.g. suggesting a direct relationship between perceived user friendliness and intention to use - Lin and Lu, 2000). Another relevant modification of the

model is the introduction of moderators. For example, user resources may also be introduced as a moderator of the relationship between intentions to use and actual use of a service (see Mathieson et al., 2001).

In many ways, TAM may be seen as a special case of the theory of reasoned action (Fishbein and Ajzen, 1975). Thus, TRA is a more general theory than TAM. It is used to explain behavior beyond the adoption of technology. However, when applied to the explanation of use or adoption behavior, the model includes four general concepts - behavioral attitudes, subjective norm, intention to use and actual use. Consequently, TAM is a special case of TRA suggesting two determinants of behavioral attitudes and no relevance of subjective norm (Taylor and Todd, 1995). In general TRA does not propose specific determinants of behavioral attitudes (attitudes towards use). However, in TRA these attitudes are composed of the belief that use leads to certain outcomes, and the evaluation of the desirability of these outcomes. The inclusion of subjective norm, however, represents an important addition when compared to TAM. In TRA, subjective norm is composed of the user's perception of how others think she should behave, and her motivation to comply with the expectations of these referents (Fishbein and Ajzen, 1975).

TRA has been applied in its original form to explain the adoption of ICT-applications (e.g. Liker and Sindi, 1997), but typically TRA is used as a basis for modifying the TAM-model with subjective norm as suggested above (Venkatesh and Davis, 2000; Venkatesh and Morris, 2000).

The theory of planned behavior was proposed as an extension of the theory of reasoned behavior to account for conditions where individuals do not have complete control over their behavior (Ajzen 1985, 1991). However, the theory also proposed more explicit formulations of the determinants of the behavioral attitude and subjective norm of the TRA-model. The model in its original form

has been applied to the explanation of several types of behavior, such as the adoption of canes among the elderly and condoms among young people, but when applied to the adoption of ICT systems or services, the model contains five concepts. As for the TRA-model, it includes behavioral attitudes, subjective norm, intention to use and actual use. The components of behavioral attitudes and subjective norm are the same in TPB as in TRA. In addition, the model includes behavioral control as a perceived construct. Perceived behavioral control reflects the internal and external constraints on behavior, and is directly related to both behavioral intention to use and actual use. Consequently, actual use is a weighted function of intention to use and perceived behavioral control (Taylor and Todd, 1995).

TPB has been applied to explain the adoption of such diverse systems as spreadsheets (Mathieson, 1991), computer resource centers (Taylor and Todd, 1995), and recently, electronic commerce services (Battacherjee, 2000), just to mention a few examples. The role of subjective norm in TPB when compared to TAM is somewhat unclear. Davis et al. (1989) and Mathieson (1991) found no support for a direct relationship between subjective norm and intention to use. The lack of findings has been attributed to little social pressure to use the systems studied by both Davis et al. (1989) and Mathieson (1991). Later, a significant relationship has been found both in studies in organizational (e.g. Moore and Benbasat, 1993) and electronic commerce settings (Battacherjee, 2000). In a recent study, Venkatesh and Davis (2000) also found strong support for a direct link between subjective norm and intention to use in a longitudinal study pooling results across four different studies and settings.

The inclusion of behavior control in the TPB-model represents a valuable addition to the explanatory power of TPB when compared to TAM. Both Mathieson (1991) and Taylor and Todd (1995) found that the addition of

behavioral control made their TPB-model explain more of the variance in intention to use than the TAM-model did. In TPB, behavioral control encompasses two components. The first component is "facilitating conditions" representing the resources required to use a specific system. Examples of such resources are time, financial resources and other ICT-related resources. The second component is self-efficacy; that is "*an individual's self-confidence in his/her ability to perform a behavior*" (Taylor and Todd, 1995, p. 150). TPB and TRA have both been criticized for not suggesting operational components or determinants of behavioral attitudes, subjective norm and, to some extent, behavioral control. When compared to the TAM-model, the lack of operational components or determinants of behavioral attitudes is particularly obvious.

To meet some of this criticism, many researchers have suggested specific components or determinants of the attitudinal concepts of the TPB-model. For example, Battacherjee (2000) suggests incorporating the TAM model in TPB with perceived usefulness and user friendliness as the determinants of attitudes towards use. He also suggests subjective norm may be determined by external and interpersonal influence, and that the two components of perceived behavioral control may also be treated as the determinants of behavioral control. Taylor and Todd (1995) suggest what they term a decomposed TPB which also includes the TAM model in the attitudinal part of TBP. However, they also include compatibility as a third determinant of attitude towards use, mainly inspired by the diffusion model of Rogers (1995). The determinants of subjective norm are believed to be context dependent, and in the case of Taylor and Todd (1995), peer influence and superior's influence are suggested. In non-organizational contexts, Battacherjee's (2000) determinants generally seem more relevant. Finally, the decomposed TPB suggests that self efficacy, resource facilitating conditions and technology facilitating conditions are the most relevant determinants of behavioral control. In a choice of models,

parsimony is also important. While the decomposed TPB adds complexity when compared to TAM, several studies have shown that the increased complexity of the TPB-model may be a small price to pay for its explanatory power. From the perspective of explaining mobile commerce service adoption, the inclusion of subjective norm and behavioral control in the decomposed theory of planned behavior seems necessary because these services are used in social contexts and technology facilitating conditions certainly limit their potential adoption (Pedersen, 2001).

2.2 Studies of mobile end-user service adoption

The adoption of simple mobile network services like voice and messaging has been studied by social scientists, industry researchers and mobile informatics researchers for some time. Much of this research is highly relevant to understanding the adoption of more complex end-user services, and some of it may be less relevant. Because researchers of such diverse areas have been involved in this research, it is hard to find any reviews covering the whole research area or any reviews trying to develop the conclusions of present research into behavioral theories and models of potential end-user service adoption in 3G networks.

This section intends to categorize research conducted in industry research, sociology, marketing and mobile informatics on end-users behavior when adopting mobile services. The review is selective in that it highlights research we feel are most important in providing conclusions that are also relevant to the adoption of end-user services in 3G networks. The review is organized in four parts. We first focus what has been the *object of study* in these contributions. While some studies have focused mobile phones as terminals, others have focused end-user services or end-users. The studies of end-user services also

vary with the respect to the complexity of the services being studied. Second, we provide some ways to characterize the *perspectives* applied when studying adoption of mobile end-user services. We suggest a typology of perspectives with two dimensions; the level of study and the focus of the adoption process. Third, we present several ways in which the *contexts* of end-users and service usage have been categorized in mobile service research. The purpose of most context categorizations is to contrast the adoption patterns between different contexts of use. However, recent research has shown more interest in users' multiple contexts and roles when adopting mobile end-user services than in contrasting given contexts. Finally, we present some of the *methodological* approaches used when studying the adoption of mobile end-user services. Within each category, we present examples of research that improves our understanding of the adoption of both existing and new mobile end-user services.

2.2.1 Objects of study

The objects of study in research on the adoption of mobile end-user services may be the terminals, services or users. We have identified research combining the study of more than one of these objects, but even in these studies, particular attention is given to the terminals, services or users.

We find that there are at least two types of *terminal* oriented studies. One is those that focus on design elements (e.g. Chuang et al., 2001). These studies are often proprietary studies commissioned by various industry or marketing research groups that are used to guide the physical design of terminals. Another category of terminal-oriented studies focuses the terminal as an object of expression (e.g. Skog, 2000). In this category of research, the value of the object of expression is context dependent. We elaborate somewhat more on

this kind of studies in section 4. Common to both categories of study, however, is a lack of interest in the services the terminal is used to access. Despite their lack of service orientation, these studies are highly relevant to understanding the adoption and use of 3G end-user services. There is no reason to believe that the importance of terminal design and terminals as objects of expression will be less among 3G users than among current 2G users.

Service-oriented studies are most often usability studies focusing on the interface between service and user (e.g. Kim, 2001). These studies are applied in prototype development projects in mobile informatics and in evaluation studies to improve the usability of present services, either those that are resident in the terminal itself or those that can be downloaded from the network. Service-oriented studies may also be categorized according to the underlying service being studied. Most studies are of users accessing simple network services like voice and messaging services (e.g. Eldridge and Ginter, 2001). Correspondingly few studies focus the kind of complex and integrating services that will be typical of 3G services like e.g. mobile commerce services (see Pedersen et al., 2001). That said, the complexity of 3G services primarily represents a challenge to obtaining widespread adoption among service providers on the supply side. On the demand side, this complexity should to a large extent be "hidden" to end users perceiving end-user services as seamlessly integrated services. Thus, behavioral studies of simple network services are also relevant to understand the adoption requirements of future 3G services among end-users.

Finally, the object of study may be the *user* of a mobile terminal and service. Green et al. (2001) describe the studies focusing the users of mobile services in four categories: Social science based studies that treat the user as a social entity or a social actor, and industry studies that treat the user as an economic entity

or an economic actor. When treating the users as *social entities*, large groups of users are characterized by their usage patterns or by demographic characteristics (e.g. Bakalis et al., 1997). When treating the user as a *social actor*, the individual users are in focus and treated as "*social actors who develop interaction and communication strategies for actively negotiating and managing their numerous identities and relationships through telecommunications*" (Green et al., 2001 p. 150). Industry studies may also be categorized by treating the users as entities or actors, but in this case they are often treated as economic entities or actors. When treating users as *economic entities*, user or customer segments are identified and analyzed on the basis of their relative economic status and value (e.g. UMTS-forum, 2000, 2001). When treating users as *economic actors*, individual users are identified and monitored on the basis of their rational economic choices. Because industry studies often are proprietary research, few studies of users as economic entities and actors are found in journals and conference proceedings. These studies also have the disadvantage of not being exposed to the peer review process and thus the integrity of the methods may be open to question. Still, these studies represent an important basis for decisions made by industry players when designing their services, segmenting their users and defining their current and future business models (e.g. Müller-Versee, 1999, Davidson et al., 1999, Müller-Versee et al., 2001).

2.2.2. Perspectives

Because mobile end-user adoption is studied by researchers of different traditions, a simple way to categorize perspectives may be by research area or tradition. However, our review indicates that researchers often use the methodology of one tradition when applying the theoretical perspectives of another (see Dahlbom and Ljungberg, 1999). Instead, different "schools of

thought" may be identified. In these schools of thought researchers of different areas agree on a *set* of relevant theories, methodologies, levels and purposes of research. Not surprisingly, these schools of thought correspond to the three traditional schools found in studies of the adoption and use of technology in general: The diffusion, adoption and domestication schools of thought. Of these perspectives, the diffusion and adoption perspectives are introduced in section 2.1. The domestication perspective, however, is typical of anthropologists and sociologist studying the adoption and use of mobile services.

The three schools of thought may be characterized by their applied level of analysis and purpose of study. The simplest way to categorize the level of analysis is to distinguish between *macro-level* studies of aggregate groups and *micro-level* studies of individual end-users. We suggest categorizing studies based upon their purpose in three categories, i.e. descriptive studies, explanatory studies and studies of consequences. Descriptive adoption studies try to *describe* and characterize the adoption and usage patterns of end users. Thus, these studies focus on the observed behavior of end-users. Other studies, however, go beyond pure description, and provide *explanations* of why a certain adoption behavior is observed. Thus, these studies focus on identifying the antecedents and determinants of the observed behavior. Finally, some studies take certain usage patterns for given, and are more interested in predicting what *consequences* this behavior may have in society. Combining these two categorizations, we suggest a typology of studies. The typology is shown in figure 2.1 with the applied level and purpose of study identified in the three schools of thought.

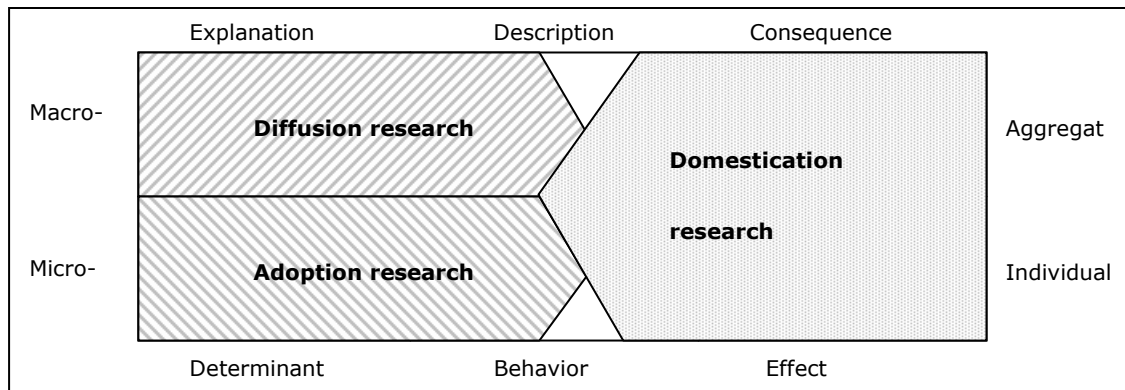


Figure 2.1. A typology of perspectives in end-user service adoption studies

Even though domestication research dominates studies of mobile end-user service adoption and use (see Ling, 2001c), relevant studies are now also found in diffusion and adoption research. *Diffusion studies* of mobile end-user services focus on describing adoption processes at the aggregate level. Typically, these studies classify adopters as belonging to different categories (segments), such as early adopters, early majority, late majority, laggards and non-adopters. For example, Tjøstheim and Boge (2001) studied the demographic characteristics of early adopters of mobile commerce when compared to non-adopters, while Mante-Meijer and Haddon (2001) did the same for general mobile services like voice and messaging. Both of these studies also did comparative analysis of the diffusion of Internet and mobile services, illustrating the opportunities for and limitations in generalizing diffusion research on one kind of technology to another. Diffusion research also explains the aggregate adoption process by the characteristics of the technology or by the characteristics of the channels used to communicate information about the technology. For example, Mahler and Rogers (2000) suggest that the difference in the adoption processes of mobile and fixed telephony may be explained by differences in network effects (externalities) between the two technologies. Both these types of comparative and explanatory diffusion

research may also be highly relevant when trying to generalize diffusion models from simple mobile end-user services to 3G services.

Adoption studies of mobile end-user services focus on describing and explaining adoption processes at the individual adopter level. Some descriptive studies focus on the decision to adopt mobile services only (see Green et al., 2001), while other studies also investigate the attitudes towards using mobile services as use is habituated (see Palen et al., 2001). Explanatory studies apply individual level adoption models. While a large number of explanatory studies may be found on traditional ICT-adoption, we have only been able to identify a few explanatory mobile end-user services adoption studies. One example is an adoption study of mobile telephony applying Davis' (1989) TAM-model (Kwon and Chidambaram, 2000) and another example is some studies applying the TAM-model to study the adoption of telemedicine (e.g. Hu, et al., 1999). Even though these studies suggest that extensions of the TAM-model are necessary to explain the adoption of mobile ICT, the simple TAM-model also proved promising. For example, the Hu et al. (1999) study showed that the TAM-model explained 44 percent of the variance in intention to use a telemedicine application among physicians. In a situation of 3G services with increasing complexity and similarity to other ICT-applications adopted for functional reasons, these studies indicate a potential for adoption research when studying mobile end-user services.

Domestication studies of mobile end-user service adoption focus on studying service use and the consequences of use. However, domestication studies are not limited to studies of individuals or aggregates, but are found describing both the adoption and usage patterns of groups in society (e.g. Townsend, 2000) as well as individual end-users (e.g. Ling, 1997). As indicated above, domestication research also investigates the societal consequences of adoption

and use, both at the aggregate and individual level. For example, Townsend (2000) analyzes the consequences of mobile telephony on the planning of cities, while Fortunati (1998) analyzes the consequences for the family as an institution and for individuals using the mobile telephone as a way of expressing their individuality. All these are examples of findings that are likely also to be important for understanding the consequences of new mobile end-user services, such as network mediating services contributing further to the mobile terminal as an instrument in increasing accessibility, flexibility and individuality. Studying consequences is also relevant because they can be reinterpreted as reasons for adopting mobile services. For example, increasing individuality is both a determinant and a consequence of using mobile end-user services for social network management (Palen et al., 2001). Consequently, domestication studies investigate adoption, use and integration processes at the individual level that may be extended to understand the potential adoption of more complex services. Some of the most important findings are reviewed below.

2.2.3 Contexts

The typology presented in figure 2.1 may be used to classify and characterize most of the studies we have identified of mobile end-user service adoption, but different studies within the same category also give different explanations of the adoption behavior, focus on different issues of user behavior, and predict consequences of service adoption in ways that are not easily categorized by perspective, level of analysis and purpose of study only. Thus, finer grained categorization of research may be useful, for example to identify different and competing explanations of micro level adoption behavior.

One way to provide a finer grained categorization of research on mobile end-user service adoption is to investigate the end-user contexts introduced when applying a specific perspective, theory or approach. When trying to categorize these end-user contexts, we observed a particular interest among researchers in contrasting different contexts. We term such contrasts "context distinctions". Context distinctions may be designed on an ad hoc basis, such as in the distinction between using a service indoors versus outdoors, or while being mobile or stationary (e.g. Kim, 2001). Alternatively, the context distinction may be more conceptual. Typically, conceptual context distinctions are the results of a long tradition of research in a particular research area. They are often applied to new phenomena, such as the adoption of mobile end-user services, using existing models and theories without much adjustment and modification (Harper, 2001). We have identified five conceptual context distinctions in mobile end-user service adoption studies. The first distinction is between different *modalities of mobility* representing different contexts. The second distinction is the traditional distinction between *work and leisure* contexts. The third distinction becomes apparent when demographic variables are used as proxies for context variables to identify a contextual contrast between end-users belonging and not belonging to specific *demographic groups*. The fourth context distinction is the distinction between the *private and the public*. The final distinction is *dynamic* and based upon the recent observation that end-users seem to participate in different contexts maintaining different roles and identities. In this perspective it is the *dynamics* of context, role and identity management that is of interest.

One way to categorize modalities of mobility has been identified by researchers in mobile informatics (e.g. Dahlbom and Ljunggren, 1999). They categorize mobile contexts by three modalities; traveling, visiting and wandering, and have used these modalities as bases for designing applications for mobile work

(e.g. Kristoffersen and Ljungberg, 1999). Haddon (2000) has also suggested modalities of mobility as a useful way to categorize contexts of mobile end-user service use. He suggests five different contexts termed preparing mobility, potential mobility, immobility, actual mobility and hypermobility. So far, the modality distinctions indicate few differences in mobile service use in different mobility contexts. An interesting finding, however, is that while the majority of fixed telephony calls are travel related and generates travel, only 20 % of the mobile calls are travel related. In addition, most of these calls modify travel rather than generate it (Ling and Haddon, 2001). This corresponds well with the finding that mobile services are often used for micro-coordination (Ling and Yttri, 2001) and approximeeting (Plant, 2001).

A much more widely applied conceptual context categorization is the distinction between work and leisure contexts. Much of the research studying the work/leisure distinction focuses on *functional* issues of mobile end-user service adoption. In a way, the functional consequences of bringing mobile end-user services from the workspace into the leisure context are frequently in focus. In the work context, research on telework is often distinguished from mobile work (see Kurland and Bailey, 1999). Research in mobile work can be categorized in several different ways, for example based upon the type of mobile workers being studied. While much previous research in this area has been conducted on the adoption of services among knowledge workers (e.g. O'Hara et al., 2001), recent work has also focused on "blue collar" workers (e.g. Brodie and Perrie, 2001). Even though much of this research is interesting because it focuses on functional reasons for adoption, little of it is directed specifically at the adoption decision of end-users. Instead, most of the research on mobile work is usability studies applied to design user interfaces and to develop work-related support applications. This sharply contrasts research on

technology acceptance in adoption research which focuses specifically on modeling the adoption decision of end-users in work-related contexts.

Research on mobile services in the leisure context has either focused directly on the functional use of mobile services in leisure and everyday contexts, or focused on how the boundary between work and leisure contexts is blurred by the use of such services. The first kind of studies often investigates the implications of bringing the functionality of work-related applications and services into the leisure space. Examples of such services are PIM-services such as calendars and project management services such as project-room applications. An example of this kind of research is the study by Palen et al. (2001) on the change in communication behavior of 19 new users after their acquisition of a mobile phone. Many of these users adopted the mobile phone for work-related reasons, but soon brought the work-related functionality of the mobile phone into their leisure space. Another observation is that Palen et al. (2001) found that the domestication process goes quickly. That is, the new users seem to adopt the ideology of being a user rather quickly. They change their attitude toward the disturbing influence of the device and they are quick to find ways that the device fits into their daily lives. This finding also indicates that while user friendliness may be an important issue at the early stage of an adoption process, the importance of this determinant in explaining usage behavior may be less at later stages.

The second kind of studies are more concerned with the consequences of the separation between working and leisure spaces from bringing work-related services into the leisure space. This research typically observes a blurring of boundaries between work and leisure life caused by the use of mobile end-user services. Two examples of such studies are the studies of homework (e.g. Yttri, 1999) and studies of quality of life issues (e.g. Akselsen, 2001). Both the cited

studies look at the integration of work-related technology into the family. Among other things, the studies have examined how some members of the family enjoy increased quality of life while others experience the opposite. Thus, work-related services adopted for functional reasons are likely to be integrated into the leisure space changing the way family-related and social network related activities are managed. It is likely that many 3G services will be targeted at improving these management tasks. Domestication research has shown us how such services are adopted quickly, but also how they create new patterns of behavior with corresponding social consequences.

The third context categorization is based upon using *demographic variables* as proxies for identifying a distinction between end-user contexts. Of these variables, gender and age have been most widely applied. While *gender* as such is not necessarily relevant as a variable explaining differences in service use, the context differences attributed to gender differences are of relevance. For example, social networks of men and women, their roles in social networks and the boundary between work and family life may all be different. When contrasting the contexts of diverse demographic groups, the "*introduction of mobile phones into existing situations illuminates various aspects of the context*" (Ling, 2001a, p. 134). Several studies focus on gender differences in mobile end-user service adoption. An early study of in this tradition was conducted by Rakow and Navarro (1993). Their work described interesting communication patterns, such as e.g. "remote mothering" among women. Rakow and Navarow asserted that, at an early point in the diffusion of the device, the mobile telephone was a device that replicated preexisting gender patterns, i.e. the role of the woman as an accessible nurturer and a person in need of male protection. This research supports the assumption that risk reduction motives are among the relevant determinants of mobile service adoption. Later, several studies have elaborated on gender differences in the

adoption of both voice and other mobile end-user services (e.g. Ling, 2001a; Ling forthcoming). The focus in these studies is on the way in which the mobile telephone was earlier seen as a technical gizmo and thus a part of the male domain. As the adoption process has continued, and indeed teen girls adopt mobile telephones in significantly higher numbers than their same-aged male counterparts, the device has been redefined as a social network device and thus within the domain of women.

Age has been the most widely applied demographic variable characterizing differences in adoption of mobile end-user services. Of these studies, the differences in adoption patterns between *young people* (teens, adolescents) and other users have been the most common focus. While some studies have been preoccupied with *describing* differences in adoption behaviors (e.g. Heinzmann et al., 1998, Karlsen et al., 2001, Eldridge and Ginter, 2001), others have suggested theoretical *explanations* of the observed differences in adoption behaviors.

The most important findings of the descriptive studies are that from age 20, adoption is a linearly decreasing function of age consistently all over Europe (Mante-Meijer and Haddon, 2001). However, when compared to Internet adoption, the older people have a much higher adoption rate of mobile phones than of Internet. Still, their use of services is very simple focusing almost exclusively on voice. The teenage segment has been described in several studies, both qualitative and quantitative. Among the most penetrating studies are a set of qualitative studies done by Rautiainen and Oksman on Finnish adolescents (e.g. Oksman and Rautiainen, 2001), by Weilenmann on Swedish teenagers (e.g. Weilenmann and Larsson, 2000) and by Ling and others on Norwegian teenagers (e.g. Ling and Yttri, 2001, Johnsen, 2000). A main conclusion that can be drawn from these studies is that service adoption and

usage varies in segments of teenagers in a way that treating the teenager group as a homogeneous segment is not advisable. A summary of qualitative observations is found in Plant (2001). In quantitative studies, mobile phones are shown to have an adoption rate of close to 100 % in teenage segments. Service usage is concentrated on text and voice usage, with a slightly higher text service usage among female than male users (Ling, 2001c). Thus, the use of mobile services is very well integrated in the daily lives of teenagers. However, the impression that services are adopted for non-functional and social status reasons only (e.g. Skog, 2000), is contradicted by many of the descriptive studies. For example, Karlsen et al. (2001) found a remarkable orientation towards usability and costs in their study of the potential adoption of new end-user services among Norwegian teenagers.

Among the explanatory studies of the adoption and use of mobile services among teenagers, a variety of explanations is found. Among these explanations are the suggestion that the adoption behavior can be illuminated by a "theory of fashion" (e.g. Ling, 2001b) wherein the popular characterization of the device seems to have changed with time, by the use of services as "ritual gift giving" (e.g. Taylor and Harper, 2001a, Johnsen, 2000), by treating the mobile phone as "symbolic capital" (e.g. Skog, 2000) or as an instrument in "family differentiation and symbol of individuality" (e.g. Taylor and Harper, 2001b), and the use of services as a "group marker or social identifier" (e.g. Weilenmann and Larsson, 2000, Larsson, 2000) or as a "self identifier" (e.g. Alexander, 2000, Hume and Peters, 2001). Currently, these explanations should all be treated as tentative because none of them has undergone formal hypothesis development and confirmatory testing. Instead, they are typically supported using ethnographic studies and documented using "citation techniques" from observation logs, diaries and qualitative interviews. Still, they suggest important explanations that eventually will have to be integrated as

parts of a more formal theory of adoption. For example, the importance of interpersonal and media influence inspired by a "theory of fashion" should be parts of such a theory. Similarly, the relationship between social reasons for use and social reasons for adoption should somehow be integrated. For example, late adopters may be affected in their adoption process by the observations they make of use among adopters who has objectified the device (Taylor and Harper, 2001a) or of those who have reached the stage of conversion making the device and their service usage parts of their own identity (Ling, 2001c). These mechanisms will have to be integrated into a theory of adoption applied to 3G service adoption, but it is necessary that this theory integrates mechanisms in which services are adopted for functional reasons as well.

The fourth categorization of contexts focuses on the consequences of mobile end-user service adoption rather than trying to explain it. The distinction between *private and public contexts* is investigated applying two perspectives. For some time, researchers have studied - and expressed opinions on - how society is affected by bringing the public into the private sphere. This question was first raised by researchers studying the domestication of fixed telephony (see Fisher, 1988). However, researchers studying the adoption of mobile end-user services now investigate the opposite perspective. The question is how society is affected by the fact that an instrument for managing personal relations and networks - the mobile phone - can be used ubiquitously. Answers to this question may be given both at the micro level by studying individuals' use of mobile services in public places such as restaurants (e.g. Ling, 1997), or at the macro level by studying more fundamental changes in society. For example, Fortunati (1998, 2001) has investigated how the use of the mobile phone increases individuality, reduces the importance of the family institution, and has "*stolen communicative space from the public sphere and attributed it to the private*" (Fortunati, 1997, p.2). As mentioned above, Townsend (2000) has

studied how mobile phones emphasize real time planning and "microcoordination" (see Ling and Yttri, 2001, Ling and Haddon 2001). These, in turn may change city planning and the everyday life in cities. All these studies focus the blurring of the boundaries between private and public spaces. Even though these studies are important to understand the consequences of widespread adoption of mobile services, their contribution to an understanding of the adoption decisions made by individual users is somewhat limited.

The observed blurring of the private and the public, and of work and leisure contexts, indicates that mobile telephone use together with other recent advances in information and communication technologies (ICT) changes society from a "door-to-door", via a "person-to-person", to a "role-to-role" society (see Wellman, 1999, 2001). The most recent trend in research on mobile end-user service adoption treats *contexts as dynamic* and end-users as *"negotiating and managing their numerous identities and relationships"* using such services (Green et al., 2001). This means that end-users manage different roles in different contexts and social networks, and that network members, and their identities and roles, may differ across contexts. Managing these identities, roles and network memberships may require mediating communication services, such as mobile end-user services. Consequently, to understand the adoption behavior of end-users, a multitude of end-user contexts should be studied applying context-dependent models. Next, the results of these studies should be integrated in some form of triangulation framework (e.g. Pedersen et al., 2001).

2.2.4 Methodologies

Because researchers from many different traditions and areas of research have been involved in behavioral end-user adoption studies, a multitude of

methodologies has been applied in these studies. Studies in mobile informatics and anthropological studies of end-user behavior both apply *ethnographic* methodologies, but with very different foci. While mobile informatics studies apply the methodology for prototype development and initial usability studies (e.g. Dahlbom and Ljungberg, 1999), anthropological studies focus societal consequences of adoption (e.g. Blinkhoff and Blinkhoff, 2000). Both qualitative and quantitative social science methodologies have been applied, but a far greater number of studies applying qualitative methodologies are found. For example, *scenario analysis* is applied to identify opportunities for development and study future consequences of adoption (e.g. Dörsch and Fiebig, 2001). *Focus group interviews* are used to investigate and refine initial propositions on adoption behavior and its consequences (e.g. Ling, 2001b). Recently, *diary and log-based methodologies* have also been applied in adoption studies, often combined with different interview techniques (e.g. Palen and Salzman, 2001). Finally, traditional *observational methods* have also been applied and combined with other methodologies (e.g. Larsson, 2000). Quantitative methodologies have also been applied, for example using traditional *survey methodology* (e.g. Marcussen, 2001), but the number of studies applying this methodology to study the adoption of complex end-user services is limited by the slow introduction and adoption of these services. For the same reason, few studies applying systematic *experimental or quasiexperimental methodologies* are found. However, with a more confirmatory approach to research and more widespread adoption of services, the number of studies applying experimental designs is likely to increase in the near future (see e.g. Cattell, 2001).

2.2.5 Domestication research characteristics

We have suggested different ways of categorizing research on mobile end-user service adoption. In each category, we have presented examples of research we find relevant for understanding the behavioral adoption requirements of 3G services. Even though many relevant studies have been identified, the categorizations also illustrate how numerous studies are found within one category, while lacking in another. This disproportion of perspectives, context distinctions and methodologies has been identified. One example is the numerous studies of mobile phones and simple services as objects, but very few studies of the kind of complex end-user services likely to be introduced in 3G networks. Another example is the numerous descriptive studies on adoption behavior and studies of consequences, but few studies focusing directly on the explanations of adoption behavior. A third example is the numerous studies of the adoption behavior of somewhat marginal demographic groups, but few studies of the adoption behavior of larger, less sophisticated user groups. A fourth example is the numerous studies applying exploratory methodologies, but few studies using a confirmatory approach and methodology.

The focus on simple services may be logical because, aside from some quasi-advanced services such as iMode, SMS and, in some cases PIM functions, there is actually very little use of mobile services beyond standard voice telephony. This awaits the development of various types of interactivity and context sensitivity and perhaps devices such as mobile web pads. In the mean time, empirical research perhaps necessarily focuses on the types of services that have certain dispersion in society. Two considerations may be taken into account when trying to understand the disproportion of perspectives and methodologies. First, the technology is still quite immature and thus the broad social consequences are only starting to emerge. Some issues such as the

facilitation of coordination, impact on the emancipation process, new forms of safety and security and finally, the disturbing influence of the device, are all potential issues. However, in some countries the adoption and embedding of the technology is taking place right before our eyes, making it possible not just to derive and explore theories but to synthesize, refine and test explanatory theory and models.

The use of exploratory methodologies may also be logical. Survey analyses increase the generalizability of results, but their potential for prediction may be limited to analyses based on regression and correlation. Panel studies, such as the IST e-Living project, address some of the issues of “single shot” studies but do not fulfill the full requirements of an experimental method, i.e. random sample of a general population, random assignment to experimental and control groups, pre and post testing and the use of experimental stimuli. When looking at mobile services in this context, experimental methodology requires careful framing of the research questions, and these studies tend to be expensive and require time to carry out. Neither of these latter requirements are common resources in the mobile services industry of today. Still, regional and segmented service introductions lend themselves easily to quasiexperimental analysis and are well suited as a framework for doing more confirmatory research.

Despite a disproportion of perspectives, contexts and methodologies, domestication research is important in understanding the adoption of more complex mobile services. Consequently, we suggest integrating many of the findings in domestication research into our adoption model.

2.3 Mobile services adoption model and propositions

To study the adoption of mobile services in general, and mobile commerce services in particular, we suggest a model integrating many of the most

important findings on adoption behavior of domestication research into an adoption model. Because this is an individual adopter model, research in the diffusion perspective is considered less relevant. The model is a modified version of the decomposed theory of planned behavior model of Taylor and Todd (1995). The decomposed TPB includes explanations of the behavioral attitudes towards use, the social explanations of intention to use transformed into an individual level concept - the subjective norm, and the careful consideration of the importance of individual and context related resources through the behavioral control concept. Thus, the model includes many of the most important determinants of end user adoption suggested by mobile informatics and sociological end-user studies (see e.g. Ling, 2001b; Taylor and Harper, 2001a; Skog, 2000; Taylor and Harper, 2001b; Hume and Peters, 2001; Green et al., 2001). To comply more fully with these studies some modifications of the model by Taylor and Todd (1995) are suggested. First, we introduce direct links from the determinants of subjective norm to the determinants of behavioral attitudes because some of the most important determinants of usefulness and user friendliness are user expectations of these perceived constructs.

We also introduce covariance between interpersonal influence and external influence because interpersonal relationships influence what is perceived externally and vice versa. We also include links from subjective norm to behavioral attitudes because mobile end-user services have shown how attitudes as well as behavioral intentions are affected by norms. Finally, we include the findings of mobile end-user domestication studies that identity related self-control is both a determinant and a consequence of the adoption of mobile services by replacing self-efficacy with self-control among the determinants of behavioral control. While self-efficacy (related to adoption) is an individual's self-confidence in that adoption will lead to the desired behavior

(see Bandura, 1982), self-control is often believed to include self-efficacy, but also go beyond it (Rosenbaum, 1980). For example, self-control is related to time dependence when an individual chooses not to consume something today because the utility is believed to be higher from consuming the good at a later point in time. It is also related to dual-outcomes, such as when an individual chooses not to consume a drug because the long term hazards are believed to be more serious than the short term satisfaction.

Thus, based upon the findings in domestication research, self-control may more effectively capture the complexity of identity related adoption determinants than self-efficacy. As a consequence, we also introduce a relationship between interpersonal influence and self-control. The final model is illustrated in figure 2.2

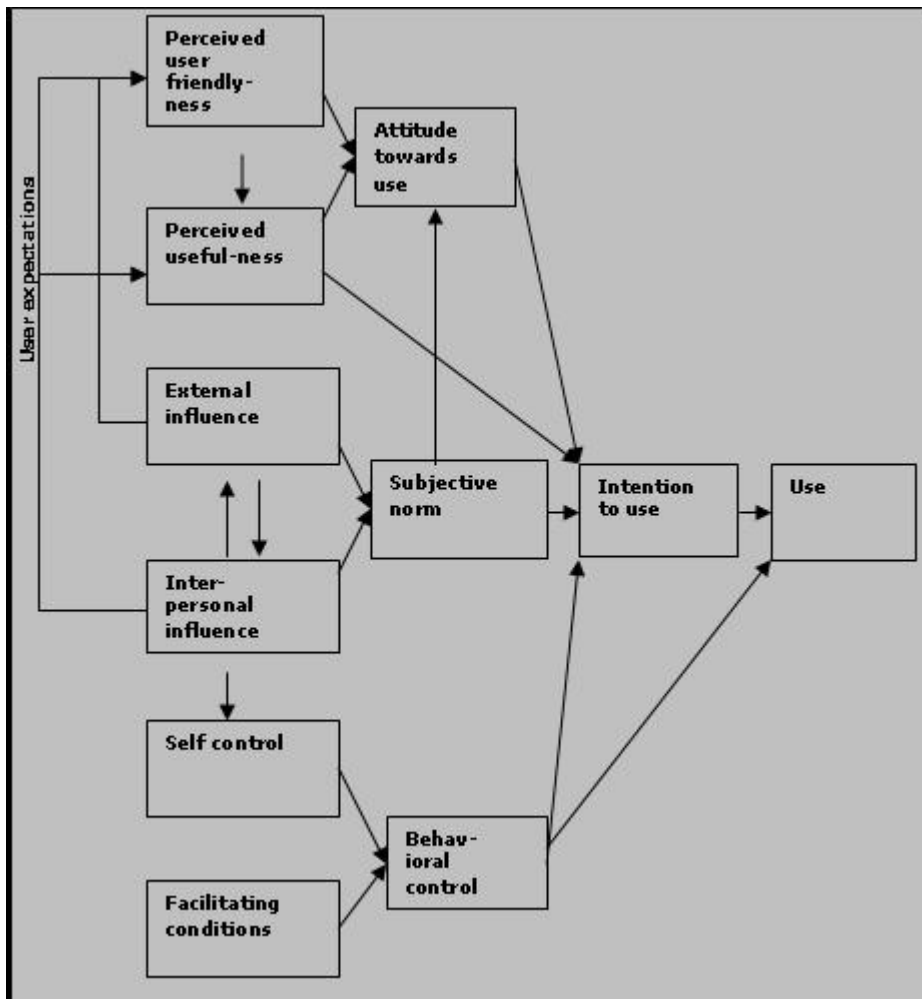


Figure 2.2 Decomposed TPB modified by domestication research findings

Even though the threefold purpose of this study implies that an exploratory approach is useful, we may also specify some more formal propositions related to the research questions we are investigating. First of all, the literature reviewed on both adoption and, in particular, on domestication research indicates that social issues such as interpersonal and external influence, are more important to the adoption of mobile services than to the adoption of traditional ICT-services adopted for purely functional reasons. For example, the context of adoption is extended outside the work context often studies using adoption research. Second, end-user resources are suggested as critical to the adoption of mobile services. In particular, sources of end-users' self efficacy is found as a so important determinant of the adoption and use of mobile services

that a model not including these concepts would lose significant explanatory power. Thus, the following general proposition can be made on the necessary extensions of the most parsimonious model of adoption research - the TAM model, when applied to explain the adoption and acceptance of mobile services:

The findings from domestication research indicate that the addition of subjective norm and behavioral control to the original TAM-model is necessary for explanatory power when applied to the adoption of mobile services (P1).

Proposition 1 is related both to the explanatory power of our model and its complexity. In the proposition, we suggest that social issues and behavioral control issues are so relevant that to maintain explanatory power, the model must have a level of complexity higher than the TAM-model.

The next general proposition that can be put forward is related to *how* the TAM-model should be extended. We have presented an extension - the decomposed TPB model that has been applied with success by several researchers (Taylor and Todd, 1995, Battacherjee, 2000). However, the findings from domestication research have made us suggest modifications to the decomposed TPB-model indicated above and illustrated in figure 2.2. Thus, we make a second proposition:

The findings from domestication research indicate that the original decomposed TPB should be modified both in its relationships and in its concepts when applied to the adoption of mobile services (P2).

First of all, the importance of interpersonal and external influence suggests modifications of the relationships of the model. Second, the importance of individuality and self-control suggests this concept should be introduced as part of the behavioral control component of the model.

Finally, we suggest a general proposition related to the validity and reliability of the concepts and measures of the model:

The concepts and measures of the modified TPB are reliable and valid (P3).

The final proposition is directly related to the purpose of our study to develop a theoretical model investigating the adoption of mobile end-user services, and in particular, the development and testing of the concepts and measures of this model. Thus, our study is more concerned with evaluating the model and its measures than with providing empirical results on the behavior end-users that generalize to larger samples or populations. However, a first step in the direction of producing such results is the development of a parsimonious model with explanatory power that is based upon valid and reliable concepts and measures.

3. METHODOLOGY

The primary purposes of this study are to review the literature on adoption of mobile services and to propose an adoption model. However, in section 2, we also propose that the measures of the model were reliable and valid. Consequently their validity and reliability should be evaluated. A survey of early mobile service adopters was conducted to evaluate and refine the proposed model of section 2. We present the design, sample and measures used in the survey here.

3.1 Design, sample and procedure

A simple one-group posttest design was applied in which respondents were recruited from discussion forums, bulletin boards or community groups on the web or newsgroups on news-servers. To reach early adopters, a set of potential forums was identified. These forums were primarily forums for the discussion of either mobile phones or PDAs¹. Altogether, 85 forums were identified containing active users discussing mobile phones or PDA's. The activity level of the forums varied considerably, with some forums receiving 10-20 postings pr. topic pr. day, while other forums received the same number of postings pr. topic pr. year.

Because the recruitment of respondents to surveys is considered somewhat inappropriate in many of these forums (possible "spam"), an invitation text stressing the independence of the survey from any commercial companies was used. In addition, we posted the text under as relevant topics as possible, not to provoke the moderator or forum users. In some of the most active forums, a reminder text was posted after 3 days. No other reposts or reminders were used

¹ Personal Digital Assistants.

to avoid creating negative reactions from moderators and forum users. Consequently, our post soon lost relevance in the list of topics or posts and thus, this recruitment method worked only for a limited time.

In addition, an invitation was posted to the "Keitai-L" and "tokyopc-mobile" email lists of advanced users and developers of "i-mode", "Ez-web", "au" and "Foma" (i-motion) services to better recruit respondents from the Asian region. All material was collected during the two first weeks of December 2001. The total sample is shown in table 3.1 with the corresponding forums from which the respondents were recruited.

Table 3.1 Recruitment forums and number of responses (* - postings on several sub-forums within the indicated forum were made)

Forums	N	Newsgroups	N
unidentified	9	alt.cellular*	6
www.forum.nokia.com	7	uk.telecom*	5
www.esato.com	18	de.comp*	1
www.microsoft.com	10	dk.marked	1
www.reviewcentre.com	1	dk.teknik*	4
www.wirelessinanutshell.com	9	fr.reseaux.telecoms*	1
www.brighthand.com*	15	no.it.telekom.mobil	11
www.pdstreet.com*	27	tw.bbs.rec.mobilecomm	4
www.howardforums.com*	19	uk.adverts.telecom.mobile	2
www.pocketpcpassion.com	2	aus.comms.mobile	8
www.syllas.com	3	pl.misc.telefonia.gsm	1
clubs.yahoo.com*	10	hr.ponuda.gsm	1
www.mobildebat.dk	2	hr.alt.cellular.gsm	1
debat.passagen.se/mobil	1	es.technica.redes.telefonia.movi	2
www.forum.siemens.com	2	it.tlc*	1
forum.hardware.no	1	comp.sys.palmtops.pilot	3
www.handyfragen.de	5	se.sator.sys.handdator	2
cell.exchange.ph	1	swnet.teknikk.telefoni	3
forums.internet.com	1	sfnet.viestinta.matkapuhelimet	5
www.mobilecomputing.com	1		
www.popularwireless.com	1	Keitai-L	18
www.itavisen.no	6	Tokyopc-mobile	1

The final sample consisted of 232 respondents answering parts of or the whole survey. A total of 579 respondents visited the survey site, but only 192 chose to complete the entire survey and submit demographic data as well. However, most of the responses of the 232 respondents participating in most parts of the study are used in the remaining analysis. The general response rate based upon the number of views of the recruitment posting can not be calculated. A minimum completion time was set to three minutes, and all subjects who completed the whole survey in less than three minutes were considered careless respondents and excluded from further analysis (4 subjects). Average completion time for the rest of the subjects was 11 minutes, 49 seconds. In table 3.2 the reported demographic characteristics of the sample is illustrated.

Table 3.2 Demographic characteristics of the sample (in percents of total)

Age (N=192)		Sex (N=190)	
0-19	9.4	Male	90.5
20-29	45.8	Female	9.5
30-39	31.3		
40-49	10.4		
50-59	10.1		
60 and above	0.0		
Education (N=192)		Continent (N=192)	
Primary/Middle level	1.6	North America	33.9
Secondary/High School	16.1	South America	0.5
University/College 1-3 years	30.7	Europe	48.4
University/College 4 years or more	51.6	Africa	0.5
		Asia	9.9
		Oceania	6.8

As can be seen from table 3.2, a relatively large number of subjects fall into the age-categories 20-39. A very large number of subjects are male and most of the subjects are well educated. We primarily recruited respondents located in North

America and Europe, despite efforts to reach respondents in Asia as well. The survey being presented in an English version only may have contributed to the small number of Asian subjects. When compared to the general Internet population, we observed a greater proportion of young subjects than the 10th GVU User Survey². However, the proportion of young subjects was very similar to our own Internet surveys (Pedersen and Nysveen, 2001), and somewhat smaller than InterTrack³ reports. When compared to GVU User Survey, InterTrack and our own studies, a lower proportion of female users were found in our sample. This may also have to do with both the problem investigated and the sources of recruitment. In a study of discussion forum users (Thorbjørnsen, Breivik and Supphellen, 2002) a similar small proportion of female subjects recruited from discussion forums was observed, even though the subject of study was different. For the education variable, our subjects are very similar to the subjects in the GVU User Study, but when compared to InterTrack and our own previous studies, the subjects of this study are generally more educated. When considering the issue of representative samples, one should keep in mind that our subjects were meant to be representative of early adopters, not necessarily of Internet users in general. Thus, the disproportion of female subjects and the higher general education of our subjects are generally in accordance with other studies of early adopters (Dickerson and Gentry, 1983).

When recruited from the forums, the subjects were linked to an opening page of the survey. The opening page introduced the survey and the concept of mobile commerce providing two definitions. Two alternative links were provided, one

² See http://www.gvu.gatech.edu/user_surveys/.

³ See <http://www.gallup.no/default.asp>.

to start the survey and one to indicate no interest in participating. The survey consisted of four pages of statements and questions. To control the procedure bringing the subjects to the right page, cookies were used. If subjects left the survey for later completion, stored cookies brought them back to the right page of the survey. To stimulate participation a drawing of prizes was included.

3.2 Measures

The model in section 2.3 contains 11 concepts: User friendliness, usefulness, attitudes towards use, external influence, interpersonal influence, subjective norm, social control, facilitating conditions, behavioral control, intention to use and actual use. All the concepts are well founded in either the adoption literature or the domestication literature reviewed in section 2. Consequently, the construct validity of these concepts is considered acceptable.

To measure the concepts, a questionnaire was designed containing multiple measures of each of the 11 concepts. In the questionnaire, the concepts were measured by the subjects indicating their agreement with a set of statements using a seven-point scale ranging from "strongly disagree" to "strongly agree" (as in Battacherjee, 2000). Some concepts were measured using seven-point scales of bipolar adjectives. The questionnaire is found in appendix A. The measures of the TAM part of the model are shown in table 3.3.

Table 3.3 Measures of the TAM part of the model

User friendliness	Usefulness	Attitude towards use
Learning to use mobile commerce services is easy to me	Using mobile commerce services makes me save time	Good/bad
It is easy to make the mobile commerce services do what I want them to	Mobile commerce services make me a better consumer	Wise/foolish
My interaction with mobile commerce services is clear and understandable	Using mobile commerce services improves my efficiency as a consumer	Favorable/unfavorable
I find it easy to interact with mobile commerce services	Mobile commerce services are useful to me as a consumer	Beneficial/harmful
I find it easy to use mobile commerce services	Mobile commerce services increases my effectiveness as a consumer	Positive/negative
$\alpha=0.93$	$\alpha=0.91$	$\alpha=0.90$

Table 3.3 also shows Cronbach's α for all the measures of the TAM part of the model. User friendliness was measured using five items developed from adapting the original items of Davis et al. (1989) to our setting. Similar operations are found also in Taylor and Todd (1995) and in Battacherjee (2000). Usefulness was measured using five items indicating the original dimensions of time saving, improvement, efficiency, usefulness and quality suggested by Davis (1989). Because the setting of mobile commerce services is an everyday life situation, the original items of Davis had to be converted into more "everyday life" terms. The items were then discussed with native English speaking subjects. Finally, attitude towards use was measured using five bipolar adjectives indicating different aspects of the attitude towards use. The items were very similar to those used by both Davis (1989), Taylor and Todd (1995) and Battacherjee (2000). Consequently, little adjustment was necessary

to adapt the original measures used by studies applying the TAM or TPB model to our setting. The measures of the subjective norm part of the model are shown in table 3.4.

Table 3.4 Measures of the subjective norm part of the model

External influence	Interpersonal influence	Subjective norm
Media is full of reports, articles and news suggesting using mobile commerce services is a good idea	Almost all of my friends use mobile commerce services	People important to me think I should use mobile commerce services
Media and advertising consistently recommend using mobile commerce services	Almost all my colleagues thinks using mobile commerce services is a good idea	People who influence my behavior think I should use mobile commerce services
In my profession it is advisable to use mobile commerce services	My friends/colleagues think that we should all use mobile commerce services	People whose opinion I value prefer me to use mobile commerce services
	Some of my friends/colleagues recommended I should try out mobile commerce services	
$\alpha=0.73$	$\alpha=0.86$	$\alpha=0.94$

The measure of external influence was based on three sources of influence - media, society and profession. Thus it includes, integrates and extends the measures used by Battacherjee (2000) and Taylor and Todd (1995). The measure of interpersonal influence was based upon Battacherjee's (2000) extension of the measures used by Taylor and Todd (1995), and adapted to our setting. Subjective norm was measured using three items almost identical to the items used by Mathieson (1991) and Battacherjee (2000). A somewhat simpler

version of the measure was used by Venkatesh and Davis (2000). All reliabilities presented in table 3.4 are considered acceptable. The measures of the behavioral control part of the model are shown in table 3.5.

Table 3.5. Measures of the behavioral control part of the model

*Self-control/**Self efficacy	Facilitating conditions	Behavioral control
**I am able to use mobile commerce services without the help of others	I am given the necessary support and assistance to use mobile commerce services	I feel free to use the kind of mobile services I like to
*Generally speaking I want to do what my friends think I should do	I have the financial and technological resources required to use mobile commerce services	Using mobile commerce services is entirely within my control
*Generally speaking I want to do what my superiors think I should do	I have access to the software, hardware and network services required to use mobile commerce services	I have the necessary means and resources to use mobile commerce services
*My friends/colleagues and I use the same kinds of mobile services	The mobile commerce services I use are well integrated and provided in a stable service infrastructure	
**I have the necessary time to make mobile commerce services useful to me	My service provider/operator facilitates the use of mobile commerce services	
**I have the knowledge and skills required to use mobile commerce services	There are no compatibility problems related to the mobile commerce services I use	
**I am able to use mobile commerce services reasonably well on my own		
* $\alpha=0.83$ /** $\alpha=0.87$	$\alpha=0.82$	$\alpha=0.82$

The measure of self-control includes and extends the self-efficacy measure used by Battacherjee (2000) and Taylor and Todd (1995). This also corresponds well to the extended *user* resources part of the "resources" scale of Mathieson et al. (2001). The included self-efficacy items are indicated in table 3.5 (*). Self-control is measured by items reflecting some of the indicators of self-control such as resisting group pressure, superior influence and group conformity(**). A principal components analysis of the items is shown in table 3.6.

Table 3.6 Principal components analysis of the self-control items (loadings below 0.30 not shown)

Component	Self 1	Self 2	Self 3	Self 4	Self 5	Self 6	Self 7
1	0.84				0.77	0.86	0.86
2		0.86	0.83	0.74			

The principal components analysis extracted two factors with eigenvalues greater than 1. The factors correspond well to the items intended to measure the original self-efficacy measure of the decomposed TPB-model and the extensions of self-control suggested in our model. If the whole scale is maintained, coefficient α is 0.77. The measure does not capture the whole range of the self-control concepts as defined by e.g. Rosenbaum (1980), but includes some items from these more complex self-control scales.

The measure of facilitating conditions is based upon the same sources as the self efficacy measure. It also extends these measures with specific items related to the infrastructure of mobile services and the facilitation of service usage by the user's provider or operator. The measure of behavioral control is almost identical to the measure applied by Battacherjee (2000) and Taylor and Todd (1995). The reliabilities of the measures are indicated in table 3.5.

Finally, intention to use and actual use was measured by presenting 30 mobile commerce services organized along the consumer life cycle. The subjects were

asked to indicate whether they had used any of these services and whether they intended to use any of these services within the next six months. The sums of the number of services used and services intended for use were applied as measures of actual use and intentions to use. To comply more fully with the measures of adoption research, intention to use was also measured with a three item scale adapted from Battacherjee (2000) and Mathieson (1991). This measure had a reliability of $\alpha=0.92$. Consequently, all our measures are based upon previously validated measures (Venkatesh and Morris, 2000), and are considered reliable.

In addition, we measured Internet experience, innovativeness, gender, age, education and home continent. Internet experience was measured using five items indicating the variety of user access points. In addition a more traditional attitudinal measure was used consisting of three items we also previously have been used with good reliability (Pedersen and Nysveen, 2001). This measure is based upon validated product experience measures, such as Smith and Park (1980) and Mitchel and Dacin (1996), and in our study it showed a reliability of $\alpha=0.92$.

Innovativeness was measured adapting Goldsmith and Hofacker's (1991) product innovativeness scale to our setting of mobile services. Goldsmith (2001) has also applied this innovativeness scale to Internet users as a measure used to identify innovators, majority users and laggards. We applied exactly the same items as those used by Goldsmith except from replacing the term "Internet" in Goldsmith's items with the term "mobile services". The measure had a reliability of $\alpha=0.95$. Goldsmith used a five point scale instead of our seven point scale and observed a reliability of $\alpha=0.85$, a mean of 18.0 and a standard deviation of 5.4. Of these users, the innovators were identified as the 20% of the subjects with the highest innovativeness score. The measure has

also been used by Agarwal and Prasad (1998) studying the innovativeness of Internet users. When compared to these data, our subjects had a mean innovativeness of 33 and a standard deviation of 8.4. When converted to Goldsmith's scale, this corresponds to a mean innovativeness of 23.5 and a standard deviation of 6. This indicates that the majority of our subjects are in the innovator category and our assumption that these are early adopters seems appropriate.

Age was measured using a six point scale ranging from 0-19 years to above 60 with intervals of 10 years. Education was measured using a four point scale and home continent was measured by the six major continents of North America, South America, Europe, Africa, Asia and Oceania. In addition, subjects also indicated their sex. Internet experience, innovativeness and the measured demographic variables were used as control variables in the study.

4. RESULTS

The propositions of section 3 are related to the explanatory power of the model and the validity of its concepts, measures and relationships. The general validity of measures has been discussed and documented in section 3. Thus, this section focuses mostly on the results of relevance to propositions 1 and 2. However, to provide a more thorough analysis of the data, confirmatory analysis of the measurement model is also done here. Supplemented with the reliability analysis of section 3, this is our way of investigating proposition 3. We first present some descriptive findings related to service use and intentions. We then go on to investigate the measurement model and the three parts of the model. Finally, we estimate the proposed model and compare it to alternative models discussed in section 2.

4.1 Descriptive data

Generally, our surprisingly low response in recruiting subjects for this survey when compared to other surveys we have conducted indicates that mobile commerce services are not widespread, and that few respondents feel they have enough experience and knowledge of these services to participate in a survey of this kind. When interpreting our descriptive results this should be kept in mind because our subjects were recruited at sites frequented by innovators and early adopters of mobile services.

As presented in section 3, our subjects should be characterized as early adopters or innovators even when measured by well established innovativeness indicators (Goldsmith, 2001). An analysis of the Internet experience of the subjects shows that their subjective experience is high when compared to the results of other surveys we have conducted using the same items of measurement. For example, the average experience of these subjects is 18.6

(SD=3.6) as compared to the 14.8 (SD=4.3) observed for the same items in a general study of Internet search behavior conducted at the same time (Pedersen and Nysveen, 2001). When compared to this study, our subjects also have access to the Internet from far more sources. This is illustrated in table 4.1.

Table 4.1 Access to the Internet

Access from	Percent - this study	Percent - Pedersen and Nysveen (2001)
Job	95.2	92.5
Home	82.7	65.3
School	31.5	21.6
Mobile PDA/PC	67.3	15.3
Mobile phone	76.8	24.4
N	185	796

The results are rather similar when it comes to traditional access sources, but are very different for access from PDA/PCs and mobile telephones. Thus, our subjects are experienced users of mobile Internet services.

When measuring use and intention to use, we suggested 30 mobile commerce services organized along the consumer life cycle. The subjects were asked to indicate whether they had used any of these services and whether they intended to use any of these services within the next six months. As shown in section 3, the aggregate measure of service use is a measure of use and intention to use, but the indicated services are also interesting as such. In table 4.2 the frequency of each service used or intended for use is shown. The table gives an indication of the interest in adopting individual mobile commerce services among these early adopters.

Table 4.2 Actual use and intention to use mobile commerce services

Service (figures in percent of totals)	Actual	Intention
Searching "yellow pages" or other commercial directory using a mobile device	42.5	34.6(-)
Alert service related to commercial matters such as offers, warnings etc.	40.4	23.7(-)
Mobile location-dependent search or alert service	30.7	36.8(+)
Wireless advertising service	21.1	24.6
Mobile access to corporate purchasing/sales service	18.0	31.1(+)
Mobile product information service (scanner or directory based)	28.9	28.1
Mobile access to travel related reservation service (flight, hotel)	32.2	35.5
Mobile access to entertainment related reservation service (cinema, concert tickets)	37.3	33.3
Mobile access to recommendation and/or reputation service	21.5	29.8(+)
Mobile access to consumer chat groups (and instant messaging)	33.8	25.9(-)
Mobile access to consumer support forums (discussion forums)	19.3	26.8(+)
Mobile access to consumer planning services (vacation planning, financial planning etc.)	14.0	27.2(+)
Mobile currency converters	38.6	23.7(-)
Mobile access to shopping agent or comparison shopping services	23.7	29.4(+)
Direct product/service download/buying to mobile device (ring tones, logos, music download)	54.8	14.0(-)
Mobile access to trust, security or escrow service	9.2	24.6(+)
Mobile auction service	16.7	25.9(+)
Mobile commercial/shopping related navigation service (driving directions)	25.4	28.9
Mobile payment service at the "point-of-sale" (credit card replacement)	10.5	39.9(+)
Mobile payment service on the Internet	18.9	37.3(+)
Mobile payment service on vending machine (and parking lot, toll road payment)	13.6	38.2(+)
Mobile access to financial service (bill payment, account balance, account transfer)	25.0	30.3(+)
Mobile access to stock trading service	16.7	24.6(+)
Mobile access to reverse auction/collaborative buying service	3.5	26.3(+)
Automated voice assisted customer support service (mobile)	27.6	18.9(-)
Mobile access to product handbooks and user manuals	18.4	28.5(+)
Mobile access to corporate support systems (configurators, faq-services)	15.8	26.3(+)
Up-sale services delivered to mobile device (e.g. alerts on related products and services)	14.5	23.2(+)
Consumer related gaming and entertainment services on mobile device (shopertainment)	39.5	19.78(-)
Mobile access to supplier support forums (discussion forums monitored by supplier)	12.3	23.7(+)
N	228	228

Even though these results should be interpreted with care, they show that the five most popular services currently used are direct download, commercial directory, alerts, games/entertainment and reservation services. This corresponds rather well to the services actually offered by current service providers on WAP, SMS and i-mode platforms. It is somewhat surprising that a relatively large number of subjects have also adopted location based services and commercial chat/instant messaging services even though these results should be interpreted with care. The most popular services that subjects intend to use within the next six months are mobile payment services, location based services, directory and reservation services. This corresponds well to the services expected to be introduced during the next six months. Some of the services actually used are still considered highly relevant the next six months, while other services are considered less relevant. However, from these results it seems as the questions of use and intention to use have been interpreted as actual use and "intention to use if not already used" for the intention to use measure.

In table 4.2, we have indicated a negative difference between the frequency of actual use and intention to use with a minus sign. The number of negative difference between actual use and intention to use for services like direct download supports the interpretation of intention to use suggested above. However, this interpretation of positive and negative differences also makes them particularly interesting. A negative difference indicates services that are already adopted and not considered to have a large growth potential, while services with a positive difference indicate services not currently adopted, but with a growth potential the next six months.

As indicated in table 4.2 with plus and minus signs for a difference greater than 5%, the service with the greatest growth potential is mobile payment services. Services with the greatest potential for decline among early adopters are direct download, games/entertainment, simple alert services and voice assisted services. It is important to interpret these results in the context of early adopters. Still, it points in an interesting direction indicating that these subjects consider the simple SMS-based services we now have related to personalization of devices and simple alerts are not currently of their highest interest. The services with the greatest potential for growth among early adopters are mobile payment services, support related services and access to company internal services. The last of these services is probably related to professional use rather than leisure use. Thus, early adopters seem to have high expectations for the coming six months when it comes to mobile payment services and commercially related location based services and support services. Somewhat surprising is the low interest in wireless advertising services, information related (e.g. scanner based) services and comparison services often presented as extremely relevant by mobile service providers and analysts⁴. However, an explanation may be that it is difficult to present this kind of integrated services that not even early adopters yet have seen even as prototype services.

Because our listed measure of user intentions should be interpreted with care, we will use the attitudinal measure of intention to use for the rest of this analysis. As indicated in section 3 this measure was based upon previously well established items and was highly reliable. The relationship between this intention measure and the summed number of services actually used showed a

⁴ See e.g. the Accenture uCommerce sample services at http://www.accenture.com/xd/xd.asp?it=enWeb&xd=services%5Ctechnology%5Ctech_home.xml

correlation of $r=0.38$ ($p<0.01$). Thus, the measure seems to capture the actual service usage of early adopters reasonably well.

4.2 Model estimation

The model estimation section is organized in two sub sections. We first estimate and analyze the measurement model. Based upon the analysis of measures in section 3 and the results of the estimation, we discuss the validity of our measurement model with reference to proposition 3. We then turn to the relationships of the model proposed in section 2. Thus, propositions 1 and 2 are discussed and analyzed in section 4.2.2.

4.2.1 Measurement model

In section 3, the reliability of all measures was discussed. For self-control, an exploratory factor analysis was necessary, resulting in two components - the traditional self efficacy concept and the new self-control additions to this concept. The rest of the measures were found to have acceptable reliabilities. Thus, a test of the measurement model should include combinations of the self efficacy and self-control measures as well as the individual measures validated separately. To test the measurement model, we focus on the independent variables of the model only. In table 4.3 the results of confirmatory factor analyses of the alternative measurement models are shown.

Table 4.3 Confirmatory factor analysis of measurement models (N=205)

Measure	Self efficacy	Self control	Combined	Integrated
χ^2/df	2.165	2.041	2.151	2.830
NFI	0.954	0.956	0.948	0.931
RFI	0.944	0.946	0.938	0.918
CFI	0.975	0.977	0.971	0.954
RMSEA	0.076	0.071	0.075	0.095
df	335	309	413	419

Table 4.3 shows that all measurement models have relatively good fit⁵. However, the model with the self efficacy and self-control items integrated into a complex self-control measure had the lowest fit of the four models. In particular, RMSEA was only just satisfactory for this model, whilst this index as well as all the other fit indexes, were very good for the other model alternatives. Thus, we reject the integrated model presented in section 3, and we will model our relationships testing the separate self efficacy, self-control and combined models only.

Based upon the analysis of reliability in section 3 and the good fit of three of our models above, we conclude that the models separating self efficacy and self control extensions and the model including the two components are all valid measurement models.

4.2.2 Model relationships

All structural models were investigated using the whole or parts of the measurement model presented above. We started with the traditional TAM

⁵ We generally employ parsimony adjusted measures of fit only. According to Browne and Cudeck (1993) cited in Arbuckle and Wothke (1999), a RMSEA less than 0.08 is acceptable. According to Bentler (1989) cited in Battacherjee (2000), χ^2/df should be less than 5, preferably less than 2, and all other indexes should be close to 1 (Taylor and Todd, 1995). In general, we apply the rules of $\chi^2/df \approx 2$ or better, $RMSEA < 0.08$ and all other indexes ≈ 1 .

model and gradually extended it with subjective norm, investigated expectancy relationships, introduced behavioral control with self-control and self efficacy also included, and finally investigated our suggested model modified as described in section 2.

The TAM part of the model is shown in figure 4.1 with relevant indexes of fit, standardized regression coefficients and squared multiple correlations.

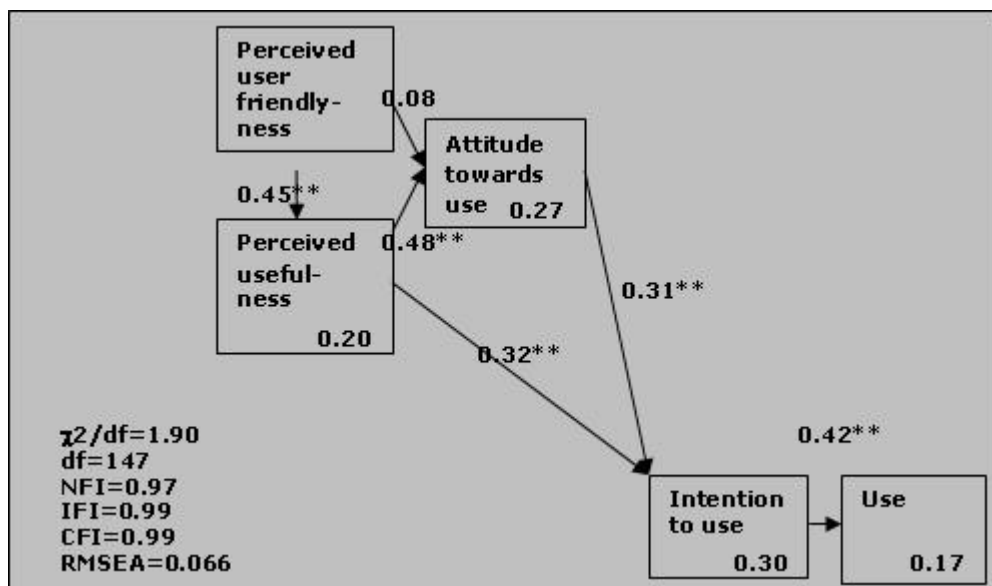


Figure 4.1 The TAM part of the model (N=205)

As we see from figure 4.1, the model fit was good. In the lower right hand corner of each variable we have shown the squared correlations and along each of the relationships the standardized regression coefficients are shown. The significance of these coefficients is indicated by * for $p < 0.05$ and ** for $p < 0.01$. The model explained 30% of the variance in intention to use and only 17% of actual use. However, as mentioned above, the actual use measure should be interpreted with care and thus, we focused on intentions to use. Furthermore, user friendliness and user friendliness explained 27% of the variance in attitude towards use and user friendliness explained 20% of usefulness. All regression coefficients were significant except from the effect of

user friendliness on attitude towards use. Thus, early adopters seemed mostly concerned with usefulness, and the effect of user friendliness was only indirect through usefulness. When compared to some other applications of the TAM model, the fit of our model was good, but the explained variance in intentions to use and actual use was low when compared to these studies. Consequently, much may be gained by extending the model as we suggested in section 2.

A first extension of TAM is to include a subjective norm part approximating a theory of reasoned action based model. In figure 4.2 an extended model including subjective norm is shown with corresponding fit indexes, correlations and regression coefficients.

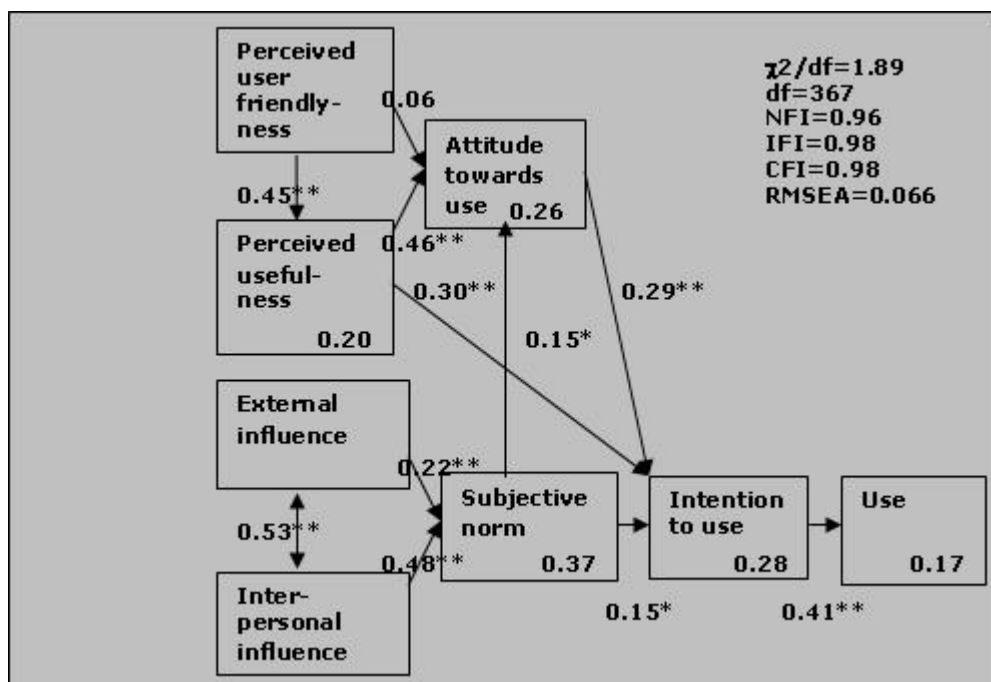


Figure 4.2 Extending TAM with subjective norm (N=205)

When extending the TAM model with subjective norm, most indexes of fit indicates that the increase in goodness in fit was not sufficient to compensate for the increased complexity of the model. Thus, only little improvement in fit was obtained by including subjective norm to the TAM-model. This was also supported by the fact the explained variance in intention to use was reduced

from 30% of the TAM model to only 28% of the TRA model. However, all relationships indicated in our model in section 3 were found significant, even the relationships between subjective norm and attitude towards use. In the subjective norm part of the model we also found that 37% of the variance in subjective norm was explained by external and interpersonal influence. Of the two determinants of subjective norm, interpersonal influence was by far the most important. We also found that as expected, external and interpersonal influence covary.

To test the importance of user expectations communicated through external and interpersonal sources, we suggested relationships between these sources and perceived user friendliness and usefulness. A test of this model showed an improved relative fit from $\chi^2/df=1.89$ of the model in figure 4.2 to $\chi^2/df=1.83$ of this model. It also showed that the only expectancy relationship significant was the relationship between external influence and perceived usefulness. The model and its corresponding parameters and indexes are shown in figure 4.3.

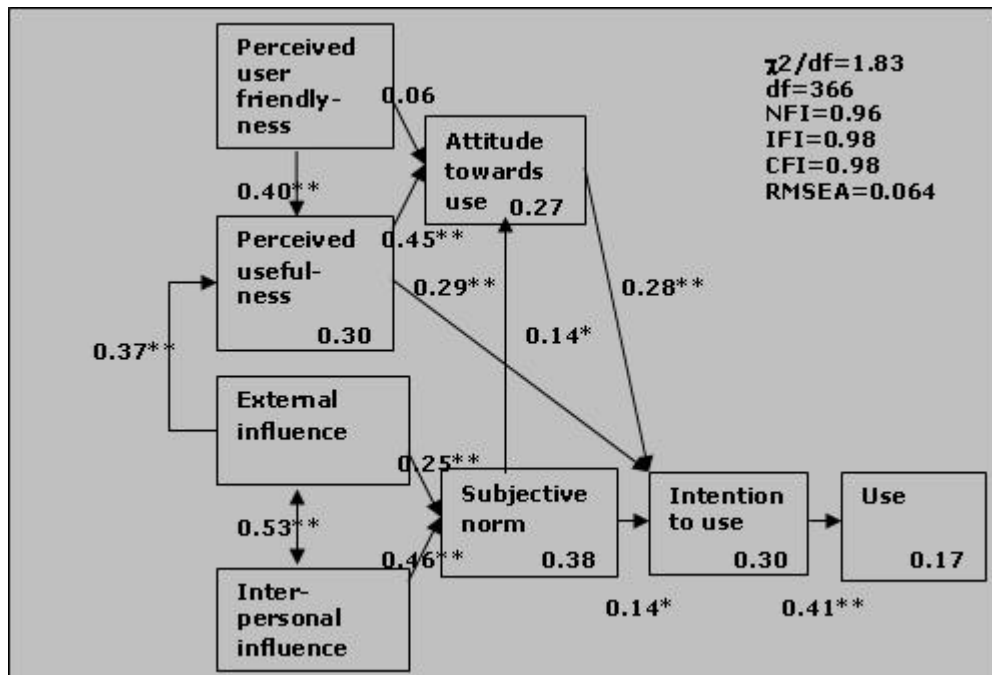


Figure 4.3 Extended TAM with expectancies (N=205)

Of the two models in figure 4.3 and 4.2, the better fit indexes and fewer free parameters suggested that the extended TAM with expectancies should be used in further analysis. It is interesting to observe that subjective norm was of surprisingly little relevance to directly explaining intention to use among these early adopters. However, the determinants of subjective norm were important in explaining perceptions of usefulness, and subjective norm was indirectly relevant in explaining attitudes towards use and intentions to use. Thus, our extensions towards the full model of section 2 should first include the subjective norm part. Below, we will test whether this part of the model may later be removed. It is also interesting to notice that there was a relationship between external influence and perceived usefulness. We have termed this relationship an expectancy relationship, but because it is a direct positive relationship, it may also be termed a communicated norm of usefulness.

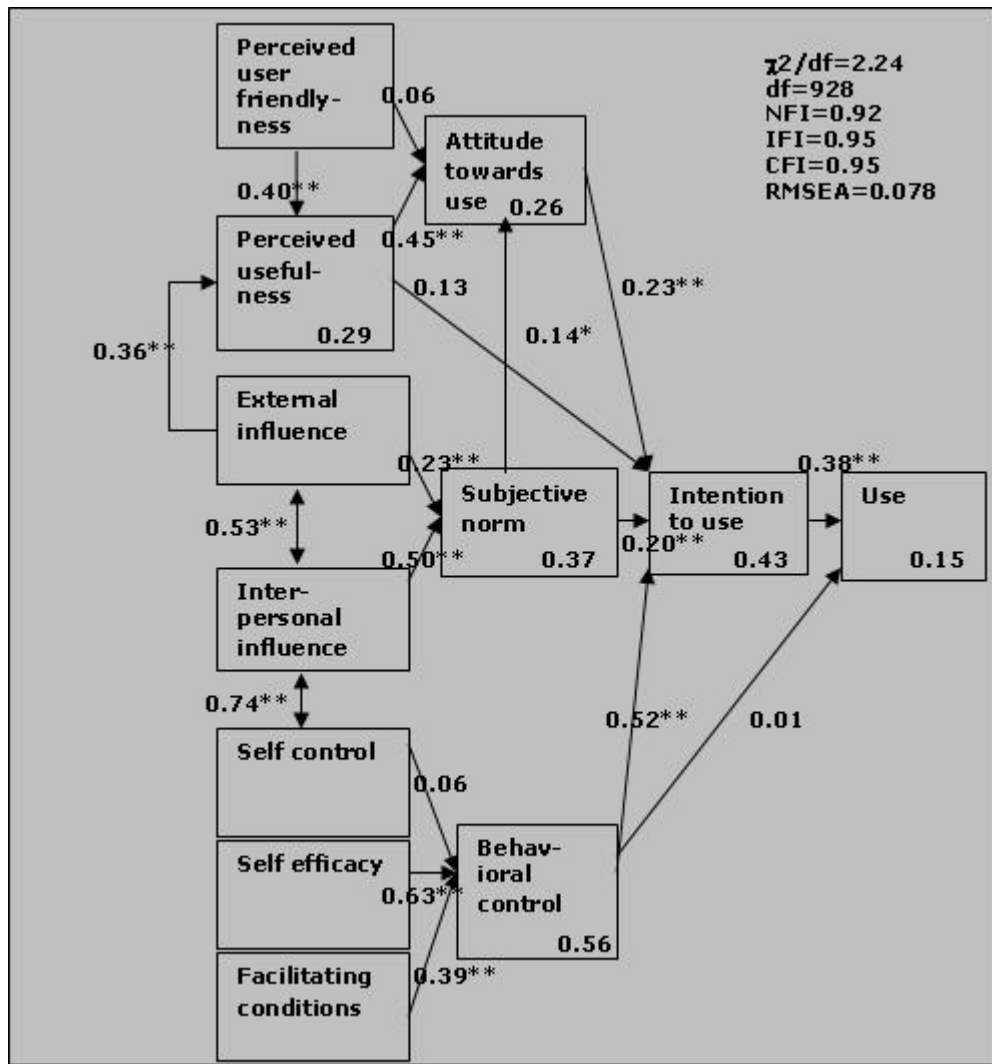


Figure 4.4. Decomposed TPB with combined self efficacy and self-control (N=205)

Above, we discussed the measurement issues related to the behavioral control part of the model. We concluded that self efficacy and self-control should not be integrated when included in the model. Thus, behavioral control was introduced using both self efficacy and self-control in addition to facilitating conditions. Fit indexes, squared correlations and standardized regression coefficients of this combined model are shown in figure 4.4.

The relationship between interpersonal influence and self-control proposed in the model of section 3 is implemented as covariance in this model. As we see from figure 4.4, model fit was not as good for this model as for the model in

figure 4.3. This is mainly due to the increased complexity of the decomposed TPB. However, when looking at the explained variance, the inclusion of behavioral control contributed significantly to an increase in the explained variance in intention to use. Thus, this increase was considered so valuable that we were willing to accept the more complex model. A closer look at the model's parameters indicated that the explained variance in endogenous variables was similar to the modified TAM model. In addition, 56 % of the variance in behavioral control was explained, mainly by self efficacy and facilitating conditions. We also observed that a set of the relationships of the model of section 3 were not found significant. First, when compared to the TAM model, the direct relationship between usefulness and intention to use was no longer significant. The relationship between self-control and behavioral control was not significant. The only role of self-control in the model was as a covariate of interpersonal influence. Thus, self-control may be used as a moderator or determinant of interpersonal influence instead. Finally, the direct relationship between behavioral control and actual use was not significant. Thus, all relationships between endogenous variables and actual use were mediated by intentions. Another observation was that the relationships between intention to use and all endogenous variables were now significant at the 1 % level.

Because the TRA model including subjective norm had little predictive power over the original TAM model, a final suggestion was to eliminate the subjective part of the model altogether. However, a test of this model showed a fit of $\chi^2/df=2.75$, NFI=0.93, IFI=0.96, CFI=0.96 and RMSEA=0.093. Thus, the reduced relative fit of this model suggested the model of figure 4.4 should be preferred to a model excluding subjective norm. When interpreting these findings and "cleaning up" insignificant relationships, the model shown in figure 4.5 may be used.

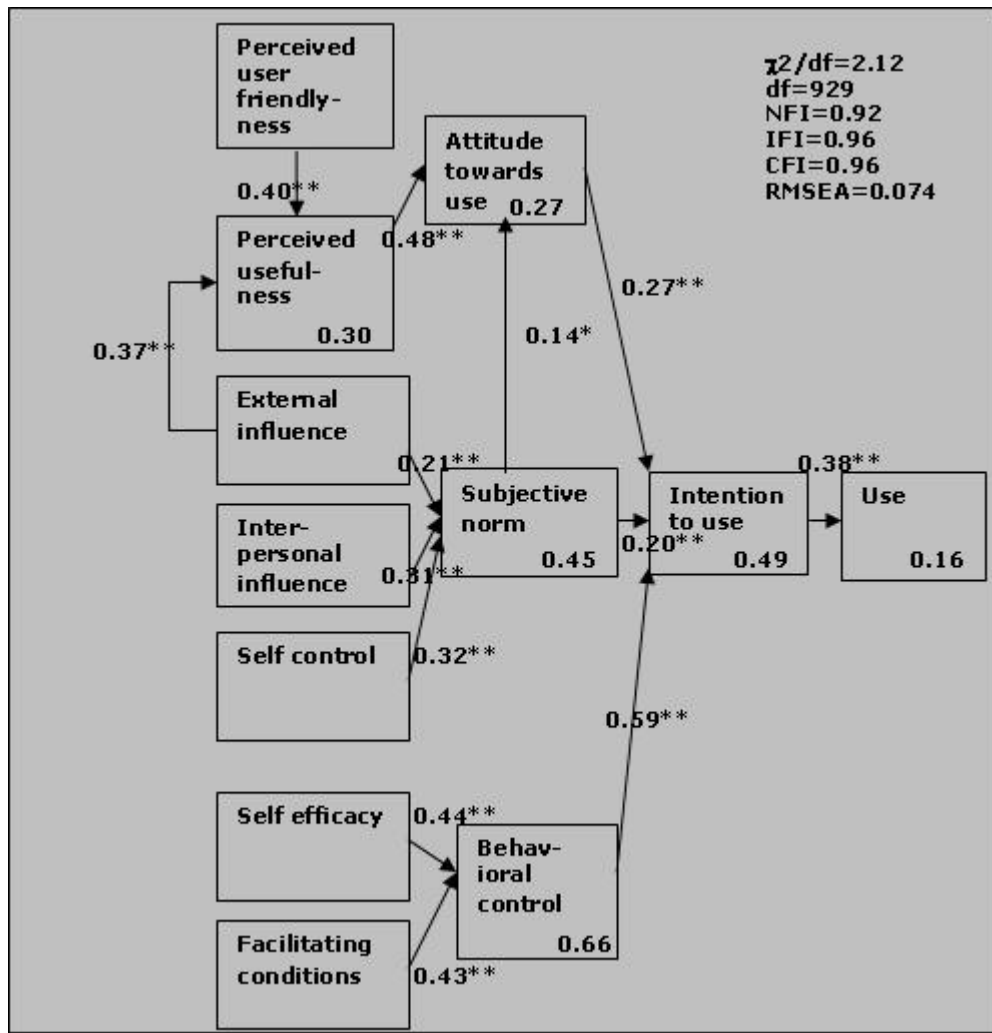


Figure 4.5 Final model illustrated with significant relationships only

From figure 4.5, we see that the final model now had acceptable fit. It also explained 49 % of the variance in intentions to use. In addition, an improvement in the explained variance in the endogenous variables was obtained. To summarize, we started with a simple TAM model with good fit. However, the model only explained 30% of the variance in intention to use. When extending the model with subjective norm, relative fit was maintained, but the explained variance in intention to use did not increase in the more complex model. When extending the model further with behavioral control, the relative fit of the more complex model was somewhat lower, but still very satisfactory. Because the inclusion of behavioral control improved the

predictive power of the model considerably, we choose to maintain the more complex model. When trying to eliminate the subjective norm part from this model, relative fit was reduced as well as predictive power. This further supports keeping subjective norm in the model. When compared to traditional studies of TAM and TPB, the predictive power of our TAM model is lower than the TAM model of some of these studies. However, the predictive power of our TPB model is comparable to the predictive power found in most TPB model studies. This suggests that behavioral control should be included in a model explaining intentions to use mobile services like mobile commerce among early adopters.

With respect to our suggested model of section 3, several conclusions can be made. First, user friendliness has no direct effect on attitude towards use, but only has an effect through improved perceived usefulness. Second, perceived usefulness has no direct effect on intention to use. Thus, usefulness is important to early adopters of mobile commerce services, but user friendliness is not a very important variable in explaining the attitude towards use of these systems. Third, subjective norm is not as important as attitude towards use in explaining intentions to use. This actually corresponds with the findings of several studies of traditional ICT adoption including subjective norm (Davis et al., 1989, Mathieson, 1991). However, subjective norm is relevant by directly explaining intention to use in our study, and indirectly because some of its determinants are also determinants of usefulness. In addition, subjective norm influences attitude towards use in our model. Fourth, behavioral control is important in the model. The suggested self-control variable is relevant as a moderator or determinant of interpersonal influence. Thus, it was reinterpreted as a determinant of subjective norm and included in this part of the model. Self efficacy is sufficient to explain the variance in behavioral control together with facilitating conditions. A final observation is that behavioral control has no

direct effect on actual use. However, our measure of actual use may be biased, and this conclusion should be interpreted with care.

5. CONCLUSIONS AND DISCUSSION

This report has two main contributions. First, it presents and reviews relevant literature on ICT adoption research and mobile service domestication research. This review is used to suggest a model of mobile commerce service adoption that integrates findings from domestication research into a model of ICT adoption - the theory of planned behavior. Second, it reports the methodology and results of an exploratory study of innovators' adoption of mobile commerce services. This study uses the model introduced above, validates the measurement model, and performs a step-wise analysis of the model's ability to explain the innovators' adoption behavior. The final model is a somewhat modified version of the model suggested from our theoretical review.

5.1 Conclusions

The theoretical part of the report concluded that there seemed to be a lack of studies applying traditional ICT-adoption theory to the adoption of mobile services. Instead, domestication research provided the dominating theoretical perspective in studies of mobile service adoption. In this perspective, we identified a disproportion in the objects and contexts studied and in the methodologies applied, as well as a lack of explanatory consensus. Even though this disproportion may be logical, it is still somewhat worrying. From the perspective of researchers and industry players trying to use present studies of mobile end-user service adoption to understand and predict the adoption behavior of large consumer groups when introduced to the complex end-user services of 3G networks, the lack of explanatory consensus and the bias in perspectives and categories of research may be somewhat worrying. For example, the lack of explanatory consensus makes it difficult for applied researchers and industry players to get a general understanding of end-users' adoption behavior when introducing new mobile services. In addition, the bias

in perspectives and categories of research also makes it difficult to generalize conclusions from studies of simple services, and in particular studies of mobile phones as objects of expression, to the adoption of complex end-user services that are likely to be adopted for functional reasons. It is also difficult for industry players to use these results to design the content and interface of end-user services, and to assist in choosing the right business models for the distribution and marketing of these services. For example, Taylor and Harper (2001b) have suggested many design implications based upon the study of young people's adoption behavior that certainly will not generalize to all end-users. It is also somewhat surprising that many of the traditional models applied to understand the adoption of traditional ICT have not been applied in adoption studies of mobile end-user services. As mentioned above, we were able to find only one study of the adoption of mobile phones using one of the most widely applied models in studies of traditional ICT adoption - Davis' (1989) TAM-model (Kwon and Chidambaram, 2000). This said, the tradition of domestication research outlined by Silverstone and the group around him has been relatively widely adopted (Silverstone 1996; Silverstone and Haddon 1996a, b), indicating a clear difference in "schools of thought" between mobile and traditional ICT adoption studies.

In the theoretical part of this report, we made attempts to unify findings in these two "schools of thought" by integrating domestication research findings into a traditional model of ICT adoption. Our approach started with a well established model of ICT adoption, and modified and extended it integrating important findings of domestication research. The extensions consisted of extending the TAM model with subjective norm and behavioral control into a decomposed theory of planned behavior. The modifications consisted of:

- (a) adding relationships in the model from subjective norm to attitude towards use
- (b) adding expectancy relationships between external and interpersonal influence and usefulness and user friendliness
- (c) adding covariance between external and interpersonal influence
- (d) adding the concept of self-control
- (e) adding relationships between self-control and interpersonal influence

The modifications were based upon findings in domestication research that indicated social influence as an important determinant both of intentions to use and attitudes towards use (a). In our model, social influence is implemented in the subjective norm part of the model. Further, the modifications were based upon the findings in domestication and diffusion research that expectations are important in determining perceptions and are generally communicated through media and interpersonal channels of communication (b). In general, perceptual and social mechanisms harmonize sources of perceptual influence, supporting the addition of covariance between external and interpersonal influence (c). Self-control is our attempt to extend the self efficacy concept of TPB considering the findings of domestication research that the use of mobile services is instrumental in the users' self-identification and social identification processes and that self-control may proxy this identity determining process (d-e).

In the empirical part of the project, we analyzed and discussed three propositions related to the model of section 2 - the need to extend the TAM model into a theory of planned behavior, the need to modify this theory of planned behavior to fit mobile services adoption data, and the quality of the

measurements of the model including construct validity. To take the last of these propositions first, we found that the measures developed in this report are reliable and that they may also be defended theoretically - indicating a reasonable validity. The validity of the measurement model was further examined using confirmatory factor analysis.

In the analyses performed to investigate the other two propositions, we found support for a need to extend the TAM model with behavioral control. We found less support for extending the model with subjective norm, but when extending the model with both subjective norm and behavioral control, the subjective norm part also contributed to good fit with the data, and the effects of subjective norm on intentions to use were found significant. When extending the TAM model with these parts, the variance in intention to use explained by the model increased from 30% to 49%. Thus, we concluded that the TAM model had to be extended, at least with behavioral control, to explain a significant part of the variance in intentions to use mobile services.

In the analyses performed to investigate the proposition that previous versions of the theory of planned behavior should be modified when explaining the adoption of mobile services, our findings were more mixed. First, we found support for a relationship between external influence and perceived usefulness indicating that there are some expectancy-related issues that should be modeled when studying mobile services. However, the exact arguments and relationships can not be conclusively identified in this exploratory study. Further, we found support for a relationship between the determinants of subjective norm and a relationship between subjective norm and attitudes towards use. Thus, it seems that subjective norm, even though it was not regarded too important to directly explain variance in intention to use, is relevant in the model because its components have indirect effects on intention

to use. Finally, we found no direct justification for modifying the self efficacy concept into a self-control concept when explaining behavioral control in our study. However, self-control was found to indirectly influence intention to use through an effect on subjective norm.

In addition to these findings directly related to the propositions in section 2, a number of other findings were made. First, user friendliness was not found directly significant in explaining attitudes towards use. Second, the direct effect of TAM between usefulness and intention to use found in some studies of TAM was not found in our study. Finally, we were unable to find support for a direct relationship between behavioral control and actual use.

5.2 Discussion

Several threats to the validity of our conclusions may be relevant. Still, our opinion is that most threats to the internal validity of our study have been considered, but external validity is naturally an issue in an exploratory study of the kind reported here. We have discussed the validity and reliability of our measures in sections 3 and 4. Furthermore, our theoretical concepts are generally well established and have previously been used and measured in studies of ICT use and adoption. The number of subjects could have been larger, but very few of the relevant model coefficients are found in the category of "close to significant" or "just significant". In fact, most of the relevant coefficients are significant at the 1% level indicating that the power of our tests is acceptable.

Of other issues that may have threatened the internal validity of our study is the self selection of subjects. For this to be an threat to validity though, the selection procedure should systematically favor recruitment of subjects that make a complex adoption decision not easily captured by simple models like

the TAM-model, that do not focus user friendliness, that are less concerned with social norms, and that are very self-confident in their ability to utilize mobile services. Most of these characteristics are relevant to innovators and early adopters in general, and we see no reason that our innovators are systematically different from other users in the innovator category. This is also supported by our analysis of user demographics. Another issue threatening the internal validity of our study is the contextual situation of our study. Subjects were asked to report their opinions relating to their own experience with mobile commerce services, but history and maturation effects may have occurred. However, these issues are only relevant if history and maturation effects contribute systematically to our findings. We see no reason why these effects should not contribute to increased unsystematic error rather than systematic bias in the direction of our results. Still, we tried to reduce these effects by defining mobile commerce services in the initial setting of the study and placed the subjects in a situation of indicating their actual use and intentions to use before starting to express their opinions on our measurement item statements.

Even though we feel that the internal validity of the study is acceptable, there are several threats to the external validity of the study. Generally, three issues are relevant. To threaten external validity, the subjects, setting or time of the study must be special in a way so that our conclusions do not generalize to other subjects, settings and times. In this study, the relevant issues are the subjects and setting. First, the subjects of the study were recruited as representative of early adopters of mobile services. We have documented that they are representative of that user category. However, less innovative subjects may rely more upon user friendliness of services, be more influenced by their peers and put more weight on the self-identifying or social identifying role of using mobile services. The setting of the study is related to the services investigated and the research setting introduced. We have discussed the internal

validity of the research setting as a setting where subjects are reminded of their use of mobile commerce services. As such, the setting is representative of a potential adoption setting of a particular mobile commerce service. However, the importance of functional and instrumental factors in the decision to adopt mobile commerce services makes our findings less relevant when trying to conclude on the potential adoption decision of less functional services, like e.g. gaming services, personalization services or multimedia services on mobile terminals. Still, we find that our conclusions are relevant to other services where functional factors are relevant, such as network mediating services, PIM services or mobile access to company intranet services. That said, the study should be treated as exploratory. Because priority was given to internal validity rather than external validity, our conclusions are mainly relevant to understand the adoption decisions of innovators and early adopters using functional and instrumental mobile services.

There are several surprising findings and lacks of findings in our study that require further discussion. The rather weak support for including subjective norm in the model contrasts the importance of interpersonal influence documented in domestication research and the importance of external influence in diffusion research. The role of subjective norm is unclear in adoption research (Davis et al., 1989, Mathieson, 1991), and this has mainly been attributed to the type of ICT applications and services studied in adoption research. One would expect that for mobile commerce services, subjective norm should play a more important role. However, there seems to be a relationship between the instrumentality of a service and the importance of subjective norm that is unexplored. An alternative explanation, that also supports the lack of consistency between the theoretical model and the final model when it comes to the importance of extending the self efficacy measure, is that our subjects are extremely innovative and self-confident subjects. We showed that this was the

case for innovativeness, but for self efficacy and self-control, we have no external norm that we can use to determine the subjects' degree of self efficacy or self-control when compared to other users.

Our lack of support for a direct effect of user friendliness may also be explained in the same way. However, Ling (2001c) has suggested that user friendliness may not be an issue in mobile services because most of these services are almost self explanatory and very easy to use. A more plausible explanation is that user friendliness only has an effect on attitude to use in the early phase of an adoption process, and soon loses its relevance. This is supported by a longitudinal study by Venkatesh (2000) showing that user friendliness lost much of its explanatory power in the TAM model when studying users over a three-month period. Our finding of a relationship between external influence and perceived usefulness indicates an expectancy relationship between the two concepts. To confirm this relationship, an expectancy model should be applied to study this relationship separately. The alternative explanation is that our subjects are more influenced by external sources than by interpersonal sources. Thus, subjective norm is not so relevant, and instead an indirect influence relationship exists between external influence and perceptions. However, this is somewhat contradicted by the observation that these subjects seem very self confident and knowledgeable. Thus, we choose to interpret the relationship as an expectancy relationship. This is also supported by the subjects' indication of their intentions to use specific services. The services they expected to use were typically services communicated as likely to be introduced in the next six months rather than services serving some specific user need.

A final finding was the lack of support for a direct effect of behavioral control on actual use. We have attributed this lack of finding to our measure of actual use. Our measure is based upon the number of services used, not the frequency

or amount of use. A similar observation of lack of explanatory power when applying an unweighted frequency measure was made by Lederer et al. (2000). Thus, our measure of actual use needs refinement in future studies and will have to be both weighted with amount of use and combined with attitudinal measures.

5.3 Further research

Even though we found that rather few of the domestication research studies were suitable in explaining the adoption of mobile services, there are some signs of a reorientation in more recent research. For example, we now find examples of broader analyses the use of mobile services in general populations. For example, in Mante-Meijer and Haddon (2001) a broad sample of users and non-users across Europe is studied. One motivation behind the study is to look into the effects of mobility, social networking and time stress on the adoption and use of mobile telephony and Internet use. A general finding is that the degree to which one participates in social networks is predictive of mobile service adoption. This, of course varies according to demographic groups. A second example of a reorientation is in the suggestion that contexts should be treated as more dynamic (e.g. Green et al, 2001), and in the reintroduction of functional issues in service adoption studies (e.g. Palen et al., 2001, Karlsen et al., 2001). Still, we would like to see more studies of end-users managing multiple roles and identities across contexts using mobile services (see e.g. Ling and Haddon, 2001). We would also like to see context-specific models applied to understand the diversity of contexts in such studies, and that these models are applied to formulate explanations of behavior, not just descriptions of such. The study reported here seeks to bring together adoption research and domestication research in a study of context dependent services - mobile commerce services. Even though the developed model seems promising in

providing explanations of adoption behavior and not just descriptions, our research needs to be extended in several ways.

First, our model provides the cognitive and attitudinal model explaining the adoption decisions of individuals using perceived concepts such as usefulness and self efficacy. However, the determinants of such perceived concepts have not been investigated. For example, service properties may determine perceived usefulness, whilst individual traits may determine self efficacy. Furthermore, operator characteristics may be an important determinant of the perceived facilitating conditions. Suggesting and testing such determinants are important issues in our future research.

Second, the importance of both determinants and perceived concepts may vary between mobile services. For example, the adoption of mobile commerce services may be less dependent upon the determinants of subjective norm, whilst these determinants, and the subjective norm concept itself, may be more important for modeling the adoption of services for the management of social relationships. Before service providers and developers can use our model as a basis for developing an adoption evaluation framework, more research is needed on how the importance of the determinants and perceived concepts vary across services.

Third, the same may be true for different categories of users. For innovators or early adopters with experience and knowledge of mobile services, like the subjects of our study, user friendliness may not be an issue in developing attitudes towards use. In a group of late adopters or laggards, user friendliness may be much more important in explaining the decision to adopt a specific mobile service. Thus, we will also extend our research to investigating the adoption decisions of users of various categories. Still, we find that the

theoretical and empirical work done in this study provides a solid basis for extending our research in the suggested directions.

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APPENDIX A

Mobile commerce services survey		
<p>The purpose of this study is to identify what mobile commerce services have already been adopted by users and what services they intend to start using in the near future. The Foundation for Research in Economics and Business Administration is responsible for the survey, and it is independent from any manufacturer or commercial company. All data and findings based on this survey will be of academic use only!</p>		
<p>Participating will only take 10 minutes and your answers may change the way mobile commerce services are developed! In addition, you may participate in a drawing of:</p>		
<ul style="list-style-type: none">• 2 x US \$200 worth gift certificate at Amazon.com• 10 x US \$25 worth gift certificate at Amazon.com		
<p>All data from the survey are anonymous and kept strictly confidential. Please read the explanation below, and use the relevant link to start answering the questionnaire.</p>		
<p>Leif B. Methlie Professor (researcher in charge)</p>		
<p>Mobile commerce services may be defined as:</p>		
<ul style="list-style-type: none">• Electronic commerce with mobile access to open networks like the Internet• Any <i>commercial</i> communication, information and monetary related interaction via a mobile telecommunications network using a communication, information, and payment device		
<p>Based upon the definitions given above, we would like you to answer the questions of the survey as carefully as possible.</p>		
<ol style="list-style-type: none">1. <u>Start the survey</u>2. <u>I do not wish to participate in this survey</u>		
<p><i>If you have problems continuing with the survey, please notice::</i></p>		
<ul style="list-style-type: none">• <i>The survey consists of 4 pages of questions. Please answer as many of the questions as possible. To guide you through the survey, we use "cookies", but the "cookies" are not used for any other purpose. Your browser should be of a fairly new version and you must allow using "cookies".</i>• <i>If you are continuously returned to this page, it is probably because your browser does not allow "cookies". Change your browser settings and try again.</i>• <i>If you have responded to parts of the survey previously, you will be automatically sent to the correct page to complete the survey. However, answers may only be submitted once.</i>		
<p>Maintained by per.pedersen@nhh.no</p>		




The following *mobile* commerce services have been loosely organized along a consumer life cycle.

We would like you to indicate whether you have already used any of these services, and if not, whether you intend to use them in the near future. By the near future, we mean within the next 6 months. Please notice that we ask whether you have used this services in *mobile settings using mobile devices* (mobile phone, PDA)

	Have used	Intends to use
Searching "yellow pages" or other <i>commercial directory</i> using a mobile device	<input type="checkbox"/>	<input type="checkbox"/>
<i>Alert</i> service related to commercial matters such as offers, warnings etc.	<input type="checkbox"/>	<input type="checkbox"/>
Mobile <i>location-dependent</i> search or alert service	<input type="checkbox"/>	<input type="checkbox"/>
Wireless <i>advertising</i> service	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>corporate purchasing/sales service</i>	<input type="checkbox"/>	<input type="checkbox"/>
Mobile <i>product information service</i> (scanner or directory based)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to travel related <i>reservation</i> service (flight, hotel)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to entertainment related <i>reservation</i> service (cinema, concert tickets)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>recommendation</i> and/or <i>reputation</i> service	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>consumer chat</i> groups (and instant messaging)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>consumer support</i> forums (discussion forums)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>consumer planning</i> services (vacation planning, financial planning etc.)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile <i>currency converters</i>	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>shopping agent</i> or <i>comparison shopping</i> services	<input type="checkbox"/>	<input type="checkbox"/>
Direct <i>product/service download/buying</i> to mobile device (ring tones, logos, music download)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>trust, security or escrow service</i>	<input type="checkbox"/>	<input type="checkbox"/>
Mobile <i>auction</i> service	<input type="checkbox"/>	<input type="checkbox"/>
Mobile commercial/shopping related <i>navigation service</i> (driving directions)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile <i>payment</i> service at the " <i>point-of-sale</i> " (credit card replacement)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile <i>payment</i> service on the <i>Internet</i>	<input type="checkbox"/>	<input type="checkbox"/>
Mobile <i>payment</i> service on vending <i>machine</i> (and parking lot, toll road payment)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>financial service</i> (bill payment, account balance, account transfer)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>stock trading</i> service	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>reverse auction/collaborative buying</i> service	<input type="checkbox"/>	<input type="checkbox"/>
Automated <i>voice assisted customer support</i> service (mobile)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>product handbooks and user manuals</i>	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>corporate support systems</i> (configurators, faq-services)	<input type="checkbox"/>	<input type="checkbox"/>
<i>Up-sale services</i> delivered to mobile device (e.g. alerts on related products and services)	<input type="checkbox"/>	<input type="checkbox"/>
Consumer related <i>gaming and entertainment services</i> on mobile device (shoputainment)	<input type="checkbox"/>	<input type="checkbox"/>
Mobile access to <i>supplier support forums</i> (discussion forums monitored by supplier)	<input type="checkbox"/>	<input type="checkbox"/>

Please use the "Submit" button when you are ready to proceed to page 2

							
Page 2 of 4							
Please indicate your level of agreement or disagreement with the following:					Strongly disagree		Strongly agree
Learning to use mobile commerce services is easy to me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to make the mobile commerce services do what I want them to	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My interaction with mobile commerce services is clear and understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find it easy to interact with mobile commerce services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find it easy to use mobile commerce services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People important to me think I should use mobile commerce services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People who influence my behavior think I should use mobile commerce services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People whose opinion I value prefer me to use mobile commerce services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
All things considered, using mobile commerce services is:							
Good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Bad
Wise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Foolish
Favorable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Unfavorable
Beneficial	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Harmful
Positive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Negative
Please indicate your level of agreement or disagreement with the following:					Strongly disagree		Strongly agree
Using mobile commerce services makes me save time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mobile commerce services make me a better consumer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using mobile commerce services improves my efficiency as a consumer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mobile commerce services are useful to me as a consumer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mobile commerce services increases my effectiveness as a consumer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Media is full of reports, articles and news suggesting using mobile commerce services is a good idea	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Media and advertising consistently recommend using mobile commerce services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using mobile commerce services is a status symbol in society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In my profession it is advisable to use mobile commerce services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Please use the "Submit" button when you are ready to proceed to page 3						<input type="button" value="Submit"/>	<input type="button" value="Reset"/>
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Page 3 of 4							
							
Please indicate your level of agreement or disagreement with the following:	Strongly disagree						Strongly agree
	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
Almost all of my friends use mobile commerce services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
Almost all my colleagues thinks using mobile commerce services is a good idea	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
My friends/colleagues think that we should all use mobile commerce services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
Some of my friends/colleagues recommended I should try out mobile commerce services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I feel free to use the kind of mobile services I like to	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
Using mobile commerce services is entirely within my control	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I have the necessary means and resources to use mobile commerce services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I intend to use mobile commerce services the next six months	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I intend to use several mobile commerce services the next six months	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I intend to use some mobile commerce services frequently the next six months	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
Please also indicate your level of agreement or disagreement with the following statements:	Strongly disagree						Strongly agree
	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I am able to use mobile commerce services without the help of others	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
Generally speaking I want to do what my friends think I should do	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
Generally speaking I want to do what my superiors think I should do	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
My friends/colleagues and I use the same kinds of mobile services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I have the necessary time to make mobile commerce services useful to me	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I have the knowledge and skills required to use mobile commerce services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I am able to use mobile commerce services reasonably well on my own	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I am given the necessary support and assistance to use mobile commerce services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I have the financial and technological resources required to use mobile commerce services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
I have access to the software, hardware and network services required to use mobile commerce services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
The mobile commerce services I use are well integrated and provided in a stable service infrastructure	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
My service provider/operator facilitates the use of mobile commerce services	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
There are no compatibility problems related to the mobile commerce services I use	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
Please use the "Submit" button when you are ready to proceed to page 4							
<input type="button" value="Submit"/> <input type="button" value="Reset"/>							
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Please answer the following questions:

I can access the Internet:	<input type="checkbox"/> At home <input type="checkbox"/> From my mobile PC/PDA <input type="checkbox"/> At work <input type="checkbox"/> From my mobile phone <input type="checkbox"/> At school
----------------------------	---

Please indicate your level of agreement or disagreement with the following:	Strongly disagree	1	2	3	4	5	6	Strongly agree
In general, I am among the first in my circle of friends to use new mobile services when they appear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I heard that a new mobile service was available, I would be interested in trying it out	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Compared to my friends, I use many new mobile services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In general, I am among the first in my circle of friends to know of new mobile services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will try a new mobile service even if I haven't heard of anyone else using it yet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know what kind of new mobile services that are available before other people do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see my self as an experienced Internet user	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When compared to others I am an expert on using the Internet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know how to use the Internet in an efficient way	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate:

Age (years):	<input type="radio"/> 0-19 <input type="radio"/> 20-29 <input type="radio"/> 30-39 <input type="radio"/> 40-49 <input type="radio"/> 50-59 <input type="radio"/> 60 and above
Sex:	<input type="radio"/> Male <input type="radio"/> Female
Your highest education:	<input type="radio"/> Primary/Middle level <input type="radio"/> Secondary/High School <input type="radio"/> University/College 1-3 years <input type="radio"/> University/College 4 years or more
Home continent:	<input type="text" value="-choose continent-"/>

Please use the "Submit" button when you are ready to finish the survey

Submit

Reset

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