

Abstract

This thesis presents a study of adoption determinants for mobile commerce, focusing on end-users of a mobile commerce pre-paid service. The main objective of the study is twofold; to identify end-user's adoption determinants and increase the validity of an adoption model by applying it to the results of the study.

In order to investigate the field of mobile commerce service adoption, information related to its' end-users was gathered. The study is based on literature studies, service tests, open-ended interviews with experts within the field and marketing meetings at Telenor Mobil's mobile commerce department as sources of input, influencing the design of the study. As a result, a case study was designed. A series of focused interviews and participant observations with end-users of the service, open-ended interviews with employees at Telenor Mobil's mobile commerce department was performed, in addition to gathering of documents and archival records on end-users.

To fully understand the adoption process of mobile commerce, Pedersen and Methlie [2002] suggest studying the mobile commerce service end-users in three context-dependent adoption perspectives. These perspectives view the individual as a technology end-user, a consumer and a network member. Each perspective is illustrated by a relevant model, consisting of a modified version of the decomposed theory of planned behaviour for the technology end-user, the customer life cycle model for the consumer and a social network analysis as a basis for the network member. Regarding Pedersen and Methlie's framework as tentative, assuming that its uniformity and nature propositions were correct, the framework was applied to the results of the study in order to validate its concepts.

The findings of the case study indicate strong support for triangulating the three perspectives suggested by Pedersen and Methlie [2002]. Many determinants were identified, the strongest based on experimental and instrumental motives. Timing of service exposure was also found important in influencing both initial and post-decisional phases of consumer adoption. Validity of the framework was supported.

Preface

This thesis is part of the Candidatus Scientiarum degree at the Department of Informatics, Faculty of Mathematics and Natural Sciences at the University of Oslo. The degree is a combination of attending advanced courses for six months, and writing a thesis on self-conducted research for a total of one year. During the course of this study, most of the research and writing were conducted at the Telenor head office at Fornebu, outside Oslo.

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During this research, I wish to thank many people for supporting me and helping me accomplish this thesis.

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And last but not least, Simen. For never failing to put a smile on my face. I love you dearly.

Acronyms

1G	First Generation mobile technology
2G	Second Generation mobile technology
2.5G	Second and half Generation mobile technology
3G	Third Generation mobile technology according to IMT-2000 standard (e.g. UMTS in Europe)
API	Application Programming Interface, a development platform for windows applications
ATM	Automatic Teller Machine
B2B	Business to Business
B2C	Business to Customer
C2C	Customer to Customer
CMC	Computer Mediated Communication
CRM	Customer Relationship Management
CPA	Content Provider Access
DNT	Den Norske Telegrafadministrasjon
EDGE	Enhanced/Evolved Data rates for GSM Evolution, allows networks to meet many of the requirements of UMTS
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
HSCSD	High Speed Circuit Switch Data
HTML	HyperText Markup Language
ICT	Information and Communication Technology
IT	Information Technology
Java	A high-level object-oriented language, allowing applets (applications) to be written once, run anywhere (whatever the platform is). The aim is to help simplify application development.

MMS	Multimedia Messaging Service
NMT	Nordic Mobile Telephone
PAN	Personal Area Network
PDA	Personal Digital Assistant
PIN	Personal Identification Number
PKI	Private Key Infrastructure
PTT	Post Telephone Telegraph , usually a state owned monopoly organisation providing these services
SAT	SIM Application Toolkit
SIM	Subscriber Identity Module. Smart card holding the user's identity and telephone directory; SMS-Applications may reside on the SIM.
SMS	Short Message Service. Facility for sending text messages on GSM handsets.
TAM	Technology Acceptance model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UMTS	Universal Mobile Telecommunication System
URL	Uniform Resource Locator, the address of a file (resource) accessible on the Internet
WAP	Wireless Application Protocol. Offers Internet browsing from wireless handsets.
WIB	Wireless Internet Browser
WLAN	Wireless Local Area Network
WML	Wireless Mark-up Language
WWW	World Wide Web

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1 Introduction

The emerging industry of mobile commerce is characterized by a continuously changing, complex and very uncertain environment, especially in regard to technological developments and demand. Rapid technological development spurs battles of establishing standards, typical in the beginning stages of the life cycle of an industry. Demand side uncertainties concern what devices will be developed, willingness to pay for services, identifying end-user need and time-frame of adoption. The latter of these uncertainties is focused on in this study, as I explore determinants for the adoption of a specific mobile commerce service, in order to attain increased understanding of behavioural adoption requirements for mobile commerce services.

1.1 Research Challenge

This study seeks to explore determining factors that lead mobile phone end-users to register as mobile commerce customers and adopt the mobile commerce pre-paid service. Due to it being an early phase in the rollout of mobile commerce services, the specific mobile commerce service was chosen as it was the one service that had gained momentum in Norway today. Mobile commerce has enabled end-users to connect their mobile phones directly to their bank accounts and create an electronic ‘purse’, introducing a new payment form. I define mobile commerce as the *process of two parties exchanging financial value by use of a mobile communication device in return for goods, information or services*. The majority of mobile commerce services deal with an exchange of goods, information and services between businesses and consumers [Panis et. al., 2001] and the mobile communication device may concern mobile phones, Personal Digital Assistants (PDAs) and portable computers. In this study, I focus on a consumer-oriented mobile commerce service, which enables end-users to recharge their pre-paid accounts by use of the Short Message Service (SMS). I therefore focus on mobile phones as the mobile communication device for conducting transactions.

Understanding adoption determinants for mobile commerce services is important for both mobile communication industry players and researchers. Telecommunication operators are often concerned with predicting future penetration and adoption of services, based on market research and statistical calculations. For researchers concerned with adoption, it is more important to identify how adoption of mobile commerce services may differ from other Information and Communication Technology (ICT) adoption [Pedersen, 2001].

In summary, the inspiration for this thesis was to:

Acquire understanding of determinants for adoption of the mobile commerce pre-paid service.

1.2 Research Approach

There are generally three approaches to ICT adoption that are commonly used; adoption, diffusion and domestication [Pedersen, 2001].

Adoption researchers typically apply cognition and social theories in describing end-users' adoption decisions. The most commonly applied theories on decision-making are the Technology Acceptance Model (TAM) proposed by Davis [1989], the Theory of Reasoned Action (TRA), which was presented, by Fishbein and Ajzen [1975] and the Theory of Planned Behaviour (TPB) proposed by Ajzen [1985]. These theories have been used in hundreds of ICT adoption studies of end-users.

Diffusion research describes the aggregate adoption process a priori as a function of time, categorizing adopters of different kinds.

Domestication research often depicts consequences of ICT integration into everyday life, based on demographic variables such as gender, age and education.

This study is based on both adoption and diffusion approach, the prior focusing on the end-user as a *technology user*. In light of the technology adoption life cycle [Moore, 1999], the subjects interviewed in the study are categorized as being a mixture of early adopters and early majority adopters of technology.

In exploring how the mobile commerce pre-paid service influences the behavioural patterns of its end-users, the service's mobility specific functionalities becomes relevant. Among these mobility functionalities, I specifically look at how the mobile commerce pre-paid service frees its end-users from spatial, temporal and contextual constraints [Kakihara and Sørensen, 2002]. The service allows them to recharge their pre-paid accounts anywhere and at any time and extends communication between operator and consumer, enabling personalized mobile advertising of services.

The mobile commerce pre-paid service can be seen as modifying the mobility of its end-users, as they no longer need to travel to retailers or Automatic Teller Machines (ATMs) in order to recharge their pre-paid accounts. The *service* however, has been mobilized, as it is has been freed from spatial constraints and is accessible wherever the end-user and her mobile phone has access to the mobile communications network.

To fully understand adoption of mobile commerce in general, Pedersen and Methlie [2002] suggested studying its end-users from three interrelated, context-dependent adoption perspectives; seeing the end-users not only as technology users, but also as consumers and members of a social network.

By viewing the end-user as a technology user, traditional models describing adoption of information technology, as those described above, can be applied, revealing adoption determinants directly related to technology aspects.

Many mobile commerce services are consumer-oriented value-added services, supporting the consumption of existing physical goods or services. The mobile commerce pre-paid service is no exception, providing consumers with an additional channel (SMS) from which they can recharge their pre-paid accounts. Consumer adoption models should therefore be applied.

Finally, as mobile phones have primarily been used as means for communication, its end-users are also seen as members of social networks. This third perspective explores how communication within these networks affects adoption of services.

Pedersen and Methlie [2002] triangulate these perspectives into a common framework for mobile commerce service adoption. In this study, I regard the framework as tentative, assuming that the uniformity and nature propositions are correct. The framework is applied to end-users of the mobile commerce pre-paid service in order to validate its concepts. As adoption determinants differ among different categories of mobile commerce services and customer scenarios [Pedersen et. al., 2002], the generalizability of the results is limited to the end-users of the mobile commerce service under study.

For research concerned with contextual conditions, Yin [2003] proposes a case study approach. A case study was thus conducted, applying focused interviews and participant observation of end-users of the mobile commerce pre-paid service, in addition to interviews with professionals within the field of mobile commerce. Relevant documents and archival records were also collected.

1.3 Purpose

The purpose of this study is twofold. My main goal is to reveal determinants for adoption of the mobile commerce pre-paid service. Secondly, by applying an academically developed model to the case study, I aim to increase the validity of the model for end-users of the mobile commerce pre-paid service. The results of the study aim to help direct attention to perspectives worth applying when designing content, interfaces, business models for distribution and marketing of the service.

In summary, the goal of this study consists of:

- I. An exploratory study of adoption determinants for the mobile commerce pre-paid service.**
- II. A validation of Pedersen and Methlie's adoption framework [2002], for the mobile commerce pre-paid service.**

I define determinants to be factors that influence and determine the nature or outcome of the adoption process.

Validity relates to whether findings in a study are true and certain [Guion, 2002]. Findings are proposed to be true if they reflect reality and certain if they are backed by evidence.

1.4 Limitations

The simplest adoption models focus on technological supply side issues only [Pedersen, 2001b], introducing a phase model of technology development. These models attempt to predict the time line of development and product launch. Adoption can be studied at the industry, firm and individual level, the latter being the focus of this study. Determinants for adoption can be found on both supply and demand side, and although individual demand side adoption determinants have been focused on in this study, explanations on the supply side must be included to fully understand all aspects of the adoption process. Both communication between the service provider and consumer and the technological stability of the services are examples of such aspects.

The mobile commerce pre-paid service is only available to Telenor Mobil subscribers. Thus, this study limits itself to subscribers of Telenor Mobil. This, in addition to financial and time constraints, is also the reason for this study to limit itself to the Norwegian market.

Further limitations concern the primary target of my research; grown-up end-users of the mobile commerce pre-paid service who are 25 years or older. This was due to the fact that there has been little research on adoption of mobile services within grown-up segments. As most content provider's services, such as ring tones, logos and Multimedia Messaging Services (MMS) are targeted at teenagers, Telenor mobile commerce has chosen "urban woman and business man" as their target market. This implies a grown-up segment. Whether mobile commerce has actually achieved its goal to reach this segment is beyond the scope of this study, but would be interesting grounds for further research.

1.5 Thesis overview

This thesis is chronologically organized in nine chapters. In this chapter, I introduced the challenge of determining behavioural adoption determinants for mobile commerce. Different approaches to ICT adoption are presented, followed by the purpose of the study. In chapter two the aspect of mobility is discussed, as it is the most important and unique characteristic of mobile commerce. Next, in chapter three, the evolution of mobile communication services is presented to provide insight into political and economic factors influencing the birth of mobile commerce. In chapter four, mobile commerce is defined and its architecture explained. Chapter five provides an insight into the mobile commerce pre-paid service. Theories on technology adoption are then presented in chapter six, followed by the research methodology of this thesis in chapter seven. Results of the investigations conducted in the study are presented in chapter eight, along with discussions of the findings. Finally, chapter nine concludes the research. Areas for further research are also presented in the final chapter.

2 Research Method

This chapter presents an overview of the research methodology followed in this study. The inspirational source and purpose of this study are presented in chapter 2.1 and 2.2. Chapter 2.3 contains a presentation of the multiple methods that were used to collect evidence for this case study. The utility and value of a mixed method approach is presented in chapter 2.4. While chapter 2.5 discussed the use of measurements and chapter 2.6 discusses the generalizability of this study,

2.1 Finding inspiration

During the initial stage of this study, I had a series of discussions with different experts within mobile communication services to define interesting propositions for this thesis. The experts included the managing director of Telenor Mobile Commerce and researchers at Telenor Research and Development (Telenor R&D). Based on their recommendations, I found the inspiration for this thesis; acquire understanding of adoption determinants for mobile commerce services.

2.2 Narrowing the scope

To gain insight into existing mobile commerce services and their functionality, I conducted a test of all the mobile commerce services available by Telenor Mobil at the time (2003). Due to it being an early phase in their rollout, many services were subject to bugs and glitches; their market penetration was therefore low. However, one service had gained momentum; recharging pre-paid subscriptions via SMS. Experts at Telenor Mobil Commerce therefore found it especially interesting to investigate which determinants influenced adoption of this service. The scope of the thesis was narrowed down to involve adoption determinants of the mobile commerce pre-paid service. The service is thoroughly described in chapter 5.

In order to learn more about the field of mobile commerce service adoption, material from existing literature on technology and mobile service adoption were gathered and reviewed. The literature study revealed a context-dependent adoption framework for integrating technological, business-oriented and behavioural studies of mobile commerce, proposed by Pedersen and Methlie [2002]. The framework was found highly relevant for this study and as there is ongoing collaboration between Pedersen, Methlie and Telenor R&D, validating the framework was found to be especially interesting. Assuming that the uniformity and nature propositions of the framework were correct, I decided to apply it to end-users of the pre-paid service. My goal was to validate the framework in the setting of the mobile commerce pre-paid service. The framework is thoroughly described in chapter 6.

In order to explore adoption determinants for the mobile commerce pre-paid service, I needed to approach its end-users. Discussions with researchers at Telenor R & D revealed concern about the lack of focus on grown-up market segments in mobile service adoption studies. Further discussions with professionals in Telenor Mobil backed this concern. Focus was hence decided to be on the adult end-users over 25 years of age. Another concern first voiced by researchers at Telenor R & D, and later backed by Pedersen [2001, p.31], was the numerous studies of the adoption behaviour of marginal demographic groups. It was time to look beyond urban end-users and target larger, less sophisticated, end-user groups. A goal for this study was therefore to provide a demographically and geographically varied sample of the population, which was done by choosing subjects from a variety of locations. The subjects were also evenly divided by gender. The table below displays the demographics of the ten subjects who participated in the study.

Age		Sex	
25 – 35	8	Male	5
35 – 45	2	Female	5
Education		Geographic spread	
Primary/Middle level	1	Northern Norway	2
Secondary/High School	2	Central Norway	2
University/College 1-3yrs	5	West Coast of Norway	1
University/College 4yrs+	2	Southern Norway	1
		Eastern Norway	4

Figure 2-1 Demographics of the ten subjects participating in the study.

To gain insight into adoption determinants that were considered important from the viewpoint of the operator, I conducted open-ended interviews with employees responsible for consumer experience at Telenor Mobile Commerce. The interviews revealed both facts and opinions on historical progression and adoption aspects, otherwise invisible to an outside researcher. Their responses served as important background material for understanding adoption from the operator's point of view. The possible bias of their statements being influenced by their work for Telenor was taken into consideration.

Another valuable source of information proved to be passive participation in marketing meetings at Telenor Mobile Commerce. Although these meetings were biased in being highly business- and profit- oriented, discussions on customer response and marketing strategies gave insight into challenging areas unknown to a researcher on the outside.

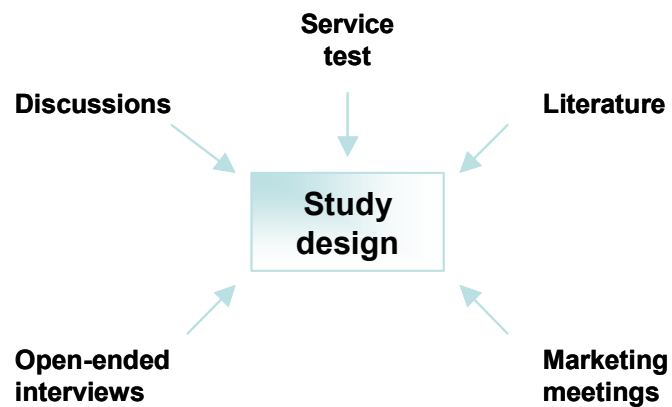


Figure 2-2 Sources influencing the design of the study.

The findings from the described service tests, literature, discussions, open-ended interviews and marketing meetings were used in parallel in designing the final case studies, ensuring that questions relevant to contemporary and not only theoretical issues were reflected in the study (see Figure 2-2).

2.3 Research approach

When choosing a relevant research approach for this study, the importance of multiple sources of evidence, addressing both historical and contemporary events, became clear. In addition to addressing end-users who had chosen to adopt the mobile commerce pre-paid service, I wished to observe end-users interacting with the service. Allowing data collection from multiple sources served as a strong argument for choosing a case study approach [Yin, 2003]. Among these sources, I found focused interviews, documents, archival records, participant-observations and open-ended interviews to be especially relevant for this study. These data sources are chronologically described below. According to Yin [2003], case studies typically reveal contextual conditions. As the adoption framework presented in this study is context-dependent, an additional argument was found for choosing a case study approach. A case study of adoption determinants for the pre-paid service was thereby conducted.

2.3.1 Focused Interviews

Focused interviews were conducted to explore, in retrospect, the subjects' attitudes and perceptions towards mobile commerce from the time they became familiar with recharging pre-paid accounts via SMS, to actual use or discard of the service today.

Candidates who qualified for the case studies were identified from a list of 500 candidates, who were randomly extracted from the Telenor Mobile Commerce end-user database. The subjects were screened according to age, and those under the age of 25 discarded. They were further divided by gender, and finally their area of residence was located. The candidates were actively recruited by calling them directly and agreeing on designated times to conduct the interviews. As the subjects were geographically spread over the whole country, the interviews were conducted mainly by telephone. Prior to the study a low response rate was assumed, based on the general attitude towards sales and marketing campaigns by telephone in general. Therefore, candidates were offered 100 NOK in SmartCash (see chapter 4.2.1) for their participation, which may have contributed to a high positive response rate.

The respondents were interviewed for approximately one hour, following a predefined set of questions they were asked to reflect upon, found in Appendix C. Actual events and use, as well as opinions, were questioned. Posing non-leading questions in an unbiased manner was important to ensure the truthfulness of the answers. It was important to pose the questions in a manner that did not create defensiveness. Becker [1998, pp 56 – 60] observed one way of doing this was by posing a “how” question in contrast to a “why” question, the latter more threatening.

The possible bias in the subjects' responses was considered, as their ability to accurately recall their expectations and initial attitudes towards the service were questioned. In order to address this concern, I needed to directly observe end-users reactions upon being introduced to the service and trying it the first time.

2.3.2 Participant-observations

As mentioned, the interest of the study consisted of both historical and contemporary events. It was therefore important to directly observe end-users interaction with the service and compare these observations with the statements of the subjects interviewed. The locations for these observations were chosen because access to mobile commerce end-users was easy. The observations provided invaluable insight into important issues of mobile commerce adoption.

Also, during the Norwegian Wood Festival 2003, a music festival held in Oslo each summer, I volunteered to work at the Telenor Mobil stand, helping to promote a new pre-paid subscription and thereby also the mobile commerce pre-paid service. My aim was to directly observe how end-users react when introduced to the concept of mobile commerce and the issues that surface when end-users go through the mobile commerce registration process and try the mobile commerce pre-paid service.

During the summer of 2003, mobile commerce launched a breakfast campaign in the Telenor Coffee Bar, at their head office at Fornebu. Employees and visitors were offered breakfast for 10 NOK (normally 30 NOK) if they paid via mobile commerce (see Appendix B for further descriptions of the service). During my time at Fornebu, I regularly positioned myself by the bar and helped Telenor employees and guests register with mobile commerce. Although these observations were not related to the pre-paid service, they provided insight into end-users reactions to the registration process of mobile commerce. In order to adopt any mobile commerce service, end-users need to go through the registration process. This process has been prone to many bugs and glitches, and end-users initial reactions to these were noted.

An important concern during these studies was the potential bias produced by mixed roles. I needed to be aware that my role at times shifted to assume an advocacy role, in aiding the end-users to register and try the services. It was important to be conscious of this pitfall, so as not to threaten the case. Another issue was the fact that a majority of the customers of the Coffee Bar were either employees or partners of Telenor, influencing their perception of how they should behave and thereby their motivation to comply.

2.3.3 Documents

During the Quart music festival in Kristiansand in July 2003, Telenor organized an event, which was named “the Future Lab”, in which 20 youths participated in an observatory study of mobile commerce use. Subjects were shown an introductory movie about UMTS (Universal Mobile Telecommunication System) and given a brief introduction of mobile commerce. They were asked to register with the service and conduct two purchases: recharge a pre-paid account and order a DVD. One observer per two subjects noted the actions of the end-users. The report containing evaluations of end-users of mobile commerce services at the Quart music festival 2003 was reviewed. Its accuracy and bias was taken into consideration, as its content was subject to debate among the various researchers involved. Another consideration was the age span of the participants, as they were all below 25 years of age. Results from the research conducted at the Quart Festival 2003 were mostly concerned with the ease of use and general attitude towards the mobile commerce services.

2.3.4 Archival records

Access to the Telenor customer databases proved valuable in retrieving evidence of end-user characteristics and demographics. The data gave useful insight into the actual use of the services, in comparison to the results of the observations and interviews.

2.3.5 Open-ended interviews

To gain more knowledge about the adoption of the mobile commerce pre-paid service from the viewpoint of the operator, open-ended interviews were conducted with employees responsible for various recruitment campaigns and the end-user interface at Telenor Mobile Commerce. The possible bias of their statements being influenced by their work for Telenor was taken into consideration.



Figure 2-3 Convergence of multiple sources of evidence

As depicted in Figure 2-3, five sources of information were used to collect data for the case study; focused interviews, documents, archival records, participant observations and open-ended interviews. In order to strengthen the results the number of subjects interviewed could have been larger. Due to the depth of the interviews and the time limit of the study, this was not possible. Another threat concerns the choice of subjects, which were randomly picked from a list of end-users provided by Telenor. Only two of the subjects interviewed had discarded the service and more interviews with end-users who had failed to adopt the service may have been useful. However, by participating at the Norwegian Wood festival and standing at the Telenor Coffee bar, I was able to speak to a number of people who failed to register with and adopt the service, which enabled me to compare the case study results with my observations of contemporary events influencing adoption. Discussions with mobile commerce employees and access to end-user statistics and documentation also improved the validity of the findings. The purpose of using multiple sources of evidence was to check and establish the validity of the study. This approach is referred to as triangulation and will be further described below.

2.4 Methodological triangulation

Research methods can be classified in a variety of ways, though the most common distinction is between qualitative and quantitative research methods:

Quantitative research methods were originally developed in the natural sciences, based upon theories that basic laws exist, which govern all phenomena. These phenomena are assumed to be quantified for statistical analysis. Examples of quantitative methods include survey methods, laboratory methods, formal methods and numerical methods.

Qualitative research methods were developed in the social sciences, to study social and cultural phenomena. The method was designed to understand the phenomena from the point of view of the participants, and the social and cultural contexts within which they live. Examples of qualitative methods are action research, case study research and ethnography. Typical data sources for qualitative research include observation and participant observation, interviews and questionnaires, documents and texts and the researcher's impressions and reactions.

In his exploratory study of mobile commerce adoption, Pedersen [2001a] presents a technology adoption model, which has been evaluated through a quantitative study of early adopters of technology innovations. The purpose of the study, was to develop and test relevant models explaining end-users' adoption of mobile commerce services. A survey of early adopters was conducted for evaluation purposes. Respondents were recruited from discussion groups, bulletin boards or community groups on the web or newsgroups on news-servers, targeting early adopters of mobile commerce. Pedersen's survey investigated the eleven concepts for determining adoption of mobile commerce services, presented in chapter 6.2.1.

Yu [2003] suggests that validating a quantitatively derived theory in a qualitative study, may improve the construct validity of the theory. In qualitative research, validity relates to whether the findings in the study are true and certain [Guion, 2002]. Findings are proposed to be true in the sense that they reflect reality, and certain in the sense that they are backed by evidence. Yu goes on to claim that applying only one approach, quantitative or qualitative, limits the ability to fully understand a phenomenon. In example, there may very well be differences between the results of interview data and regression analysis. By using mixed methods, one can address gaps between the two.

Pedersen's [2001a] technology adoption model has already been applied to end-users of mobile commerce services through a quantitative approach. My goal is to compliment Pedersen's study and apply a qualitative study of the model, comparing its constructs with my findings, establishing validity.

To check and establish the validity of their studies, researchers often use triangulation [Guion, 2002]. Triangulation deals with the combination of different methods, study groups, local and temporal settings and different theoretical perspectives when dealing with a phenomenon [Yin, 1994]. Triangulation can help provide a more balanced, holistic picture than applying an individual method alone and is often associated with the view that both qualitative and quantitative methodologies can be used together, rather than being mutually exclusive [Yin, 1994].

Methodological triangulation deals with the use of multiple quantitative and/or qualitative methods [Guion, 2002]. If the conclusions from each of the methods are the same, validity of the data is established. Multiple qualitative methods have been triangulated in this study, including interviews with different stakeholders, document analysis, archival data and observation. As presented in the previous section, the methods complement one another; end-users who have adopted the service and are interviewed may have difficulty in remembering initial reactions to the service, while it is difficult to predict actual adoption among end-users who are exposed to the service for the first time. This approach should improve the ability to draw conclusions from the study, and thereby the external validity of the data [Yin, 1994].

2.5 Measurements

Another important distinction between Pedersen and my approach to the adoption model needs to be made. Pedersen's adoption model presents eleven concepts, well founded in both adoption and domestications literature. During his survey analysis, some of the concepts were measured using seven-point scales of bipolar adjectives, while others were measured by the subjects' level of agreement with a set of statements. As opposed to this positivistic generalization of concepts and well aware of the challenges related to mixing two viewpoints, I choose an interpretive viewpoint, seeing the concepts as subject to individual interpretation, varying over time and service, proposing that their relationships were not determined and one-dimensional. To fully understand the end-user's perception of these concepts, a close relationship to the subjects needed to be established. The concepts and their context dependencies served as blueprints of for discussion and reflection, rather than quantification. Participants were allowed to use their own words and images as well as draw upon own concepts and experience.

Pedersen and Methlie's [2002] adoption framework allows the concepts from Pedersen's [2001] adoption model to be analysed in different contexts and see how these contexts influenced the adoption concepts. In a clear-cut positivistic approach, universal laws lead the researcher to disregard such contextual and historical conditions in triggering events or influencing human action.

I assume an interpretive approach in this study, attempting to understand the adoption process of mobile commerce within cultural and contextual situations. The adoption process is examined from the perspective of the participants. Although a theoretical grounding of concepts is presented, they are not considered objective and quantifiable.

2.6 Generalizability

The lack of basis for scientific generalization in case studies has been subject for concern for many researchers. Yin [2003] however, argues that although this may be true to populations and universes, it is possible for case studies to generalize to theoretical propositions.

Generalizability refers to the validity of a theory in a setting different from the one where it was empirically tested and confirmed [Lee and Baskerville, 2003]. Lee and Baskerville [2003] present a framework for classifying different forms of generalizability, and claim statistical generalizability to be only a subset. In presenting their framework, a distinction is made between empirical and theoretical statements, and what researchers generalize from and to. By joining these four attributes, generalizability is proposed to occur in four ways; from empirical statements to other empirical statements, from empirical statements to theoretical statements, from theoretical statements to empirical statements and finally, from theoretical statements to other theoretical statements.

Based on this framework, another important distinction between the research conducted by Pedersen [2001] and that of this study needs to be made. Of the four forms of generalizability described above, Pedersen applies the second: generalizing measurements, observations and other descriptions to theory. His theoretical output presents new adoption determinants and relationships among them, explaining behaviour and actions of early adopters of mobile commerce.

In contrast, I apply the opposite of this approach; generalizing a theory to a description. Pedersen's academically developed theory is applied in a different setting than where the data was collected when developing and testing the model. According to Hume's truism [Lee and Baskerville, 2003, pp 235], a theory may never be scientifically generalized to a setting where it has not yet empirically been tested and confirmed. From the standpoint of external validity, the study gathered interview data from ten end-users in addition to observing tens of end-users interact with a single mobile commerce service within one country, which per force limits the generalizability of the results to concern scientific validation of Pedersen's adoption model for end-users of the mobile commerce pre-paid service in Norway today.

2.7 Summary

The purpose of this study is to learn from application, by generalizing a scientifically derived theory to a setting where it has not been applied. I regard Pedersen and Methlie's [2002] triangulations framework for adoption of mobile commerce as tentative, and apply it to a set of end-users of the mobile commerce pre-paid service in order to validate it. A qualitative case study, collecting data through focused interviews, documents, archival records, participant-observations and open-ended interviews is conducted. Through an interpretive philosophical approach, the adoption process of mobile commerce is explored within cultural and contextual situations. Following Hume's truism, the generalizability of the results is limited to concern adoption determinants for mobile commerce pre-paid end-users in Norway today.

3 Mobility

The evolution of mobile and wireless communication technologies has dawned new methods of exchanging information. Mobile communication terminals have rapidly developed into devices that can store high amounts of data and are becoming more and more easy to use. In Scandinavia, mobile phones have become increasingly wearable as their owners personalize their appearance, with personal covers, ring tones and logos. Access to the mobile network is more or less taken for granted as mobile phone end-users carry their devices at virtually all times [Telenor R&D, 2003].

Today, mobile phones may be used for a wide range of transactions. By use of SMS alone, end-users can order ring-tones remotely over the network, pay for products at vending machines locally at the point of sale or communicate with other devices. With increasing globalization, a continuing explosion in mobile services, the ever-closer integration of voice, data and video and widespread penetration of Internet, the global telecommunications marketplace has become one of the fastest-growing, fastest-changing markets in the world. In Norway, the penetration rate of mobile telephones is closing on 90% by July 2003, as shown in the figure below.

	January 2001	July 2001	January 2002	July 2002	January 2003	July 2003
Abonnement subscriptions	74,2 %	77,2 %	83,1 %	83,0 %	85,9 %	87,7 %

Figure 3-1 Penetration rate of mobile subscriptions in Norway [NPT, 2003]

In this chapter, mobility specific perspectives are introduced in order to understand how the aspect of mobility affects the adoption process of mobile commerce. Chapter 3.1 extends the definition of mobility in terms of spatiality, temporality and contextuality. In chapter 3.2, mobility within telecommunications is defined, extending the perspective of spatial mobility. Finally, in chapter 3.3, two competing models of mobile computing are introduced.

3.1 Extending Mobility

Mobility is the most important and unique characteristic of mobile commerce. Wireless applications are likely to be inferior to wired counterparts in terms of limited devices, interface and networks, except for the aspect of mobility [Camponovo, 2002]. There are many perspectives on the definition of mobility. Some narrow their view and define mobility exclusively in terms of human's independency from geographical constraints. Mobile phones are thereby communications tools, which enhance this independency, enabling human interaction despite geographical location.

When exploring how mobile telecommunications services influence interaction, it serves useful to apply Kakihara and Sørensen's [2002] extended perspective of mobility, which include the way in which humans interact. Their research presents three interrelated dimensions of human interaction; spatial, temporal and contextual mobility. Spatial mobility describes the movement of humans, objects, symbols, images, voice etc. Temporal mobility seeks to explain the change in the people's perspective of time. Contextual mobility depicts how modern technology influences the way in which we interact.

3.1.1 Spatial mobility: anywhere

As the speed of transportation has increased, so has our geographical reach within a given time span. Modern technological developments, such as train and aeroplane systems, have made travelling more sophisticated and pleasurable, increasing the frequency of travel. Vilhelmson [1999] defines reproduction travel to be travel related to housework, medical care and other social services, which would include travelling to shops. From an individuals perspective, travel can be related to both household members (e.g. driving children to school or events) and to other social networks, including visiting family friends. These mobile situations have a bearing on adoption of mobile communication services and vice versa.

In the notion of an increasingly mobile society, the aspect of spatial mobility does not solely refer to the geographical movement of people. The mobility of objects, such as mobile telecommunication services and technologies, is included into this aspect, as their movement intertwines with the movements of people. The mobility of symbols is taken into account, as mobile communication technologies provide common places for exchanging information, sounds and images beyond national borders. Mobility of space represents these common places, or virtual communities, allowing computer-mediated communication (CMC).

Mobile commerce services are examples of such objects, as they intertwine with the movements of people. Mobile commerce services free end-users from spatial constraints, enabling commerce to be conducted remotely, over the network, modifying the need for travel. The same has been found for voice services as Ling and Haddon [2001] found that most mobile calls modified, rather than generated, travel. In these scenarios, it is the mobile communication services, or objects, that have been mobilized. The mobile telecommunication network represents the mobile space enabling CMC.

3.1.2 Temporal mobility: anytime

ACTS¹-funded UMTS market requirements studies found that the increased time spent travelling has led to a growth in dead or unproductive time. In such unproductive times, mobile communication services are one way of exploiting travel time, enabling its end-users to conduct transactions when on the move. Applications that provide efficacy, such as the availability of e-mail on PDAs and mobile phones, are often termed win-time applications. In contrast, kill-time applications, such as games or gambling services, are built to 'kill' time while on the move.

Temporal mobility refers to aspects of time. Important aspects of temporality are monochronicity and polychronicity [Barley, 1988]. The first of these terms refers to structuring activities and planning of events, by allocating time in specific orders. The second explains the opposite perspective, where structure and chronology is less important. The introduction of ICTs such as SMS or other asynchronous ICT applications has led to an increase of polychromic interaction, enabling people to deal with multiple tasks at the same time. People are no longer bound to linear 'clock-time' perspectives of interaction, as information and ideas can be instantaneously transmitted and simultaneously accessed across the globe.

Mobile commerce services consist of both win-time and kill-time applications, although the service under study is an example of the prior. The polychromic nature of mobile commerce services enables end-users to conduct transactions instantaneously, freeing them from temporal constraints.

3.1.3 Contextual mobility: in any situation

Contextuality captures situations of human interaction. Ljungberg and Sørensen [2000] characterise two dimensions of interaction modality; un-obtrusive vs. obtrusive and ephemeral vs. persistent. Obtrusiveness of interactions depends on how strongly one imposes response from the receiver. Ephemeral interaction refers to action that only exists for a very short time, while persistent interaction leaves a trail of further discussions and inspections. Based on this framework, text messages are an example of un-obtrusive-persistent interaction.

¹ Advanced Communications Technologies and Services

Computer-Mediated Communication (CMC) not only enables asynchronous communication between people despite geographical location, it also provides people with access to a number of contacts with whom they have weak social relationships, extending their communication possibilities beyond contextual constraints. Aspects such as cultural background, shared mood, high degree of mutual recognition, time and space, are important in face-to-face communication, but more flexible in CMC. Contextual mobility hence deals with the mobilized situatedness of interaction in particular contexts and relations in social lives.

As we will see in the next chapter, mobile communication technology has enabled personalized communication between operators and end-users, allowing un-obtrusive-persistent marketing of services via SMS.

3.2 Mobility in telecommunications

In this study, I define mobile services as the process of two parties communicating by use of mobile phones. Mobile commerce is one such service, and is defined as the process of two parties exchanging financial value using a mobile communications device in return for goods or services.

Within telecommunications, mobility may often be confined to wireless networks, although wire-line networks may also offer mobility, an example being portable laptops. Neither can it be assumed that wireless means mobile as vending machines and parking meters may communicate wirelessly although immobile [Thanh, 2000]. Although many mobile commerce services are wireline or immobile, this study deals with a service that is both wireless and mobile.

Mobility can be divided into *continuous* and *discrete* [Thanh, 2000], the prior enabling continuous availability of services while the end-user moves, such as in mobile telephony systems. The latter enables availability of services within certain areas and for certain access points, an example being Wireless Local Area Networks (WLAN). The mobility specific functionality of the mobile commerce pre-paid service is continuous.

Extending Kakiyama and Sørensen's perspective of spatial mobility, Thanh [2000] further divides mobility into six distinct types; terminal, component, personal, role, application and session mobility.

3.2.1 Terminal mobility

A terminal is defined as a *device capable of sending, receiving, or sending and receiving information over a communications channel* [ANST, 2000]. Terminal mobility thus deals with the spatial mobility of terminals, such as mobile phones, and their ability to access services while in movement, as well as the capability of the network to identify and locate the terminal.

3.2.2 Component mobility

Components refer to parts of an assembly that are essential for the operation, e.g. an earphone or microphone. Component mobility allows components of a terminal to change location while maintaining all services. The components thereby form a Personal Area Network (PAN).

3.2.3 Personal mobility

Personal aspects have to do with particular person. In a telecommunications context, this person is an end-user of a device or service. Personal mobility involves the ability of a person to access or be accessed by the network wherever there is an access point or terminal in the network. Services are provided in accordance with the end-user's service profile.

3.2.4 Role mobility

Roles refer to the access preferences, rights and limitations of a end-user. Role mobility therefore allows the end-user to change roles and get access to distinct preferences, rights and limitations.

3.2.5 Application mobility

Applications are software entities, such as codes, objects and processes that perform specific tasks or functions. Application mobility allows these entities to be relocated from one machine to another or even be moved between machines while processing, allowing the end-user interface to have the same look and feel. Applications are brought to end-users as a service, in other words a service is realized by one or several applications.

Thanh [1997] classifies applications according to their degree of mobility awareness; mobility-unaware applications, mobility-aware applications and mobility-based applications. The first of these classifications, mobility unaware applications, refers to applications that do not need to be modified by mobility-related data such as terminal capabilities to be available to mobile end-users. In contrast, mobility-aware applications refer to applications that collect mobility-related data, such as location, terminal capabilities etc. Finally, mobility-based applications explicitly use the mobility-related information in their services [Thanh, 1997].

3.2.6 Session mobility

Sessions are here used to mean communication flows between terminals and applications. Session mobility ensures that active sessions are not disrupted while end-users, terminals or applications are being moved. Sessions are able to halt and be resumed later. Session mobility differs from application mobility as sessions can be moved between different types of devices, in example from a mobile phone to a desktop computer.

An important distinction needs to be made between services, applications and sessions. An application when being executed will offer a service to an end-user through a session. As an example, an application will run sessions on an end-user's mobile phone upon recharging her pre-paid account via mobile commerce. This application offers the end-user a payment service.

In addition to the mobility of terminals and humans, the aspect of role and application mobility is especially interesting when exploring adoption determinants for mobile commerce services. As will be described in the following chapters, mobile commerce end-users have different roles as their access preferences, rights and limitations differ, depending on the nature of their mobile phone subscription, and whether they have connected their bank accounts to their mobile phones or not. Mobile commerce services are mainly value added services, providing an additional geographically independent channel for conducting transactions. Mobile commerce services have thereby been mobilized. The mobile commerce pre-paid service is an example of a mobility-unaware application, as it does not depend on mobility related data for end-users to conduct transactions. As seen in the next section, there are alternatives to the mobility approach described above.

3.3 Mobile computing

Of the attributes built into mobility, Camponovo [2002] claims ubiquity is the most obvious advantage of mobile phones, as it fulfils both the need for real-time information and communication everywhere. Another important attribute involves reachability, as mobile terminals enable people to be reachable and on-line virtually anywhere, at anytime. How being reachable affects communication within social networks of mobile phone end-users, is therefore relevant in exploring adoption of mobile services. In reality, most people do not travel around the world looking up stock quotes in New York one day and roaming the streets of Hong Kong the next. Mobile phone end-users limit their reachability to particular persons, content and times.

“If we define mobile computing as the use of technology that you bring with you as you move, then ubiquitous computing will mean the end of mobile computing.” [Dahlbom and Ljungberg, 2003]

The increased mobility in society has spurred movement away from traditional stationary computing towards more mobile solutions, the ultimate goal being access to services irrespective of location. Falk and Björk [2001] suggest two approaches to reach this goal: providing the end-users with their own personal portable computers to be carried at all times or providing end-users with access to computers in all possible locations. These competing models of future human-computer interaction consist of *wearable* and *ubiquitous* computing.

3.3.1 Ubiquitous computing

In ubiquitous computing, the computer is moved away from the desktop and seamlessly integrated into the environment surrounding the end-user. The computers are moved into the background of the physical environment, away from the end-user.

3.3.2 Wearable computing

On the opposing side, moving the computer away from the desktop but closer to the end-user, we find wearable computing. In this approach, computers are worn like clothing, seamlessly integrated with the wearer. Computers are considered personal.

Although both approaches seek to move the personal computer away from the desktop, they differ in the design, use and relationship to the computer. Both approaches support technology use in new situations and locations and other activities than those provided by conventional computers. Having continuous access to communication and information devices impacts everyday life, as it influences the way in which people interact and communicate.

Some researchers, such as Camponovo [2002], consider ubiquity to be an important characteristic of mobile communication terminals, as they encompass access to a service independent of a location. Mobile phones can be viewed as public and communal in the sense that they can handle public announcements, such as broadcasted text messages. However, they only provide information to the 'wearer'. In countries with a high penetration rate such as Norway, mobile phones can be found virtually everywhere, in the sense that people surrounding you carry them. Still, most researchers do not consider mobile phones ubiquitous, as they are not accessible to all the people present.

On the other hand, many research communities do not consider mobile phones wearable, even though they are carried around and constantly available for use. Despite this view, wearable computing services such as e-mail, connection with bank accounts and personal calendars [Falk and Björk, 2001] have become increasingly available on mobile phones and their use has therefore become more personal. Researchers at Telenor R&D argue that they can indeed be seen as a 'new limb', since end-users carry them everywhere and rarely ever turn them off. Mobile phones have become increasingly personalized, the design, tones and logos seen as a reflection of the owner. A parallel with artefacts such as jewellery, clothes and hairdos, with strong feelings, can be made. Arguments can therefore be made to expand the definition of wearable computers to include mobile phones.

3.4 Summary

In summary, extending the perspective of mobility enables us to see how mobile commerce not only involves geographical movement of its end-users, mobile phones and services. It explains how mobile commerce services influence temporality, enabling polychronicity for its end-users. They no longer need to depend on 'clock-time' perspectives of interaction, as commerce can be conducted at any time. Adding a contextual dimension to mobility, we can explore how end-users of mobile commerce communicate within social networks. Mobile phones enable operators to interact directly and with end-users through more or less obtrusive-persistent personalized messages. The aspect of application mobility adds yet another dimension to mobility, as mobile commerce frees services from spatial constraints, enabling continuous access to most mobile commerce services. Finally, ubiquity and wearability present two approaches to achieving accessibility to services at all times. Mobile phones are proposed to becoming more and more wearable. How these aspects affect end-users is highly relevant in understanding the determinants of adoption of mobile commerce services.

4 Mobile Commerce

Picture a world where ATMs and cashiers desks no longer exist. You can walk into any store in the world, pick up the products you wish to purchase, whereby they are automatically detected by your mobile phone and deducted from your VISA account, which is linked to your mobile phone, enabling you to walk straight out of the store without waiting in line at any cashiers desk. Then, picture a world where all financial transactions, which today may be conducted by Internet or ATMs, can be conducted from the comfortable environment of your home by use of your mobile phone. Say a friend owes you money, and all you need to do is send her an SMS requesting for the amount, which automatically transfers the money from her bank account to yours, upon a single click of approval on her mobile phone. Although these scenarios may seem somewhat far-fetched and futuristic, they may not be so far away. Solutions linking bank accounts directly to mobile phones already exist in the market and enable consumers to purchase services and products by the simple use of SMS- and Wireless Application Protocol (WAP-) based technologies.

This following chapter seeks to define mobile commerce and provide a description of the building blocks of the mobile commerce architecture. In an effort to provide an understanding of the mobility specific technology which lies behind mobile commerce services, an overview of the evolution of mobile telecommunications technology is presented in chapter 4.1. Mobile commerce is defined, and different payment services and service categories are described in chapter 4.2. Chapter 4.3 then presents the Telenor Mobile Commerce architecture. I wish to emphasize that the services and technologies referred to in this study are those provided by Telenor Mobil.

4.1 The evolution of mobile communication services

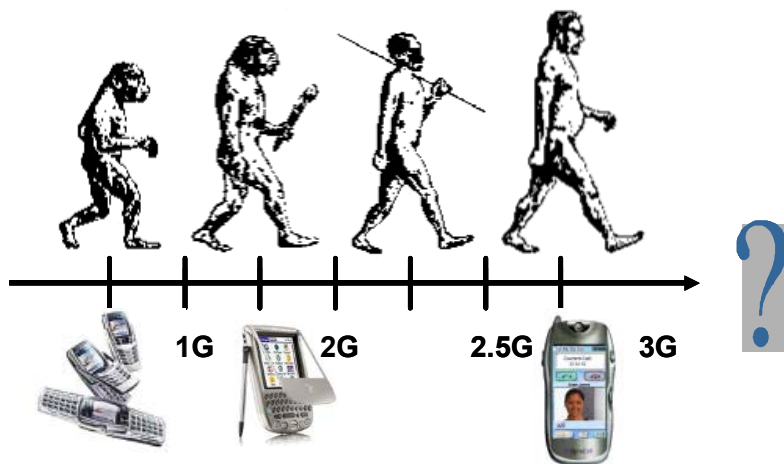


Figure 4-1 The evolution of mobile telecommunication

In 1855 Norway's first official telegraphic connection, the Norwegian Telegraph Administration, DNT, was established. The first telegraph network was built between the cities Drammen and Kristiania, while the first telephone line opened in 1878 between Arendal and Tvedestrand. In 1967 Norway implemented its first mobile telephony service, the Official Land mobile Service (OLT). OLT provided a one-way sequential (simplex) voice service, where the end-user manually chose the radio frequency to contact the service central and the service central then established a new connection on a different frequency towards the targeted respondent.

In 1969 at the annual Nordic telecommunications conference in Kabelvåg, northern Norway, the Swedish delegation envisioned that there could be practical advantages in a building a common Nordic mobile communications network [Haug, 2002]. A mandate for a Nordic Mobile Telephone (NMT) group was issued and the NMT standard was designed by Telia, Tele Denmark, Televerket (Telenor) and Telecom Finland (Sonera). NMT 450 was launched in 1981 as the first international, fully automatic mobile telephone network in the world, offering roaming possibilities between the Nordic countries [Iversen, 2002]. In contrast to OLT, NMT is based on duplex communication, enhancing the voice service to enabling two way communication. In 1984, there were over 100 000 mobile telephony subscribers in the Nordic countries, demand was high and the network capacity overloaded [Telenor, 2003]. NMT 900 was therefore introduced in 1986, enhancing communication in urban areas. The NMT standard has been labelled the first generation (1G) of mobile telephony.

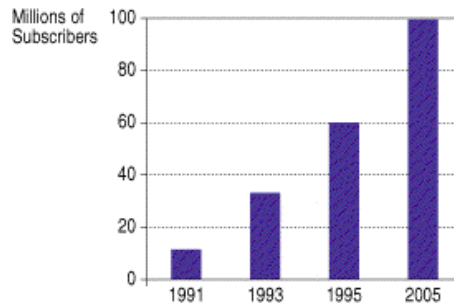


Figure 4-2 Cellular Subscriber Growth Worldwide

A shared opinion existed among European Post Telephone Telegraphs (PTTs) that each European country would benefit from the introduction of a pan-European system [Fomin & Keil, 2000]. The same year NMT was launched, work commenced with the next generation of mobile telephony. In 1982, the inaugural meeting of the Group Special Mobile (GSM) took place, with representatives from eleven European countries under the chairmanship of Thomas Haug from Swedish Telecom.

Today's Global System for Mobile communication (GSM) standard was introduced in 1992, ending the traditional European fragmentation and incompatibility in the mobile field. The market for mobile telephony boomed, and the number of mobile phones increased from less than two million in 1995, to more than 10 million in 1999 [Iversen, 2002]. GSM is digital and, in addition to telephony services the network delivers SMS and data communication. GSM 900 was introduced in 1993, while GSM 1800 was launched in 1998 due to shortage of capacity in the original frequency-band. The standard has become the world's leading and fastest growing mobile standard, spanning over 190 countries. Today the technology is used by more than one in ten of the world's population and it is estimated to reach over one billion subscribers within 2005 [IET, 2003]. GSM is denoted the second generation (2G) of mobile telephony.

Due to high bandwidth demand, mobile operators needed to develop more advanced standards which resulted in the High Speed Circuit Switch Data (HSCSD), General Packet Radio Service (GPRS), Enhanced Data rates for GSM Evolution (EDGE) and Universal Mobile Telecommunication System (UMTS). HSCSD is an expansion of the GSM network enhancing transition speed up to 65Kbps or more. As it is circuit switched it offers a fixed bandwidth to its end-users. The technology is most useful for videoconferencing and transition of large files.

GPRS was launched in 2000 and represented the biggest leap forward in mobile Internet services, bringing together two fast growing industries of mobile communications and Internet, representing the second and a half generation (2.5G) of mobile telephony. GPRS was designed to reuse as much as possible of the GSM infrastructure in addition to enhancing the bandwidth. It offers a faster and permanent Internet connection, where end-users only pay for sent and received data when using services, rather than the time spent browsing. GPRS uses packet switched communication in addition to the circuit switched technology of GSM. Data can therefore be transmitted during voice transition, the maximum data transfer rate being approximately 100Kbps.

EDGE represents the next development step after GPRS, offering a higher throughput of up to 384 Kbps. The technology is not as robust as GSM, and compared to GPRS the deployment of EDGE demands a high amount of adjustments to base stations. EDGE can be used to improve both circuit switching (HSCSD) and packet switching (GPRS). The technology's high throughput makes it possible for EDGE to coexist with UMTS, in order to provide high-speed connections in rural areas as UMTS will first appear in urban and highly populated areas [Lunde and Mjøvik, 2000]

UMTS represents the next generation of mobile telephony, the third generation (3G). It supports advanced multimedia terminals and is expected to introduce a new era in mobile communication [Ericsson, 2001]. As with GPRS, UMTS offers an 'always on' functionality for mobile devices and is expected to deliver pictures, graphics, video communication and other new information services, allowing total mobile communication. The UMTS frequency level lies between 1920 and 2170 MHz and offers a data transition rate up to 2Mbs, depending on the speed in which the device is travelling and population density. Deployment of the UMTS network commenced in 2001, but has been delayed due to the high cost of the master technology. At present, only a test net is up and running in Norway.

4.1.1 The emergence of mobile commerce

Telecommunications industry players have large investments in these 3G networks, both in obtaining licenses and deploying the networks themselves. In addition, further investments will be made in service development, marketing and distribution. Databased traffic volume is now larger than the voice-based volume in fixed networks, while traffic volumes in mobile networks are still primarily voice. Mobile voice is quickly becoming a commodity, and mobile operators are trying to find new ways to reduce the loss of subscribers to cheaper competitors and at the same time open up new revenue streams [Panis et. al., 2001]. Offering mobile commerce services is hoped to be one way of achieving both of these goals. Telenor Mobil launched its mobile commerce service on September 27th 2001.

4.2 Defining mobile commerce

Mobile commerce is difficult to define, and can be interpreted in a variety of ways. Some interpret mobile commerce as transferring e-commerce to mobile devices and, although many e-commerce services can be transferred, many are not suitable for mobile devices due to screen size, lack of keyboard or low bandwidth.

I have previously defined mobile commerce as *the process of two parties exchanging financial value using a mobile communications device in return for goods, information or services*. Mobile communications devices have been confined to mobile phones.

Mobile commerce offers an alternative solution to that of online banking, without having to invest in new technology or a new payment infrastructure. Customers can turn their mobile phones into a mobile payment device and use it to pay for goods, information and services at a real or virtual point of sale. Using functionality already existing in Subscriber Identity Module (SIM) cards, telecommunications operators have created an alternative payment system to online banking. Millions of SIM cards with digital IDs are in use, all of which have high capacity compared to the first processors that were developed. Today's infrastructure can thereby be used for authentication and cryptography, thus also as a form of payment [Telenor R & D, 2003].

The Telenor Mobile Commerce vision is to replace the traditional wallet, in creating an electronic wallet, enabling consumers and content providers to exchange products by use of their mobile devices. The ultimate goal of mobile commerce is to provide end-users with a new and secure payment solution that frees consumers from temporal and spatial constraints.

As the mobile commerce industry is still in its infancy, there are many unsolved problems related to its services. One major issue is the development of services which are able to support the diverse array of mobile devices, in addition to multiple networks. Not only do software and interfaces vary among different terminal suppliers, but also software versions vary within one supplier's product range.

4.2.1 Mobile payment services

Mobile commerce services are value-added services, content and applications that an end-user can access on her mobile device. The primary actors are content providers and application providers. Currently, three forms of mobile payment services exist; overtaxed SMS messages charging the subscribers phone-bill, creating a mobile purse and linking the mobile phone to credit or debit card accounts [Pedersen et. al., 2002].

Overtaxed SMS

Overtaxed SMS messages represent the most common form of mobile payment, and are typically used as payment in exchange for services valued between 2 and 30 NOK, which are delivered to the mobile phone or by Internet. Examples of such services are logos and ring tones. By using the subscriber's phone-bill, payments for services can be linked to an already existing payment infrastructure. Payments are thereby invoiced or credited, depending on when content providers are paid by the operators. A restriction connected to this payment form may for example concern end-users who whose phone-bills are financed by their employers. For these end-users, purchase of such services may be unacceptable.

Electronic purse

A second payment form is the creation of an electronic purse on the mobile terminal. The purse substitutes phone-bill payments, and can contain up to 1000 NOK. Money can be transferred to these purses through Internet banking. It is typically used for services that are valued over 10 NOK, like mobile gambling and payment for physical services such as transportation on buses and trains. The dominating purse solution in Norway is the SmartCash solution provided by Telenor.

Bank accounts

Finally, by linking the mobile terminal directly to credit or debit card accounts, payment for services can be deducted directly from an end-users bank account, deploying the existing payment infrastructure of credit and debit cards. By leveraging existing infrastructures and established channels of payment, operators and banks can deliver completely integrated solutions that allow free and active sharing of the customer, product and transaction information across many different channels.

In the Telenor mobile commerce solution, the latter two of these payment forms are combined. An electronic purse, SmartCash, is automatically created for all end-users who register with the mobile commerce service. In addition, end-users can chose to link their mobile terminals and this purse to their credit or debit card accounts. If they do so, money can be transferred to their SmartCash account via SMS, which will be further described below.

4.2.2 Service categories

Mobile commerce services can also be classified according to end-user types (private and business), according to market segments (B2C², C2C³ or B2B⁴) and also with regard to technical aspects. The majority of existing mobile commerce services deal with an exchange of products, services or information between businesses and consumers (B2C) [Panis et. al., 2001]. This study, directs its attention towards private end-users and transactions that take place between a customer and a professional provider, in this case Telenor Mobil. Services within this segment can be further categorized into different mobile commerce areas, including financial services, information provisioning, advertising, entertainment and shopping services [Panis et. al., 2001].

Financial services

Within financial services, end-users experience financial and payment related services via their mobile device. Mobile banking services provide both public information, such as exchange rates and interest rates, as well as private information, such as for checking and banking account or paying invoices. Mobile brokerage services offer services for buying and selling stock, managing portfolio etc. The financial value of services in this category can be high, and typical payment forms are electronic purses and linking bank accounts to mobile terminals.

Mobile Information Provisioning

Mobile Information Provisioning involves mobility based applications, such as mobile alert services. These may include informing drivers where police radar controls are positioned, maps and routing directions and other location-based services. Information comes mainly from end-user private data, such as a calendar or address book or content made available through content service providers. Content providers typically use overtaxed SMS messages as a payment form.

Mobile Advertising

Mobile devices provide unique possibilities for freeing contextual constraints on communication between the marketing industry and consumers. One-to-one marketing capabilities are enabled, through more or less obtrusive-persistent messages to end-users. Relationships between service providers, operators and consumers are strengthened, through personalized communication. Mobile advertising extends mobile marketing where new advertising methods are envisaged, replacing advertisement messages sent by SMS.

² Business To Consumer

³ Consumer To Consumer

⁴ Business To Business

Mobile Entertainment

Gambling and betting services such as lotto, instant games and sports betting which are popular in the real world can also be deployed in the virtual world. Mobile end-users can place their bets using text based technologies like SMS, WAP or play games. These mobility unaware kill-time applications represent impulse purchases and are typically charged through end-users mobile purse or linked banking account.

Mobile Shopping

Certain products can be located and ordered from a mobile device using SMS or WAP. Cinema tickets, candy bars at vending machines and even pizza are all examples of physical products that can be ordered through the interface of mobile phones. These services are discrete, as there are spatial and temporal constraints to their use. Other mobile shopping services, such as purchase of DVDs via SMS are continuous. The current mobile commerce solutions for these products automatically deduct the value of the product from the end-user's mobile purse or banking accounts.

4.3 Mobile commerce architecture

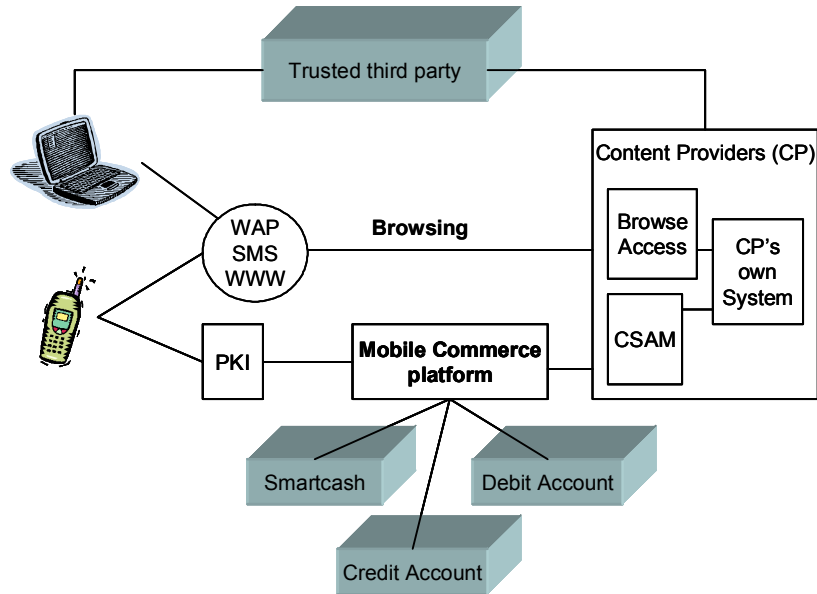


Figure 4-3 Telenor Mobile Commerce architecture

The above figure illustrates how the Telenor mobile commerce architecture is built. End-users communicate with services through any of the three interfaces SMS, WAP and the World Wide Web (WWW), further described in chapter 4.2.1 . How security of transactions is achieved through the Private Key Infrastructure (PKI) is discussed in chapter 4.3.2. The roles of content providers are discussed in chapter 4.3.3, followed by a discussion on the payment forms of the mobile commerce platform in chapter 4.3.4.

4.3.1 End-user Interfaces

As we have seen from the various categories of mobile commerce services, not all service are freed from spatial, temporal or contextual constraints. Neither are all services continuous, and thereby wireless and mobile. Three interfaces facilitate access to mobile commerce services; SMS, WAP and WWW. These will be described below.

World Wide Web

Some mobile commerce services need to be accessed through the Internet, due to the limitations of mobile communication devices. These e-commerce sites provide consumers with the possibility of entering their mobile account number instead of disclosing VISA or Master card account numbers when purchasing products (see appendix B for details). Shortly after a purchase has been registered, a pop-up dialog (described below) appears on the end-user's mobile phone prompting for confirmation of the purchase and entry of a Personal Identification Number (PIN) code. The mobile commerce payment solution for e-commerce thereby offers an additional security for end-users, who are sceptical of leaving credit card information on the Internet. Access points to the Internet limit the spatial mobility of both end-users and services. These spatial constraints are freed by the following interfaces.

Wireless Application Protocol

WAP is an open, global standard for mobile solutions, including connecting mobile terminals to the Internet. Through WAP enabled devices, such as mobile phones and PDAs, end-users access information from WAP-supported web sites. End-users type the Uniform Resource Locator (URL) of a web site into the devices micro browser, which sends a request over the wireless network. A WAP gateway connected to the Internet converts webpages from HTML (HyperText Markup Language) to WML (Wireless Markup Language), which is a text-only wireless language. The mobile device receives information from the WAP gateway and displays it on the device's screen.

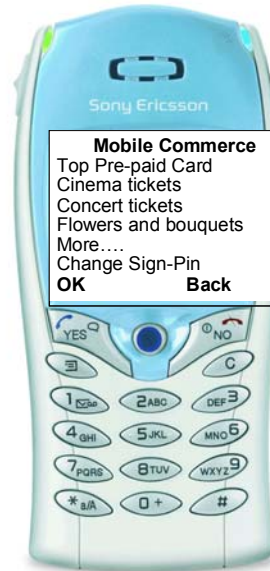


Figure 4-4 Mobile commerce WAP interface (<http://wap.mobilhandel.no>)

An overview of some of the mobile commerce services can be found in the Telenor mobile commerce WAP menu, which can be found at <http://wap.mobilhandel.no>. As illustrated in Figure 4-4 the end-user can scroll through a list of products and services, ranging from cinema tickets to ordering flowers. As seen in the figure, the mobile commerce pre-paid service is available through the WAP interface. Although the protocol may very well solve some of the limitations of SMS described in the next paragraph, the WAP standard for Internet access still needs to prove itself successful, as the adoption rate in Europe has been slow.

Short Message Services

SMS is one of the most successful innovations in mobile technology. Norwegian mobile telephony subscribers sent a total of 1.47 billion text messages, providing 19 percent of the total revenue for operators, during the first six months of 2003. Commercial content messages consist of 8,8 percent (120 million messages) of the SMS traffic during the same period [NPT, 2003].

There are many different categories of content services. Database-based services are services that require the end-user to access a database and obtain results from the query, and are typically charged by overtaxed SMS. Most SMS services fit into this category, as they are solely concerned with the information in the database. Mobile commerce services do not necessarily access databases in the same manner, as services concern physical products and payment transactions in addition to information.

SMS was the initial technology for many of the mobile commerce services. By sending a message containing specific code words to a specific number (typically four digits) services are initiated. Although SMS is widely used in mobile commerce services, there are some limitations. For example, SMS can only contain 160 characters and end-users must remember the exact syntax of the code words for the service she or she wishes to use. For payment by overtaxed SMS, another limitation lies in their cost as it is regulated to a maximum of 30 NOK.

Technology

Upon initiating services through either of SMS or WAP, pop-up dialogs appear on the end-user's mobile device. These pop-up dialogs provide communication with end-users and enable the end-user to respond immediately to requests. Illustrations of such dialogs can be found in the next chapter.

To enable the pop-up dialogs, mobile customers need SIM cards that support SIM Application Toolkit (SAT). SAT technology allows telecommunications operators to send applications wirelessly, as SMS or as Cell Broadcast messages, in order to update SIM cards with changed or new services. SAT provides mechanisms which allow applications, existing in the SIM to interact and operate with any mobile equipment, in this case the mobile phone, that supports the specific mechanisms required by the application. For applications written in SAT commands, the SIM can initiate actions rather than only read commands from the mobile phone. The SIM can for example initiate the mobile phone to create a menu for the application to perform banking operations or request service information. Most new SIM cards support SAT.

The Telenor mobile commerce solution does not use SAT directly, but uses a SIM based WML browser denoted WIB (Wireless Internet Browser). WIB is implemented as a SAT application and mobile commerce communicates to it via WML scripts. As seen in the figure below, WIB and its server gateway WIG, provide mobile end-users access to WML-based contents and applications on the Internet. WIB allows an operator to deliver WML-based services to the existing large base of mobile telecommunications subscribers.

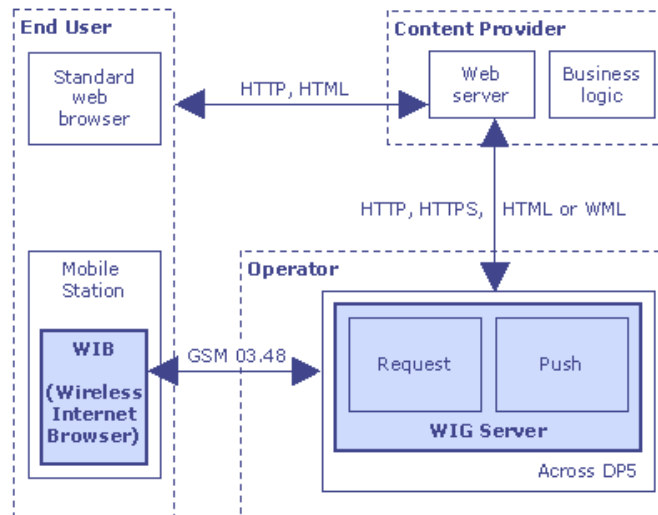


Figure 4-5 WIB technical overview

As illustrated above, WIB consists of two main entities, the WIG server and the WIB browser. WIB is menu driven and mobile end-users access Web-applications through this menu. The WIB menu points to either a locally stored WML application or just an URL address on the Internet, where the service is located. WIG supports cookies to enable multiple browsing requests. It also contains a push interface where operators can push content to mobile phones. Finally, WIB supports plug-in modules to generate signatures and to retrieve location-based information.

Services such as web surfing, information retrieval, information pushing, e-mail along with location-based, payment, banking and stock trading services are built with WIB.

4.3.2 Security

Security is a key enabling factor in mobile commerce and smartcards are a way of gaining access to a secure system. Mobile commerce transactions are secured through a mobile PKI solution. The mobile PKI secures the transactions, authenticates the end-user and content providers and their rights. *Digital certificates* provide this authentication through private and public keys. The private key is accessed by its owner for identification, signing and authentication reasons. The public key is used to check if the signature is correct. The public key is available to the remote end-users through a trusted third party. The digital certificate is placed in the end-users SIM card.

After registering with mobile commerce the first time, an activation code, initiating the PKI solution, is mailed to all new mobile commerce customers. The activation code needs to be picked up at a postal office by its recipient personally. Upon activating mobile commerce with this activation code, the customer enters her own unique sign-PIN code which establishes a unique ID. The sign-PIN is used to confirm payment transactions. This activation process has been subject to faults, due to both technological issues and issues concerning the user-dialog and will be subject to discussion in later chapters. A new PKI release, with an improved user-dialog text is currently being released when this study is in writing (autumn 2003).

4.3.3 Content providers

Content providers develop their own applications where the customer can find services and goods, both virtual and physical. The mobile commerce open API (Application Programming Interface), CSAM (Commerce Serve Access Module), provides the communication between content providers' applications and the mobile commerce platform, which can be viewed as both a service aggregation platform and the payment platform. Several independent providers offer their product on the platform, and payment for transactions are conducted here. A list of content providers and Telenor mobile commerce services is found in appendix B.

4.3.4 Payment forms

As mentioned, the Telenor mobile commerce platform enables two payment forms; an electronic purse, SmartCash, and linking credit or debit card accounts. All mobile commerce transactions are charged by either of these, and thereby go via the operator.

In contrast, traditional Content Provider Access (CPA) models communicate directly with the consumers and charging services by use of overtaxed SMS. The CPA model has its advantages, as services are not proprietary to one operator. Although several mobile commerce services are available to subscribers of competing operators, the mobile commerce pre-paid service is not one of them.

However, the CPA model has its disadvantages, as it is costly for content providers. 25-30 % of revenue from service transactions go to the operators who own the network. In contrast, upon using the mobile commerce architecture only 2.5–3.6 % of the revenue falls into the hands of the operator.

Another constraining issue is ensuring credible customers. The smart card (SIM) within the mobile phone provides the authentication of the owner. End-user data, such as billing address, mobile phone number, e-mail address, choice of mobile phone and calling patterns are invaluable information for service providers, but is accessible only to operators. By linking these individual characteristics with a database, network operators can leverage the data to personalize their services and communicate with consumers through mobile advertising.

4.4 Summary

In summary, the large investments that have been made in third generation mobile telecommunications networks has created a need for operators to find new ways of reducing loss of subscribers to cheaper competitors and at the same time open up new revenue streams. The introduction of mobile commerce is hoped to be one way of achieving this. By leveraging existing payment infrastructures, mobile commerce has linked mobile phones directly to bank accounts, enabling mobile phone end-users to conduct commerce through the interface of the mobile phone. There are various categories of services, differing in end-user types, market segments and technical aspects. The mobile commerce pre-paid service consists of a private financial service between business and consumer. It can be accessed through both WAP and SMS, and communication between the operator and end-user comprises through SAT dialogs. Mobile commerce services provided by Telenor are secured through a mobile PKI solution and all transactions thereby go via the operator. In contrast, in traditional CPA models service providers communicate directly with their consumers.

5 The pre-paid service

The successful development of mobile commerce depends on operators taking advantage of the special capabilities connected to its mobility, freeing its end-users from spatial, temporal and contextual constraints. The mobile commerce service presented in this chapter is envisioned to encompass these capabilities. Based on the operators' customer ownership, personalized communication such as mobile advertising is enabled. Its wearability supports transactions from virtually any location and its end-users can reach the service at their own convenience.

It is here important to make a distinction between registering as a mobile commerce customer, and actual use of mobile commerce services such as the pre-paid service described below. The registration process is an independent one-time process, enabling access to all of the services provided by Telenor (see Appendix B). The process is nevertheless important in exploring adoption of services, as it represents end-users initial introduction to mobile commerce and the complexity of the registration process may very well have an impact on adoption decisions. The registration process of mobile commerce is presented in chapter 5.1, followed by a description of the actual service under study in 5.2.

5.1 Registration process

To enable mobile telecommunications customers to use mobile commerce services, their personal information needs to be verified. Initiation of the mobile commerce registration process is done in several ways. In trying to conduct mobile commerce services without having registered as an end-user, the registration process is automatically triggered. Sending a text message containing **REG** to the number **2500** has the same effect. This four digit number has been reserved by Telenor Mobile Commerce for mobile commerce services. An electronic purse, SmartCash (described in chapter 4.2.1), which can contain up to 1000 NOK is automatically created. A series of SAT dialog boxes automatically appear, prompting the option of connecting a credit card account to the mobile commerce account. As seen in Figure 5-1, the end-user has to enter her social security number along with their VISA card number to register their credit card account. For security reasons the end-user is then prompted to choose a temporary self-assigned PIN-code. Debit accounts can also be deducted in mobile commerce transactions, although the process of registering such an account is manual. A paper-based form needs to be filled out and mailed to the operator (see Appendix D).

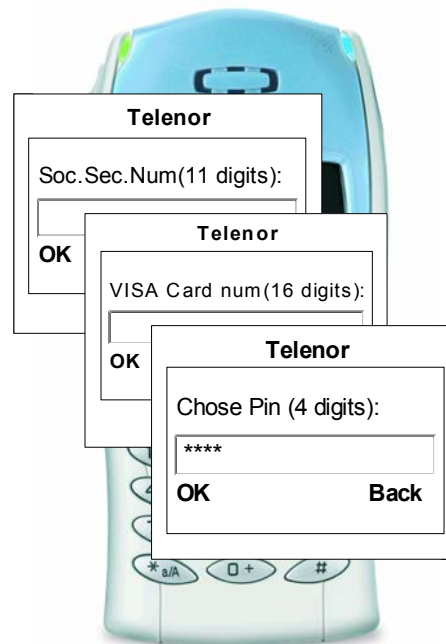


Figure 5-1 Mobile commerce SAT dialog for registration

Upon registering a credit card account with mobile commerce, the end-user is temporarily enabled to conduct transactions for 200 NOK, until the PKI solution (see chapter 4.3.2) has been fully activated. As the activation code is sent through the postal service, it can take several weeks before a customer receives it. Upon activating the code, the customer can conduct transactions freely.

When a banking account has been registered, the end-user can deduct money directly from her bank account when using mobile commerce services. Money can also be transferred from a bank account to the SmartCash account by sending an SMS containing the code words **OVERFØR**⁵ <sum> to **2500**.

Registration is also possible via the Internet, through the Telenor Mobile Commerce home page, which can be found at <http://www.mobilhandel.no>.

5.2 Pre-paid subscription

Pre-paid is a mobile phone subscription designed for end-users who wish to pay for mobile service use in advance, rather than receive monthly bills. It is designed for end-users who do not spend high amounts of time communicating by voice, especially not to fixed telephone networks as call-rates are high. Another reason subscribers choose this subscription is consumption control, as parents wish to control their children's mobile phone use. Call-rates to both fixed and mobile networks are lower in evenings and at weekends. Pre-paid customers can check the credit value of their pre-paid accounts at any time by sending a text message containing the word **SALDO** to the number **2525**. The four digit number, 2525 is also reserved by Telenor Mobile commerce for services directly related to the pre-paid service.

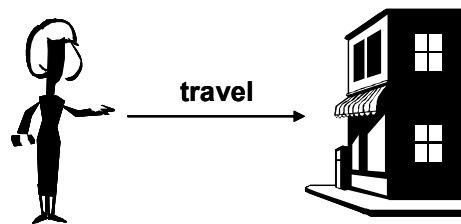


Figure 5-2 Recharging pre-paid accounts via retailers

⁵ OVERFØR, Norwegian for transfer

The traditional way of recharging pre-paid accounts is by buying recharge cards, which can be found in 12000 retail shops in Norway. Recharge cards are available in three different values; 150 NOK, 300 NOK and 500 NOK. Following the instructions on the card, end-users call a free service number and punch a charge-code. The value of the recharge cards is automatically transferred to the end-user's pre-paid account. Only the pre-paid account associated to the SIM card in the mobile phone from which the charge code is entered can be recharged by use of recharge cards, which is illustrated in Figure 5-2. The figure illustrates the end-user having to travel to a retail shop to recharge her own pre-paid account.



Figure 5-3 Recharging pre-paid accounts via ATMs

In addition to buying recharge cards, an additional payment channel enables end-users to recharge their pre-paid through ATMs. By inserting a credit or debit card and choosing 'Telenor Mobile Pre-paid' in the menu, the end-user is prompted for a mobile telephone number. As any Telenor subscription phone number can be entered, other accounts than the end-users' own can be recharged. The recharge values available are the same as for recharge cards; 150 NOK, 300 NOK and 500 NOK. After choosing a value, the transaction needs to be confirmed before the value is automatically transferred to the target pre-paid account. The service is provided by approximately 2000 teller machines in Norway, by the following banks; Sparebanken Gjensidige NOR, Nordea, Handelsbanken and DnB. As illustrated in Figure 5-3 the end-user still has to travel to locate an ATM, but an additional value is added to the service freeing her from contextual constraints, as she can recharge other Telenor pre-paid accounts than her own, remotely over the Internet and GSM net.

5.2.1 Mobile commerce pre-paid service

Mobile commerce introduced a third payment channel for recharging Telenor pre-paid accounts; recharging mobile pre-paid accounts by use of SMS. The service is initiated by sending an SMS containing: **LADE <recharge amount> <phone number> to 2525**. There are no fixed recharge values and the end-user can freely choose the value of the <recharge amount> parameter. Accounts can be recharged with any value greater than 10 NOK. The <phone number> represents the target pre-paid account one wishes to recharge. If the end-user wishes to top her own pre-paid account, she does not have to provide this number. By sending an SMS containing **LADE 10**, an end-user fills her own pre-paid account with 10 NOK.



Figure 5-4 Recharging pre-paid accounts via mobile commerce

As illustrated in Figure 5-4, the end-user no longer needs to travel to locate a retailer or ATM, freeing her from spatial constraints, allowing her to recharge any Telenor pre-paid subscription, remotely over the Internet and GSM net. In this aspect, the mobile commerce pre-paid service can be seen to modify travel of its end-users. The actual service is what has been mobilized. As the service provides temporal efficacy, it falls under the category of win-time applications. Polychronicity is enabled, as end-users no longer need to allocate travel time in order to conduct services, in addition to being freed from the constraints of opening hours of shops. The process of recharging pre-paid accounts has been mobilized in terms of contextuality as well. Both ATM and mobile commerce services have reshaped interaction patterns, as the person recharging another account than her own no longer needs to have face-to-face interaction with the receiver. In contrast to the previous solutions for recharging pre-paid accounts, the mobile commerce pre-paid service is continuous, enabling personal, terminal and application mobility.

End-user Interface

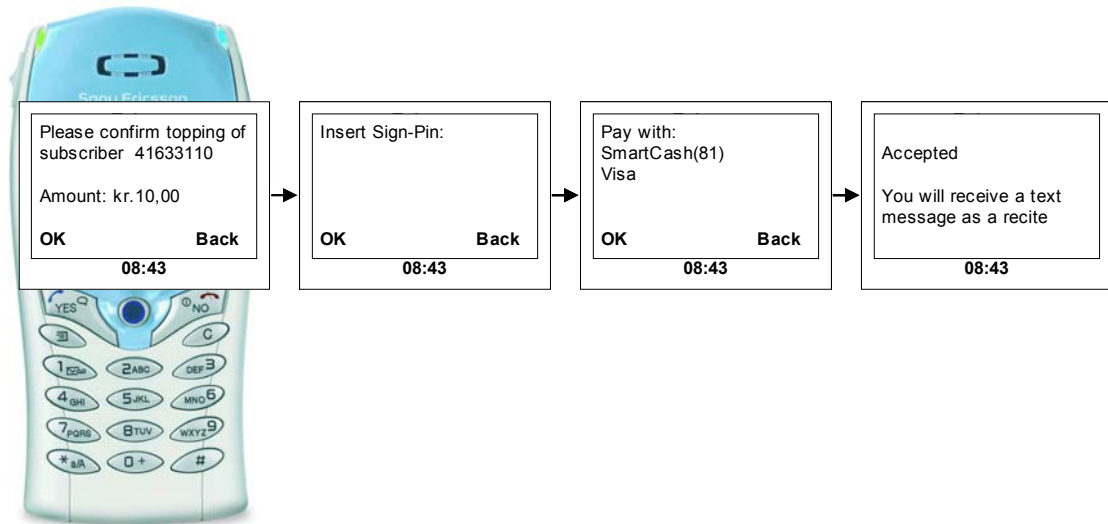


Figure 5-5 SAT dialog for recharging pre-paid accounts

Illustrated above is the SAT dialog, which appears shortly after the end-user has sent the SMS that initiates the service. The dialog asks for a confirmation of the purchase before prompting for the end-user's sign-PIN. The end-user can then choose to pay with SmartCash, or deduct the amount directly from her or her bank account. The number in brackets denotes the value of the purse. The transaction is then verified and the end-user receives a receipt by SMS.

The end-user dialogs are continuously subject to modification. In time of writing (October 2003), the dialog is being modified to remove visibility of the mobile purse (SmartCash) when recharging accounts. End-users thereby only see VISA as an alternative in the third dialog box. For new end-users, this makes the service less complex, as they do not have to be concerned with the concept of electronic purses. In reality, upon initiating a pre-paid transaction, the system still transfers the recharge amount from the VISA account, via the electronic purse, to a pre-paid account.

The mobile commerce pre-paid service can also be accessed through the WAP interface, as illustrated in Figure 4-4. Upon choosing the service, a SAT message prompts for the amount that the end-user wishes to transfer, followed by a dialog similar to that of Figure 5-5. A similar list of mobile commerce services exists on the end-users' SIM card, and can be found in the Telenor menu on the mobile phone. The process of recharging a prepaid account by use of this menu is similar of that of using WAP.

Mobile Advertising

By leveraging data on end-user characteristics, operators can personalize their communication with their customers. Mobile phones are an ideal tool for using this data for one-to-one marketing of services. Freed from the spatial and temporal constraints of end-users, operators can communicate directly with consumers in more or less obtrusive-persistent manners. Mobile advertising is one of the marketing methods used by Telenor to promote its services. Telenor conducts mobile advertising in several ways.

Personalized automatic reminders when pre-paid customers' accounts fall below 10 credits, reminding them to recharge their accounts and informing them about the mobile commerce, is one. Not only does this provide promotion of the service, it serves as a reminder of the code words for customers who have already used the service. End-users are informed about the mobile commerce solution for recharging accounts wherever they may be situated, and can choose freely if and at what time they wish to respond, at any location, at any time and in any context, as long as they have access to the network.

Mobile advertising is also used when end-user prompt the service for information regarding their pre-paid accounts. When pre-paid account holders query the operator for the value of their pre-paid account, e.g. by sending **SALDO** to **2525**, information about the mobile commerce service has been automatically added to the end of the account information message.

In an effort to facilitate the adoption process, consumers who recharge pre-paid accounts through mobile commerce receive 15% bonus in credits. Pre-paid subscribers who recharge their subscriptions through traditional interfaces, such as recharge cards and ATMs, do not receive this bonus.

5.3 Summary

In summary, to become a mobile commerce customer, end-users first need to go through a registration process, which is accessed either by Internet or via SMS. Upon registering, a postal package containing the security solution is shipped to end-users by mail. The mobile commerce pre-paid service is one of many services available upon registering with mobile commerce. It provides subscribers of Telenor Mobil with the possibility to recharge pre-paid accounts via SMS, freeing them from spatial, temporal and contextual constraints. Telenor Mobile Commerce uses mobile advertising to promote the pre-paid service.

6 Adoption Theory

*“Mobile commerce is expected to be the next big wave of business
[Khalifa and Sammi, 2002]”*

Given the high penetration rate of mobile phones, closing on 80% in Scandinavia (see figure Figure 6-1), and the rapid growth of exposure to mobile communication services in general, the adoption of mobile commerce may seem a sure thing. Many mobile commerce services have thus been developed and some are already in use.

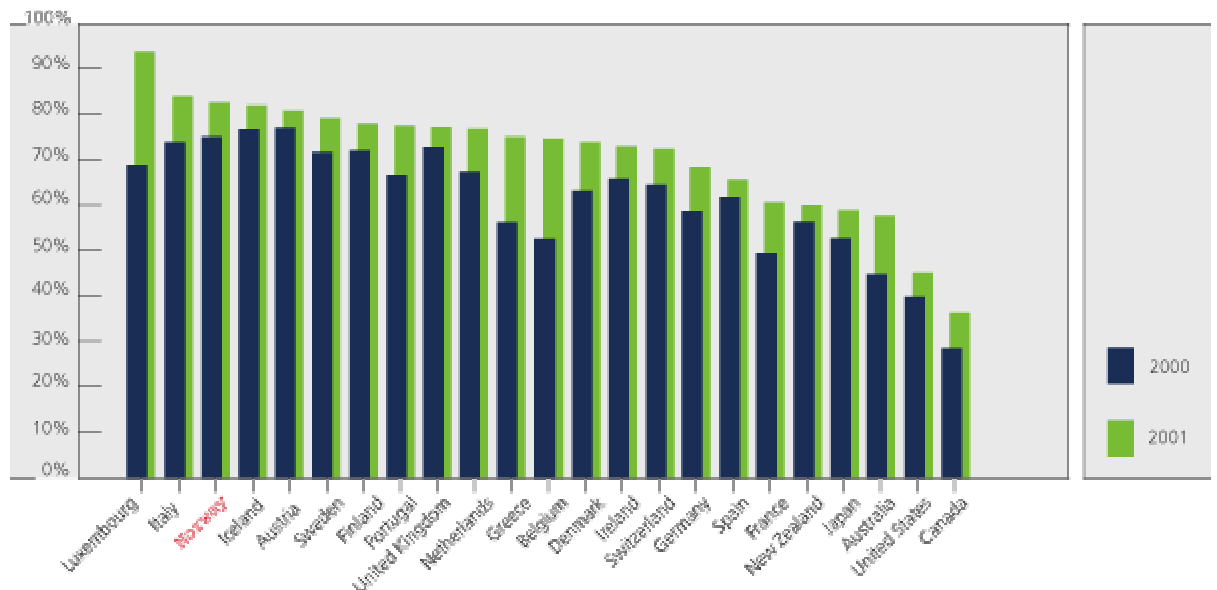


Figure 6-1 Penetration rate of mobile phone subscribers world wide [NPT, 2003]

However, despite the high penetration rate of mobile phones in Europe, adoption of WAP services has been slow. Technological explanations, such as low bandwidth and interface limitations, are given for the slow adoption of these services. Technologies like HSCSD and GPRS (see chapter 4.1) may overcome many of these limitations, but Pedersen [2001b] suggests that non-technological explanations are necessary as well.

The case of Japanese I-mode service is often used to illustrate that other reasons for the slow adoption must be addressed. Initially the bandwidth, interface and service functionalities of the I-mode service were very similar to the European WAP-based services of today. More than 19 million I-mode subscribers were using the service in February 2001. When confronted with this success, European operators often refer to non-technical explanations, such as cultural differences between Japanese and European mobile phone end-users, different pricing schemes, and different end-user experiences due to the packet switching technology of the I-mode service. Technological and non-technological explanations should therefore be combined to understand slow adoption of mobile Internet in Europe, and consequently of mobile commerce.

This chapter introduces theories on mobile commerce adoption. Chapter 6.1 defines adoption and presents the life cycle of technology adoption. In chapter 6.2, three interrelated context dependent adoption perspectives are presented. Finally, in chapter 6.3 a triangulation of these perspectives is presented, forming an adoption framework, which will be applied and validated in this study.

6.1 Life cycle of technology adoption

*“Adopt
: choose to take up or follow an option or course of action [Oxford Dictionary,
2001]”*

In this study, I define adoption as *the evaluation process prior to the first purchase and the post-decisional evaluation process which leads to continual use of a specific service.*

To better understand the evaluation process and acceptance of new technological products, Moore [1999] presents the technology adoption life cycle, originally developed by Rogers [1995]. The model describes market penetration of technology innovations in light of the consumers using the product. As seen in Figure 6-2, Moore categorises adopters of technology innovations into five types of consumers; innovators, early adopters, early majority, late majority and laggards. The technology adoption life cycle focuses on moving from left to right in the curve, capturing each of the segments gradually.

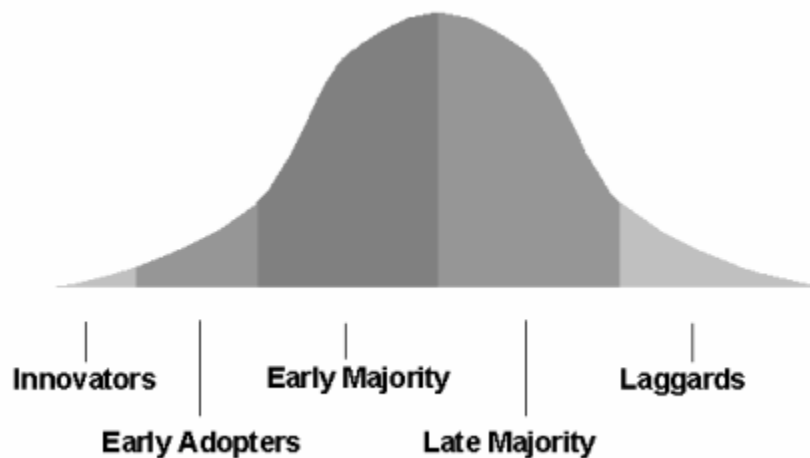


Figure 6-2 Technology Adoption Life Cycle [Moore, 1999]

Innovators typically pursue technology products aggressively.

Early adopters are, on the other hand, not technologists, but buy into technology innovations at an early stage in the life cycle. They typically appreciate the benefits of new technology and relate to them. Early adopters do not rely on well-established references in choosing to adopt a technology, but decide based upon intuition and vision.

Early majority adopters are driven by practicality, and typically wait and see how others adopt to the innovation. In contrast to the early adopters, early majority adopters rely on well-established referents before making an investment into an innovation. This category comprises of one third of the total buying population.

Late majority adopters are less comfortable in handling technology products. They wait for established standards and demand support. They typically buy from large, well-established companies and comprise of another third of the total buying population.

Laggards are late adopters of technology and choose not to adopt new technology due to both personal and economic reasons.

As can be seen from the model, different phases in the life cycle of any given technology have an influence on the types of end-users who choose to adopt it. Not only does the model prove useful in depicting which phase of market penetration the technology is in, but the characteristics of its end-users, e.g. being early adopters or early majority adopters, influences which determinants are important for adopting the technology. It is therefore not only useful in capturing which segment current consumers of the mobile commerce pre-paid service belong to, but based on the consumer attitudes associated to each segment, it is useful in understanding which determinants are most influential on their choices to adopt the service. The model also illustrates how these determinants may change in a later phase of the adoption life cycle. As we will see in the following chapter, all of the technology adoption models emphasize that beliefs and attitude towards certain behaviour are important determinants of an individual's intention towards adopting that particular behaviour. Chapter 6.2 presents many of the determinants that influence adoption decisions of technology innovations.

6.2 Determinants of adoption

The elements that influence the outcome of the adoption evaluation process are the focus for this study, and are denoted determinants of adoption. To fully understand the adoption process of mobile commerce, Pedersen and Methlie [2002] suggest studying the mobile commerce service end-user in three context-dependent adoption perspectives. These perspectives view the individual as a technology end-user, a consumer and a network member, and are described thoroughly below. Each perspective is illustrated by a relevant model, consisting of a modified version of the decomposed theory of planned behaviour for the technology end-user, the customer life cycle model for the consumer and a social network analysis as a basis for the network member.

6.2.1 Technology Adoption

In IS literature, several behavioural models have been proposed to describe the adoption of information technology. Amongst these are the Technology Acceptance Model (TAM) proposed by Davis [1989], the Theory of Reasoned Action (TRA) which was presented by Fishbein and Ajzen [1975], the extension of TRA into a Theory of Planned Behaviour (TPB) by Ajzen [1985] and finally the decomposed Theory of Planned Behaviour proposed by Taylor and Todd [1995]. The models explore determinants for adoption in direct relation to the technology, labelling the end-user as a technology end-user.

In all of these models, beliefs and attitude towards certain behaviour are important determinants of an individual's intention towards adopting that particular behaviour. Pedersen [2001] bases his research on the original models integrating many of the most important findings on adoption behaviour of domestication research into a modification of the decomposed Theory of Planned Behaviour. His model and proposed extensions and modifications are progressively described below.

Technology Acceptance Model

TAM was designed in 1986 by Davis to predict future use of Information Systems. According to Davis [1989], an end-user's attitude toward a specific technology and its perceived usefulness were determinants for her behavioural intention, as illustrated in Figure 6-3.

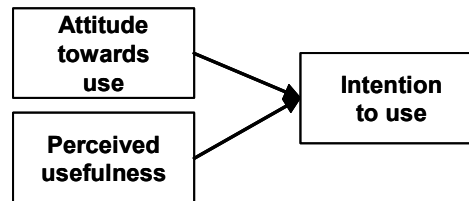


Figure 6-3 Determinants for Behavioural Intention.

*“Intention:
aim or plan [Oxford Dictionary, 2001]”*

Intention can be defined as a person's determination or aim in acting a certain way [Oxford Dictionary, 2001]. Behavioural intention in mobile commerce therefore reflects to what degree an individual plans to actually use the service. This plan, followed by a decision to use or discard a service, is influenced long before she actually touches its interface for the very first time [Myers & Avison, 2002]. This raises an important issue in applying the TAM model to the adoption of mobile commerce; instrumental utility and usefulness is insufficient in obtaining widespread adoption of end-user services [Pedersen and Methlie, 2002]. Well-designed and user-friendly interfaces are important, but not enough to influence an end-user's intention to adopt the service.

*“Usefulness:
the quality of having utility and especially practical worth or applicability
[Webster, 2003]”*

Usefulness is a derivative of useful, which is concerned with the convenience and practicality of an action or object. A service's perceived usefulness depends on the extent to which an application contributes to the enhancement of the end-user's performance [Davis, 1989]. The enhancement of end-user performance is seen by Davis in an organisational context, but can also be applied outside this context. For mobile commerce end-user services, enhanced performance implies to which extent utilizing the service provides added value, improving the end-users perceived quality of the service.

*“Attitude:
a feeling or emotion toward a fact or state [Webster, 2003]”*

Attitude reflects a way of thinking or feeling about someone or something and an attitude toward any given technology is the result of an evaluation and implies both positive and negative feelings. Pedersen [2001] believes that the attitude formation process for usefulness, ease of use, enjoyment and expressiveness is similar in that an individual sees a service as instrumental in fulfilling various gratifications or not, thereby developing a positive or negative attitude towards using it. For established services intentions to use the services may be based upon general attitudes and less on experimentally derived motives. For new and unknown services such as mobile commerce services, instrumental and experimental motives may be the most important explanations of end-user intentions.

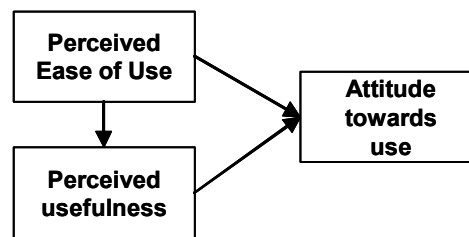


Figure 6-4 Determinants for Attitude.

Davis [1989] goes on to claim that an end-user’s attitude is determined by both perceived usefulness and its perceived ease of use. It is important to notice how the end-user determinants are based on *perceived* usefulness and end-user friendliness, in contrast to some “objective” measure [Pedersen and Methlie, 2002].

*“Ease:
absence of difficulty or effort [Oxford Dictionary, 2001]”*

Ease of use relates to the degree of labour affiliated with a certain action. Within mobile commerce, ease of use concerns to what degree an end-user believes adopting the service would be free of effort. Ease of use of an action is also proposed to influence end-users’ perception of its usefulness. As mobile communications services differ in complexity and ease of use, their adoption process also differs [Pedersen et. al., 2002]. Perceived ease of use is also dependent on which phase in the adoption life cycle the end-users are associated. Innovators and early adopters are more likely to bear with bugs and glitches in a service than end-users associated with the late majority.

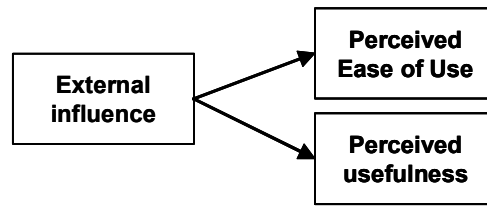


Figure 6-5 Determinant for Ease of Use and Usefulness.

Davis' model also proposes that external variables influence end-users' perceived usefulness and ease of use.

*“External
: not intrinsic or essential: situated outside, apart, or beyond [Webster, 2003]”*

The term external is concerned with aspects that come from a source outside the subject affected, while influence relates to the power or ability to affect someone's beliefs or actions. External influence in mobile commerce adoption therefore relates to social issues that may have an impact on the adoption process. One such critical issue may be exposure to information about the services. Observing others use a mobile commerce service may very well influence an end-user's perception of the service's usefulness and ease of use. Whether this leads to actual use of the system, however, depends on the strength of the end-user's behavioural intention [Khalifa and Sammi, 2002]. A summary of these determinants is illustrated in the figure below.

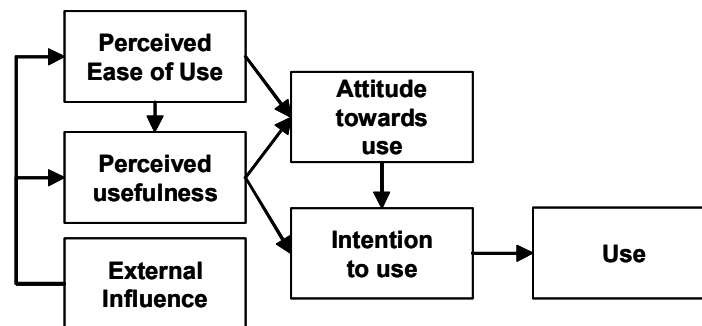


Figure 6-6 Technology Acceptance Model [Davis, 1998]

Extending TAM with the decomposed Theory of Planned Behaviour

TPB was originally designed to predict behaviour in many settings, and is based on the Theory of Reasoned Action (TRA). The importance of end-user expectations is included in these models, which in contrast the TAM model lacks. The divergence between communicated expectations and end-user perceptions may seriously affect end-users' long-term attitudes towards mobile commerce services and slow individual end-user adoption [Pedersen, 2001].

TRA also stipulates that human behaviour is preceded by intentions. These intentions are formed based on an end-user's attitude towards the behaviour, subjective norms and control beliefs. In research on mobile commerce adoption, Pedersen [2001] suggests extending TAM with these variables and applying a modified version of the decomposed theory of planned behaviour.

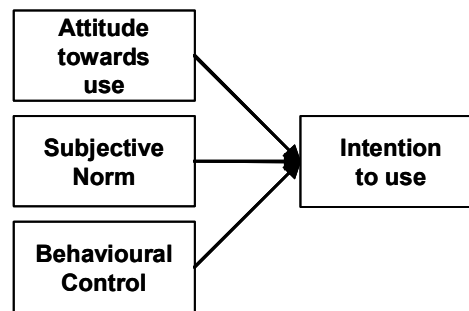


Figure 6-7 Determinants for Intention.

*“Norm:
a standard that is required or acceptable [Oxford Dictionary, 2001].”*

Subjectivity implicates an attitude that is based on, or influenced by, personal opinions. Subjective norm therefore reflects perceptions that significant referents desire the individual to perform, or not perform, a behaviour. These significant referents may be family members, peers, authority figures or even the media. The determinants for subjective norm are believed to be context-dependent and Battacherjee [2000] suggests that subjective norm may be determined both by external and interpersonal influence.

*“Interpersonal:
relating to relationships between people [Oxford Dictionary, 2001]”*

An interpersonal influence relates the influence of peers and superiors. Pedersen [2001] suggests some modifications of the model, and adds a covariance between the concepts of interpersonal influence and external influence, as interpersonal relationships are perceived externally and vice versa. Again, the phases of the technology life cycle in chapter 6.1 become relevant. Innovators and early adopters do not rely on well-established referents upon choosing to adopt a service. In contrast, end-users associated with later phases in the cycle are more prone to be influenced by their peers and superiors.

A relationship between subjective norm and behavioural attitudes is also introduced, as research of mobile communication end-user services have shown that not only behavioural intentions are affected by norms. Pedersen also suggests direct links from both determinants of subjective norm to the determinants of attitude, as he proposes the most important determinants for these concepts are expectations of these.

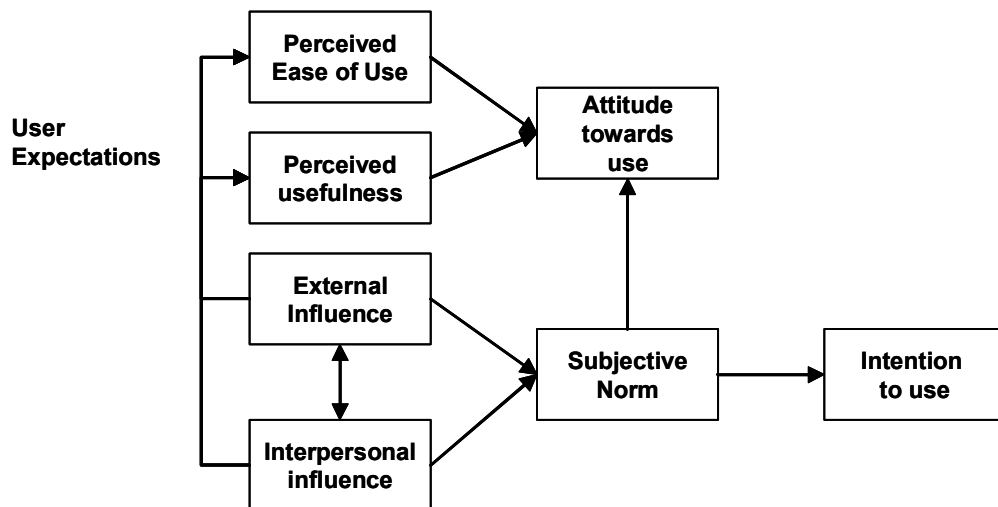


Figure 6-8 Determinants for subjective norm.

Control denotes having power over, limiting or regulating something. Perceived behavioural control reflects the perceptions of both internal and external constraints on behaviour.

The internal constraint encompasses self-efficacy, which reflects an individual's self-confidence in her ability to perform a behaviour [Taylor and Todd, 1995, p. 150]. Pedersen [2001] replaces this constraint with self-control, which goes beyond an individual's self-confidence in her capabilities to master behaviour. A relationship between interpersonal influence and self-control is also introduced, as exposure to a service can improve an end-user's self-efficacy thereby enhancing behavioural control [Khalifa and Sammi, 2002].

The external constraint concerns Facilitating Conditions, which are conditions that make actions easy or easier [Oxford Dictionary, 2001]. Facilitating conditions represent financial and technological support and assistance available to use a specific system. Access to software, hardware and network are examples of such resources. Battacherjee [2000] also suggests that these components be treated as determinants of behavioural control.

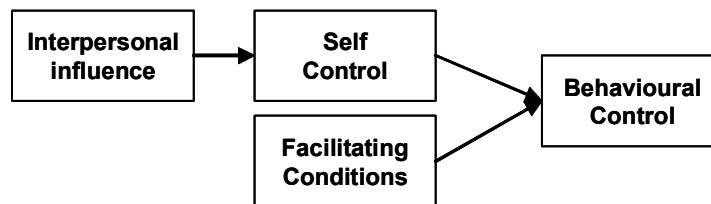


Figure 6-9 Determinants for Behavioral Control.

The final model is illustrated in Figure 6-10. This model presents eleven concepts; ease of use, usefulness, external influence, interpersonal influence, self-control, facilitating conditions, attitude to use, subjective norm, behavioural control, intention to use and actual use and their dependencies. The model aims at covering the determinants that influence the decision-making process for adoption of a mobile commerce service. The strength of the dependencies depends on both the service category and phase in the adoption life cycle of its end-users. General attitudes may, as mentioned earlier, be less influential for new and unknown services such as the mobile commerce pre-paid service. The determinants differ as services vary in complexity and thereby ease of use. Perceived ease of use and behavioural control will not only change over time, as the end-user's exposure to the service increases, but depends upon the segment in which the end-user is associated with according to the adoption life cycle. The next chapter shows how the model can be applied in several phases of the consumer life cycle.

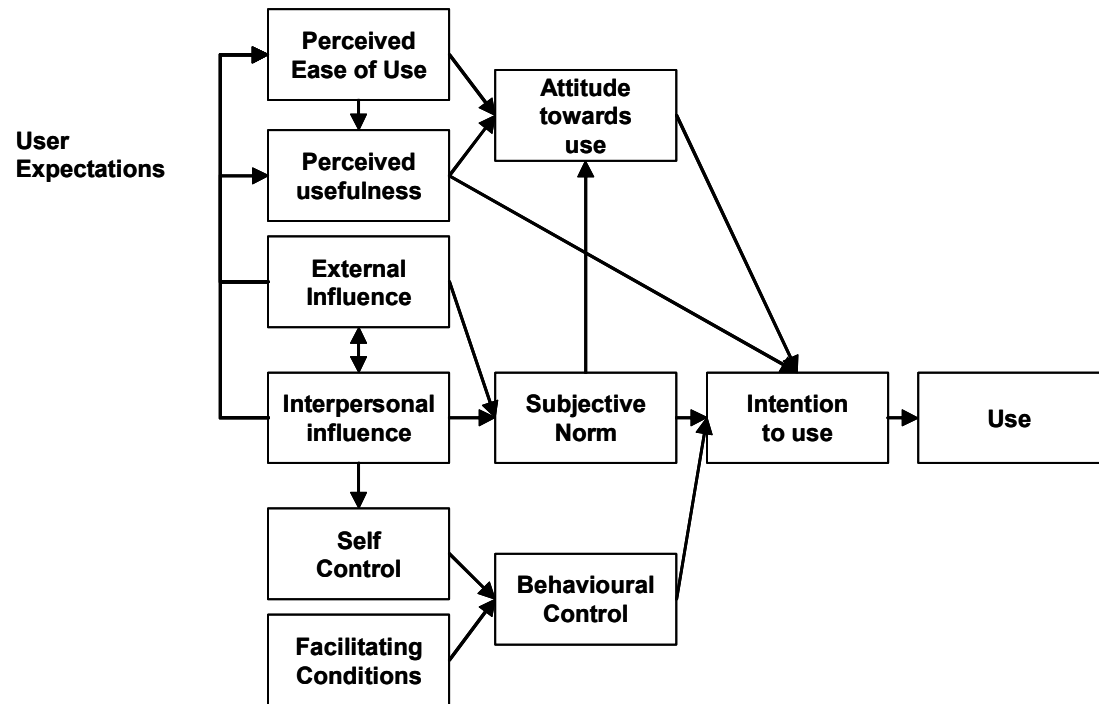


Figure 6-10 Decomposed TPB modified by domestication research findings [Pedersen, 2001]

6.2.2 Consumer Adoption

I define a consumer as *a person who buys a product or service for personal use*. Although mobile commerce end-users are technology end-users, the adoption of mobile commerce should be applied in a consumer context to fully understand the adoption of services. Many mobile commerce services are consumer-oriented and value-added services, supporting the consumption of existing physical goods and services.

Consumer life cycle

Consumer adoption models often focus on the “first-purchase decision”, which is well suited for separate consumer goods. Mobile commerce end-user services, on the other hand, are not context independent services but depend on the adoption of complementary and integrated physical goods and services [Pedersen, 2001b]. Revenue depends upon repetition of identified needs and perceived satisfaction, leading to reiteration of purchases. Traditional decision-based models of the “first-purchase decision” should therefore be supplemented with models of the consumers’ “post-decisional” buying behaviour. The post-decisional phase involves use and maintenance of needs and satisfaction, which includes customer support. Adoption of mobile commerce services should therefore be treated as a transition between stages of increasing consumer sophistication [Pedersen, 2001b]. Consumer learning history and stage in the consumer life cycle should be parts of the applied adoption model [Pedersen and Methlie, 2002].

Channel Integration

Mobile commerce is yet another payment channel which is integrated and mixes freely with other payment channels. Depending on what is appropriate for the occasion, consumers choose communication mechanisms, whether by post, phone, face-to-face or by Internet banking. For simple money transfer between accounts, the choice of channel will depend on the context. If an end-user is currently on-line anyway, she may choose the web interface to conduct a transaction. On the other hand, if she is on the high street and needs to conduct an impulse transaction, she might whip up her mobile phone and conduct the transaction by SMS, WAP or by voice. To be able to integrate these channels, activities such as sales and customer service need to be coordinated across channels at both business and Information Technology (IT) level. Blending products and services across these channels in this manner, is one way organisations hope to maximise revenue, minimize cost and achieve best possible customer loyalty for the operators.

6.2.3 Network member Adoption

End-user services of mobile commerce are not isolated services, and are either integrated or contribute in supporting end-users participating in their networks. One of the reasons this perspective is important, is that mobile terminals are traditionally associated with communication. Another reason is that use will be affected by network effects that can only be understood by applying this perspective. Communication within the networks and the social position of its members are important in network theories of diffusion [Pedersen and Methlie, 2002]. The concepts of external and interpersonal influences presented for the technology-user are especially viable here.

Networks vary from the simplest personal and relational networks to the networks of networks and differ in context. Not only are there social network relationships of families and friends, relationships exist between brands and individual consumers. A network member may participate in several different networks of varying complexity, and the mobile communication end-user services can be viewed as a mediating and coordinating technology between these consumer-oriented networks [Pedersen and Methlie, 2002].

Network Effects

Exposure to technology relates to which extent the individual has acquired or exchanged information about the technology and its usage. Higher exposure to mobile commerce strengthens an individual's attitude toward a given service and makes it clearer [Khalifa and Sammi, 2002]. Self-efficacy and self-control may develop from multiple sources of information, verbal persuasion and vicarious experience in particular [Khalifa and Sammi]. Observing others perform certain behaviours help individuals to gain confidence in her ability to master the same behaviours. Trial of mobile commerce will also have an effect on an end-user's intention to adopt.

User-expectations may also be influenced by exposure to other end-users' opinions or mass media. As presented in chapter 6.2.1, the people surrounding us, and their perception of usefulness, will most likely influence our decision of use [Bergman, 1997]. External influences differ by service and category; some services may be communicated by word of mouth and others by large advertising budgets. Especially in services with strong network effects, user-expectations should not be underestimated [Shapiro and Varian, 1999].

In the above examples, network members are affected by other members' perceptions and use of specific technologies and services. These network effects have an impact on pricing, willingness to pay and adoption of mobile commerce services [Camponovo, 2002].

Social marketing

Another aspect of external influence is how an end-user of mobile communication services uses these services to express style and get access to symbolic capita [Alexander, 2000]. One example is the existence of multiple forms of payment; seen in the context of the "social meaning of money" different forms of payment have different relative social and cultural advantages, rather than technological advantages [Singh, 1999, 2000].

For mobile communication services, Pedersen and Methlie [2002] propose that adoption in general has little background in social influences, although adoption models may very well differ across different service categories.

6.3 A triangulation perspective

Pedersen and Methlie [2002] have combined these perspectives into a common framework. This has been done to achieve a better understanding of how the adoption determinants differ among the different categories of services and different customer scenarios [Pedersen and Methlie, 2002].

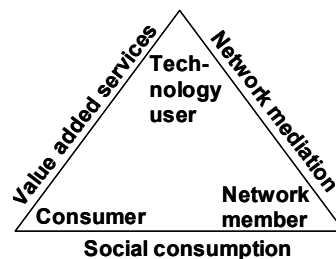


Figure 6-11 Suggested triangulation of perspectives [Pedersen and Methlie, 2002]

6.3.1 Value-added services

In combining the consumer and technology perspectives, one sees how many mobile commerce services are value-added services supporting decision-making and post-decisional consumption activities [Pedersen and Methlie, 2002]. The mobile commerce pre-paid service adds value to consumers by providing them with an additional channel in which they can recharge their pre-paid accounts.

6.3.2 Social Consumption

By combining the consumer and network member perspectives, one sees consumption as a social activity [Pedersen and Methlie, 2002]. As presented in chapter 6.1, social influences will vary depending on which phase in the adoption life cycle the consumer belongs to. In light of the mobile commerce pre-paid service, consumption can be seen in a social context as consumers can recharge the pre-paid accounts of their surrounding social network.

6.3.3 Value-added services

Finally the framework combines the technology and network member, which illustrates how many 3G services represent coordination and mediation services for different networks in which the end-user is a member [Pedersen and Methlie, 2002]. The mobile commerce pre-paid service can be seen as mediating communication between its end-users as they can recharge each others pre-paid accounts through the service. It can also be seen as mediating operators and end-users, as they can communicate directly with their end-users through personalized mobile advertising.

6.4 Summary

The life cycle of technology adoption characterizes end-users of a technology innovation, which is useful in understanding how determinants for adoption differ depending its end-users. To fully understand adoption of mobile commerce services, a framework viewing end-users in three interrelated context-dependent perspectives is proposed. In addition to adoption determinants related to technological aspects, the end-users are seen as consumers and members of social networks. These perspectives are triangulated into a common framework for mobile commerce service adoption, presented by Pedersen and Methlie [2002].

Pedersen and Methlie's research were introduced to me through researchers at Telenor R&D, as an active collaboration between the parties exists. I regard their adoption framework as tentative, assuming that the uniformity and nature propositions are correct. In the next chapter, the framework will be applied to end-users of the mobile commerce pre-paid service in order to validate its concepts.

7 Analysis

Almost all the subjects interviewed were curious about the study, and were more than willing to participate. However, all of the subjects were quick to point out that they were not experts on the field of mobile commerce and none of the subjects felt they had enough experience and knowledge to participate in the study. None but one of the subjects, used other mobile commerce services than the pre-paid service, nor did they have knowledge of the full range of services available. Two of the subjects were not even familiar with the term ‘mobile commerce’, unaware that by using the pre-paid mobile commerce service they were mobile commerce customers and had access to other mobile commerce services. Upon referring to the end-users interviewed, I denote them as *subjects* from this point forward.

The subjects fall between the two consumer types: early adopters and early majority (chapter 6.1). They all claimed to adopt technology innovations at an early phase and all except one were non-technologist, their educational background ranging from middle level school to University College degrees. None of the subjects knew any significant referents that used the service, and had chosen the technology due to its benefits and related to these. However, as we will see later in this chapter, the subjects claimed the most determining factor leading to their adoption of the service, was due to its practicality and usefulness, which indicates that they are also associated with late majority adopters. The ten subjects interviewed belong somewhere in the chasm between early adopters and early majority market phases.

The following chapter presents the results of the case study and applies them to Pedersen and Methlie’s adoption framework. Chapter 7.1, 7.2 and 7.3 discusses the relevance of the three perspectives presented in the framework; technology end-users, consumers and network members respectively. The results are applied to the framework in chapter 7.4 and validated. Additional avenues which the framework might explore are discussed in chapter 7.5.

7.1 The subjects as technology end-users

Based on the findings in the case study, the explanatory power of the determinants in Pedersen's technology adoption model [2001] were analyzed. The original model can be found in Figure 7-2, on page 73. The following chapter focuses on the relevance of each of the determinants in accordance to the mobile commerce pre-paid service. In presenting the material, I split up the model and gradually build in the influencing factors and relevant concepts found in the study.

7.1.1 Applying the results

"We are entering an innovative era, where a lot of exiting things are happening" (Subject #4 regarding the evolution of mobile services)

In order to pinpoint the subjects technological capabilities, the end-users' general attitude towards telecommunications innovations was explored. As mentioned, a majority of the subjects saw themselves as typical early adopters of mobile technology innovations and several of the subjects were genuinely interested in innovations of both terminals and services and would regularly check to see what was new on the telecommunications market. Although interested in new mobile services and phones, the subjects would typically wait until prices decreased before purchasing new mobile phones, which is yet another factor indicating that they belong somewhere in between the two categories of early adopters and early majority adopters in the adoption life cycle presented by Moore [1999].

The subjects were asked to reflect upon why they initially had chosen to adopt the service and the value added in actual adoption. Their responses were unanimous in mentioning practical issues as the most determining factor for their choice of service adoption.

Several of the subjects interviewed came from rural areas, where locating a retailer or ATM was bound to spatial and temporal constraints. They found the service to modify their need to travel, winning them time. Also urban respondents were intrigued by the temporal efficacy and polychronicity of the service. The continuous availability of the application was highly appreciated by all of the subjects, enabling them to recharge their pre-paid accounts anywhere at any time. These findings indicate that the subjects' choice of adoption was related to its usefulness. As subject #1 remarked:

"It (recharging accounts) became much easier. I could lie at home on a Sunday evening and recharge my account from the couch. That's useful!"
(Subject #1 regarding the usefulness of the pre-paid service)

The above citation suggests an influencing relationship between the concept of ease of use and usefulness. Results from statistical analysis of the mobile commerce end-user database also show that motivation to comply is often triggered at the point in time when end-users identified their need of a service. For instance, new end-users who have old SIM cards that do not support SAT receive a message asking them to register via the Internet when they try to initiate the mobile commerce pre-paid service. Very few of these end-users end up as registered mobile commerce customers, as the additional effort of registration becomes too big. The same result was found for the registration process for debit card accounts. Few end-users were found to be bothered with filling out the paper based registration forms and mailing them to the operator. If end-users can not use the service at the point in time when their need has been identified they are not likely to adopt it at all.

Today 87% of end-users register with mobile commerce upon testing a specific service. During the Norway Cup 2003, thousands of youth and their parents participated in football matches in the outskirts of Oslo. Many of the youth were pre-paid subscribers, and found themselves to be in a remote area, far away from ATMs or retail shops selling recharge cards. In order to keep in touch with each other and their parents, the participants needed to recharge their pre-paid accounts. Parents have normally been found to pay for their children's credits and were therefore approached by mobile commerce employees. Discussions with employees participating in the recruitment campaigns such as these, revealed that usefulness of the service was easily communicated towards customers in situations such as the one described above. Their general perception was that exposing consumers to the pre-paid service at a point in time when customer need is easily identified, is important in influencing choice of adoption.

The subjects' responses indicate that adoption of the pre-paid service was based on both instrumental and experimental motives, indicating strong and direct relationships from respectively usefulness and attitude towards intention to use. This coincides with Pedersen's [2001] findings, which indicate that complex end-user-services are likely to be adopted for functional reasons.

Ease of use of both the registration process and the services were explored to see how they affected the subjects' adoption decisions. Although all of the subjects completed the registration process without help, they had not done so without difficulty. None of the end-users were familiar with pop-up dialogs on their mobile phones prior to using mobile commerce, and the end-user dialogs had been subject to misinterpretations. Three of the subjects had trouble with the registration process, having to restart the procedure. These findings coincided with statistics from the mobile commerce end-user database, which show that end-users run through the registration process in average 1.8 times before successfully completing it.

Today, approximately 21% of end-users who try to register with mobile commerce complete the process. A survey, conducted by Telenor Mobile Commerce, towards end-users who chose not to register concluded that one can not expect more than 35% of end-users to complete the registration process. This number was found to be independent of technological solution and user-interface. The main reasons for this were due to the fact that many end-users who are exposed to mobile commerce are not really interested in its services or are under-age. Telenor Mobile Commerce promotes its services to a wide target market, which reaches many customers, many of which try to registering without understanding what they are registering with.

The activation code, finalizing registration, was received through the postal service a few weeks after actual registration. None of the subjects experienced any difficulties in activating the code, although some of the subjects mentioned that they experienced the time gap between registration and receiving the code to be wide. The first of these findings does not coincide with results found in the end-user database, which show that the activation code is subject to many failed trials. The mobile PKI solution is the most common reason for the failures and a new PKI release is being launched as this thesis is in writing (autumn 2003).

Despite the difficulties in registering with mobile commerce, 21% of end-users will not discard the service. Both the mobile commerce end-user statistics and results from the interviews show that although registration failure may very well delay actual use of the mobile commerce pre-paid service; end-users persistently try to register again at a later point in time. Most end-users try to register again the next time they are exposed to the service. This may be the next time their pre-paid accounts fall below 10NOK, and they receive a pre-paid reminder. This indicated a relationship between external influences, usefulness of the service and intentions to use. Although ease of use of the registration process influences the end-users' attitudes to the service, it is the usefulness and ease of use of the actual service that determines the end-users' attitudes toward adoption.

*“It can’t get any easier, unless someone actually did it for me
(Subject #3 regarding the pre-paid service)”*

Upon shifting focus from the registration process to the actual service under study, the overall perception was that of a service that was easy to use, as subject #3 expressed in the above citation. As the pre-paid service is SMS-based, all of the subjects were familiar with the user-interface prior to taking the service into use, and experienced little difficulty in understanding how to recharge their accounts. In contrast to the registration dialog, end-users experienced little difficulty with the SAT dialog that appeared during service utilization. The dialog was generally perceived as easy to understand, with clear instructions. The subjects agreed that the simplicity of the service was an important determinant for adoption, identifying a relationship between ease of use and attitude.

Although the end-user interface of SMS is familiar, the one obstacle that several of the subjects mentioned was remembering specific code words and four digit numbers for the text messages. The subjects would often confuse the code words for transferring money to SmartCash (“overfør”), recharging the pre-paid account (“lade”) and prompting for the credit value of the account (“saldo”). An additional point of confusion was remembering whether to send the message to 2500, which is the case for transferring money to SmartCash, or 2525, which is the case for all pre-paid related services. The pre-paid reminders, see chapter 5.2.1, which the subjects received when they were running low on credits, served as reminders of the code words. Evidence was therefore found that conveniently timed exposure to the service was influential in reminding the subjects of its usefulness and easing its use. Direct relationships between external influences towards both ease of use and usefulness were thereby identified.

External influences, such as mobile advertising, also influenced most of the subjects interviewed in the initial adoption decisional phase, as all except one had been introduced to the mobile commerce pre-paid service through marketing campaigns. Eight of the subjects were introduced to the service either through brochures in the mail or promotional information via SMS. Observations from the participatory observations at the Norwegian Wood festival and responses from the subjects indicate that the usefulness of the pre-paid service is easily communicated, and when exposed to it the subjects were easily convinced of its usefulness. Observations done by employees in the mobile commerce department coincided with these findings, and the success of the pre-paid service as opposed to the other mobile commerce services was believed to be largely due to the fact that its usefulness was easily communicated to potential customers. These findings support the relationship between the concepts of external influence, usefulness and intention to use.

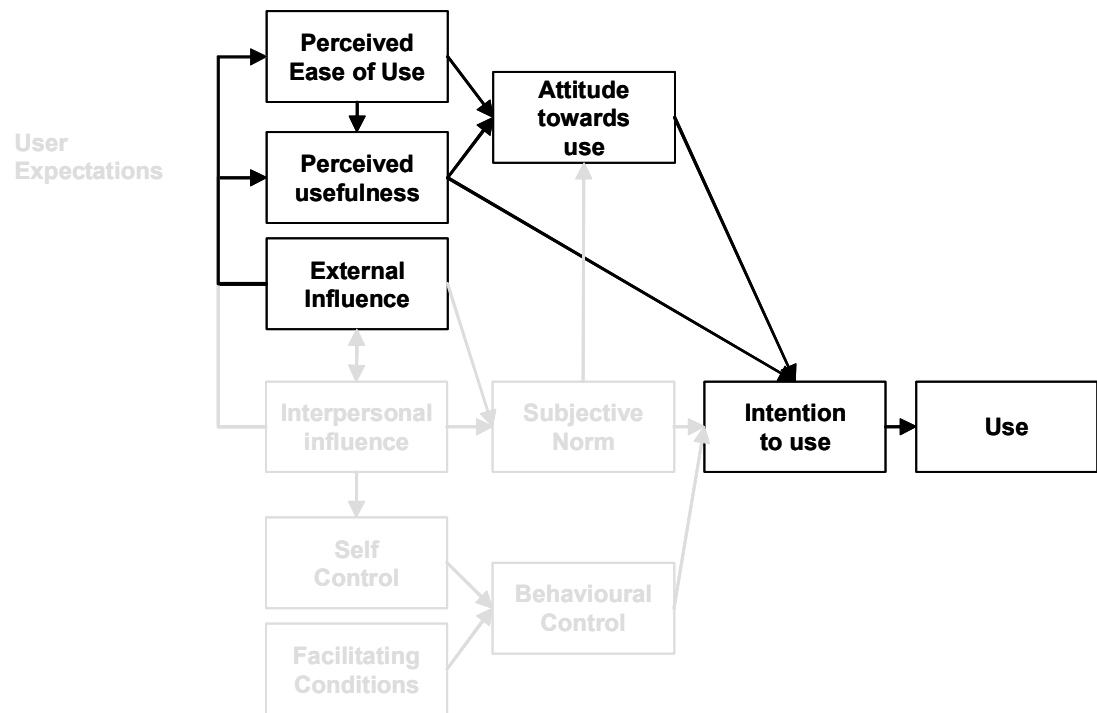


Figure 7-1 The results applied to TAM

“It is strange that Telenor has launched a service that works so badly (subject #9)”

As can be read out of the citation above, the subjects interviewed expected services delivered from Telenor to be of high quality and several of them were surprised to see the registration process fail. These findings were supported by observations at the Norwegian Wood festival and the Telenor Coffee Bar. The registration process often failed and the end-users found this both surprising and annoying. Subject # 10 had been introduced to mobile commerce through a student festival at the Norwegian School of Economics and Business Administration (NHH⁶), where all of the students who participated were given 100 NOK in SmartCash to buy goods and services. Many of her friends were never able to get the service to work, which was highly frustrating, as they had all followed the same procedures for registration. She felt the campaign had given mobile commerce bad word of mouth, many had sworn never to try it again. The divergence between communicated expectations and the participants’ perceptions influenced their attitude towards mobile commerce, and the subject herself was still sceptical towards other services.

⁶ Norges Handelshøyskole

Another common problem concerned failed transactions. Subject # 7 would often receive a message claiming that he did not have enough SmartCash to conduct a recharge transaction even though he knew he had coverage. By repeating the exact same recharge message the transaction would eventually succeed.

The subject's expectations towards ease of use of the service were identified, and prior to taking the service into use they had all expected payment transactions via mobile phones to be more complex than the interface of the pre-paid service. On the other hand, the subjects had not expected the registrations process to be challenging. In reality, they experienced the opposite. The user-interface of both registration process and service are similar, as both are initiated by SMS and completed via SAT dialogs. The fact that so many end-users experience difficulties during the registration process is likely to be due to the familiarity of SAT dialogs. The first time end-users are exposed to SAT dialogs is during registration. They then become familiar with the nature of pop-up dialogs and are more comfortable when interacting through them during service utilization. This may also explain that end-users run through the registration process 1.8 times.

Another important finding was associated with the wearability of the subject's mobile phones. Their use of voice and text message services varied, but they were highly dependent on being reachable. The social network surrounding them expected them to be reachable, just as they themselves expected to be able to reach others. They always brought their mobile phones with them and rarely ever turned them off. The mobile commerce pre-paid service served as an assurance to the subjects that they did not need to be concerned with running out of credits and being 'isolated'. Subject #4 even claimed that the only reason she had switched her subscription to pre-paid, was the possibility of recharging her account by SMS. Recharging her pre-paid account through retailers and ATMs would not have been an alternative for her, as she would have been frequently out of credits. So, although none of the subjects knew other people who used the mobile commerce pre-paid service prior to taking it into use, an indirect relationship from interpersonal influence on subjective norm influencing intention to use was found.

Although the subjects claimed social capita to be unimportant in their choice to adopt the service, all subjects except #10 stated they typically learned about new services through advertisements. Subjects one, three and four stated they were easily influenced by commercials, indicating a relationship between external influence and subjective norm.

Another relevant external influence was the additional 15% credits the subjects received when recharging their accounts by SMS. However, only two of the subjects interviewed felt that 15% additional credits when recharging by SMS was an important determinant for their adoption. The rest of the subjects were indifferent to the matter and subject #2 was not aware of the bonus at all. This suggests that pricing is influential although not determining.

Little support was found among the subjects to suggest a relationship between interpersonal influence and ease of use, usefulness and self-control, as none of the subjects knew any other mobile commerce customers. Customer research at Telenor Mobile Commerce shows that most present end-users register with mobile commerce on their own. Interpersonal influences first became relevant when the subjects themselves tried to convince significant referents that were less technologically literate to adopt the service. As an example, subject number eight, had taught her 49-year-old mother how to use the service. She described her mother as a person who did not typically embrace technological innovations, encompassing low self-confidence in her ability to master technology in general. She would typically belong in the category of late majority adopters in the life cycle of technology adoption. The registrations process had proven more difficult for her than for the daughter, but with her daughter's help and influence she had nevertheless been convinced to adopt the service. The findings support an relationship between interpersonal influences and usefulness and ease of use, especially for late majority end-users. Similar parent-children interpersonal influences were observed during the Norwegian Wood festival. Many teenagers expressed little confidence in their parents' abilities to adopt the service. Many regarded their parents as typical late majority adopters, not comfortable in handling technology. Several of the teenagers were sure that they themselves would have to show their parents how to register with and use the service. The observations support a relationship between interpersonal influence and self-control and indicate that self-control is a more influencing constraint for end-users belonging to this category in the technology adoption life cycle.

The above observations show that although adoption of the mobile commerce pre-paid service is still in its infancy transferral of experience and knowledge does occur. Interpersonal relationships, such as parent-children communication, may be perceived by the surrounding environment. On the other hand, exposure to the service through pre-paid reminders or recruitment campaigns may be perceived interpersonally. Support was therefore found for a covariance between interpersonal and external influences.

“15% additional credits are worth a lot of money, especially when you are a pre-paid subscriber (subject #7)”

An important facilitating condition, making use of the service easier, is the assistance provided by the pre-paid reminders containing the code words for the specific service. The subjects found them very helpful. Another facilitating condition is the use of SMS as the end-user interface for the service. As SMS is a highly adopted and well-known service, the subjects had no difficulty in understanding how the mobile commerce pre-paid service worked. The fact that the access point for the service is a personal device also eases the barriers of behavioural control.

The results indicate both internal and external constraints on behavioural control. Internal constraints were observed to be less influential for early adopters, as they encompassed a high level of self-control. External constraints, such as end-user interface and support, were influential in facilitating adoption.

The subjects' intentions towards use were formed by both attitude towards the pre-paid service and their behavioural control. A weak influence on intentions was also found from subjective norm amongst the subjects interviewed, although this relationship was found to be stronger for adopters in the mainstream market. Intentions formed by these determinants were found to determine actual choice of adoption.

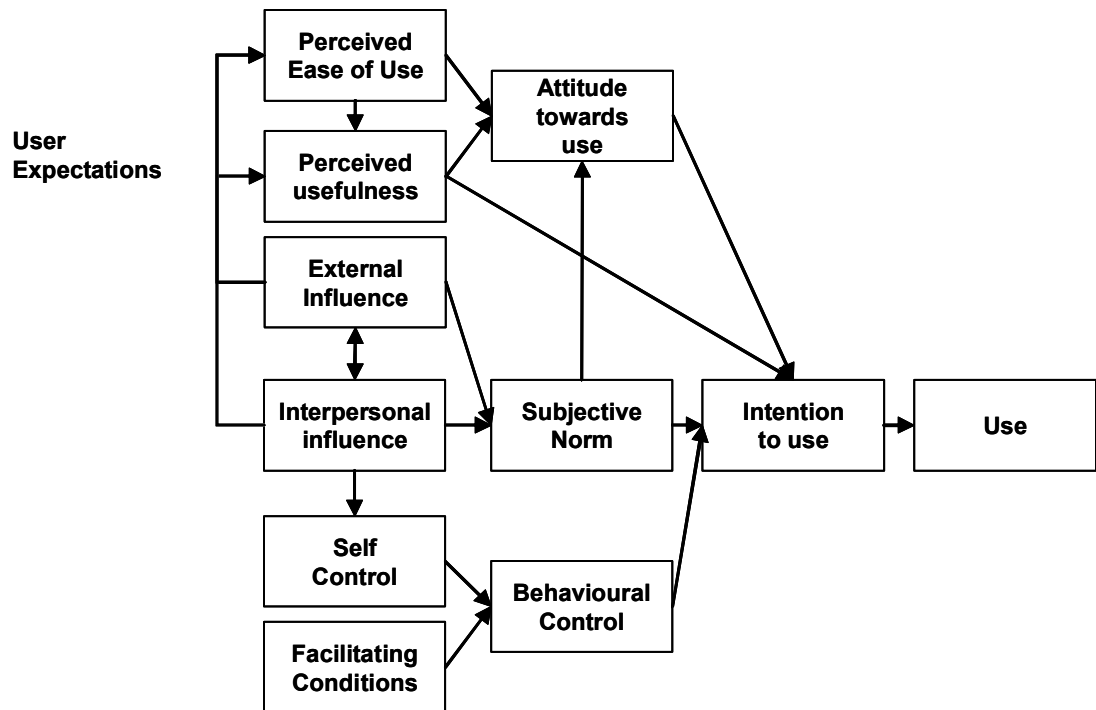


Figure 7-2 Research results applied to the modified version of the decomposed TPB [Pedersen, 2001]

As seen in Figure 7-2, although varying in strength all of the determinants in Pedersen's model were found relevant in influencing adoption of the mobile commerce pre-paid service. The model was found to be dynamic, as its dependencies varied for different consumer types, and as we will see, different phases of adoption. For the subjects participating in the study, validity of the model was established. As discussion of the strengths of the determinants can be found below.

7.1.2 Strength of determinants

In examining the elements in Pedersen's [2001] model, the strongest motives for adopting the mobile commerce were found to be instrumental and experimental. Both the interviews and the results of the participant observations, found usefulness to be the strongest determinant for adoption.

Also, exposure to the service at a point in time where end-users easily identified a need for the service was found to be highly influential on adoption decisions. External influence was therefore also identified as a strong determinant, facilitating adoption and easing behavioral control.

Ease of use was also found to be a strong determinant, freeing the end-users of temporal and spatial constraints associated with the alternative ways in which they could recharge their pre-paid accounts. The well-known user-interface of SMS was also found to be a strong influence on adoption. Especially for less technologically literate end-users, the familiarity of SMS-based services was important.

The element of self-control was found to be strong, as all of the subjects interviewed had adopted the service on their own and saw themselves as highly technology literate. End-users with a lower degree of self control were found to be less determined to adopt the service on their own.

This brings us to the determinant which was found to be weakest; interpersonal influence. For the subjects interviewed, the influence of significant referents was not relevant in their choice to adopt the mobile commerce pre-paid service. None of the subjects knew other end-users of the service prior to adoption and none of them felt using the service provided them with any form of social capita. However, indirectly, interpersonal relationships influenced adoption in the sense that the subjects were dependent on being reachable.

Interpersonal influence was found to be more influential on subjective norms, for less technologically literate end-users. Also, bad word of mouth as a result of registration failures during promotional campaigns was also found to influence adoption decisions.

7.2 The subjects as consumers

The subjects were asked to reflect upon how recharging accounts via SMS had affected their call frequency. No clear change in their call patterns were found. Several of the subjects claimed that they recharged their account more frequently than before, but with smaller sums as they now could decide the value themselves. One of the subjects however claimed to recharge his account only once every three months with 500 NOK. Results from consumer research by Telenor, show that although the pre-paid mobile commerce consumers buying pattern of credits is affected, in that they recharge their accounts more often than before, they do so with lower sums. This does not necessarily affect their frequency of mobile phone use. Only one of the subjects interviewed was found to use her mobile phone more often than before.

7.2.1 Consumer life cycle

Queries toward the end-user database show that 13% of registered customers actually use services, indicating that use of mobile commerce services is not only a first purchase decision. An important distinction between different types of customers needs to be made. Customers who have not linked their bank accounts to their mobile phones are not likely to be active end-users of mobile commerce services. Paying for services is a too complex process for these customers, as they need to fill their SmartCash accounts via Internet banking. In contrast, end-users who have linked their bank accounts to their mobile phones have cash directly available and are therefore more likely to use services. End-users statistics show that 30% of these customers use services on a weekly basis.

During the recruitment campaign conducted at the Quart 2002 festival, focus was directed at registering as many customers as possible. Several hundred consumers registered with mobile commerce, but few of these became end-users of mobile commerce services. This is presumed to be related to the fact that they had not identified need for a specific mobile commerce service. The subjects interviewed all registered with mobile commerce in deciding to use a service, which is the case for most new end-users of mobile commerce. The findings support the importance of identifying a reiterating customer need, as for the case of the pre-paid service where the consumers regularly need to recharge their pre-paid accounts. The findings indicate that consumers should be exposed to services of interest in order to reach a decision of adoption.

The mobility specific functionality of the pre-paid service, combined with end-user statistics in the database, enables the operator to identify the point in time when end-users are in actual need of credits and influence the post-decisional phase in the consumer life cycle. Most of the subjects were exposed to the pre-paid service in a situation where they were low on credits. The wearable characteristic of mobile phones enabled the subjects to register and conduct a transaction immediately upon identifying their need, leading to a high-perceived satisfaction among the subjects. The pre-paid reminders, reminding the consumers they were low on credits and reminding them how to recharge via SMS maintained use by supporting the post-decisional phase in the life cycle.

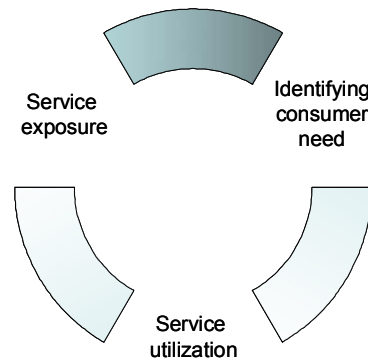


Figure 7-3 Applying the consumer life cycle

The observations indicate that consumption and repurchase are a continual process for the pre-paid service and it is therefore difficult to isolate adoption into simple cycles. Figure 7-3 illustrates the adoption life cycle as continually influenced by service exposure and identification of consumer need.

7.2.2 Breaking the cycle

In an attempt to see what factors could potentially break the customer life cycle the subjects were asked to reflect upon instances that had led to sudden abruption in using the service. Subject #1 had been unable to reregister her new credit card after having her old card stolen. In the months since this had happened she had not been in contact with customer services. In the mean time she had not been able to use the service. Not only did the subject come from a rural area, where access to retailers and ATMs were far in between, but also her children were dependent on her recharging their accounts via text messages. Despite the fact that she was very enthusiastic and dependent of the service, she had not found the time or effort to call customer service to fix the problem, indicating a failure in customer relationship management. Subject #3 had experienced a similar scenario in trying to delete his old credit card information and register his new credit card number.

7.2.3 Channel Integration

The pre-paid service is integrated with other payment channels, as SmartCash accounts can be recharged via Internet banking and pre-paid accounts can be recharged via ATMs and retailers. These channels can be mixed freely, and end-users are free to choose which channels to use. Although the majority of subjects which were interviewed were committed to filling their SmartCash via SMS, subject #2 chose to fill his SmartCash via Internet banking.

The importance of utilizing existing payment infrastructures became evident upon introducing the concept of electronic purses to participants at the coffee bar or at the Norwegian Wood festival. Many participants could not see the usefulness of the purse and why all transactions were not directly deducted from their bank accounts. Subject #2 felt that the payment structure was more complex than it needed to be and was also curious to the necessity of the SmartCash account. He felt that the mobile purse was confusing and felt it would be easier to deduct all purchases directly from his bank account. This conclusion has also been drawn by Telenor Mobile Commerce, and the user-interface has been modified to remove visibility of SmartCash for new customers.

7.3 The subjects as network members

In applying social network analysis, network specific issues in the subjects' adoption scenarios were enlightened. The physical environment and social networks surrounding the end-users were expected to influence the use of the service.

7.3.1 Network Effects

As mobile commerce is in its infancy, market penetration is still low although rapidly increasing. Knowledge of the portfolio of mobile commerce services may also be low, but statistics in the user-database show that 50% of end-users who have tried one service, try another. It was therefore interesting to explore what network effects, if any, did occur.

The most important finding was of subject #1 whose children had switched their subscriptions to Telenor, from a competing operator, to enable their mother to recharge their pre-paid accounts by SMS. As only Telenor pre-paid subscriptions can be recharged through the service, an important relation is built between the customer and provider, creating loyalty. However, the proprietary solution can have the opposite effect, as mobile phone subscribers belonging to other operators who are not able to use the mobile commerce pre-paid service may choose not to adopt other mobile commerce services.

Although none of the subjects interviewed new other pre-paid customers before taking the service into use, transferral of knowledge already occurred among the subjects interviewed as in the case of subject #8 who taught her mother how to use the service. The subject had also spoken about the advantages of the service to friends who had pre-paid subscriptions;

*“It is so much easier than going down to the local gas station”
(Subject #8)*

Most of the subjects did not know any other pre-paid mobile commerce end-users, and most of them had never recharged pre-paid accounts other than their own. Three of the subjects however, recharged their children’s pre-paid accounts.

Network effects need not only be positive, as in the case of subject #10. Her experience at the NHH student festival, where many of the participants experienced both registration and service failures, did not provide a positive image for mobile commerce. As mobile commerce was given a lot of focus during the festival, it was subject to bad word of mouth, which may very well have influenced long term attitudes toward mobile commerce and the operator. Subject #10 claimed that many of her friends swore never to try mobile commerce again.

7.3.2 Social marketing

During the interviews the subjects were asked to what extent they regarded use of the service as providing social capita. None of the subjects felt that social capita was relevant at all in adopting the service as they did not know any other mobile commerce customers prior to use. All of the subjects claimed that mobile commerce was not a topic for discussion among their peers at work or friends. However, subject #8 had introduced the pre-paid service to friends in situations where they had been low on credits the service came in handy. There was therefore little evidence of using mobile commerce for social marketing. Several of the subjects mentioned that they believed that teenagers would gain a higher amount of social capital in using the mobile commerce pre-paid service, as mobile phones and services might be a more common subject among younger age groups.

7.4 Applying Triangulation

Upon structuring the results into the triangulations framework [Pedersen and Methlie, 2002] illustrated below, important relationships between the three perspectives surfaced.

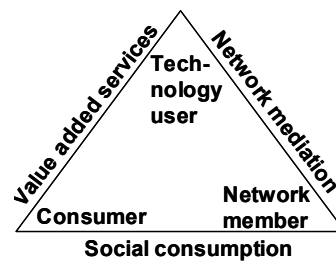


Figure 7-4 Triangulations framework for adoption of mobile commerce [Pedersen and Methlie, 2002]

7.4.1 Value added

In exploring the subjects as a combination of technology end-users and consumers, the subjects were asked to reflect upon the added value of the service. Their immediate response concerned the practicality and efficacy of the service. All the subjects agreed that freeing them from both spatial and temporal constraints added value to the pre-paid subscription and existing recharge solutions.

*“It is superb when you are in need of your mobile phone quickly”
(Subject #1, regarding her motivation to use the pre-paid service)*

Another value added to the consumer is of economic measure and concerns the 15% extra credit bonus for recharging with SMS. Even though few of the subjects felt this was a determinant for adoption it is relevant as an added value for consumers. Approximately 70% of mobile commerce end-users are pre-paid customers, which is due to the fact that the mobile commerce pre-paid service is the only service that has gained considerable momentum. The subjects interviewed claimed their consumption of voice services and SMS services was low, explaining why they had chosen pre-paid subscriptions. However, when I asked how many credits the end-users recharged their pre-paid accounts with, and how often, the responses indicated that they used their mobile phones more often than they thought. Several of the subjects recharged their pre-paid accounts with more than two hundred credits every other week. The subjects who recharged their accounts most often were also the subjects who expressed that pricing was important, which indicated that the end-users may not have been as conscious of their consumption and pricing as they portrayed.

7.4.2 Social consumption

In combining the consumer and network member perspective allows consumption to be seen as a social activity. This becomes clearer when focusing on the fact that mobile commerce allows its end-users to transfer credits to other accounts than their own. While this thesis is in writing (autumn 2003) a recruitment campaign based on consumers recruiting other consumers by recharging each others accounts and thereby exposing them to the service is being launched. The campaign rewards consumers who, by recharging other pre-paid subscribers accounts, influences them to register with mobile commerce and adopt the mobile commerce pre-paid service. Exploring the results of this campaign would be interesting for further research.

Consumption can also be seen as social activity within families where parents recharge their children's pre-paid accounts. The activity enables a kind of remote parenting, as children can stay in touch with their parents and communicate where they are and what they are doing without being able to excuse their lack or reporting by low credits.

7.4.3 Network mediation

When exploring the service in light of the subjects as both technology end-users and network members, their social positions in various networks were discussed. The mobile phone was important for all the subjects as a communication terminal. The most obvious roles were those within group networks of families and friends. Their relationships with the operator through their use of services were also analyzed.

All three of the female subjects who had teenage children used the service to recharge their children's accounts. The parents at the Norway Cup also saw usefulness in the service from a parental perspective. Within families the service can be seen to mediate communication between its members, as parents no longer need to give their children cash or recharge cards face-to-face.

The service under study also mediates communication between the subjects, bank and the operator, traditionally mediated through voice, mail, e-mail, retailers and ATMs. Telecommunication operators are not known to have close relationships with their customers, but for mobile commerce somewhat personalized customer relationship management (CRM) has been enabled. By leveraging the characteristics of the end-user database the service can send personalized messages to each of the customers depending on their use patterns. The pre-paid reminders are an example of this.

However, to maintain positive network relationships between brands and consumers direct, interactive and synchronous communication should not be discarded totally. Subject #9 experienced difficulty during registration and admitted that he was about to discard the service if it had not been for a personal call from customer services. He was impressed by the personal call and claimed it definitely influenced his attitude towards mobile commerce. Establishing direct communication with end-users who experience some kind of difficulty, either with the registrations process or with service use, should therefore be prioritized.

7.4.4 Validating the framework

As seen, the findings of the case study indicate strong support for triangulating the three perspectives suggested by Pedersen and Methlie [2002]. In addition to the technological solution and user-interface, characteristics of the end-users as members of social networks and consumers were found highly relevant in influencing their choices to adopt the mobile commerce pre-paid service.

As discussed, the interpersonal networks of technology end-users may not seem important for early adopters and early majority end-users of technology, but are nevertheless influential for less technologically literate end-users. In viewing other networks, such as relationships between operator and end-user, one sees how communication within these networks has an effect on adoption decisions. Exposure to the mobile commerce service through direct reminders and mobile marketing clearly influenced the end-users adoption decisions.

Support was also strong for including the consumer perspective into an adoption framework for the mobile commerce pre-paid service. Continual exposure to the service, identifying consumer need at strategic times had a strong effect on post-decisional phases in the consumer life cycle.

Validity of the framework was thereby established.

7.5 Additional findings

In addition to the elements presented above, several additional aspects were found worthy of discussion, as they might be valuable avenues to explore.

7.5.1 Self-identity

An issue that has been a focus point in Pedersen's research is the aspect of self-identity, suggesting that people adopt technologies in order to integrate their sense of personal identity. The findings of this study indicate that end-users do not adopt the mobile commerce pre-paid service to show off and gain personal capita. Nor are early adopters and early majority adopters willing to invest high amounts of money in mobile technology innovations.

Adoption amongst early adopters and early majority adopters is more likely to be linked to their personal satisfaction in experimenting with new technology. The element of interpersonal influence was found to be weak for these end-users. Network effects of social pressure were more likely to influence late majority consumers.

7.5.2 Trust

In exploring the subjects' actual adoption and intentions to use they were asked to recount which services they used and how often they used them. They were also asked to reflect upon what potential services they would be willing to adopt. Attention should here be brought to treating these reflections with care, as it is difficult to present integrated services that end-users have not yet been exposed to. Only one of the subjects had tried other services than the pre-paid service and although the rest of the subjects expected products offered by Telenor to be safe, they expressed scepticism towards security of mobile payment in general and were not keen on using other services. As Telenor provides the platform and registration process for mobile commerce and is the service provider of the pre-paid service, none of the subjects felt reluctant to supply sensitive information, such as social security numbers or credit account numbers during registration. This coincides with observations done at the Quart festival 2003 and Norwegian Wood festival 2003. An advantage for the pre-paid service was found to be that it is associated with a known and trusted brand, Telenor Mobil, and does not involve unknown third party content providers.

*“The price of security is complexity”
(Director Mobile Commerce)*

Several of the subjects mentioned that having to collect the activation code at a postal office was somewhat of a hassle. However, the additional complexity of having to personally present identification in receiving the code gave the subjects an additional sensation of security. Subject #10 felt that the amount of paperwork she went through, when registering at the NHH festival gave her the same sensation. Electronic receipts for transactions also contributed to perceived trust in the security of the service.

The subjects were also asked to reflect upon expectations and concerns they had prior to taking the service into use. Several of the subjects pointed out that Telenor is known to be one of the most expensive operators and they were therefore initially suspicious of the mobile commerce pricing-scheme. They expected the service to have either high transactions costs or high annual or monthly subscription fees, similar to those of banks. This coincided with my findings at the Norwegian Wood festival 2003 and in the Telenor Coffee Bar, where the most common response upon introducing mobile commerce was concerns about cost. The same results were found in the Quart 2003 report, where participants were concerned with the cost of transactions. When end-users realized that transaction of text messages was the only cost of the service, many still felt that the text messages sent during mobile commerce service use should be free of charge. Trust in the pricing scheme and security issues seemed important influences in adoption of the service.

7.5.3 Reaching the mainstream market

Based on the findings, the mobile commerce pre-paid service may have captured the market of early adopters and is currently moving towards the early majority consumer market. The service has shown that it has intrinsic value and appeal to non-technologists. Its power and value have been captured and are easily communicated and understood by its end-users. The next leap towards reaching the mainstream market means acceptance among early adopters, who have totally different demands towards the product.

In order to fully conduct the transition from an early market dominated by visionaries to a mainstream market, ease of use of the service needs to stabilize. The majority of technology adopters are not prepared to bear with the inevitable bugs and glitches of innovative technologies in the market. Early majority end-users expect productivity improvement by buying into the product. They want enhancement and not to debug someone else's product. Today's mobile commerce platform does not provide services that are integrated appropriately and work properly with the existing technological base of mobile phones. Both registration process and services suffer from bugs and glitches associated with being in an infancy stage. Thus mobile commerce may not be ready for this market segment as of yet. Mobile commerce services must first be made increasingly easier to adopt, the registration barrier being hard to overcome for the majority of mobile end-users that are less comfortable in handling technology products. In situations where there is significant divergence between communicated expectations and perceptions, the end-users attitudes toward both mobile commerce services and the operator are influenced.

In addition to the technology barrier, significant referents were observed to influence mainstream adopters. Little evidence was found to indicate a relationship between interpersonal influence and perceived ease of use, usefulness and self-control among the subjects interviewed, which is typical among early adopters of technology. The concept of interpersonal influence was found to be relevant when the subjects attempted to transfer their knowledge to less technologically literate end-users. The majority of adopters rely on well-established references when adopting technology, which will be increasingly possible when the pre-paid service achieves a higher penetration rate in the market. At that point in time, mobile telephony end-users will potentially experience a higher level of exposure to mobile commerce from their surrounding network, influencing their subjective norm as well as their usefulness and ease of use. The findings stress the importance of existing customers acting as ambassadors and references of mobile commerce instead of communicating bad word of mouth.

The Telenor mobile commerce pre-paid service is unique in Norway, as no other solutions are currently found on the market. In reaching late majority adopters, the operator has an advantage in being a large and well-established company. The observation of trust in the relationship between the operator and the consumers, concerning security issues, indicates a strong brand. As scepticism was associated with third party service providers of mobile commerce services and products, there is reason to believe that Telenor mobile commerce should be even more visible to its end-users when marketing services from third party providers, to stipulate that the same level of security be assured for all the mobile commerce services.

7.5.4 Customer relationship management

In order to preserve existing consumers, and especially in recruiting less technologically literate end-users, the operator should consider closer customer relationship management. Consumers in the later phases in the technology adoption life cycle expect a high level of support and although the cost is high in pursuing personal, interactive and synchronous communication with individual consumers who experience some kind of system failure, it may prove vital in maintaining relationships that have already been established. This is especially important for mobile commerce service, since they have been prone to a high degree of system failures. The findings indicate that even early adopters are not likely to take action in fixing the problem when services fail.

8 Conclusion

The goal of this study was to acquire a general understanding of end-users' adoption behaviour, related to the specific mobile commerce pre-paid service and thereby validate the adoption framework presented by Pedersen and Methlie [2002].

The following chapter summarizes the conclusions found during the study. Finally, chapter 8.2 presents further areas of research.

8.1 Conclusion

In order to achieve validation, the adoption framework was applied to a group of mobile commerce pre-paid consumers. The results may be applied in designing the content and interface of mobile commerce end-user services, and assisting in choosing the right business models for distribution and marketing of these services.

In the empirical Case Study, I discussed determinants related to three context-dependent perspectives with ten end-users of the mobile commerce service, in addition to observing tens of end-users interact with it. The results were analyzed and structured according to the adoption determinants that were identified. The generalizability of the results is limited to generalizing the theoretical framework to a description of end-users of the mobile commerce pre-paid service in Norway today.

The main findings from the study, suggest that experimental and instrumental motives are the strongest determinants for adoption of the mobile commerce pre-paid service. Timing of service exposure was also found important in influencing both initial and post-decisional phases of consumer adoption. Validity of Pedersen and Methlie's adoption framework [2002] was found.

8.1.1 The technology end-user

In applying Pedersen's [2001] model for technology adoption illustrated in Figure 8-1 below, I found its concepts and dependencies to be valid for end-users of the mobile commerce pre-paid service.

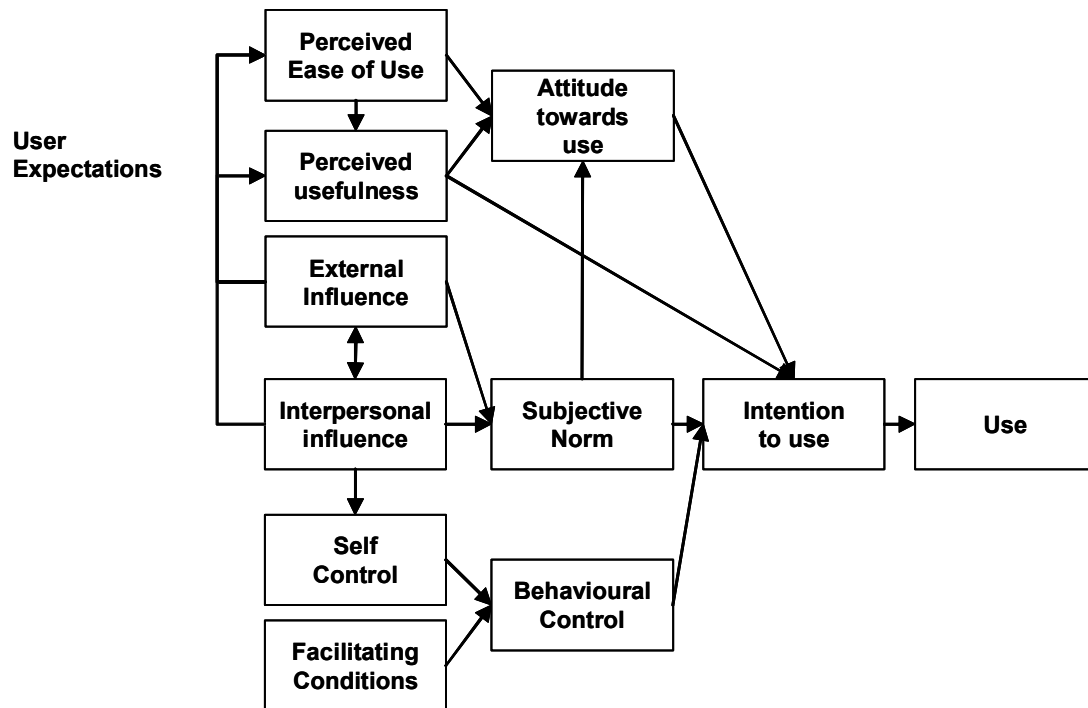


Figure 8-1 Decomposed TPB modified by domestication research findings [Pedersen, 2001]

For the subjects interviewed the strongest determinants for adoption were based on experimental and instrumental motives. The influence of usefulness was strong on both attitude and intention to use and the expectancy relationship from external influences was clear, as the usefulness of the service had been easily communicated towards its end-users. As the mobility-specific functionality of the mobile commerce service allowed its end-users to respond immediately upon exposure to the service, intention was influenced in a situation where they could easily identify need for the service.

Registration proved difficult and served as a barrier delaying adoption. At the same time, many consumers who had managed to complete the registration process had not adopted any mobile commerce services. Perceived ease of use and usefulness of an actual service was found to determine adoption, influencing both attitude and intention. Again, exposure to a service at the right time and place, when the consumer could identify a need for it, proved important.

Interpersonal influence was found to have little relevance in the decisional phase of adoption, as was found to be typical for early phases in technology adoption. An indirect relationship between interpersonal influence and subjective norm was found among the subjects interviewed. The relationship may very well be service specific, as it was due to the specific functionality of the mobile commerce pre-paid service; increasing reachability for its end-users. Support for interpersonal influences was found among less technologically literate end-users, as influencing ease of use and self-control.

A relationship was established between external influence and subjective norm. I thereby found less support for the relevance of subjective norm among the subjects interviewed. Instead, the determinants of subjective norm, external and interpersonal influence, were found to influence perceived usefulness and ease of use for less technologically literate end-users. Self-control was identified as an important influence on behavioural control for both early adopters and early majority adopters, influencing their technological abilities to adopt mobile commerce with or without the influence of significant referents.

Customer support through pre-paid reminders and SMS, were both found to be relevant and influencing facilitating conditions. However, an additional need for direct customer relationship management was identified, when consumers experienced some kind of technological difficulties with the service. These conditions were found to influence behavioural control and thereby adoption of mobile commerce.

Intention to use the service mediated all the relationships between endogenous variables and use, as no other determinant was found to influence use directly.

The concept of trust was found to be relevant in the adoption of mobile payment services. Scepticism towards both security and pricing of services indicates that the brands associates with service providers and operators are relevant in influencing the adoption of mobile commerce.

8.1.2 The consumer

Applying the consumer perspective illustrated how buying patterns are affected by the mobility specific functionality of mobile commerce. The pre-paid service did not seem to affect call patterns. The consumer life cycle enlightens the relevance of repurchase and reiterating consumer need. In order to maintain consumer satisfaction and loyalty, the post-decisional phase in mobile commerce adoption can be supported by personalized communication between operator and consumer based on behavioural patterns and demographics found in the end-user database.

By integrating the service into existing payment channels, development costs were minimized. Moreover, by allowing these channels to mix freely, consumers' were able to choose their preferred payment channel, depending on occasion.

As the service binds its consumers to one operator, one way of achieving their goal of customer loyalty and at the same time open up for new revenue streams has been identified.

8.1.3 The network member

In light of the network perspective, several network effects on adoption of mobile commerce were identified. A result of binding the mobile commerce pre-paid service to Telenor was loyal customers. Other mobile commerce services may not have this effect, as they are not dependent on this consumer-operator relationship.

Technological failures and weaknesses in the mobile commerce platform may have long-term effects on attitudes and intentions to adopt services. The results indicate that by identifying need for a mobile commerce service and exposing end-users at the right time, attitudes and intentions may easily be influenced in a positive direction.

No evidence was found to indicate any relevance of social marketing in the adoption of mobile commerce among the subjects interviewed.

8.1.4 Triangulation

Triangulations of the above perspectives lead to further conclusions concerning adoption of mobile commerce.

The mobile commerce pre-paid service was found to add value to its end-users in providing a new channel of recharging pre-paid accounts, which freed them from both temporal and spatial constraints. In addition to financial value, these added values were identified as the most influential determinants adoption. Identifying added value during the decisional phase of adoption was found to be important, for post-decisional consumption. Consumption of the mobile commerce pre-paid service was seen as a social activity, as its end-users were enabled to recharge the pre-paid accounts of others in their social network. Evidence was found to support seeing mobile commerce services as mediating networks. Social networks, as those between parents and teenage children, were found to be particularly relevant. Networks between operators and consumers were also mediated through mobile advertising.

8.1.5 Validating the framework

For adult end-users, crossing the chasm between early adopters and early majority adopters of the mobile commerce pre-paid service, validity of Pedersen and Methlie's framework [2002] was found. The findings are therefore true, as they reflect the reality of the subjects interviewed and observed in the study. They are also certain, as they are backed by evidence uttered by the end-users themselves.

8.2 Further Research

As mobile commerce is in its infancy, there are many unexplored areas, which may serve as basis for further research. Not only are there unidentified use areas to be explored, but enhancements of existing solutions need also be developed.

Results from the on-going recruitment campaign, where pre-paid consumers are prized when recruiting family and friends to use the mobile commerce service, serves as grounds for further research into social consumption of services and its affect on adoption of mobile commerce services.

Further research needs to be conducted in applying the adoption model to other categories of services, such as mobile commerce entertainment services. Multimedia services, such as games, cartoons, pictures and movies, are typical 'kill-time' services, as apposed to the 'win-time' financial services, such as the pre-paid service. The determinants that influence adoption in these services may very well differ from those of the service studied in this study, and identifying them would serve useful for further understanding of determinants for mobile commerce service adoption.

The complexity of mobile commerce services compared to other mobile services is largely due to a higher amount of technological elements involved in the infrastructure. One of the major challenges for mobile commerce has been developing a platform that is compatible with the range of mobile terminals in the market today. Mobile commerce services have yet to achieve full mobility, as several of its applications fail to communicate with specific terminals and software. Defining technological possibilities and constraints in achieving this would serve as a useful area for further research.

Further exploration into the relevance of remote parenting of the pre-paid mobile commerce service could also prove insightful, as I observed the service to be useful to parents with teenage children with whom they wished to keep in touch.

In light of the aspect of parenting, the case study revealed only female subjects recharging their children's pre-paid accounts. Although significant adoption differences based on gender were neither observed nor the focus of this study, an investigation into gender issues may prove useful in creating further personalized interfaces with consumers. By extending the framework and applying gender issues to mobile commerce adoption, new determinants may surface.

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Appendix B Mobile commerce services

SmartCash & bank account payment by sending an SMS to 2500

VENDING MACHINES

ABRA vending machines	Chocolate and candy. Code words: DIGG <vending machine ID>
Ringnes Soda	Sodas at Ringnes vending machines. Code words: BRUS <vending machine number>

SUPPORTING AID ORGANISATIONS

Care	Financial gifts to this world aid organisation. Code words: CARE GAVE <amount>
MOT	Support work against violence and narcotics. Code words: MOT GAVE <amount>
Norway Red Cross	Support the Red Cross. Code words: RC GAVE <amount>

SUBSCRIPTIONS

Cupido	Six month and annual subscriptions of Cupido. Code words: CUPIDO ABO / CUPIDO ABOH
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PRODUCTS

DVD huset	Movies: Code words: FILM <title> Or visiting www.dvdhuset.no
DVD strax	DVDs. Code words: DVD <title> Or visiting www.dvdstrax.no
Easy Park	Parking tickets. Registration is done by sending the code words: BILREG <licence plate number> Code words for initiating parking: PSSTART TAKSTGRUPPE Code words to stop parking: PSSTOP
Ski pass	Lift passes at ski slopes can be ordered by SMS: <SLOPE> <PASS CODE> <KEYCARDNUMBER> <pass code> reflects type of pass; day pass, afternoon pass a.s.o.
Pre-paid	See chapter 5
Airport bus	Airport bus tickets. Code words: SASBUS
U-wash	Car wash service in the Oslo area. Code words: UW <amount>

LOTTERY AND BETTING SERVICES

SMS Jackpot	Lottery tickets. Code word: JP
SUPER	Betting service on horses. Code word: SUPER

WEB or WAP payment

By entering your mobile account number, payment is deducted through mobile commerce at the following websites:

Autospar Spare parts for cars.
www.autospar.no.

TICKETS

Billettluke Cinematickets
www.billettluke.no

Billettsservice Ticket for concerts, festivals and sports events.
www.billettsservice.no

Filmweb Cinematickets.
www.filmweb.no or
WAP: wap.mobilhandel.no

DVDs, music and electronics

Benni's music CDs and DVDs.
www.bennis.no

My Spaceworld Mobile terminals, data technology and electronics.
www.myspaceworld.com

Snurr DVDs
www.snurr.no

Telehuset Mobile equipment
www.telehuset.no

Xenses Digital cameras, DVDs and MP3 players
www.xenses.no

DIV

Embla Research tools for family research
www.embla.no

Euroflorist Flowers and bouquets.
www.euroflorist.no or
WAP: wap.mobilhandel.no

Pro Stuff Clothes, sunglasses & watches from Nixon and Electric:
www.prostuff.no

Sport-it Sports clothes and equipment:
www.sport-it.no

Mobile Commerce menu at Take Off Coffee Bar

By sending an SMS containing the code words below, the following products could be purchased at the Telenor Coffee Bar during the summer 2003.

Send en SMS - betal med MobilHandel

For å bestille sender du en sms med TAKE ANTALL KODE til 2500

MAT/DRIKKE	SMS KODE	PRIS
Kaffe	take kaffe	kr 6,-
Enkel latte	take latte	kr 16,-
Dobbel latte	take dlatte	kr 22,-
Espresso	take espresso	kr 12,-
Dobbel espresso	take despresso	kr 18,-
Latte m/smak	take mocca	kr 19,-
Dobbel latte m/smak	take dmocca	kr 25,-
Cappucino	take capp	kr 14,-
Dobbel cappucino	take dcapp	kr 20,-
Iskaffe	take iskaffe	kr 16,-
Dobbel iskaffe	take diskaffe	kr 22,-
Fruktshake	take shake	kr 25,-
American Bakery	take kaker	kr 14,-
Baguette ost/skinke	take ost	kr 24,-
Baguette luxus	take lux	kr 30,-
Frokost	take frokost	kr 19,-
Mineralvann	take brus	kr 13,-
Lettøl	take munk	kr 18,-
Pils 0,33	take liten	kr 28,-
Pils 0,50	take øl	kr 42,-
Øl på flaske	take flaske	kr 38,-
Husets glass rødvin	take rød	kr 45,-
Husets glass hvitvin	take hvit	kr 45,-
Bar snacks	take snacks	kr 20,-



Vil du f.eks kjøpe en kaffe latte, send TAKE LATTE til 2500.

Ønsker du å kjøpe to kaffe latte, sender du TAKE 2 LATTE.

Finner du ikke koden til det du vil kjøpe på menyen?

Send TAKE BELØP til 2500. Eks. TAKE 50

Appendix C Interview guide

Kjønn:

Alder:

Bosted:

Utdanning:

Yrke:

Hvordan anskaffet du mobiltelefonen?

via arbeid / gave / kjøpt selv / annet

Hvem betaler abonnementet?

Arbeid / privat / annet

Hvordan ble du introdusert for mobilhandel?

Hvordan blir du kjent med nye tjenester/produkter generelt?

Kjenner du andre som benytter mobilhandel?

Kjenner du andre som kunne hatt behov for mobilhandel?

Foreldre/barn – familie / Venner

Hvordan forholder du deg til mobilhandel som statussymbol?

Hvordan opplever du brukervennligheten til mobilhandel?

registrering / påfylling av kontantkort

Gjennomførte du registreringen på egenhånd/med hjelp fra andre?

Har du opplevd feil/problemer med mobilhandel?

Hvordan kunne tjenesten vært lettere for deg?

Hvordan tror dine nærmeste ville forholde seg til denne teknologien? Foreldre?

Hvor viktig er det for deg å være tidlig ute i å benytte nye tjenester og teknologi?

Er det forskjell på kvinner og menn når det gjelder denne typen teknologi?

Hadde du forventet at det skulle være enklere/vanskeligere å lære seg å bruke mobilhandel?

Hvordan fylte du kontantkortet ditt før?

Hva var utslagsgivende for at du tok i bruk mobilhandel?

Er enkelhet viktig?

Er 15 % ekstra ringetid viktig?

Er tidsbesparelse viktig?

Er nytteverdi viktig?

Hvordan er mobilhandel nyttig for deg?

Hvordan er ditt forhold til tjenester som tidsfordriv? Spill for eksempel?

Hvordan forholder du deg til å benytte mobilen til betaling generelt?

Hvordan vurderer du det sikkerhetsmessig?

Hvordan vurderer du det nyttemessig?

Hvor ofte benytter du telefonen til:

Tale?

SMS?

Påfylling av eget kontantkort? Hvor mye fyller du?

Påfylling av andres kontantkort? Hvor mye fyller du?

Andre mobilhandeltjenester?

Spill?

WAP?

Appendix D Debit card registration form



Ja, jeg ønsker



SmartPay™ - sikker betalingsløsning for MobilHandel

Grå felt må fylles ut

(NB! BRUK BLOKKBOKSTAVER)

For- og mellomnavn	<input type="text"/>
Etternavn	<input type="text"/>
Gateadresse	<input type="text"/>
Postnr. + poststed	<input type="text"/>
Fødselsnr. (11 siffer)	<input type="text"/>
Mobiltelefon nummer	<input type="text"/>
E-Post	<input type="text"/>
Bankkontonr.	<input type="text"/> (min belastningskonto for SmartPay)

Ved utsendelse av nytt SIM-kort, vil ditt eksisterende kort bli deaktivert etter 14 dager.
Vi ønsker derfor ikke å sende ut kort når du er bortreist.

- Jeg samtykker til at det sendes opplysninger og markedsføring elektronisk.
- Jeg vil ikke være bortreist kommende 30 dager
- Jeg vil være bortreist kommende 30 dager: Fra til
- Dag Mnd Dag Mnd

Jeg er kjent med og aksepterer vedlagt «Vilkår for SmartPay™». Betaling med SmartPay™ forutsetter bruk av elektronisk ID levert av Zebsign AS. Jeg aksepterer derfor også vedlagte «Avtale for bruk av elektronisk ID og sertifikatstjenester fra Zebsign». Jeg gir herved samtykke til å belaste min konto når jeg benytter denne tjenesten. Jeg innestår for at alle opplysningene er korrekte.

<input type="text"/>	<input type="text"/>	<input type="text"/>
Dato/Sted	Søkers underskrift	Vergers underskrift (2 stk)
		<small>Kun for søkere under 18 år, med konto i DnB eller Postbanken</small>

Dersom kontoen du har oppgitt ovenfor ikke er en DnB eller Postbanken-konto må AvtaleGiro-delen nedenfor fylles ut.

Jeg har gjort meg kjent med vilkårene for AvtaleGiro og aksepterer at min bankkonto blir belastet med AvtaleGiro når jeg bruker MobilHandel med SmartPay™.

Avtale Giro

Betalingsmottaker Den norske Bank ASA	Mottakerskonto 7001.95.16448	Beløpsgrense per måned <input type="text"/>
		<small>Hvis maks beløp ikke fylles inn, vil beløpsgrensen bli satt til kr 10 000,- per måned.</small>

For- og etternavn	<input type="text"/>
Gateadresse	<input type="text"/>
Postnr. + poststed	<input type="text"/>
Belast min konto: <input type="text"/>	<input type="checkbox"/> Jeg er inneforstått med at jeg ikke blir varslet om betaling jmf. vilkår i avtalen om SmartPay™.
KID	Sted <input type="text"/> Dato <input type="text"/>
	Betalers underskrift <input type="text"/>