Designing Mobile Information Services

An Approach for Organisations in a Value Network

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Voor mijn ouders,

Hans, Primo en Tijn

Colophon

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Preface

In this dissertation we examined how mobile information services can be designed. This is related to design, to management, to the telecommunication sector and to the Internet. All these topics kept me busy in my former lives as student at the faculty of industrial design in Delft, as a student at the faculty of business administration in Rotterdam, while working at KPN Telecom on new telecommunication services and as a consultant in the booming Internet period on strategic Internet marketing projects.

I am indebted to many people that were involved in this study. First I would like to thank my supervisor Henk Sol for managing the process of getting this PhD done. At the right moments he found ways to help me set priorities and to get me to work on this thesis.

I thank my co-authors of various papers, all of whom helped me to improve my scientific writing: Mariëlle den Hengst, Jaco Appelman, Harry Bouwman, Patrick van der Duin, Carleen Maitland and Uta Wehn de Montalvo. Some joint journal articles with Carleen and Uta are still in the pipeline!

The organisation that I joined for my first case study was KPN Mobile, a subsidiary of my former employer KPN Telecom. I worked there as a consultant and could use the project as a case study for this dissertation. I would like to thank the employees of the product innovation and marketing departments of KPN Mobile for this opportunity. In particular, I would like to thank Ingrid Vos for joining me in writing an article and keeping me informed about M-info after I left the company. I would like to thank Mary Berkhout and Franklin Selgert for having discussions on the latest strategies in the mobile markets.

I have had the pleasure of being involved in three research projects organised by the Telematica Instituut in Enschede, PLACE, MOBUS and BITA, of which the last two have been used in this dissertation. I would like to thank the Telematica Instituut for organising these inspiring projects with participants from the Telematica Instituut and also other institutes such as the Delft University of Technology, TNO Telecom (former KPN Research), TNO STB, Lucent technologies, Atos Origin and ING bank. In conjunction with this I would like to thank all the companies that we interviewed to get information for the case study research.

Many people were involved in my final case study, the 'MIES on the campus' project, which was done on the UMTS testbed at Delft University of Technology. The acknowledgments made in the report 'MIES on the campus' are repeated with renewed thanks. Here I will just mention names and organisations: Rudi Westerveld, Amr Ali Eldin, Ralph Feenstra, Mariëlle den Hengst, Jaco Appelman, Peter Jacobs, Roy Chin, Wenlong Zhao, Yan Wang, Gwendolyn Kolfschoten, Fleur Hinse, Jorne Meijer, Joris Knegge, Alexander Verbraeck, Corné Versteegt, Jelle Attema, Evren Akar and Jessica van den Bosch from the faculty of Technology, Policy and Management; Thijs Weenk, Jorg Schiffers and Arnold van der Meer from the faculty of Industrial Design; Ronald van den Heuvel and Ronald Sobel from DTO; Edward Verbree from the former faculty of Geodesy, now part of OTB; Nico Vink and his colleagues from T-

Mobile; Cinco Veldman and Felisberto de Brito of Delft Plaza; George Pluimakers, Evert Janssen, Nico Horsmans and Erik de Kooter of The Vision Web; Jeroen Elfferich and Paul Elfferich of Ex Machina; the firm TomTom; Hans van Dam of Katalogon; Richard Hazenberg of AtoBe; and Frans Kleer from DIE Subisidie. The project was funded by a Senter subsidy and an ICT speerpunt fund, of which René Wagenaar arranged the last. The last persons to thank in this project are the 'victims', the test persons from the ESS conference and students from the SSE course, who played with and tested very enthusiastically MIES, the mobile service for conference visitors!

The PhD project of which this book is the realisation was carried out at Delft University of Technology from 1999 to 2004. The work was done at the Faculty of Technology, Policy and Management, systems engineering group and I am much indebted to my colleagues in this section. I was fortunate to share a room with Mariëlle den Hengst, she had to listen to all my sighs, live with my messy desk and answer many of my questions. I want to thank Alexander Verbraeck for his never-ending enthusiasm for my work and for providing me with very useful ideas and feedback. I owe thanks to all my colleagues in the dynamic systems engineering group for creating and maintaining a good atmosphere with many cups of coffee and sometimes stronger drinks. I would especially like to mention Tonja van Diepen who helped me to get to know all the habits of the university community when I just joined the section, Peter Jacobs for presenting solutions to more than one problem and Corné Versteegt for dragging me away from my computer to the fitness training.

I would like to thank Sabrina Roderigues for supporting me in many practical ways. Thanks are also due to Miranda Aldham-Breary for correcting my English. I want to thank the PhD students Nathan, Martijn, Joyce, Edwin from my 'peer group' and our coaches for the constructive discussions that we had. I wish them the best with finishing their doctoral dissertations.

Last but not least I want to thank my family and friends, my parents who always encouraged me to study, to travel and to work, and especially I owe my three fantastic men at home and on vacation, my comrades Hans, Primo and Tijn who take care of the love and fun part of my life and keep me in touch with the real values. And I wonder how mobile information services will be used as part of daily way in the lives of Primo and Tijn ….

Els van de Kar

Delft, October 2004

Table of contents

1 Introduction

The mobile telecommunications industry is searching for new services, not only to regain its investments in licenses but also to stay competitive in the future. The industry is undergoing a radical transformation and organisations in the telecommunications, information technology and media sector are becoming increasingly interdependent. Organisations collaborate in complex networks to create new mobile information services. The challenging is to design services in these complex value networks.

1.1 The value network for mobile information services

The telecommunications industry has become more complex as a result of liberalisation and the lowering of technological barriers to entry. Due to this the numbers and diversity of players, along with their strategies and business models, have increased (Li and Whalley 2002). The transformation of the telecommunications value chain into value networks has become an issue and the mobile telecommunication industry is typically a phenomenon of this (Li and Whalley 2002; Maitland et al 2002; Olla and Patel 2002; Sabat 2002; Ballon et al 2002). The telecommunication industry, information technology organisations (IT), and the media sector are leveraging the flexibility of digital technology to offer services that go beyond their traditional sectors and target markets. The blurring boundaries between the telecommunications, IT and media industries are becoming further complicated by the emergence of new players leveraging the full potential of the Internet to deliver content, access and services (EITO 2000). Various viewpoints on value chains and value networks for the mobile industry are presented in the literature (Barnes 2002; Li and Whalley 2002; Maitland et al. 2002; Olla and Patel 2002; Sabat 2002). All these studies mention activities or value drivers, actors, roles. The following actors are organisations that are relevant for mobile information services.

Mobile Network Operators (MNOs) participate in multiple platforms on access to the Internet using their knowledge and ensuring funding for joint R&D (e.g. Open Mobile Alliance; www.openmobilealliance.com). One of the issues in these platforms is to enable the use of the Internet Protocol (IP) for voice telephony. MNOs seek to achieve positions as shareholders in *Internet Service Provision* to control the interaction with the customer. Sometimes MNOs own 100% of Internet Service Providers (ISPs) or they make no distinction between the Operator and Service Provider part of the service (e.g. KPN Mobile's iMode). Mobile Network Operators form alliances with media content providers to make their services more appealing to life-style communities and they ally with key players in the IT, retail, finance industries and information/content providers jointly to provide attractive home banking and home shopping solutions. Although the boundaries are blurring, the core of the activities of the Mobile Network Operator and the Service Provider differ. Even when the actors may be the same, the different roles have to be distinguished.

IT organisations benefit from the convergence of the telecommunications, IT and media industries since it increases their potential market. Some organisations like Application Service Providers (ASPs) and ISPs have taken initiatives to develop new channel strategies. At the end of the nineties, IT organisations invested a lot of capital to educate Internet technology developers to accelerate Research and Development (R&D) and the IT industry co-operated with the telecommunication industry in R&D in the area of the Wireless Application Protocol (WAP) technology.

Content providers position the Internet as an extension of their traditional know-how. Media players show a high level of activity in engineering services to offer new media content tailored to the characteristics and marketing rules of the Internet. Content Providers try to use Mobile Internet as a new channel for their stock of available information. This is a real challenge since the mobile device is limited for presentation of content compared to the personal computer. This is core business for new players like content syndicators, who experiment with different access propositions, like homepages customised for a target group and target device.

The *hardware provider* of consumer electronics and network equipment are mainly global players. They have increased their R&D to accelerate the availability of multiple platforms for access to the Internet. Organisations like Nokia have taken co-marketing initiatives with telecommunication and retail organisations to promote their products. The hardware manufacturers are considered to be the main drivers behind developing standards like WAP.

Last but not least, there is the *customer*. Mobile information services are an example of an interlocked innovation, where innovations in the domain of technology, organisational processes, and services have to match customer needs to be successful. Taking into account the chequered history of new technologies and services aimed at consumer markets, careful analysis of customer behaviour would seem advisable. If we want to determine how firms are going to deliver value to their customers, we definitely have to take a closer look at the behaviour of customers that are confronted with an ever-increasing number of alternatives (Van de Kar and Bouwman 2002). The user and customer are often the same actor but this does not always have to be the situation. E.g. in the business market the employer might be the customer of the service provider and the employee the user; in the consumer market parents might be the customer and the children the users. The term 'end-user' also appears to emphasise that this person is the real user and the 'last' one in the value chain.

A simplified picture of the main actors; the customer and the other actors that have a relationship with the customer: the service provider, the telecom operator, the content provider and the hardware provider is shown in Figure 1-1. Other important actors that support these organisations are IT organisations. All these organisations form a (complex) value network that 'produces' a mobile information service.

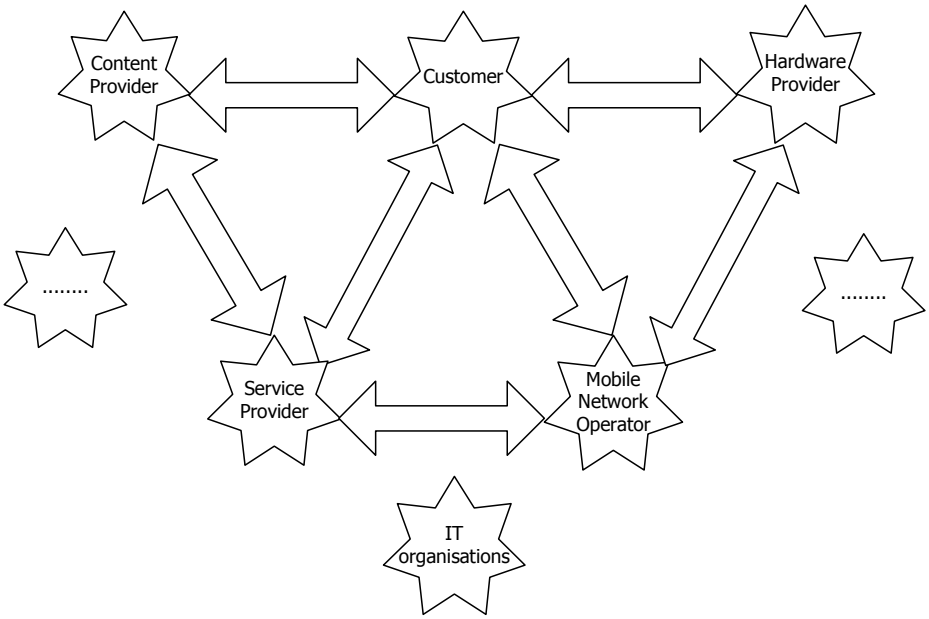

Figure 1-1 Roles and relationships

The above-mentioned roles have to be fulfilled in the development of mobile information services, yet the delineation of the roles is not clear. They are interdependent with each other but they are also potential competitors in a changing value network. The traditional players are repositioning themselves, moving from their old slots into newer niches even as new entrants are rushing in to grab their slots (Sabat 2002). The types of information, financial and physical streams flowing between the actors, are constantly changing and have become the object of business model studies. The rise of the Internet gave rise to business model research (see e.g. Afuah and Tucci 2001; Timmers 1998; Rappa 2000; Rayport and Sviokla 1995; Hedman and Kalling 2003) and this also became a topic of research for the mobile Internet (Ballon et al. 2002; Ostwalder and Pigneur 2003b; Heitmann and Stanoevska-Slabeva 2003). The value chain is part of business model research and vital to understanding what might alter the dynamics of a company's existing relationships (Kolakota and Robinson 2002). We call this a value network instead of a value chain because the actors, their roles and their way of interacting change. It takes the well-coordinated effort of a number of companies to ensure delivery of mobile services to the customer, and all the companies in the chain must have a raison d'être. Mobile information services will be successful only if there is a win-win situation for all the parties involved.

1.2 Research domain

There is a complex value network of actors who need to collaborate to deliver mobile information services to the customer. This is the supply side. Then there is the demand side, consisting of customers that actually use the services. The services developed by the suppliers should offer customer value and it must be possible to charge for that value. The lack of effective revenue models has constrained service innovation as competition and commodotisation have reduced prices and raised customer expectation for cheaper services. Users of mobile services want the services to deliver them added value (usefulness) and to be easy to use (usability). There are all kinds of interaction between the demand and supply side. This is shown in Figure 1-2, the elements are discussed below.

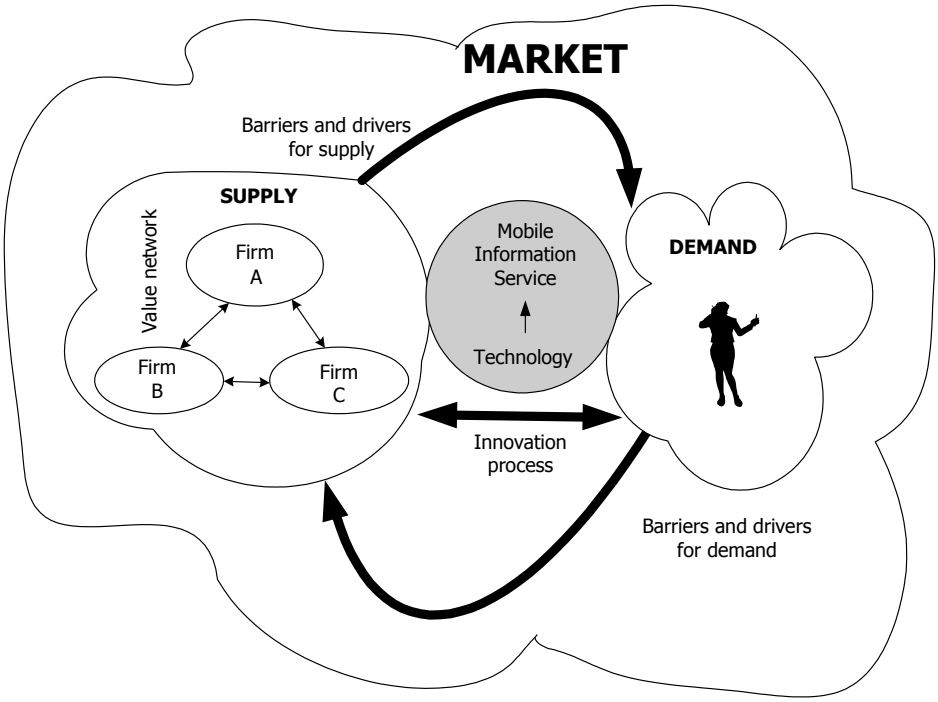

Figure 1-2 Interaction between supply and demand side

Suppliers experience *barriers to access the market*. Barriers are related to economies of scale, product differentiation, capital requirements, cost disadvantages independent of size, access to distribution channels and government policy (Porter 1985; Porter 2001; Ashkenas et al. 1995). Since mobile services are developed in a multi-actor setting there are also barriers due to this inter-organisational setting.

There are also *drivers to access* the market. Mobile can be considered to be a new channel and this creates possible interchannel synergies (Steinfeld et al. 2001). These synergies are

potential cost savings, differentiation through value added services, improved trust and market extension (Van de Kar and Bouwman 2002). Customers' demand is the result of the *benefits and barriers that drive or inhibit customer adoption* of mobile services. The potential benefits of mobile services are that they can be used anytime, anywhere, personally and that they might be aware of the location of the user (location-based).

Rogers (2003) defines innovation as an idea, practise, or object that is perceived as new by an individual or other unit of adoption. Rogers argues that most of the ideas for which their diffusion has been analysed are technological innovations, and we often use the word "innovation" and "technology" as synonyms. Christensen (1997) shows how mainstream customers initially reject breakthrough innovations – or disruptive technologies – because they cannot currently use them. Christensen mentions mobile telephony, packet-switched communications networks and hand-held digital appliances as examples of disruptive technologies. Disruptive technologies should be framed as a marketing challenge and not a technological one. The crux lies in finding a new market that values the characteristics of the disrupting technology. Christensen calls this agnostic marketing and described this as an approach to discover "emerging markets for disruptive technologies under the assumption that no one – not us not the customers – can know whether how or in what quantities a disruptive product can or will be used before they have experiencing using it". Christensen argues that failure and interactive learning are intrinsic to the search for success with a disruptive technology. He describes how organisations can cope with the accelerating change that has become so critical in our society. For this, value networks strongly define and delimit what companies within them can and cannot do. Christensen describes "how companies are embedded in value networks because their products generally are embedded, or nested hierarchically, as components within other products and eventually within end systems of use". This also counts for the technology that enables the development of mobile information services.

Fast developing technology appears in all layers involved in producing mobile information services. The layers between a service and the user are the content, servers, content platform area, gateways, networks and clients (Natsuno 2003). Each of these layers has it's own industry participants and together they produce mobile information services. The improved technologies regarding the client and network will have the most impact on service development. On the *clients* side new phones appear that are smaller, lighter, with colour displays, built-in cameras, sound chips for playing polyphonic ringtones, wireless connectivity to other devices, and software to connect the device to the Internet. The *network* has evolved, analogue, to GSM, HSCSD, GPRS, EDGE and UMTS, and each step has provided the user with higher transmission speeds and therefore shorter downloading times. For the client side to profit fully from this the *gateways*, *content platforms* and *servers* also have to evolve. When all the involved firms manage to cooperate, the new technologies can be used to enable new services that are adopted by users. The various actors, who are interdependent, have to learn together and find a way to launch services in a newly created market. A design approach helps to reach this objective.

1.3 Research questions and objective

The technologies described above enable mobile information services that can be used anytime, anywhere, personally and location-based. The appearance of these services on the market is behind expectations. To design these services a variety of actors have to collaborate in a design process. A design approach is needed to guide this design process. Such a design approach that embraces uncertainty in demand and value, fast developing technology, and the multi actor situation cannot be found in the literature. This leads us to the following research question.

Central research question
How can interdependent actors in a network organisation design mobile information services that can be used anytime, anywhere, personally and location-based?

This raises a number of research questions that are dealt with in this thesis.

1. What are mobile information services and how did they evolve?

First, the definition and taxonomy of mobile information services have to be sharpened to set boundaries for the research. How did mobile information services evolve? What is the history of their technology? To say something about the match between technology and demand requires an understanding of the service innovation process. What is an innovation and when is it adopted in the market?

2. What are the methods currently used for designing services? What are the advantages and disadvantages?

It is hard to find methods for developing services in the literature. Our starting point is a system engineering approach. System Engineering is an interdisciplinary approach to evolve and verify an integrated and life-cycle balanced set of system product and process solutions that satisfy a customer's need (Sage and Armstrong 2000). This is a broad approach that embraces other design theories. There are theories of organisational design (e.g. Williamson 1985; Wigand et al. 1997), information system design (Boehm 1988; Cadle and Yeates 2001; Brown 2000) and product development (e.g. Roozenburg and Eekels 1995, 1998). Business engineering builds a bridge between organisational design and information design while taking a process management perspective (e.g. Van Meel 1994). Process management theory is a useful perspective for service design (e.g. Bruijn et al. 2002). A quality assurance method like Quality Function Development (QFD) that builds forward on product development theories is often used within organisations and also interesting for further exploration (see e.g. Cohen 1995). Organisations have their own methods for developing services and sometimes they use a widespread method like QFD or Six Sigma (Barney and McCarty 2003; Creveling et al. 2003).

3. What are the critical elements when designing mobile information services and what are the possible solutions?

The previous sections have shown that the setting for designing mobile information services consists of fast developing technology, uncertainty in demand and value and the various actors that are needed to develop a service. The multi-actor situation might also be described as an inter-organisational setting, a value network or an interfirm service network. The crux is that one company can no longer design a complete service. The multi-actor setting creates a problem with three dimensions: the problem of coordination and communication between the actors with their own interests, the problem of the coordination with the customers and the problem of a lack of guidelines for an effective design process. It is important that all the actors can collaborate to create wins for each actor. Thus the question is: How can companies create a network, and how can they coordinate their activities in a way that the developed services will be accepted in the market?

This leads to the following research objective.

Research Objective
To develop and test an approach for designing mobile information services, which can be used to support organisations creating a value network and to coordinate activities within that value network.

The approach can be described as a suite of 'do's' and 'don'ts', of guidelines, a supporting environment using system engineering tools. The approach should include the perspective taken on the problem field, the managerial aspects of the design process and a way to carry out the tasks in the design process.

The contribution of this research for academics will be the development of a design approach for services based on fast developing Information and (tele) Communication Technologies. The research builds further on collaborative business engineering approaches (Den Hengst and De Vreede 2004). Our approach deals with service development in a network consisting of various actors and it takes customer value as the starting point. The benefit for business is that a tested service design approach can be used to provide companies with insight into ways to make their design process more effective and efficient. We expect better market acceptance for these well-designed services.

1.4 Research strategy

Service design is a rather new research area with little theoretical or methodological support. The literature on product design and development (Roozenburg and Eekels 1995, 1998; Buijs and Valkenburg 2000; Creveling et al. 2003; Cohen 1995) and design of information technology applications among which webapplications (Brown 2000; Davis 1989; Brigss and Gruenbacher 2002; Nielsen 1994, Boehm 1988; Isaacs and Walendowski 2002) is rather overwhelming but not equally relevant. Existing literature on services pays little attention to collaborative design issues but more to quality dimensions for services

(Grönroos 2001; Zeithalm et al. 2000; Parasuraman et al. 1985, 1988, 1991; Iacobucci 1998; Kayamana and Black 2000; Liljander et al. 2002). It seems hard to identify the main issues and to generate solutions for designing services in an inter-organisational setting in a purely deductive way. We first have to achieve an understanding of the problems and then we need to investigate how to solve these problems, to develop an approach for designing services in a value network. With respect to the nature of our research problem we argue that our research problem represents an ill-structured problem (Sol 1982). "In the tales the hero spends an incredible amount of time just wandering around, apparently getting nowhere, or worse, being blown farther away from this quest. The approach is circumambulatory, a marvelously long word for confusion" (Churchman 1971). In this wandering around the researcher creates an image of reality and this raises questions and imposes requirements on the research approach. Bosman (1997) states that many researchers argue that they are part of the reality and that therefore no objective, for everybody valid, reality exists. According to Bosman (1997) and Sol (1988) a design approach is always based on the worldview of the designer. One can only strive for improvements and progress.

The inductive-hypothetic cycle corresponds very well with the characteristics of our research (Sol 1982). This model cycle is based on the Singerian inquiring system. This can be characterised by adapting it endlessly, inductively, and a multidisciplinary manner based on new observations (Churchman 1991, Sol 1982). According to Sol (1982), the main benefits of the inductive-hypothetic strategy are the following that it:

- emphasizes the specification and testing of premises in an inductive way
- opens up possibilities for an interdisciplinary approach
- enables the generation of various alternatives for the solution of the problem
- permits feedback and learning

These benefits make the inductive-hypothetic strategy very useful for new and emerging research fields such as mobile information service design.

Our *inductive-hypothetic research strategy*, see Figure 1-3, consists of five activities (Sol 1982, Van Meel 1994, De Vreede 1995):

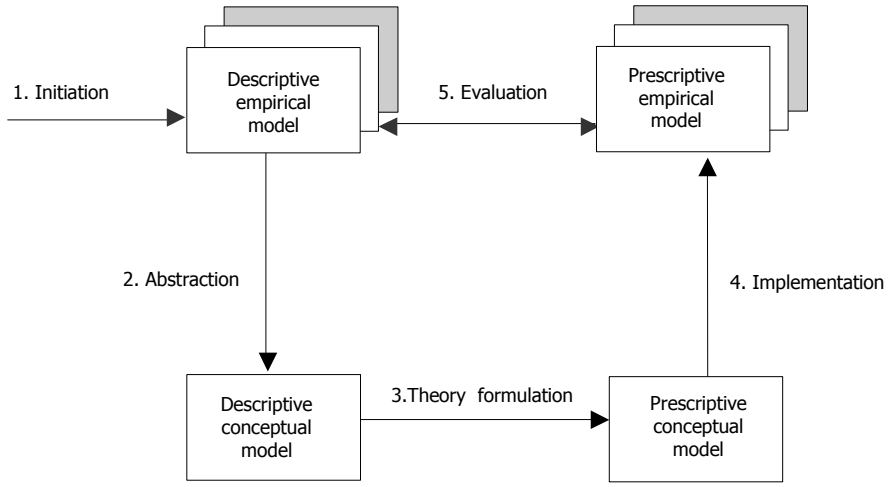

Figure 1-3 Inductive-hypothetic research strategy

The strategy is organised around the construction of five steps and four model types. In the first step, one or more descriptive empirical models are constructed each describing a perceived situation in a specific field of interest, i.e. designing mobile services. Analysing these perceived situations should provide a better understanding of the research area. The empirical models may contain elements from practise and from theory. During the second step, an abstraction is made from the empirical models, which results in a single descriptive conceptual model. This model describes the problems found in the perceived situation at a generic level, and gives indications of possible solutions. During the third step, the solutions are combined into a general theory for solving the problems found. "Note that in the context of the inductive-hypothetic strategy, the term 'theory' is used in a broad sense. A theory constitutes a proposed solution for a problem situation, for example, in terms of (a combination of) a set of problem handling guidelines and modelling concepts, modelling support, or an inquiry system" (De Vreede 1995). During the fourth step, the prescriptive conceptual model is elaborated into one or more prescriptive empirical models. This implies that the approach developed is applied in practice; in the specific area of designing mobile information services in an inter-organisational setting. Comparing the prescriptive empirical models and prescriptive conceptual model allows us to evaluate the effectiveness of the proposed theory. The approach is evaluated in this way and this may result in additional requirements for improving the prescriptive conceptual model and an iteration of the cycle.

1.5 Research instruments

Various research instruments were applied in this research. The instruments used in any given research concern the means with which data on the phenomenon studied is collected and subsequently analysed. By describing the research instruments, it is defined how the steps from the research strategy are carried out (De Vreede 1995). Case study research and

action research fit this strategy very well (Sol 1982). In observatory case study research, the researcher maintains a distance from the research object and in a participant observation case study the researcher may participate in the events being studied by being a subject of the study, taking a functional role, serving as a staff member of being a key decision maker (Yin 2003). A participant observatory case study can also be called 'action research'. We applied both observatory and participant observatory case study research and extended this with focus groups, a survey research and literature review. Within the case studies we collected data by documentation, participatory observation, interviews and archival records (Yin 2003).

Instruments used in the initiation phase

Literature was reviewed to study the status of the fields of general systems engineering and other more specific design methodologies. The researcher participated in the MOBUS project workshops to gain insight into the developments in the industry (Ebeling et al. 2001; Hille et al. 2001). The objective of the project was to find out what uncertainties have to be dealt when designing services. In the MOBUS project workshops were organised with participants from different companies and research institutes. This matches the description of a *focus group*: "the general approach of focus groups is to bring from two to ten people together to discuss their reactions to a limited, but not explicitly bounded, set of concepts, products, problems, or design considerations (Williams et al 1988). The MOBUS project aimed at triggering innovation in the field of financial services by looking at the potential of third generation (3G) mobile networks (UMTS) for this service industry. The project ran throughout the year 2001. Two years later, we did *survey research* and asked experts again about their view on the uncertainties. In this way we followed the developments over a longer time period and applied a longitudinal comparative research instrument (Van der Zwaan 1990).

In addition, *case study research* and *action research* were applied. The strength of a case study is that it can be used to describe complex relationships, personal interpretations, and historical narratives of the phenomenon under study. Its weaknesses are that a case study is typically limited to a single setting or set of individuals, often relying on the reconstruction of past events, and these are susceptible to multiple interpretations (Williams et al. 1988). Single case studies are often seen as inferior to multiple case studies with respect to generalisability; however, when selected with care, a limited number of case studies, or even a single case study may be appropriate under several circumstances (Yin 2003 provides five rationales for this). Action research is a type of investigation combining practise and theory that is designed to cooperate with and support enfranchised actors and groups in a system of study (Williams et al. 1988). We use a combination of case studies and action research to explore this field further. These studies concerned the M-info service and two iMode services. In the Netherlands, M-info was one of the first mobile Internet services and was launched by KPN Mobile in 1999. The researcher was part of the team that developed and introduced the service onto the market. In this sense this case study can be

considered to be action research. After the service had been on the market for more than a year, the case study was updated using interviews. Later, two other case studies were executed as part of the BITA research project[1]. In the BITA project a group of researchers carried out case studies to investigate business models for innovative telematic applications. One of the domains is mobile information and entertainment services. In total we worked with three researchers on five case studies (see also Maitland et al 2003a, 2003b). The Radio 538 ringtune iMode service and Finder iMode service are further analysed for the purpose of this thesis. Case study research and action research are often criticised for relying too much on subjective interpretations of collected data. Using various data sources and research teams as in the BITA projects allowed the researcher to counterbalance the researcher's bias.

Instruments used in the abstraction and theory formulation phases

Firstly, this phase was conducted as an individual creative process based on the literature review, focus groups, survey, case studies. Next, an expert session was organised to discuss the preliminary ideas in an electronically supported group session. This belongs again to the research instrument *focus group*. A group of experts, practitioners and researchers, from the Telecom and IT domains participated in the session to discuss the first version of the design approach in summer 2002. A skilled facilitator structured the session. The researcher presented a short introduction and was subsequently an observer during the session. All the knowledge obtained resulted in a prescriptive design approach.

Instruments used in the implementation phase

The implementation phase allows us to gain a better feeling for the practical consequences of the approach. Fortunately T-Mobile built a UMTS testbed on the campus of Delft University of Technology in the period April 2003 – April 2004. This gave us the opportunity to apply the developed design approach. In what was clearly an *action research* project the researcher acted as an innovator who developed and launched a mobile information service. The whole predetermined design approach was followed and adapted where necessary. Observation, questionnaires, interviews and a group discussion were used to get feedback on the design approach and the results, and to counterbalance possible researcher's bias.

Instruments used in the evaluation phase

The evaluation phase was an individual process based on the knowledge gained from the UMTS testbed project and discussions of the results with participants in the project. The project results were also presented during various gatherings in different settings. The feedback from these meetings formed part of the material used for reflection.

[1] MOBUS and BITA are different research projects initiated by the Telematica Instituut. In those projects companies (KPN Research, ING Group, Atos Origin, Lucent Technologies, Rabobank, and others) work together with researchers from research institutes (Telematica Instituut, TU Delft and TNO). MOBUS is an acronym for MObile BUSiness engineering (2001) and BITA means Business Models for Innovative Telematics Applications (2002 and 2003).

More information of the research methods used is provided at the beginning of each chapter.

1.6 Outline of the thesis

The outline of the thesis is shown in Figure 1-4. The outline is related to the research strategy as presented in Figure 1-4. A short explanation per chapter including a link to the inductive-hypothetic research strategy elements, descriptive empirical model, descriptive conceptual model, prescriptive conceptual model and prescriptive empirical model, is given below.

We deal with the problem field in chapters 2, 3 and 4. Chapter 2 starts with some background on service literature and discusses the evolution of mobile services. Based on current developments in the market the (fast changing) state-of-the-art in the sector is described. Insights into the innovation process of mobile services are provided in Chapter 3. The knowledge gained in the MOBUS project and the follow-up two years later is used to describe the uncertainties in the field. The chapter concludes with a discussion of the problems in mobile service innovation. The necessary available theoretical background on design approaches is presented in Chapter 4. Literature research was done to build forward on existing knowledge, with the aim to develop a design approach for mobile services in an inter-organisational setting. Therefore, design approaches in the fields of systems engineering, business engineering, information systems and product design are presented. Theories on organisational design and process management are described to cover the interorganisational issues. Furthermore the latest publications specifically addressing the design of mobile services and location-based services are reviewed. The chapter concludes with a framework for the case studies.

Chapter 5 consists of the intermediary research product 'the descriptive empirical model'. The three case studies M-info, Finder iMode service and the Radio 538 ringtune iMode service are described in this chapter.

The requirements for the design approach are presented in Chapter 6. These are based on the literature, observations in the case studies and the output from an expert session. The prescriptive conceptual model on how to design a mobile information service is given in Chapter 7.

The action research project in which a location-based mobile information and entertainment service was built on the UMTS testbed for visitors to the campus of the TU Delft is described in Chapter 8. This is the prescriptive empirical model.

Chapter 9 consists of an overview of the answers to the research questions, reflections on the research and recommendations for further research.

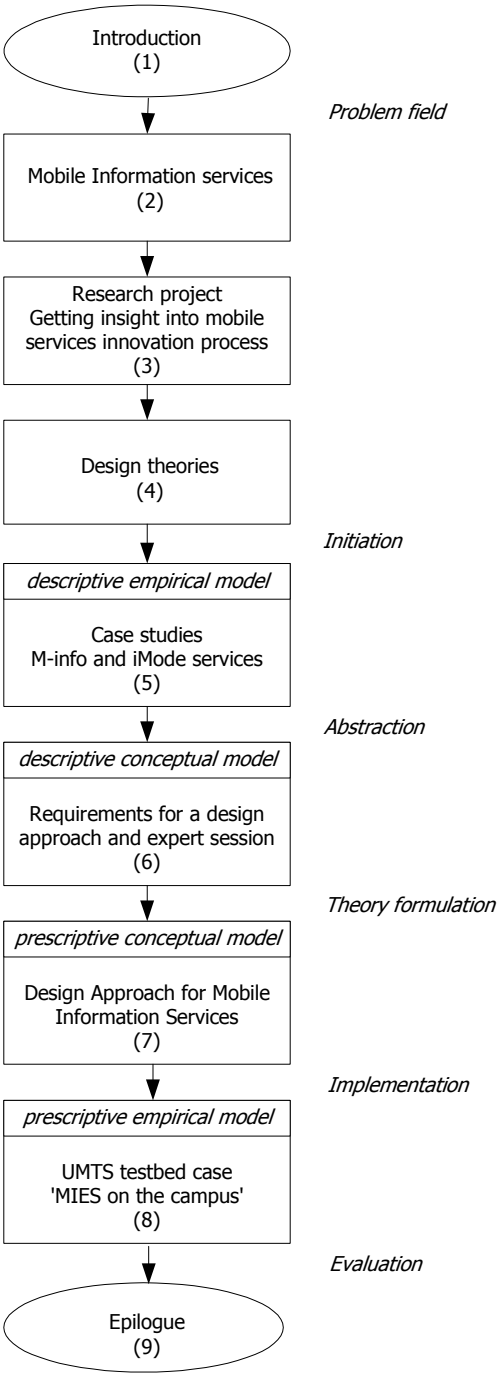

Figure 1-4 Research outline

2 Mobile Information Services

In this chapter we explain the terms services, electronic services, and mobile services. How can these terms be defined? What are their characteristics? And what is service quality? We focus on mobile information services and location-based mobile services. How can they be categorized and what is the technology that enables them?

2.1 Service characteristics

Designing services differs from designing physical goods since they have different characteristics. The services literature abounds with definitions of traditional services and delivers a set of generally accepted definitions of traditional services (Judd 1964, Kotler 1991, Bateson 1992, Zeithalm and Bitner 1996, Grönroos 2001, Kasper et al 1999). Grönroos identifies three basis characteristics of services: 1) services are processes consisting of activities or a series of activities rather than things; 2) services are at least to some extent produced and consumed simultaneously; 3) and the customer, to a greater or lesser extent, participates in the service production process. A comparison of a set of similar and generally accepted characteristics of traditional services, and the equivalent characteristics of physical goods is presented in Table 2-1.

Table 2-1 Differences between services and physical goods (Grönroos 2001)

Services	**Physical goods**
• Intangible	• Tangible
• Heterogeneous	• Homogenous
• Production, distribution and consumption simultaneous process	• Production and distribution separated from consumption
• An activity or process	• A thing
• Core value produced in buyer-seller interactions	• Core value produced in factory
• Customers participate in production	• Customers do not (normally) participate in production
• Cannot be kept in stock	• Can be kept in stock
• No transfer of ownership	• Transfer of ownership

The differences between products and services, which have consequences for adapting product design theories for service design are shown in Table 2-1. E.g. the quality of an activity or process is more difficult to measure than the quality of a thing. The question is whether it is possible or desirable to distinguish physical goods and services when designing mobile information services. A mobile service is bundled with a handset. The characteristics of the handset are relevant for designing mobile information services, e.g. the user interface

via the browser and the keyboard of the mobile phone. The distinction between services and physical goods seems to be rapidly eroding.

In addition to the differences between services and physical goods, electronic services differ from traditional services. The common denominator that distinguishes e-services from regular services is the availability of the service via an Internet channel, which makes it accessible from anywhere and consumable 24 hours a day. Grönroos (2001) distinguishes high-tech services, such as telecommunication services, and high-touch services which are dependent on the people producing services. However, he argues that high-tech services are often even more dependent on the service orientation and customer-consciences of its personnel because human interactions occur so seldom and when they occur they do so in critical situations, such as complaint situations or technology failure. The following definition for an e-service is based on the definition of Grönroos (2001) and Kasper et al (1999):

'An e-service is an activity or series of activities of intangible nature that take place in interaction through an Internet channel between customers and service employees or systems of the service provider, which are provided as solutions to customer problems, add value and create customer satisfaction'.

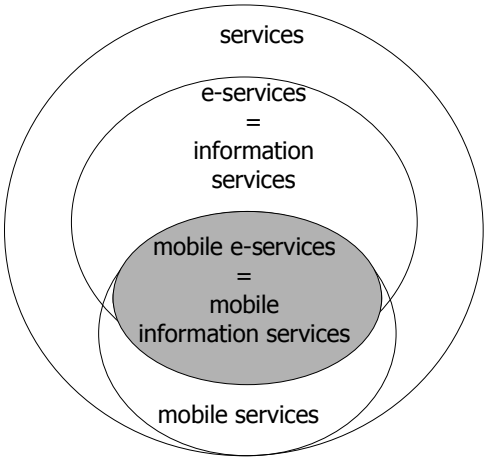

Figure 2-1 Positioning mobile e-services

Mobile services are a subset of services as are e-services as shown in Figure 2-1. Mobile voice services are part of mobile services but not of mobile e-services. The term e-services and information services can be seen as synonymous, for example mobile e-services or mobile information services. When the e-services definition is extended to include the mobile aspect the following definition for mobile e-services or mobile information service is derived:

'A mobile information service is an activity or series of activities of intangible nature that occur when the consumer is mobile and a mobile telecommunications network supports the interaction through an Internet channel between customers and service employees or

systems of a service provider. The aim is to provide solutions to customer problems and needs, add value, and thus create customer satisfaction'.

The heterogeneous quality of the mobile e-services and the difficulty of measuring that quality are relevant when designing mobile information services. The design of these services given this heterogeneous quality is complicated by the fact that different stakeholders are involved in the design of a mobile information service; that all these actors may have different perceptions regarding the user requirements for the services; and the fact that these expectations regarding the technological performance often exceed what is possible in reality. The M-info case (see Chapter 5), for example, shows that the actual technical performance of WAP (on GSM) did not fulfil the promised functionality. The increased bandwidth that UMTS potentially offers is driving content providers to consider the mobile channel as a potential outlet for consumers. Handset manufacturers are very busy developing handsets for UMTS. However, none of these players knows what quality the customers will require. Even the customer has problems with describing the desired quality due to their lack of knowledge regarding the possibilities and restrictions of the mobile technology. We will take a further look at service quality in the next section.

2.2 Service quality

A widely acknowledged way of looking at service quality is to make a distinction between the outcome (what) and the process (how) (Grönroos 2001). The service outcome quality, also defined as technical quality, can be measured objectively by both producer and consumer. This aspect of service delivery is mostly measured by the specific benefits for the context in which the service is delivered: "Is the service useful?" It is difficult to establish uniquely whether a service is useful to a customer, as we can find various drivers like saving time, easier execution of processes, improved quality, working more quickly, better job performance, increased productivity, higher effectiveness (Davis 1989). Actually, this is the value proposition of the service. The functionality of m-commerce services is based on the new value areas of ubiquity, localisation and convenience (Clark 2001).

The service process quality cannot be measured as objectively as the elements of technical quality because the customers' presence affects the delivery process. Quality regarding the production process is widely defined as meeting customers' expectations. The best known service quality dimensions are proposed, and improved in later versions, in the SERVQUAL model of Parasuraman et al (1985, 1988, 1991): tangibility, responsiveness, reliability, assurance and empathy. Liljander et al (2002) published quality dimensions of 'pure' e-services based on the dimensions of the SERVQUAL model. We apply them for mobile information services.

- Reliability: currency and accuracy of product information, correct technical functioning of e-services, explanation of purpose and accuracy of execution of service promises. This is very relevant for mobile services considering the fact that users are in the move and often in time-critical situations.

- Responsiveness: providing prompt service, help available, directly providing the information the customer wants to address his/her inquiry; again, time-critical situations enforce this requirement.
- Design of the User Interface: overall design, ease of navigation, finding without difficulty, overall ease of use and aesthetics. The small screen of mobile devices demands special requirements of the user interface.
- Trust: feeling of confidence and trust regarding privacy and security and freedom of risk when using e-services.
- Customisation and personalisation: meaning presenting the information in a flexible, adequate and tailored format. This can be done both by and for the customer. We define personalisation as a certain level of customisation and therefore as a category within customisation. Mobile users personalise the screen, tunes and navigation menu of their mobile phone.

We look at mobile information services in more detail in the next section.

2.3 Categorisation of mobile information services

Combining Internet and mobile telecommunication facilitates mobile information services. Unlike the use of the mobile phone for telephony, these services are not widespread in the market.

Mobile Services can be classified by their basic function: information, communication, transaction and entertainment (Van de Kar and Vos 2000). Another way of classifying mobile services is by their application: mobile financial application, mobile advertising, mobile inventory management, proactive service management, product locating and shopping, wireless re-engineering, mobile auction or reverse auction, mobile entertainment services, mobile office, mobile distance education, wireless data center and mobile music (Varshney and Vetter 2001). Varshney and Vetter call the applications 'value-added services in mobile commerce'.

Mobile commerce is the term for the extension of electronic commerce from wired to wireless computers and telecommunications, and from fixed locations to anytime, anywhere and anyone (Keen and Mackintosh 2001). Turban et al. (2004) define mobile commerce as any e-commerce done in a wireless environment, especially via the Internet. Another definition is *the delivery of electronic commerce capabilities into the consumer's hand via wireless technology*[1]. Mobile commerce is related to mobile services with the transaction function; customers buy something from a third party using their mobile phone and mobile telecommunication as a channel. Thus by transaction services we mean services that facilitate the payment between third parties and customers for e.g. wireless shopping and mobile ticketing.

[1] www.gmcforum.com last accessed 12 October 2004.

There is also a distinction between wireless and mobile. Kalakota and Robinson (2002) state that wireless commonly means *mobile and online*. This means that there is a real-time live Internet connection via satellite, cellular or radio transmitters. *Mobile and offline* means that the device runs self-contained programmes but is not connected to the Internet, for example a synchronised PDA. Sabat (2002) uses a matrix to categorize emerging solutions by the access mode (fixed or mobile) and the mode of connection (wireline or wireless) of the device with the content source in the wireline world. Broadband wireless access is an example of wireless-fixed; and the mobile Internet is an example of wireless-mobile. This distinction is important because it affects the way services are designed and used. We focus on mobile telecommunication network-based services, which means that we exclude *mobile and offline* or *wireless-fixed*.

A mobile information service was defined in Section 2.1 from the angle of services and providing solutions to customers We distinguished mobile information services and mobile services by mentioning that mobile information services take place in interaction through an Internet channel. This means that we exclude communication services like voice services. We also outline mobile transaction services in our research and focus on information and entertainment services. Entertainment might be considered as a kind of information. This means that the keywords required to make the dividing line of this research clear are mobile and online, and information and entertainment.

Location based services can be found within this area of mobile and online and information and entertainment. The relationship between mobile services, mobile information and entertainment services and location-based services is visualised in Figure 2-2 (see also Maitland, Van de Kar and Wehn de Montalvo 2003a). *Mobile information [and entertainment] services* (category 2) are a subset of the broader category of *mobile services* (category 1), which are simply services made available to mobile users independent of the type of network, like GPS, public switched mobile network, etc. Mobile services classified as having a transaction or communication function belong to category 1. As defined here, mobile information and entertainment services require a connection to a network, which is in turn connected to the Internet. Currently, the dominant mode of access is through the mobile telecommunications network infrastructure connected to the fixed public switched network. In general *location based services* can be offered through the mobile telecommunications network (category 3), independent of this network (4) and also in a fixed environment (5). Of interest to this research are services offered in the domain of category 2, mobile information [and entertainment] services, and category 3, location based mobile services, offered over the mobile telecommunications network.

Location-based mobile services are further discussed in the next section.

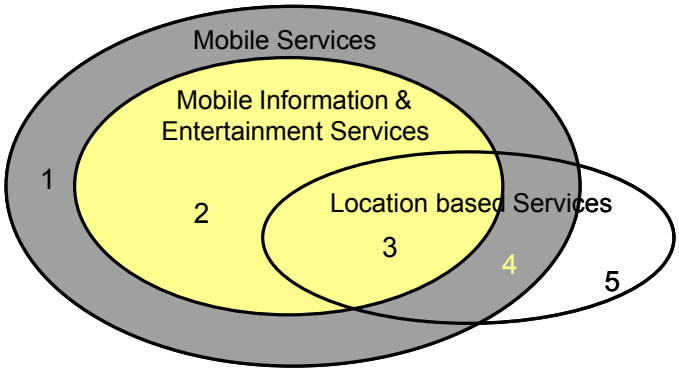

Figure 2-2 Positioning mobile information (and entertainment) services (Maitland, Van de Kar and Wehn de Montalvo 2003a)

2.4 Location-based mobile services

Location-based mobile services are a category of mobile services. Location based mobile services are attractive to both consumers and business alike and offers them safety, convenience and productivity (Turban et al. 2004). If a third party wants to offer services to the end-user, an ability to locate this customer may help the supplier to deliver services that are customised to the needs of the customer in a specific spatial context. The European Telecommunications Standards Institute (ETSI 2001) describes location services as a network-provided enabling technology consisting of standardised service capabilities enabling the provision of local applications. This term 'location services' is used alternately with the term 'location-based mobile services' (LBMS). The latter term indicates more precisely the type of services under study but is longer. Location services can also be interpreted as any service in a given location, e.g. delivering groceries at home, enabled by a fixed infrastructure, or digital traffic information. We define location-based mobile services as *services based on the mobile telecommunication network, accessible by the mobile station of an end-user, and making use of the automatically determined location of the mobile station.* A more practical shorter definition is: location-based mobile services are services that exploit information of where a device (mobile user) is located.

The combination of mobile telephony and position technology allows for an array of new types of services. According to a white paper by Gravitate, Inc. (in Koeppel 2000), different generations of location-based mobile services can be distinguished. The first generation of services relies on the user to provide the location information manually, for example, as a street address or postal code, to applications, and that application returns maps and routing information. The next generation of services has some built-in positioning ability that is sufficient to provide routing or proximity information, for example, to find the nearest restaurant or petrol station. The third generation of location-based services has greater position awareness and thus can also deliver services in the push service category, such as

notification of events or traffic alerts. A fourth generation of location-based mobile services can be added to this and consists of location-aware applications based on infrastructures, technologies and techniques that enable context aware information to be seamlessly offered to the end-customer.

Wehn de Montalvo, Maitland and Van de Kar (2002a) organised location-based mobile services according to the following approaches.

a) Service model
   Services might be pushed or pulled. Services in the 'pull category' enable users to 'pull' information wherever and whenever required, such as travel directions, taxi hailing, mobile yellow pages and m-commerce. Services in the 'push category' utilise the position of the mobile device to determine whether the user meets the criteria of a potential customer or service recipient (Koeppel 2000). Privacy is an important issue for push services.
b) Application
   Barnes (2003b) categorizes location-based mobile applications in four key areas. These areas are Safety, Navigation and Tracking, Transactions and Information. The typical accuracy and speed of the network requirements is different for the various applications. Giaglis et al. (2003) provide a taxonomy of mobile location applications and services in which they distinguish Emergency, Navigation, Information, Advertising, Tracking and Billing.
c) Market segment
   Services might be targeted on the consumer market, business market, or public sector (e.g. Niedzwiadek 2002). Employees can be separately mentioned or as part of the business market. Another way to distinguish target groups is to divide them into society (government), operators, professional end-users and private end-users (Swedberg 1999).
d) General type of location information
   Another classification scheme that can be very detailed is the information-based overview. Different types of information concern positions, events, distributions, assets, service points, routes, context, directories and transactions sites.

The different, sometimes conflicting or overlapping approaches to categorising location-based services are indicative of several important issues. First, the (almost) general applicability of the 'location element' to a whole range of mobile services may be partially responsible for the current state of uncertainty in the field with respect to placing theses services in a specific 'box' or category. This may also have implications for the marketability of these services. Second, owing to their general applicability, in the long term, location-based mobile services are likely to be integrated and seamlessly available to the end-customer to offer customised, localised content wherever and whenever necessary and applicable. In terms of the value added, this will have implications for singling out the location-aware component of content.

Examples of location-based mobile services, found in various literature sources, are given in Table 2-2. A lot is written about the potential of these services however only very few are available on the market. The services are categorized in two ways. The first axis is the market segment directed to consumers (b2c, e2c, g2c or c2c) and to businesses including employees and the public sector (b2b, b2g, g2b or b2e)[1]. The second axis chosen is based on a combination of the areas of applications as mentioned by Van de Kar and Vos (2000) and by Barnes (2003a).[2]

Table 2-2 Examples of location-based mobile services

	Consumer Market (b2c, e2c, g2c or c2c)	**Business Market (b2b, b2g, g2b or b2e)**
Information	• Geographic messaging of general, local information like news and weather at specific location • Information update on public transportation and traffic • Yellow pages • Product information; track the product life cycle in the shop • Shopping locator services • Financial services like foreign currency info, closest ATM	• Business travellers services like scheduling and local traffic information • Geographic messaging e.g. when you pass reception of company or other relevant location. • Financial services: foreign currency info, closest ATM. • Yellow pages • Mobile workers: planning, hour-registration, invoice information, kilometre expense account. • Vehicle tracking • Location-based scheduling and tracking for sales forces and field-service engineers; • Customer Relationship Management tools to mobile workforce
Entertainment	• Guided tours with hotel, restaurant, pubs, cinema, theatre and events information • Locate and direct people for dating and friend finder services • Location-based gaming	• Business relationship services; trips, hotels etc.; and services like translations and guide tours
Navigation and tracking	• Navigation applications: best route from A to B; driving directions • Tracking service: find persons and/or goods, children, stranded drivers. • Alerting services	• Supply chain management, Inventory management, Fleet management • Tracking and tracing of assets like transported goods

[1] B2c=business to consumer; e2c=employee to consumer; g2c = government to consumer; etc..

[2] Van de Kar and Vos (2000) mention Information, Communication, Transaction and Entertainment; Barnes (2003a) mentions Information, Navigation and Tracking, Transaction and Safety.

	Consumer Market (b2c, e2c, g2c or c2c)	Business Market (b2b, b2g, g2b or b2e)
Transaction	• Location-based billing e.g. for automatic pricing of road usage • Wireless shopping assisting services for cross selling • Public transportation reservations • M-Tickets: ticket purchases, i.e. for movies, theatres and concert • Buying local content • Mobile Coupons, i.e. discounts	• Location-based billing • Tax collection dependent on localisation e.g. mileage registration • Just In Time orders from places without wired infrastructure, e.g. construction sites
Safety	• Tracing services: tracing mobile terminals to provide safety i.e. child and elderly people tracing; prevent theft by car tracing • Emergency services • Roadside assistance	• Security and access services • Hazardous goods transport

Sources: Keen and Mackintosh 2001; Kalakota and Robinson 2002; Lacy et al, 2001; Rao and Minakis 2004; Niedzwiadek 2002; and a variety of business magazines.

Entertainment can also be considered as a special kind of information. In the rest of this thesis we implicitly include entertainment if the term mobile information service is used.

2.5 Evolution of mobile information services

Mobile information services have evolved partly in line with the evolution of mobile telecommunications technologies. The first widely known mobile information services were based on the Wireless Application Protocol (WAP) technology. The WAP Forum defines the WAP protocol as an open, global specification that provides mobile users with wireless devices to access and interact with information and services. The WAP Forum, which began in 1997 with four founders (Phone.com, Ericsson, Nokia and Motorola), has now grown to more than 500 members. WAP works on the Global System for Mobile Communications (GSM), a second-generation technology, with either circuit-switched networks (CSD and HSCSD) or packet-switched networks, like General Packed Radio Service (GPRS). GPRS is about five times as fast as the GSM speed of 9,6 Kbit/s. WAP is also suitable for future generation infrastructure bearers. In 2002, the WAP Forum and the Open Mobile Architecture Initiative established the Open Mobile Alliance (OMA)[1].

WAP was especially developed to make the Internet available to mobile users, taking into account limitations of the handset and the connection, which can be characterized by low bandwidth, long delays, poor connection stability, limited screen size and limited input possibilities (Vos and De Klein 2002). The 2.5 and 3rd generation mobile networks will

[1] www.openmobilealliance.org last accessed 12 October 2004.

reduce some of these limitations, but not all. The protocol continued to evolve and in January 2002 the WAP Forum launched the technical white paper of WAP 2.0. The next step in its evolution was colour WAP that can be accessed by a range of mobile devices such as mobile phones with colour displays, smartphones and PDAs with in-built network capabilities or in combination with a mobile phone for network access.

KPN Mobile was the first Dutch telecom operator to introduce a WAP service in the Netherlands in 1999. The service was introduced on the market with the brand name M-info. By the end of 2001 in excess of thirty phone manufacturers had deployed WAP-based micro browsers in mobile phones and more than sixty wireless carriers world-wide had implemented WAP "gateways" in their networks, which optimise the exchange of data between the Internet and WAP-based mobile phones (Kalakota and Robinson 2002). As mentioned in Section 2.1, the design of the service is related to the design of the handset. At the time of the WAP introduction an often heard joke was that WAP stands for "Where Are the Phones". Despite the rapid adoption of the technology by operators, as KPN discovered early on and Kalakota and Robinson (2002) note, the public opinion was that the performance of WAP (on GSM) does not fulfil the promised functionality. The criticisms were aimed at speed, ease of use and the limited number of worthwhile services. Barnes (2003) states that the use of WAP phones has been disappointingly low and he refers to figures with the per cent of mobile phone users who accessed the Internet in 2001 being 6 per cent in Finland and US; 10% in UK and 16% in Germany. Vodafone and T-Mobile have introduced WAP based services such as 'Vodafone Live!' and 'T-Mobile's T-zone' though these are not marketed as WAP and WAP figures overall are not available. To give some comparison, the largest competitive service 'Vodafone live!' had about 20 million customers worldwide in 2004[1]. Despite, or maybe thanks to, these disappointments KPN Mobile and other mobile operators have learned valuable lessons in their WAP deployments. As described in the case studies in this thesis, KPN expects to use this experience to improve future services such as (a) WAP on GPRS and (b) iMode.

Another noteworthy development for mobile information services was the Short Messaging Service (SMS). SMS is very popular among the young, and was used initially for communication purposes rather than delivering content services. Text messages with a maximum length of 160 characters can be sent and received via all GSM phones. It is also possible to send SMS messages from a PC with special software via the Internet. Requesting information about traffic jams, share prices, or the weather has been possible since 1996. The breakthrough of SMS began in Western Europe at the end of 1999. Mobile Multimedia Messaging Services (MMS) are the new generation of SMS with functionalities like audio and video clips, photographs and images (Vos and De Klein 2002).

During the time that Western Europe was experimenting with WAP and SMS, in Japan NTT DoCoMo built a large market for its iMode service. iMode operates on a proprietary cHTML

[1] http://www.vodafone.com/assets/files/en/prelim_results_2004.pdf last accessed 12 October 2004.

technology and uses the GPRS network. The number of iMode subscribers grew explosively from the launch in February 1999 to over 30 million in December 2001 (Natsuno 2003) and to 41 million in April 2004 in Japan[1]. In 2000, NTT Docomo acquired a 15% interest in KPN Mobile and they entered into a partnership to develop iMode. KPN Mobile is a subsidiary of KPN and owns and operates mobile technology networks in the Netherlands, in Germany, via its daughter E-Plus and in Belgium, via its daughter Base. Other countries where iMode has been introduced are France, by Bouygues Telecom in 2002, Spain by Telefónica Móviles in June 2003 and Italy by Wind in November 2003. In Asia, NTT DoCoMo worked closely with KG Telecom of Taiwan to develop an own iMode service, which was launched in June 2002. NTT DoCoMo is also building important relationships in the USA, where it is engaged in the development of mobile multimedia business with AT&T Wireless.[2]

The latest network technology in Europe and Asia is UMTS[3]. Much money has been spent on obtaining licenses for exploiting UMTS-licenses (Ure 2003). Together with the costs necessary to build the UMTS-network and the downfall of the stock quotes, it might not come as a surprise that mobile telecommunication companies are desperately searching for solutions to solve their financial problems. One of these solutions might be to speed up their potential for innovation, for instance by developing mobile data services based on UMTS (e.g. Keen and Mackintosh 2001). The development of UMTS-based services is surrounded by many types of uncertainties, technological ones and also those in society and in the market. The impact of these uncertainties is enhanced by the fact that UMTS innovation takes time. It is unsure when the first UMTS services will be available on a broad scale in the main European mass markets. Operators were organising pilots in 2003, e.g. KPN Mobile with trials for service engineers and T-Mobile with a UMTS testbed on the campus of the TU Delft. In the Netherlands, Vodaphone's launch of UMTS services started in February 2004 and KPN Mobile in May 2004. In Japan, NTT Docomo launched UMTS services in October 2001 and Vodaphone K.K. in December 2002.

The main technological driver for location-based mobile services is positioning technology. There are different location techniques, being (1) network-based, i.e. cellular location techniques, (2) satellite-based techniques such as the Global Positioning System (GPS) and (3) hybrid techniques, a combination of handset and network techniques. The first one mentioned, cellular location techniques, contains different kinds of techniques that all make use of the communication between the mobile phone and the base station (Barnes 2003a).

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[1] http://www.nttdocomo.com/companyinfo/subscriber.html last accessed 12 October 2004

[2] http://www.nttdocomo.com/corebiz/imode/global/index.html last accessed 12 October 2004

[3] UMTS stands for Universal Mobile Telecommunications System, which operates in a different frequency band than GSM networks. For complete details see http://www.umts-forum.org last accessed 12 October 2004. While during the years 2003 and 2004 the telecommunication industry in Europe and Asia is working on UMTS, the USA is more focussing on wireless LAN solutions like WIMAX, see e.g. http://www.tiaonline.org/media/mrf.cfm last accessed 12 October 2004.

The other positioning techniques, satellite-based or hybrid techniques, require modifications to the handset or both, to the handset and the network but they offer far more accuracy. For example, positioning using GPS (Global Positioning System) is enabled by the signals satellites are constantly beaming down. The performance of positioning methods depends on the context of the user, whether s/he is indoors, outside, or in urban or rural surroundings. Alternative localisation positioning solutions for indoor situations are Bluetooth and Wireless Local Area Networks (WLAN) indoor positioning technologies (Kofahl 2004).

2.6 Value and Adoption of Mobile Information Services

The above-described technologies facilitate the special characteristics of mobile information services to provide value to the customers. In this section we will discuss the values of mobile services and the factors that influence the actual adoption of the services.

The value of mobile services has been considered in recent research projects and publications on mobile services. Baldi and Thaung (2002) mention as distinctive characteristics of mobile services ubiquity, accessibility, reachability, localization and personalization. Anckar and D'Incau (2002) identified the following five different settings in which mobile services can create value.

- Time-critical arrangements; this is defined by applications for situations where immediacy is desirable.
- Spontaneous decisions and needs; this means that the driver is internally awaked and not a result of external events. Spontaneous needs can be related to a purchase decision, entertainment and efficient or time-critical situations.
- Entertainment needs; mobile applications fulfil the need for killing time/having fun in situations where there is no access to wired entertainment applications.
- Efficiency ambitions; m-commerce gives time-pressured consumers the ability to use the 'dead spots' in the day more effectively. Benefits of portable computing devices are increased worker productivity and the increased availability to work away from the office.
- Mobile situations; these are situations where services are of value only through a mobile device, as ones need for these services predominantly arise when away from home. Anckar and D'Incau mention localisation services as an example.

It is worth mentioning that Anckar and D'Incau explicitly exclude personalisation of services, which has been pointed out as a value-adding feature in mobile information services by numerous authors. "Personalised services do not, at least not unquestionably, offer m-value from a consumer perspective, although they intuitively fit well with mobile media. Rather, personalised services should be seen as a prerequisite for m-commerce due to the imperfect usability of handsets and the situations and settings in which many m-transactions are likely to be made." Others argue that leveraging these new sources of value and functionalities leads to a greater emphasis on personalisation, and subsequently to more user-centric (Ropers 2001) or individual, or I-centric services (Arbanowski et al. 2004). Senn (2000)

mentions that personalised services are expected to require the passive, where the transfer of data occurs without action on the part of the end user, such as email receipt, status monitoring and automatic updates, and the active participation of the user, such as shopping, information gathering and appliance management.

The following three values of mobile services were found in the research project MOBUS[1]: location awareness, immediacy and independency (Ebeling et al. 2001). This is based on a number of unique selling points of mobile communication and mobile services identified by team members of the research project group.

- Location awareness; services can make use of the location of the user, other users or object.
- Immediacy; mobile services allow their users to respond immediately to triggers in their physical or virtual environment. It thus enables impulsive reactions. Mobility enables immediate access to information; static information but more importantly also information that is continuously updated.
- Independence; mobility enables people to use services at locations where there is no fixed Internet connectivity. Independence also stresses individuality, a personal identity and personalisation.

When we combine the above-described values of mobile services we can draw the following conclusion for the value of mobile services. Whether users will get value out of mobile services depends on conditions like mobile situations (independence); time critical arrangements and spontaneous decisions and needs (immediacy); and efficiency ambitions (to be realised by location awareness among others). Furthermore users might 'have the need' for some entertainment, to kill time.

When a mobile information service provides value to a person it will not automatically mean that this person will also actually use the service. Rogers (2003) presents a model using the innovation-decision process. This is the process through which an individual, or other decision-making unit, passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. Many studies on adoption decisions of information technology in fixed or mobile settings have built on Davis's (1989) widely recognized and used technology acceptance model (TAM). Anckar et al. (2003) argue that TAM constructs such as perceived usefulness and perceived ease-of-use are multidimensial constructs that are too general to have significant explanatory power. They set out from a perceived value-based view on adoption decisions with the objective identifying the key benefits and barriers that drive or inhibit consumer adoption of mobile commerce. Their findings (based on a 1000 consumer survey in Finland) are that the main determinants of m-commerce adoption or rejection are not primarily related to a wide disagreement on the obstacles involved in

[1] More information on MOBUS see chapter 3.

using mobile services, but instead they originate from conflicting perceptions on a number of key benefits offered by mobility. These benefits are enhanced communication features, flexibility, new dimensions of communication and more effective use of time. This brings us back to the values of mobile services.

Barnes (2003a) presents a general model of technology acceptance based on Roger's findings and the Theory of Planned Behaviour (TPB) of Fishbein and Ajzen to explain the success of iMode in Japan. This model consists of (1) behavioural beliefs about adopting/using technology being relative advantage, compatability, complexity, trialability, observability, trust and image and (2) normative beliefs about adopting/using technology that affect individual's adoption. The latter is determined by significant others like friends, working colleagues, family members and opinion leaders. Barnes ads also factors of the economic and technological environment that play a role as third category, e.g. the market situation and the mobile value network with the operator holding a strong position. Barnes mentions the following key lessons to be learned: "the importance of a trusted, branded, useful, easy-to-use, holistic package of services, and the value of investment and leveraging of technological infrastructure such as networks and handsets".

What is important to understand from this section for service design is that the situation of the user determines whether the mobile information service might add value to the user. These are mobile situations, time critical situations in which spontaneous decisions and needs play a role, and situations where people have time to increase efficiency or to kill time using entertainment. In these situations people might adopt mobile information services. The adoption of new technology depends on factors such as perceived usefulness, perceived ease-of-use and other behavioural beliefs and normative beliefs. In this research we focus on the part that is related to how the service process quality and service outcome quality as described in Section 2.2 is perceived. Furthermore, the economic and technical environment plays a role in the acceptance of the service in the market.

2.7 Conclusion

In this chapter we answered the questions 'What are mobile information services?' 'How did they evolve?' and 'What is their value?'. The services literature abounds with definitions of traditional services and delivers a set of generally accepted characteristics of services. The emerging field of electronic commerce provides definitions on mobile commerce. Both sources provide a basis for deriving a mobile information service definition. We defined mobile e-services or the synonym mobile information services from the involved activity point of view provided by the service literature.

'A mobile information service is an activity or series of activities of intangible nature that occur when the consumer is mobile and a mobile telecommunications network supports the interaction through an Internet channel between customers and service employees or systems of a service provider. The aim is to provide solutions to customer problems and needs, add value, and thus create customer satisfaction'.

It is important for our research that we focus on services that are mobile and online and on information and entertainment services. If the term 'mobile information services' is used entertainment is implicitly included. Location-based mobile services are a mobile information services with the feature that the user can be located.

The evolution of mobile information services is whimsical and this makes it hard to predict the market acceptance of mobile information services. SMS was surprisingly a success in the market; the success of WAP and location-based mobile services remains to be determined.

The value of mobile services depends on the situation of the user. Therefore the situation of the user has to be the starting point in the service design approach. The user will only adopt the service if the service has quality. To enforce service quality attention has to be paid to the service outcome quality (value proposition) and the service process quality dimensions (reliability, responsiveness, user interface, trust and customisation). The heterogeneous quality of mobile services and the bundling of the service with a handset with browser functionalities are relevant for designing mobile information services. Existing and potential customer demand has largely unclear characteristics; as shown in Chapter 1, and this is common with disruptive technologies (Christensen 1997). The increased bandwidth UMTS promise is acting as a driver for content providers to consider the mobile channel as having potential value for users. Handset manufacturers are very busy developing handsets for UMTS. As described in Chapter 1, these and other stakeholders need to cooperate to design a mobile information service. All these actors may have different perceptions regarding the value proposition to the user. Achieving service quality is complicated due to the need to deal with fast developing technology, a large number of involved stakeholders and unknown user requirements. This is surrounded with uncertainties; we explore these uncertainties in Chapter 3.

3 Uncertainties in the mobile services domain[1]

The penetration of mobile phones is high and mobile Internet has received a lot of attention from the business and academic world. Publications giving possible scenarios for new generations technology and the adoption of these technologies are amply available. However, the development of mobile information services is surrounded by many uncertainties. These uncertainties along with their impact on service design are discussed in this chapter.

3.1 Introduction

The telecom industry is characterized by huge investments in networks and other equipment that have long lead times (e.g. Preez and Pistorius 2003). One of the solutions to the financial problems in the telecommunication sector might be to speed up its potential for innovation, for instance by developing mobile data services based on UMTS (e.g. Keen and Macintosh 2001). This is not an easy task since the principles for innovation in the 'old telco world' no longer apply fully to the mobile data market where telecommunication, media and IT business come together, and value chains and industry structures evolve (Maitland et al. 2002). The development of UMTS based services is surrounded by many types of uncertainties, technological ones and also those in society and in the market. The impact of these uncertainties is enhanced by the fact that UMTS innovation takes time. It has taken, for example, years between the operator's purchase of UMTS licenses and the availability of the first UMTS services in the main European mass markets. During development time a lot of unexpected changes can occur. Developing a future vision at an early stage of the development of a service should allow the market, technology, and other uncertainties to be identified and any necessary adjustments to the service to be made. This may lower the risk of service development failure (Lin 2001; Preez and Pistorius 1999; Twiss 1992).

It takes a long time between the conception of an idea for a new telecom service and its ultimate implementation into the market and its subsequent use (Floyd 1997; Twiss 1992). Although many companies strive to decrease the time-to-market, innovations cannot arise overnight, and it is difficult to shorten the time-to-market. For instance, considering the increasing complexity of innovation in the emerging mobile data service market where, more and more, companies are involved outside the traditional (mobile) telecommunication companies, it is questionable whether the time to market in the mobile telecommunication industry will be shortened in the coming years. As described in Chapter 1, a mobile information service is nowadays developed and produced in a complex value network

[1] This chapter is based on Van de Kar and Van der Duin (2004).

consisting of various content providers, application developers, handset manufacturers, an operator, a service provider and others. It will not come as a surprise that it might take time for all these parties to agree on issues concerning the development of mobile data services.

Development and diffusion of new mobile services takes time. The diffusion of innovations is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers 2003). The novelty of an innovation means that some degree of uncertainty is involved in diffusion. Uncertainty is the degree to which a number of alternatives are perceived with respect to the occurrence of an event and the relative probability of these alternatives (Rogers 2003). In the rest of this chapter we look at uncertainties surrounding mobile information services.

3.2 MOBUS project

In this section we report on the MOBUS[1] project to shed light on the uncertainties surrounding the development of mobile services (Hille et al. 2001; Ebeling et al. 2001). The project's goal was to generate and work out new ideas for UMTS-based services for the financial sector in the business to business market by making use of the scenario-method (Van der Heijden 1996). The scenario study was intended as a first step towards an innovation-framework for developing UMTS based services in the future. To answer the question regarding the evolution of uncertainties over a period of two years we added a second phase. In 2003, the original members of the project-group were asked again their judgement of the uncertainties. A second group of experts in the field of mobile technology and services drawn from universities, consulting companies, telecommunication operators and telecommunication suppliers were also asked to judge the uncertainties. The research approach used in the first phase of the project was a combination of a focus group and literature research. In the second phase we carried out a survey. This comparison of the developments over a period of two years allowed us to use a longitudinal approach.

In six workshops, combined with desk research, the project group worked on identifying the common interests of the project participants (Interests), defining their uncertainties (Uncertainties), building scenarios (Scenarios), providing support for the scenarios (Insights), describing use cases (Use cases), and deducing generic and scenario specific mobile financial services based on the scenarios and use cases (Service propositions). These results were provided to the business partners for assessment and testing the service further as part of their business strategy and product portfolio.

[1] MOBUS is an acronym for Mobile Business Engineering. The project was initiated and led by the Telematica Instituut in the Netherlands. Other participants were the TU Delft, KPN Research, ING, Lucent and ATOS Origin.

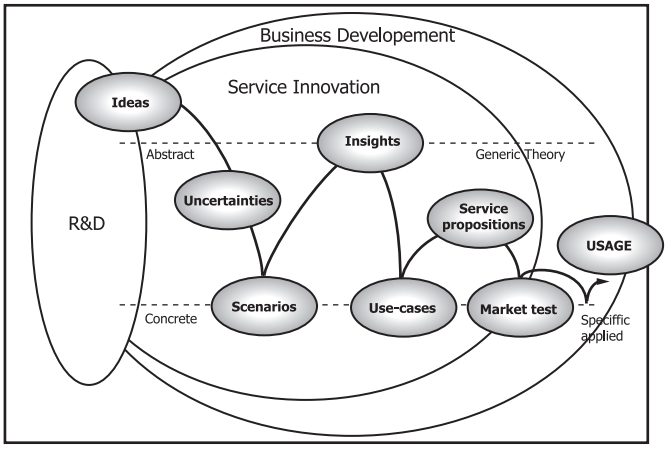

Figure 3-1 MOBUS activities placed in an innovation process

When the project was finished researchers analysed and reconstructed the activities that were done during the workshops and between the workshops. The result of this analysis is the service innovation part of Figure 3-1 with the 'bubbles'. We added the Research and Development (R&D) and Business Development (BD) phases for the purpose of this research to show the position of the service innovation phase in a service life cycle. In this chapter we only discuss the 'uncertainties' part of the MOBUS project.

3.3 The initial identified uncertainties

Independently, each MOBUS team member contributed at least two aspects relevant to mobile (UMTS) services that s/he was uncertain about regarding future development during a brainstorming session. This produced 19 identified uncertainties. In the next step the 19 uncertainties were discussed extensively and reformulated as much as possible to give a specific question that would have two extreme possible answers, e.g. high or low.

It was necessary to structure the 19 uncertainties because if these uncertainties were combined the amount of combinations would be extremely high and this would make it practically impossible to think about possible scenarios and services for UMTS. The starting point for reducing the number of uncertainties was to rate them based upon their importance for the success of mobile services and the level of the group's consensus on how they should further be developed in 2005. The interesting uncertainties were those with a high relevance for the success of mobile services and about which there was a high level of disagreement within the group about their future state.

An overview of the uncertainties grouped into four categories: 1) technologies, 2) supply side, 3) demand side and 4) the interaction between the supply and demand side is given in Table 3-1.

Table 3-1 Initial identified important uncertainties for mobile service development

Uncertainty	Group expectation	Notes
Uncertainties regarding technology		
The quality of UMTS?	No consensus	Will be as perceived by customers.
Will mobile interfaces be advanced?	Yes, advanced	They must be more advanced than the current interfaces to support more complex type of service. That requires advanced user interfaces so people can use them.
Is mobile payment technology available?	Yes, available	Consumers show a real interest in mobile payments. Several organisations are already looking into it.
Is intelligence in the network or the connecting devices?	No consensus	Much intelligence can be put into the network if the network operator has the largest stake in producing services.
Single terminal or pervasive?	No consensus	Depends on technological developments.
Uncertainties regarding supply side		
Structure of UMTS service provisioning: open or closed service market?	No consensus	In other words: does the operator of the UMTS network impose few or many (severe) restrictions on service provisioning by third parties over its network.
Exploitation strategy will be usage-based, flat rate or different?	Flat rate	Group mainly thought that predictability of costs would be important for businesses. This uncertainty is not regarded as very relevant in the B2B/B2E market.
Direct or indirect income? For example from sponsoring or cross-product financing.	Direct	From the end-user.
Uncertainties regarding demand side		
Users' willingness-to-pay?	Yes, they are	Business customers are willing to pay under the assumption that the services offer added-value to their firms.
Acceptance of digital signatures?	Yes	They will be accepted but the question is: When?
Mix private and professional life?	No mix	People will separate their private from their professional lives. Not regarded as very relevant.
Will people be social or individual?	No consensus	More relevant for consumer market than business market
Will people be active or passive?	No consensus	More relevant for consumer market than business market
Uncertainties regarding interaction between supply and demand side		
Economic growth?	No consensus	Recession seems to be visible at the horizon
Market penetration of UMTS-based	Commodity	The extent of the penetration of the UMTS

Uncertainty	Group expectation	Notes
ICT?		based ICT into the business market depends on services and technical capabilities.
Will mobile service be multimedia based?	Low amount of multimedia	This will heavily depend on the kind of service.
Technology push or market pull?	Market pull	i.e. customers will understand the benefits
Localisation important?	Yes, important	For mobile services in general localisation is regarded as important. For financial services, however, it remains to be seen.
Will future services be voice or data based?	Data	Facilitating traffic is the crucial point in migrating from connection-based mobile networks towards packet-based 2.5 and 3G networks.

To decide which two uncertainties would be suitable for the scenarios the MOBUS team members ranked the uncertainties for relevance regarding the central question of MOBUS and the extent of the uncertainty. During the project the focus year was 2005, at that time four years ahead of us. After discussion it was decided to use the parameters: 'economic growth' and 'accessibility' of the market for service provisioning to new entrants as most important uncertainties. We refer to Ebeling et al. (2001, 2002) for more information on the continuation of the project.

The MOBUS project was an attempt to deal explicitly with uncertainties when designing mobile data services. The consortium considered the approach functioned well as a creative method for coming up with suitable service proposition ideas. The contribution of the MOBUS project is that it presented a method that allowed both academics and representatives of companies to deal with uncertainties when developing mobile services. The other interesting contribution of MOBUS is the list of uncertainties that the team of experts defined. We investigated these uncertainties again two years later.

3.4 Results regarding the uncertainties two years later

The MOBUS project took place in 2001 when the telecom market was booming, although there were signs of a change in the economic climate. The defined uncertainties and the subsequent scenarios were of course strongly influenced by the issues that were important around that time despite it being our aim to picture a range of possible futures. So the question arises as to whether the uncertainties defined at the beginning of 2001 were still valid two years later. The extent to which they still were (or not) gave us information about the quality or robustness of the uncertainties on which the scenarios were built.

In 2003, the original 19 uncertainties were presented to the ten members of the MOBUS project group and to nine other experts in the field of mobile communication. They were asked to react to the following requests.

- To say whether they thought the uncertainties were still uncertain and to give a short explanation of their answer.
- To discuss the current relevance of the uncertainties.
- To list any new uncertainties.

The outcomes of the questionnaire are summarised in Appendix A. Nine of the original ten members of the MOBUS project group responded. Most of them still worked for the same company, three were employed elsewhere. From the 19 original uncertainties there was one item that was unanimously considered to be certain: mobile services will be multimedia based. Three other items were considered to be certain by at least seven of the nine respondents: the exploitation strategies of telecommunication companies will be usage based, revenues will be generated by direct income and services will be data based. The remaining 14 items were predominantly uncertain. An item is also an uncertainty when the respondents all say that it is an certainty but that their prediction of the outcome is opposite. What was very remarkable was the response regarding the market penetration of UMTS based ICT, all but one of the respondents marked this as an uncertainty. Initially the MOBUS members considered this as a certainty.

To further research the uncertainties a second group composed of nine other experts in the field of mobile telecommunication were asked their opinion. Three of the group worked for a mobile operator, one for a consulting company, one was a university researcher and four of the respondents were students working in the telecommunication business on their master thesis project. Far more 'I do not know' answers to the uncertainty question were given in this group, often meaning that the respondent did not understand the item. Only one item was unanimously considered as certain: mobile services will be multimedia based. All the other answers were very mixed. Table 3-2 shows an overview of the revised uncertainties two years after the initial workshops.

Table 3-2 Reviewed uncertainties two years later

Uncertainty	**Overall Impression**	**Notes**
Uncertainties regarding technology (R&D phase)		
Quality of UMTS? *	Still uncertain	In Europe we cannot say anything about the UMTS quality yet. UMTS is available in countries like Japan and Korea, but there are no clear signals of the quality. The adoption of FOMA in Japan seems to stay behind expectations.

Uncertainty	**Overall Impression**	**Notes**
Will mobile interfaces be advanced?	Uncertainty due to different opinions	Most respondents see this as a certainty but their views on whether it will be advanced are very different. There is about 50-50% division between respondents who think it will be advanced and those who think it will be simple.
Is mobile payment technology used?	Usage becomes quite certain	This uncertainty had changed since 2001. We asked whether it would be available and in 2003 we asked whether it would be used. The reason for this is that the technology is available now, but not broadly on the market. The majority answered that it will be used, once it starts to take off!
Is the intelligence in the network or in connecting devices?	Uncertainty	The answer mostly given was 'both'. It is also an uncertainty for many respondents, especially in the second group.
Single terminals or pervasive?	Uncertainty due to different opinions	This is a certainty for the majority of the respondents but the item is an uncertainty because the answers on the outcome differ, The answer mostly given is pervasive and some respondents think that both terminals will be on the market.
Uncertainties regarding supply side		
Structure of UMTS service provisioning? *	Uncertainty due to different opinions	This is also a certainty for most people. A slight majority thinks that the market will be more closed, others think that it will be open. One respondent answered both.
Exploitation strategy?	Uncertainty due to different opinions	The answer mostly given is that it will be usage based. Some think it will be both usage based and flat rate and only one foresees flat rate. People distinguish between the near future and the further future. In some years it may change from usage based to flat rate, comparable with the fixed internet.
Direct or indirect income?	Uncertain with tendency to certainty: direct income	The failed expectations in the Internet industry about indirect income seem to indicate for most persons that mobile services will have to be paid for directly by the end-user.

Uncertainty	Overall Impression	Notes
Uncertainties regarding demand side		
Users willingness to pay? *	Uncertainty	Most respondents think it is an uncertainty, the ones who regard it as a certainty think it will be low.
Acceptance of digital signatures?	Uncertainty	Still an uncertainty for most people. Persons who do consider it as a certainty think that it will be accepted.
Mix private and personal life?	Ambiguous	Very ambiguous: not possible to generalise
Will people be social or individual?	Ambiguous	Very ambiguous and uncertain: not possible to generalise. Family values are important, personal communication is one of the most promising kind of mobile services. However, also services that offer possibility for privacy, like secretly communicating by SMS, are demanded.
Will people be active or passive?	Ambiguous	Ambiguous: not possible to generalise. Pay-per-view is not taking off because people put no extra effort in. They just want to look at the 8 o'clock news.
Uncertainties regarding interaction between supply and demand side		
Economic growth? *	Nowadays low, future uncertain	This is one of the uncertainties that turned into a certainty: economic growth is very low! We are sure about the recession. For the future the respondents answer that it is an uncertainty or that it will be low. This is considered to be very relevant.
Market penetration of UMTS-based ICT? *	Very uncertain	Big majority regards this as uncertain!
Will mobile services be multimedia based? *	Certainty: multimedia based	The issue with most consensus that it is a certainty and that it will be multimedia based.
Technology push or market pull?	Uncertainty due to different opinions	Almost all respondents see this as a certainty, however their view is evenly divided between technology push, market pull and both. Technology push is failing e.g. slow penetration of UMTS. Market pull is succeeding e.g. fast penetration of SMS. It seems that you have to get both right.
Localisation important?	Uncertainty, tendency to important	Behind expectations. Still an uncertainty and some people see it as important. Seems to have taken off for the car industry.

Uncertainty	Overall Impression	Notes
Will future services be voice or data based?	Tendency to data	Data based services are behind expectations, but almost all respondents think that it will be data. Considering the use of 2.5G it will be data based in the long run. But we still do not know for sure.

*The * marked uncertainties are considered as very relevant*

There is not a very big difference between the original MOBUS group and the other experts in their opinion regarding the relevance of the uncertainties. Both groups considered six uncertainties to be relevant: 'high or low economic growth', 'the quality of UMTS', 'structure of the provisioning market', 'users' willingness to pay', 'the market penetration of UMTS based ICT services' and 'whether mobile services will be multimedia based' (average above 3.5 on a 1-5 scale, see Table A-2). Two uncertainties disappeared, being 'mobile payment technology is available' (usage is still an issue) and 'mobile services will be multimedia based'. This means that i.e. there is very little real progress.

There were also new uncertainties mentioned, see Table A-3 in Appendix A. A new uncertainty related to technology is the competition of UMTS with GSM and GPRS and also WLAN technologies (see also Lehr and McKnight 2003). Other technology related issues are the coverage of UMTS, roaming problems and standardisation of system interfaces. Uncertainties regarding the demand side are related to privacy, security issues, spam and the impact of mobile phone use on health. Several uncertainties concern the behaviour of the players in the industry: How will telecommunication companies go about in consolidating? Will telecommunication companies partner with other industries? Which player will determine the rules? Other kinds of cited new uncertainties are legal and government regulation issues, e.g. digital right management and government's investments; financial issues e.g. the financial position of the telecommunication companies and handset subsidising; and global markets issues, e.g. the gap between Europe and the USA and the power of pan-European operators.

3.5 Discussion and conclusions

There is a difference in working method between the initial workshops which used discussions and the questionnaires used and interpreted by the researchers two years later. For instance, the whole group in the workshops almost immediately, discussed the 'individual' uncertainties that were initially generated by the MOBUS project group. The respondents two years later had not discussed the uncertainties. The MOBUS group also had a better understanding of the uncertainties than the 'new' expert-group; the latter had a rather high 'I do not know' response to the questionnaire. This pleads for collaborative workshops instead of surveys as a research instrument for investigating uncertainties.

The initial most uncertain and relevant uncertainties, i.e. economic growth and open/closed UMTS service provisioning, were considered to be still the most uncertain and relevant two years later by the initial and new groups of respondents. The amount of new uncertainties added two years later was rather high. One very remarkable outcome was that initially the experts were quite sure about the market penetration of UMTS-based ICT in the timeframe of 4 years that we had in mind, while two years later the respondents considered this to be very uncertain. It looks like no progress has been made in the two years and even a step backwards in development has taken place.

Below we will discuss the uncertainties and the questions they give rise to. This discussion is organised around the perspectives for reaching service quality mentioned in Chapter 2: (1) a user's perspective (2) a technological perspective and (3) an organisational perspective. We leave out the uncertainties that have a more social nature and are relevant over a longer time horizon like 'mix private and personal life', 'social or individual' and 'active or passive people' since their impact on service design is indirect.

Design activities regarding the service from a user's perspective

It was briefly described in Chapter 2 how key benefits and barriers drive or inhibit the user's adoption of mobile commerce. The uncertainties mentioned in Chapter 2 regarding the user's perspective were whether 'digital signatures will be accepted' and 'are the users willing to pay'. The service related relevant issues categorised under 'interaction between demand and supply side' have been shown to be 'market penetration of UMTS-based ICT' and 'will mobile interfaces be multimedia based'. These issues are related to the technology push and market pull discussion. Suppliers must offer these services and users must have a need to use them. This is also the case with localisation. There have been high expectations for location-based mobile services since the nineties. However, mass-market acceptance remained uncertain for a longer time than expected. The uncertainty 'localisation important' scored medium on the relevance question[1]. We can conclude that one of the requirements of the service design approach is that it has to include a solution for the elicitation of user requirements. This should be done for specific settings since the value of mobile services depends on the setting of the user. To know whether users will adopt a service feature such as localisation, services should be prototyped and tested by groups of people to get a good understanding of the users' appreciation.

Design activities regarding technology

New technologies are developed in R&D laboratories. The results of these efforts provide input for the service designers. Several technological issues play a role in the development of mobile information services. Firstly, there is the availability of different networks. As

Tilson et al. (2004) show a variety of causes for the uncertainty around location based services, i.e. related to the market, services, capabilities for internal and partners organisational issues, technical capabilities and the context

UMTS networks are not yet available on a broad scale, content-based services will be offered through GSM and GPRS. The question is whether GPRS offers enough bandwidth for customer demands, combining with wireless technologies based on radio frequencies also offers opportunities that may limit the need for UMTS. Next, to offer location-based mobile services, network operators have to choose between the different forms of positioning technologies as outlined in Chapter 2. Such choices can create lock-in effects for the network operators. However, the value proposition that the different technologies imply varies and therefore the usability for the different categories of services will also differ. Since the market demand for location-based mobile services is not well known, this will create uncertainty for network operators about which technology to choose and, implicitly, what categories of location-based mobile services to offer. Alternatively, network operators may decide to let other players offer the services, and bear the risks.

Service designers make decisions for the level of intelligence of the network or the devices. To some extent they are dependent on the handset designers. There are many handsets available on the market and users want to use the services on whatever handset they have. It is accepted that some services are only available on the latest handsets, e.g. taking a picture. Some other services have to be designed in such a way that they can be accessible by any handset, e.g. Internet pages. Handset manufacturers play the decisive role in the uncertainty surrounding single or pervasive terminals. The content is offered via the handset to the users. The content is from different heterogeneous databases and has to be accessed and combined with local content to provide highly relevant and up-to-date information within a reasonable response time. This is a technological challenge since semantic differences between stock databases need to be dealt with (Rao and Minakakis 2004). It is also an organisational issue since the activities of all the various actors, like the handset manufactures and content providers, who have to provide access to their respective stock databases, need to be coordinated.

Design activities regarding the organisational issues

As mentioned above, the impact of heterogeneous databases from various providers, like geographical information providers, yellow pages content providers etc., is a challenge from an organisational perspective. Furthermore, the structure of the market to provision UMTS services was shown to be relevant in both the workshops in 2001 and the questionnaire in 2003. There is the issue of an open market, walled garden or closed market as the means to organise the governance of the service provisioning. "Walled garden is a term applied to a service package that provides customers access to certain predetermined functions and content" (Fredebeul-Krein 2004).

The actors also have to find a strategy for exploitation of the service. Whatever model is chosen, it is important for companies to develop a capability of partnering and cooperating because different companies nowadays carry out innovation from different perspectives in a sometimes-chaotic process. In the service innovation phase actors search for ways to become part of a value network in which they have to agree on issues like the importance

of localisation, a market pull or technology push strategy and the extent to which the mobile services should be multimedia based. Issues like the exploitation strategy and direct or indirect income seem more relevant in the business development phase when preparing for the market launch. The R&D phase, service innovation phase and business development phase cannot be gone through in a linear way. Somehow a way of interactivity has to be found.

To conclude

As long as the market penetration of UMTS services remains to some extent a changing uncertainty, the issue is how to design these kinds of mobile information services. Service design is a vital part of service innovation. It is at this point that service designers must take important decisions regarding the service to be designed including its enabling technology and involved partners. This service design process can be positioned between Research and Development (R&D) and Business Development (BD). However, the boundaries are not sharp. First, there is an interaction between the technology used and R&D. We see service design as assemblage of technology that has been developed, tested and approved in laboratories. No new technology will be developed but existing components will be assembled. Secondly, there is a blurred boundary between the service innovation and business development phase, for example the business model can have an impact on service features like the downloadable amount of data. These issues go beyond the UMTS technology but are general for designing services enabled by new technology.

A scenario study, as was done during the MOBUS project, provides ideas for services to design. The project was not aimed at investigating service design guidelines or at validating conclusions. The aim was to generate questions for a literature review. The technology, demand side and supply side are interdependent. E.g. the choice for technology has an impact on the relations between the suppliers, the revenue model influences the service features, and this last one is directly related to the users' willingness to pay. During the design approach concrete steps have to be taken to take the three elements into account. We want to find answers to the following questions.

- How to design services that include elicitation of user requirements and users' tests of prototypes applied in the aimed setting of the user to investigate what the user wants?
- How to design services which have as a starting point that the idea that service designers have to deal with existing technological components?
- How to design services with a variety of actors? How to create a network of actors?

A long and changing lists of uncertainties was provided in this chapter. Analysis of these uncertainties showed that there are many considerations and interrelations. A value perspective and a technology perspective have to be embraced. These are all issues that characterise large systems. Literature on design is reviewed in the next chapter starting with systems engineering literature.

4 Design approaches

The theoretical background to design approaches is provided in this chapter. First we look at theories around organisations and especially network organisations. Next, we present system related design theories, i.e. system engineering, information systems and business system engineering. Relevant issues on process management follow this. The last theory presented is product design. The chapter ends with an overview of the most relevant design approach elements positioned in the 'ways of' framework.

4.1 Framework

Preliminary theoretical notions on design approaches relevant for designing mobile information services in an inter-organisational setting are presented in this chapter. Designing mobile information services can be seen as developing a system that consists of technology, actors (suppliers and users) and a service formula. We are looking for guidelines for designing this system. Therefore we take a look at system engineering and the derived theories on information system design and collaborative business engineering in Section 4.3. The multi actor perspective is important here since mobile information services are designed in a multi-actor setting. A process perspective helps to support a multi-actor process and this is described in Section 4.4. In Chapter 2 we explained that the distinction between services and physical goods seems to be rapidly eroding. The mobile handheld can be seen as part of the mobile information service system. Therefore we take a look at product design theories in Section 4.5.

A design approach is commonly understood to be a coherent set of activities, guidelines and techniques that can structure, guide and improve a (complex) design process. Design approaches can be expressed as a way of thinking, a way of working, a way of modelling and a way of controlling, see Figure 4-1 below (adapted from Seligmann et al. 1989).

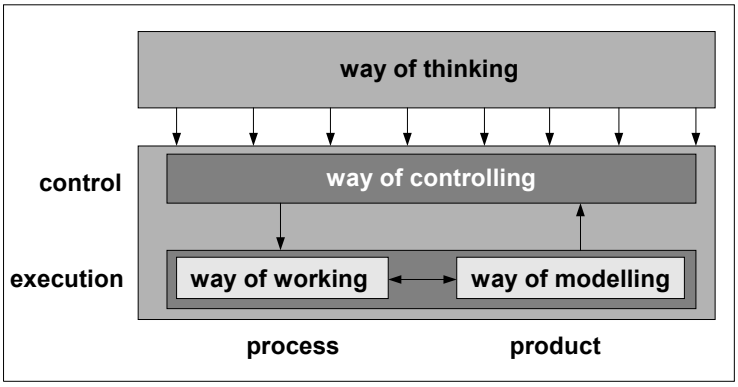

Figure 4-1 Framework to analyse approaches

This 'ways of' framework has been used to construct methodologies for new problem areas by e.g. Van Meel (1994), De Vreede (1995), Janssen (2001), Bockstael-Blok (2001) and Van Laere (2003). We refer to them for a comprehensive discussion of the 'ways of' of the dynamic modelling approach.

- The way of thinking of an approach expresses the underlying philosophy; the perspective taken on the problem field is stated and underlying assumptions are made explicit. The way of thinking determines the way of modelling, way of working and way of controlling. The way of thinking is often expressed in guidelines, rules of thumb, do's and don'ts, metaphors and design theories.
- The way of controlling, or the managerial method expresses the managerial aspects of a design approach.
- The way of working, or the working method, expresses the possibly compound tasks that must be carried out in the design process.
- The way of modelling refers to the modelling tasks and the use of modelling concepts that are suitable for modelling relevant aspects of the problem situation.

We will use the 'ways of' design approach model at the end of this chapter to structure the summarisation of existing design theories that are useful for designing mobile information services. Before we describe the design theories for systems, processes and products we introduce network organisations.

4.2 Network organisations

In Chapter 1 we described the value network of interdependent actors that have to collaborate to design mobile information services. In this section we investigate the basic organisational forms market, hierarchy and network to find useful elements for our design approach.

Powell (1990) begins his discussion of the network form of organisations by discussing why the familiar market-hierarchy continuum does not do justice to the notion of network forms or organisation. A starting point in this discussion is the transaction cost economics (TCE). TCE is an interdisciplinary approach to the study of economic organisation in which the transaction is made the basic unit (Williamson 1985). Transaction costs serve as a measure of efficiency for the evaluation and selection of various institutional arrangements. Powell (1990) argues that besides economic exchange other forms of exchange also have to be taken into account. He compares the market, hierarchy and network form and describes them as follows.

- In *market* transactions the benefits to be exchanged are clearly specified, no trust is required, and agreements are bolstered by the power of legal sanction. The means of communication are prices. The degree of flexibility is high, the amount of commitment is low, the climate is precision and/or suspicion and the actors are independent.

- In *hierarchies*, communication occurs in the context of the employment contract. Relationships matter and previous interactions shape current ones, but the patterns and context of intraorganisational exchange are most strongly shaped by one's position within the formal hierarchical structure of authority. The means of communication are routines. The degree of flexibility is low, the amount of commitment is medium to high, the climate is formal, bureaucratic, and the actors are dependent.
- *Network* forms of exchange entail indefinite, sequential transactions within the context of a general pattern of interaction. Sanctions are typically normative rather than legal. The means of communication are relational. The degree of flexibility is medium, the amount of commitment is medium to high, the climate is open-ended, mutual benefits and the actors are interdependent.

Networks or network organisations have emerged as an organisational form to overcome the problems with hierarchies and to create greater structural effectiveness and responsiveness with trade-partners (Powell 1990). To develop mobile information services a company needs new know-how and capital that is scarce. Wigand et al. (1997) argue that entry barriers to new know-how and capital markets are additional factors that promote the blurring of organisational boundaries through symbiotic arrangements. Networks and joint ventures are examples of symbiotic arrangements. Networks have no high or low coordination and production costs, and are somewhere in the middle of hierarchies and markets. "Coordination in a situation of interdependence can be achieved by standardisation, by plan, and by mutual adjustment" (Thompson 1967). Thompson argues that coordination place increasingly heavy burdens on communication and decision and that there are very real costs involved in coordination.

One way to describe an interorganisational network is to use the characteristics of its members. If we consider a limited set of organisations, *firms*, this creates a more narrow set of network relations: the *interfirm network*. Sydow and Windeler (1998) define an interfirm network as an institutional arrangement among distinct but related profit organisations which is characterised by (1) a special kind of (network) relationship, (2) a certain degree of reflexivity and (3) a logic of exchange that operates differently from that of markets and hierarchies. The network relationship is typically complex and reciprocal and reflexivity implies problem solutions often require inter-firm coordination. The logic of exchange is one that combines cooperative and competitive elements, dependency and autonomy and trust and control.

A network must also have limits that define its membership. One such limit is the goal of the network, with network membership being established by each individual firm's contribution to the attainment of this goal (Jones et al. 1998). Using this approach, a service network will be limited to those firms actively involved in the provision of the service.

Nooteboom and Gilsing (2004) distinguish networks for exploration and for exploitation: exploitation entails improvements with respect to established practice, while exploration

entails the development of new practices. This distinction is useful to compare the case studies described in Chapter 5 and 8 of this dissertation. They compare the network structure and strength of ties for both kinds of networks; see Table 4-1.

Table 4-1 Networks for exploration and exploitation (Nooteboom and Gilsing 2004)

Network features	Exploration	Exploitation
Network structure:		
Density	High	Low
Stability	Limited	High
Centrality	Low	Often high
Strength of ties:		
Scope	Wide	Narrow
Duration	Limited	Often long
Frequency of interaction	High	Low
Control	Low	High
Trust/openness	High	Generally low

Mobile information services are developed in a network where companies cooperate. First in the exploration phase in which network organisations design services by experimenting with and learning from using disruptive technologies and business models. If the service is on the market the network organisations successively exploit the service, this is the exploitation phase.

4.3 System design approaches

Systems' thinking is the underlying view for various design approaches. Therefore we first describe system engineering in general (subsection 4.3.1) followed by the derived theories of information systems (subsection 4.3.2) and collaborative business engineering (4.3.3).

4.3.1 System engineering

A *system* can be defined as a whole of objects one would like to recognise in a certain problem area under study, during a certain period of time (Sol 1982). Another definition is that a system is a group of components that work together for a specific purpose (Sage and Armstrong 2000). Systems are often classified by their ultimate purpose: service-oriented systems, product-oriented systems, or process-oriented systems. This research is intended to develop a service-oriented system. All the components and organisations involved have to work together to provide a mobile service that adds value to the users. *Engineering* can be defined as designing solutions for actual and practical problems (Van Meel 1994). *Systems engineering* can be defined in different ways, but all definitions consist of a formulation, analysis and interpretation effort. Therefore, systems engineering can be seen as a management technology that includes knowledge perspectives, knowledge principles and knowledge practices (Sage and Armstrong 2000). Knowledge perspective represents the

view on the present reality and the future; knowledge principles represent the problem solving approach; and knowledge practices represent the standard operating policies based on accumulated wisdom and experiences.

Sage and Armstrong (2000) present ten important issues that must be dealt with to manage large systems. These issues are (1) many considerations and interrelations; (2) many different and perhaps controversial value judgments; (3) knowledge from several disciplines; (4) knowledge at the levels of principles, practices and perspectives; (5) considerations involving product definition, development and deployment; (6) considerations that cut across the three different life cycles associated with systems planning and marketing, RDT&E and system acquisition or production; (7) risks and uncertainties involving future events that are difficult to predict; (8) fragmented decision-making structures; (9) human and organisational needs perspectives and value perspectives as well as technology perspectives; and (10) resolution of issues at the level of institutions and values as well as the level of symptoms.

These issues have to be dealt with when designing mobile information services; some examples will be used to illustrate this. In Chapter 3 we pointed out that the mobile field is characterised by uncertainties (issue 7). Uncertainties regarding the technology, the demand markets (customer value), the supply market (value web) and the interaction between the demand and the supply market. This shows that mobile information services have to embrace the perspective of the need of the customer, the customer value, value for the involved business actors delivering the services and the technology perspective taking into account the dynamic development in the mobile field (issue 9). Decision-making takes place at a company level, at a dyad, triad and network level. This makes it complex (issue 8).

Knowledge drawn from a combination of disciplines has to be used (issue 3) to develop an approach for designing mobile information services. First, there is knowledge on the design of systems (Sage and Armstrong 2000, Checkland 1999, Nadler 1995, Jackson 1991) and software engineering (Brown 2000 Boehm 1988; August 1991). A firm has to take decisions in line with their strategy and, therefore, theory on strategy and a more specific strategy for service organisations is relevant (e.g. Ansoff 1965, Porter 1985, 2001, Rayport and Sviokla 1995; Tapscott 2001, Hamel and Prahalad 1994). Mobile information services are innovative and therefore information on innovation is needed (e.g. Rogers 2003; Christensen 1997). Management theories are necessary to manage the design process and especially theories on *coordination in inter-organisational settings* (e.g. Mintzberg 1983; Wigand et al. 1997; Powell 1991).

Besides the need for knowledge of several disciplines there is also the need for knowledge at different levels (issue 4). To develop a mobile service oriented information system it is necessary to have a view on the present reality and a future perspective (knowledge perspective); to know how to solve problems in an unstructured environment like merging telecommunications and media sectors (knowledge principles); and to be able to determine

which standard operating policies are available from more established disciplines like e.g. product design (knowledge practices).

Checkland (1999) states "in the literature is often stated that 'hard' systems thinking is appropriate in well-defined technical problems and that 'soft' systems thinking is more appropriate in fuzzy ill-defined situations involving human beings and cultural considerations." He mentions that this is not untrue but that it does not define the difference between 'hard' and 'soft' thinking; the ultimate definition is the result of our feeling our way to the difference between 'hard' and 'soft'. He illustrates this with a picture in which the observer in the 'hard' world perceives the real world as systems and the observer in the 'soft' world as complexity and confusion in which he can see a learning system. This 'soft' world description fits with the uncertainties in the mobile domain as described in Chapter 3. However, we also want to engineer, to develop applications. Hard and soft system thinking is combined in business engineering (BE). BE can be positioned between organisation design and information systems design (Van Meel 1994). We first discuss the design of information systems and then come back to business engineering.

4.3.2 Design of information systems

Alter (2002) defined information systems as "a work system whose business process is devoted to capturing, transmitting, storing, retrieving, manipulating and displaying information, thereby supporting other work systems". One of the six systems Alter distinguishes is the communication system, defined as "helps people work together by interacting and sharing information in many different forms". Mobile information service oriented systems are part of this type of information system. 'Work' has to be interpreted broadly since people might also interact and share information for, for example, leisure reasons.

It is difficult for users to answer the question: What are your requirements for this or that information system? The same counts for mobile information services. If answers are given they will vary. This problem can be mitigated through the inclusion of users in the design phases of mobile services as in an evolutionary development model. An evolutionary approach is suitable in situations where the requirements are not well formed or understood by the users, where it is difficult to specify the requirements, or where it is difficult to determine how a proposed solution will perform in practice. "An evolutionary design approach stages consist of expanding increments of an operational product with the directions of evolution being determined by operational experience…. the disadvantage of this approach is to distinguish it from the old code-and-fix model, whose spaghetti code and lack of planning were the initial motivation for the waterfall model" (Boehm 1988).

The waterfall and the spiral model are two basic developments models for information systems (Cadle and Yeates 2001). The waterfall model originates from the seventies while Boehm (1988) introduced the spiral model at the end of the eighties. The waterfall model is a stage-by-stage model, the spiral model combines this with an evolutionary approach. The

aim of the spiral model is to give a structured and incremental approach to the service designing process. The project starts at the centre of the spiral and progresses outwards, so problems occur during the various stages and are not all found at the end. In three or more rounds various quadrants activities are carried out until the service designers are satisfied by the results, see Figure 4-2.

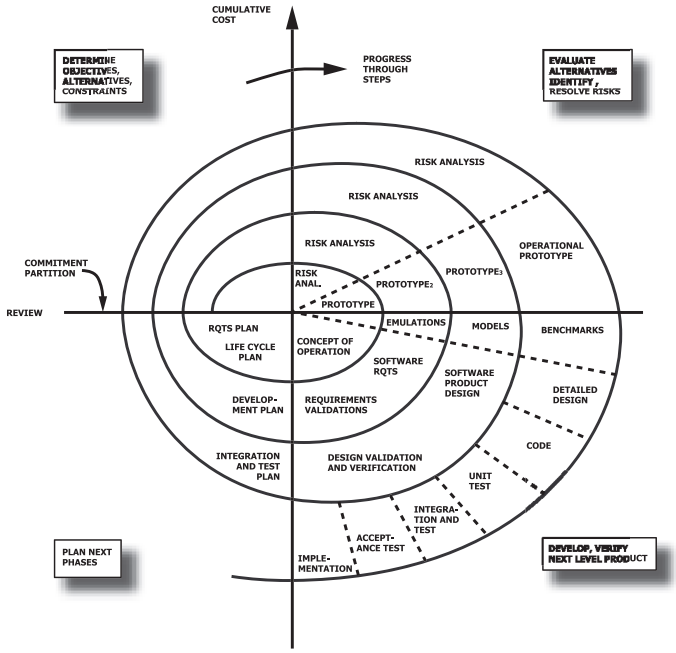

Figure 4-2 Original diagram of spiral development (Boehm 1988)

Since various dependent actors are involved in a relatively unknown area it is important to create wins for each actor. A win-win approach is defined as "a set of principles, practices and tools, which enable a set of interdependent stakeholders to work out a mutually satisfactory (win-win) set of shared commitments" (Boehm et al. 2001). In the EasyWinWin approach the WinWin Spiral model is combined with collaborative knowledge techniques and automation of the Group Support System; this approach has been applied in about 50 projects (Briggs and Gruenbacher 2002).

Growing commercial pressure to achieve competitive advantage by developing systems quickly means that approaches like Rapid Application Development (RAD) and Dynamic System Development Method (DSDM) are becoming increasingly popular (Cadle and Yeates 2001). Many variants exist for these approaches. The methods take into account management issues and design issues related to the user. Management issues are conditions on the environment, empowerment of staff and fit for business purpose. Interesting elements for a user centred design approach are the following.

- Testing is seen as being an integral part of the iterative cycle.
- Products are delivered frequently rather than as a perfect end product.
- Interactive and incremental development is an integral part of the approach.
- Users must be actively involved.

In the past few years the software industry has been characterised by rapid and continual change in the domains in which software is applied, and in the underlying technologies they target and use (Brown 2000). Mobile information services are one of the domains in which software is applied. Brown argues that component-based development offers the most promising attempt to meet the challenges in the rapidly changing domains and that it provides the basis of a new set of techniques supporting the next generation of software-intensive solutions (Brown 2000). Components are defined as '*an independently deliverable piece of functionality providing access to its services through interfaces'*. Three of the reasons Brown mentions for using components, and that are relevant for mobile information services, are *reduce delivery time*, *make use of best-in-class,* and *support parallel and distributed development*. A component-based development approach consists of the following three activities (Brown 2000).

a) 'Understand the context', the objective of 'understand the context' is to obtain a clear statement of initial requirements. This can be modelled by use case modelling and business type modelling.

b) 'Define the architecture', the aim is to identify all the components that will be used to build the application, and to identify the dependencies between these components. The ways that can be used to model this are:

   - Component architecture modelling; to identify all components that will be used to build the application and to identify the interdependencies between these components; for example UML use case diagrams. The components architecture modelling of mobile information services can be structured in layers: the telecommunication network, the middleware, the applications and the presentation layer.
   - Context modelling; to include a description of the proposed system as a key part of the model and to understand how the system works within the context of the defined business types.
   - Interface modelling; to obtain a set of candidate interfaces, and begin to describe the details of those interfaces.

c) 'Provision the solution'. In a pure top-down approach, the provisioning of the solution starts when the architecture of the system has been completed. In reality this is an interleaved development process in which architecture definition guides provisioning decisions, and provisioning experiences are used to inform and refine the architecture.

4.3.3 Collaborative Business Engineering

Van Meel (1994) stated that the design perspective on the role of IT in organisations is labelled as 'business engineering' (BE). He positioned business engineering between organisation design and information systems design. The BE approach is based on the dynamic modelling (DM) approach that has proved suitable for dealing with design of complex human activity systems in different types of problem situations (Bockstael-Blok 2001 referring to Sol and Van Hee 1991; Sol and Crosslin 1992). This approach has been further applied and developed in numerous studies in several types of problem situations. Some examples are research on the design of organisational coordination (Van Meel 1994; De Vreede 1995; Van Laere 2003) and on interorganisational systems from a chain perspective (Bockstael-Blok 2001). The BE approach is also applied in Business Process Redesign (BPR) projects using collaboration and simulation support within organisations. Den Hengst and De Vreede (2004) describe these case experiences and lessons learned as Collaborative Business Engineering (CBE). The 'collaborative' part is also important for this research since mobile information services have to be designed in a network of actors, as showed in Chapter 1. One organisation cannot design services on its own since services are the result of coordinated design activities by different actors like operators, handset manufacturers and content providers.

The CBE approach is aimed at dealing with solving ill-structured problems. The design approach should not focus on finding the single optimal new organisational design, but on facilitating a diagnosis and design process that will yield a satisfying and acceptable solution (Den Hengst and De Vreede 2004). The CBE approach is usually based on *problem solving.* We prefer to call the situation opportunity driven since the design of mobile services is more often aimed at finding new business for companies than for solving problems for the users. However, the services will only be successful if they are useful and help to solve problems and meet the needs of the (potential) users. The motivation for designing mobile services is opportunity driven. The 'opportunity' owner wants to make a profit with new mobile services and has to take a customer driven or market driven approach in a market with a lot of uncertainties. The design activities for solving CBE problems are problem formulation, problem conceptualisation, models specification, model checking, solution finding and solution implementation (Den Hengst and De Vreede 2004).

The BE approach is usually based on *incremental improvement.* This is the opposite of radical thinking. When designing mobile services we think that incremental improvement only is dangerous because organisations are locked in their processes and may miss opportunities. Only radical thinking, however, is also impossible since organisations and the market have their history and institutionalised habits. The CBE approach allows for both radical and incremental change (Den Hengst and De Vreede 2004).

The CBE approach combines the *hard and soft system thinking* from system engineering. As described in subsection 4.3.1, both hard and soft thinking are relevant when designing mobile services. Hard system thinking is useful to deal with the engineering aspects:

designing the network infrastructure, mobile middleware and applications; and soft thinking to learn, to deal with actors and to reach consensus among the actors within the value network.

Modelling has a prominent place in the CBE design approach, especially in this environment where customer value is key and the customer cannot imagine whether s/he is interested in the services. A distinction can be made between conceptual models, that define the structure of a problem situation, and empirical models, that represent a further specification of the problem situation and facilitate analysis and diagnosis of the problem or possible solutions (Den Hengst and De Vreede 2004). The way of conceptual modelling in the CBE approach nowadays is object oriented. Visualisation is a variant of empirical modelling that is useful in the design process of mobile information services. Modelling visual interactive features graphically may be very time consuming but it has a high added value in terms of a vehicle for communication and gaining insight.

4.4 Process management

Process management techniques can help to involve the relevant actors in the design process. As Checkland (1997) argues 'a systems thinker would know that the process of policy creation and policy content are entirely complementary, the process itself concidioning what might emerge as content. Both need to be thought about together; but this is not yet a familiar concept.' De Bruijn et al. (2002) elaborated on process management. Actors and their values, language and argumentation are important in a process management approach. The focus is on identification and implementation of changes. The design requirements are more than just involving parties, namely: a sense of urgency, openness and integrity, protection of core interests and core values of parties, incentives for continuation, and process type arrangements to facilitate sufficient content. The actors focus on following agreements, meetings and negotiations. The process architect has to design the process that results from negotiations with the involved stakeholders.

The core elements of process design are (1) openness, (2) protection of core values, (3) speed and (4) substance. It is a one-side picture to say that with process management the value of openness surpasses that of speed. If disputes arise later these have to be handled and it can take longer to deal with the dispute than the time needed to design well beforehand.

Process management can be positioned versus project management. As stated above, project management is one of the most basic forms of management used to control projects. In project management it is assumed that problems and solutions are reasonably stable within certain limits and that management techniques like clear goals and targets, a time schedule, a clear framework and a prefixed end product can be used. De Bruijn et al. (2002) argue that this only works in a static world and that this approach is impossible for dynamic activities. They add "there will be dynamic particularly when decisions have to be taken in a network. The various parties hold different views about how a problem and a

solution should be defined. As a result, the decision making will always be capricious and unstructured".

4.5 Product design methodologies

Generating an idea for a product is part of an innovation process with divergent and convergent activities. Product planning is part of the strategy process of a company, and the realisation of the product consists of a technical development process and a commercial development process. Therefore, Roozenburg and Eekels (1995 referring to Hall 1969) argue that for product development as a whole a special implementation of the empirical cycle of the problem-solving model of systems engineering is quite close to the basic product design cycle. They present several product design overviews. Their basic cycle of design is presented in Figure 4-3.

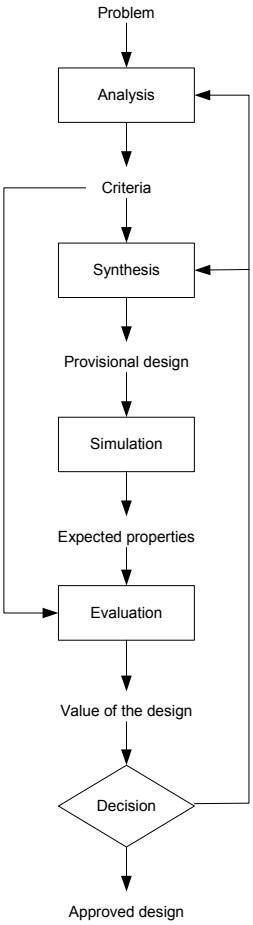

Figure 4-3 The basis cycle of design (Roozenburg and Eekels 1995)

The basic design cycle presented in Figure 4-3 provides valuable input for the design approach for mobile information services. Additionally, Roozenburg and Eekels (1995) provide methods, rules and recommendations for each phase of the basic cycle. Although these are directed towards tangible products like vending machines and phones, some of these tools provide inspiration for designing services. Buijs & Valkenburg (2000) present a similar kind of model for developing innovative products with the phases: analysis, synthesis, materialisation and optimalisation. For each phase they present the input, activities and output with an evaluation between each phase.

Roozenburg and Eekels refer to Quality Function Deployment (QFD) in their explanation of how to get from a design problem to a design specification: QFD is a method that is mostly based on an organisational approach that resembles a typical Japanese approach to product innovation. Quality Function Deployment is a method for structured product planning and development that enables a development team to specify clearly the customer's wants and needs, and then to evaluate each proposed product or service capability systematically in terms of its impact on meeting those needs (Cohen 1995). The method is tailored to the organisational context in which the process of developing a specification takes place (Roozenburg and Eekels 1995). The sequential approach of product development is replaced by a concentric, concurrent approach in which different stakeholders are involved in the product development process from beginning to end. The method supports a team of designers in identifying the needs of the customer and interpreting them in terms of technical parameters and target values. The QFD process involves structuring matrices of which the first displays the customers' wants and needs. This matrix is the most well-known and called the 'house of quality'. In the QFD handbook the activities are structured in phases: phase 0 = planning phase; phase 1 = gather the voice of the customer; phase 2 = build the house of quality; phase 3 = analyse and interpret. Creveling et al. (2003) present a methodology built upon a balanced portfolio of tools and best practises to enable a product development team to develop the right data[1]. The critical components in product development are (1) product development process; (2) tools and best practises and (3) project management. Creveling et al. present a technology development roadmap (invent/innovate, develop, optimise, verify) and a product development roadmap (concept, design, optimise and verify). They link Quality Function Deployment (QFD) to the invent/innovate phase in the technology roadmap and the concept and design phases to the product development roadmap.

4.6 Recapitulation of design approaches

Considering the number of components required for mobile services and the complexity perceived by the actors in the mobile field we consider mobile information service to be

[1] This is based on the Six Sigma Approach created by Motorola and popularised in corporate business by General Electric.

complex. Designing mobile information services can be seen as developing a system that consists of technology, actors (suppliers and users) and a service formula. We are looking for guidelines for designing this system. The theories mentioned in this chapter provide useful elements for this.

We introduce Collaborative Business System Engineering (CBSE) based on CBE. We add 'System' to express that it is a combination of insights from system engineering (complex, hard and soft thinking), information system design (waterfall model, spiral model, component based development) and collaborative business engineering (collaboration, incremental improvement and radical thinking, modelling).

An overview, of the approaches for CBSE, process management and product design is provided in Table 4-2. The useful elements of system engineering and information system design are integrated in the CBSE approach column.

Table 4-2 Overview of design approaches

	Collaborative Business System Engineering	**Process Management**	**Product Design**
Characteristics	Managerial approach for an integrated design of ICT, processes and structures. Incremental change *with* radical change. Organisational component.	The design of the *process* ends in the problem solution. Focus on identification and implementation of changes. Actors and their values, language and argumentation are important.	Prescription of structure, construction and use of a physical entity. Conflict between need for creativity and uncertainty reduction.
Way of thinking	Dealing with complex systems. Problem driven, ill-structured problems. Hard and soft systems thinking. An actor network perspective.	Network perspective. Getting support. Reducing substantive uncertainty. Incorporating dynamic. Enriching problem definitions and solutions.	Reducing complexity. Design in a top-down manner. Explicit specifications at the start. Balanced design choices. Start with customer's wants and needs (emphasised in QFD).

	Collaborative Business System Engineering	**Process Management**	**Product Design**
Way of controlling	Measurement as basis for management purpose. Adaptive strategy with close cooperation of stakeholders and experts (analysts).	Focussed on following agreements, meetings and negotiations.	Interdisciplinary teams Project management, like. QFD
Way of working	Problem solving activities: • Conceptualise problem • Create and validate empirical problem, diagnose problem • Construct alternative models and conduct experiments • Choose most preferred solution • Implement solution • Ex-post evaluation. For information systems: waterfall model and spiral model.	The design requirements are more than "involving parties" namely: • Sense of urgency • Openness and integrity • Protection of core interests and core values of parties • Incentives for continuation • Process type arrangements to facilitate sufficient content.	Design phases: • Design objective → Analysis of function • Specifications → Evaluation • Requirements → Concept development • Concepts → Evaluation • Choice for one concept → Details design • Prototype → Evaluation • Final design → Optimalisation • Product.
Way of modelling	Conceptual modelling. Object oriented dynamic modelling. Empirical modelling like simulation models e.g. with visual interactive features.	Gaming in social context to validate process steps.	Art impressions; scale models; prototypes; calculations, computer simulations.

Sources: Den Hengst and De Vreede (2004), Van Venrooij (2002), Bockstael-Blok (2001), De Bruijn et al. (2000), Buijs and Valkenburg (2000), Roozenburg and Eekels (1995).

CBSE is considered as a managerial approach for an integrated design of ICT, processes and structures. The focus of process management is on identification and implementation of changes and therefore actors and their values, language and argumentation are important. Product design is about the prescription of structure, construction and use of a physical entity. Product designers have to deal with the conflict between the need for creativity and uncertainty reduction. None of the above mentioned theories completely cover the design process of mobile information service systems. A combination of elements of the theories however offers a good start to answer the questions asked in Section 3.5. The three design approaches given in Table 4-2 form the basis for our further research.

Our way of thinking is that the design of mobile information services is actually the design of mobile information service oriented systems. This is a complex system for which we need hard and soft systems thinking. An actor network perspective is required and we need to start with the wants and needs of the customer. We translate this into a way of thinking framework with the service concept based on the customer's needs, the 'hard' enabling information and communication technology and the 'soft' organisational part consisting of the value network of actors as core elements.

The other elements of the 'way's of' framework (controlling, modelling and working) can be used to control and execute the design process. The way of controlling expresses the managerial aspects and how the design process is organised. The theories for network organisations can be used to enrich the way of controlling presented in Section 4.2. We have shown that it is useful to distinguish networks for exploitation and exploration phases. In the exploration phase theories of project management and process arrangements are helpful. In the exploitation phase concepts of business models and value networks might be observed. The way of working can be described by an iterative cycle of a series of activities. These activities can be categorised into analyses, preparation, synthesis, implementation and tests. User requirements are uncertain and therefore the inclusion of users is recommended. Models are helpful to use when interacting with users; for example storyboards and prototypes. Other useful models in the design process are component architecture modelling, context modelling and interface modelling. The organisation can be modelled using actor and role models.

The general design approaches in Table 4-1 form the background for the description of design theories applied on *mobile* information services in Chapter 6. The focus of the research presented in this thesis is network creation and coordination of the activities between actors in the value network, but we can only study this by taking into account the service concept based on the customer's needs, and the enabling technology. First, we will investigate what happens in practice by describing three initial case studies. These case studies were set up according to the preliminary framework of describing the mobile service system from a user's perspective, technology perspective and organisational perspective. The activities carried out from these perspectives together form the design approach of the service-oriented system.

5 Three case studies on mobile information services

The Wireless Application Protocol (WAP) made it possible to use existing GSM mobile devices and networks to surf on the Internet without being connected to a wire. Later, other concepts like iMode followed. We present the WAP based M-info service and the iMode based Radio 538 ringtune service and Finder service in this chapter.

5.1 WAP and iMode

We started to describe the evolution of mobile information services with the development of WAP in Section 2.5. WAP was the first technology that enabled the wireless Internet. The purpose of WAP is to enable easy fast delivery of relevant information and services to mobile users. However, WAP started with a technology push oriented concept and the first customer reactions were quite apathetic. The introduction of iMode was more customers oriented and made use of the lessons learned with WAP. iMode is a wireless Internet connection that enables users to browse iMode content sites and send and receive e-mail. To appeal to the mainstream consumer market, iMode is positioned as simple, usable and fun. Customers sign up for iMode as an extra service to their mobile phone subscription. They are billed separately for iMode, the iMode services they use and the data transmitted. From a customer's point of view there a big differences between iMode and WAP. IMode is a brand and WAP is a bundle of technologies and protocols. The expectations of WAP have not been met in most countries and part of the problem is the limitation of technology and the non-subtractive nature of services (Barnes 2003b). As shown in Chapters 2 and 3, the future of iMode and WAP remains uncertain given upcoming mobile networks like UMTS and JAVA-based application protocols.

In this chapter we present case studies on one WAP and two iMode services. The WAP service is the first Internet based mobile service in the Netherlands, namely the M-info service introduced by KPN Mobile in 1999. Two years later KPN Mobile and its daughter E-Plus introduced iMode in Europe. We describe the Radio538 ringtune iMode service in the Netherlands and the location-based iMode service Finder in Germany.

The case studies are described along the way of thinking framework core elements with the service concept based on the customers' needs, the enabling technology and the organisational perspective with the creation of and coordination a the value network. For each service we also describe more or less extensively how the design process was managed. This provides insight into the way of controlling and working in the projects. Furthermore we describe the market acceptance of each service to show how the service is performing on the market. First, we describe how the case studies were set up.

5.2 Set up of the case studies

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used (Yin 2003). As explained in Chapter 1, case studies have advantages and disadvantages. To achieve quality in case study research, Yin (2003) has developed case study tactics designed to withstand the tests of construct validity, internal validity, external validity and reliability. To achieve this, attention should be paid to the design of the case study and to the site selection, sources of evidence and method of analysis (Yin 2003; Van Meel 1994; Van Laere 2003).

Designing a case study

Design a case study involves decisions about the object and goal of the study, the unit of analysis and use of single or multiple cases (Yin 2003). As described in Chapter 1, the object of study consists of a network of organisations designing mobile information services. This network first has to be created; subsequently the activities within this network of organisations have to be coordinated to develop customer value. The goal of the study is to develop a design approach in terms of a way of thinking, a way of controlling, a way of working and a way of modelling. The unit of analysis is the network of organisations that together produce the mobile information service. The mobile information service can be regarded as a system that should embrace the users', technology and organisational perspective. The objective is that of the service provider that wants to deliver a useful and easy-to-use service to the market. To ensure construct validity, internal validity, external validity and reliability we applied the following case study tactics (Yin 2003). To achieve construct validity we used multiple sources of evidence and had the interviewees review the interview transcripts and draft reports of the case studies. This is further explained below under collecting evidence. To achieve internal validity we applied pattern-matching and explanation building, further explained below under data analysis. To achieve external validity we used multiple case studies to discover issues. We want to stress that the purpose of these multiple case studies is not to generalise but to achieve an understanding of the problems. To achieve reliability and minimise the errors and biases in the case studies we documented all our steps and discussed the procedures and results with other researchers.

Criteria for site selection

The criteria for site selection can be derived from the mobile information services field described in Chapter 2. The service should be so complex that it can be considered to be a service oriented system (see 4.2.1). This service-oriented system should be characterised by elements of service concepts designed for end-users, enabling fast developing technology and supporting a complex value network of involved actors. Lastly, the site must give good opportunities for carrying out case study research. With regards to this last point, Yin (2003) argues that the choice of a case study is often based on opportunism, rather than on rational grounds. The described case studies fulfil these requirements.

The first case study is the development of a service based on the Wireless Application Protocol (WAP), a technology that can be used to surf wireless on the Internet. In the Netherlands, M-info was one of the first mobile Internet services and was launched by KPN Mobile in 1999. The researcher was part of the team that developed and introduced the service on the market. The team consisted of KPN Mobile employees, suppliers and consultants. On March 2nd 2004 KPN Mobile sent a SMS message to its customers that it would cease to provide the M-info service as of 1st of April 2004.

The two other case studies were done as part of a broader project named BITA[1]. One of the research areas in the BITA project was 'mobile information and entertainment services'. Within this research area services over the mobile telecommunications network were chosen that could be categorised in category 2 (mobile information and entertainment services) and category 3 (location based mobile services) as depicted in Figure 2-1 in Chapter 2. Within this context five mobile information and entertainment service cases were identified. The services were offered to end-users in three European countries: the Netherlands, Germany and Sweden. Two of these case studies were extended with research into the service design approach followed and these two case studies are discussed here. The first case study concerns one of the most popular mobile entertainment services in Europe, ringtones. More specifically, it is concerned with the Radio 538 ringtunes service offered via KPN Mobile's iMode service. The second case study concerns a location-based mobile service. This is named Finder and offered via the E-plus iMode portal to the German market.

Collecting evidence

A number of different data collection sources were used to collect evidence. In the M-info case the main source of data collection was participant-observation. The researcher was part of the project team that developed the service. A first version of the case study was written with the responsible marketer for the service (see Van de Kar and Vos 2000). In 2002, after the service had been on the market for more than a year, the case study was updated using interviews and available information taken from the Internet. In the iMode cases the main source of data collection was interviews. Interviews were held during the summer and fall of 2002. The interview protocol was set up within the research program BITA and the aim was to uncover specific aspects of the business model and relate them to the overall service network structure. For the purpose of this research, questions were added in the interview protocol for the Radio 538 ringtune case and Finder case, regarding the management of the design process of the services. For each service, depending on the

[1] The research reported in this paper is part of the BITA (Business models for Innovative Telematics Applications) and B4U (Business for Users) projects. In these projects the Telematica Instituut co-operates with Delft University of Technology, TNO-STB and TNO-Telecom. We acknowledge the effort of our colleagues who worked with us in these projects. The projects and its objectives are documented at the Telematica Instituut Web site: http://bita.telin.nl. Some of the analysis is done as part of the B4U project as BITA's successor; see http://www.freeband.nl/projecten/b4u.

network size, interviews were held at between two and five organisations. At each organisation, the interviewees were typically managers in charge of relations with the external partners associated with the particular service. To be specific, for the Radio 538 ringtune case managers from three different firms were interviewed. At KPN Mobile we interviewed the manager responsible for the iMode portal, at Tutch we interviewed the CEO and at Radio538 we interviewed a member of the management team responsible for Internet and mobile services. For the Finder case study interviews were held with managers at three companies. At E-Plus we interviewed the former project manager who set up the service but had left the company at time of the interview. Later we also interviewed three managers of E-Plus that were at that time responsible, an external consultant responsible for strategy, a content administrator and a technical productmanager. At Webraska we interviewed the regional sales director for central Europe. At Schober.com we interviewed the head of strategic sales and partnerships. The interviews took two to three hours each. The interviewees received the interview transcript and the draft version of the case study report and were asked if the transcript was correct and whether there was confidential information in the transcript. Data from interviews were supplemented with information from company websites and industry reports.

Data analysis

The analysis of the data of the inductive case studies presented in this chapter is used "to play with the data in a preliminary sense". The case studies are described based on the issues discovered in chapters two and three: the service from the user's point of view, the enabling technology and network organisation with the value network of actors.

The chronological events over time have been traced in the M-info case, which may be considered as a special form of time-serie analysis (Yin 2003). A final case study report was produced at the end of each case study. The M-info case study was discussed at international conferences (Van de Kar 2000 [AMCIS conference]; Van de Kar 2002 [Bled conference]); and during class discussions with master students at the TU Delft (E-business courses in the academic years 2001/'02, '02/'03 and '03/'04). The final iMode case study reports were discussed with other researchers in the BITA research project and published with different angles of reflection (see Wehn de Montalvo 2002b, 2004; Maitland 2003a, 2003b). The Radio 538 ringtune case study has been published with co-authors from the BITA research group (Van de Kar et al. 2003).

5.3 Case 1: M-info

M-info was one of the first mobile Internet services and was launched in the Netherlands by KPN Mobile in 1999. M-info is a mobile service based on the WAP protocol. The WAP Forum developed the standard behind this technology. The WAP Forum began with four founders in 1997 (Phone.com, Ericsson, Nokia and Motorola) and it has now grown to more than 500 members, many of whom are among the most powerful telecom, IT and software companies from around the world. The WAP Forum is the industry association comprised of

hundreds of members that have developed the de facto world standard for wireless information and telephony services on digital mobile phones and other wireless terminals. In 2002 the WAP Forum became part of the Open Mobile Allicance (OMA)[1]. The implementation of WAP has provided both problems and opportunities but nevertheless it is an important starting point for the growth of the wireless Internet (Barnes 2003b).

The largest Dutch telecommunication, and until 1989 state-owned, company KPN Telecom joined the WAP Forum in 1997. Its department KPN Research took care of this. KPN research is the research and development department of KPN Telecom where researchers work on the newest telecommunication technologies and applications to fit the market needs. At the end of 1998 the WAP Forum approved the standard WAP 1.0 and KPN Mobile started an internal test together with Alcatel[2] and Phone.com[3] to gain experience with WAP. The WAP 1.1 standard was launched in June 1999. This version of the protocol was suitable for commercial applications. KPN Mobile made a deal with Nokia to become a launching customer for their gateway and handsets.

KPN Mobile wanted to be the first Dutch Telecom Operator to introduce WAP on the market and succeeded in this. M-info was the name of this first commercial service based on WAP 1.1 in the Netherlands. M-info was launched at 25 November 1999 and taken out of the market on the 1st of April 2004.

5.3.1 Service Formula

We describe the target group, the service levels and the content of this service below.

Target group

KPN Mobile offers prepaid services and subscriptions via the brands 'Hi' and 'FlexiBel', and via corporate arrangements. Hi is the brand for services to young people, cheap and fancy. FlexiBel is the brand used for services with a higher service level and targeted at Small and Medium Enterprises (SME) enterprises and the top-level of the consumer market. GRIP is the brand for services for the corporate market, for large companies. Furthermore there are services with no specific brands and just called 'prepaid' or 'KPN Mobile'.

The M-info launch was targeted at the young professional; at people who use their mobile phone and the Internet a lot, and are interested in using new services. The first users were expected to be innovators, technocrats who love to play with a new toy and people who want to impress their friends and business relations with those toys. Different target groups can be distinguished that are attracted by the use of brands.

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[1] www.openmobilealliance.com last accessed 12 October 2004.

[2] Alcatel is a French company and a supplier of telecommunication hardware.

[3] Phone.com is the founder of mobile Internet. They decided in 1997 to share their technological know-how with dominant market players like Ericsson, Nokia and Motorola to set a standard with their technology. This led to the birth of the WAP-forum.

FlexiBel subscribers had the best fit with the targeted group of innovators. The reasons to position M-info as a FlexiBel service were the following.

- M-info handsets had limited availability and were too expensive for the mass market.
- The connection set-up time was too long for acceptance in the mass market.
- It was not possible to deliver the M-info service for pre-paid customers, FlexiBel has only subscribers.

M-info was mentioned as one of the key features in a communication campaign for the FlexiBel brand on television; however, subscribers of other KPN Mobile subscriptions like Hi can and do use M-info. It was NOT possible to use M-info with a prepaid card. The "above the line" campaign for the specific target group was terminated at the end of the first year. Since then, information on M-info has been communicated "below the line", i.e. on KPN websites, via its callcenter and in shops to people who are interested in a Hi or FlexiBel subscription.[1]

There were good reasons not to choose the mass consumer market however the launch got a lot of publicity and pitched expectations too high. The situation was ambiguous since KPN wanted to be seen as an innovative company and was happy with the free publicity, but the service could not be launched for the mass market due to the limited technology. KPN did a low cost minimal marketing campaign with one commercial in the existing serial FlexiBel television commercials, which showed the professional use of M-info by a businessman, to show the benefits of M-info. However, a large audience watched television commercials. After the launch, the target group ceased to be a topic of discussion because M-info was accessible for all KPN Mobile subscribers and no longer communicated above the line.

M-info service levels

KPN Mobile decided to offer four kinds of service levels to four corresponding types of WAP users.

- The first group consisted of users who owned a handset with a WAP browser. These users might decide not to use the WAP function, or to use the WAP function using a different WAP gateway than the M-info gateway. In the last case the user had to contact a different WAP server to get WAP pages. The user then had no access to the M-info homepage or to pages from content-providers that asked for money for their services, because this capability was related to the M-info service.
- The second group of users consisted of customers who own a handset with a WAP browser and register as M-info users. Not all the customers who registered kept using M-info. Some people just had a look a few times and were not attracted enough to use the service more often.

[1] "Above the line" means disseminating via mass-media like commercials, newspaper ads, etc.; "below the line" means using direct contact media like the internet, direct mail, call centers, etc.

- The third group of customers continued to use M-info. These were the actual users who used M-info at least once a month.
- The last group consisted of customers who became an M-info member. This membership meant that the customers got extra personal services. People who actual used M-info and the M-info members were not the same group of people. There were also people who registered as a member but did not really used M-info and the other way around.

shows the size of these different groups as percentage of customers with a handset with a WAP browser in the Netherlands. The numbers shown in are for the month of December 2001, which was a quite representative month, according to KPN Mobile. At that time there were about 10 million mobile phones in the Netherlands.

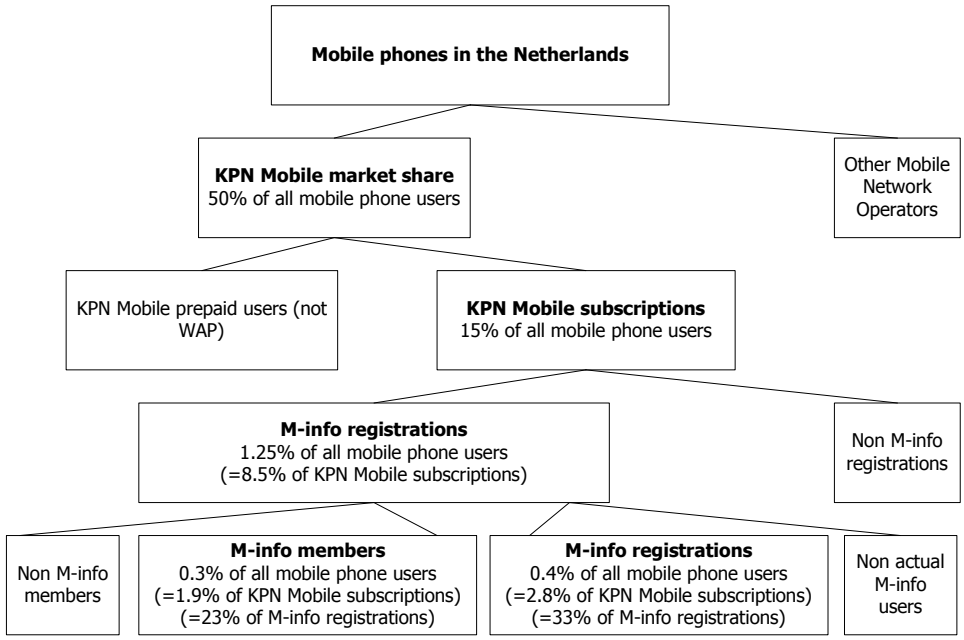


Figure 5-1 M-info customers as % of mobile phone users in the Netherlands (Dec 2001)

M-info content

Once a person had a handset and was registered as an M-info user, he or she could start using it. However, to encourage the actual use of M-info it was necessary to offer interesting content. The categories in the M-info menu were in January 2002:

- My Info, for members only, e.g. Agenda, Address book, own WAP site
- M-Magazine, e.g. New, Top-5

- Communication, e.g. E-mail, Chat and E-cards
- Actual, e.g. News, Sport, Weather and Finance
- Search, e.g. Directories and WAP sites
- On the road, e.g. Car and Public transport
- Entertainment, e.g. Games, Horoscopes and Jokes
- Leisure, e.g. Restaurants, Shopping and Dating

This content can be categorised into general content, personal content and corporate content. Email is part of personal content. The marketers put a lot of effort into the possibility to email from an existing account on your WAP phone. In 2001, about half of the M-info use was e-mail. Corporate content can be found on intranets. A Mobile Intranet offers opportunities for employees who spend a lot of time working away from the office. The M-info Intranet service was introduced half a year later than the public M-info service.

A measure to promote the actual use of M-info was to minimise the dial up time. The marketers really had to push the technicians to put an effort into this. However, the public opinion remained that WAP on GSM was too slow. With a WAP handset a person has access to all the WAP servers in the world. It is an open system to get access to all available free content. Some content providers ask money for the content on WAP sites. This means that there has to be a billing system in place to arrange the financial process. KPN Mobile has a billing server for handling the payments. KPN Mobile customers get billed for the priced content via their mobile phone invoice. This meant that the WAP sites in the M-info menu with priced content were only accessible for KPN Mobile customers.

5.3.2 Enabling technology

WAP works on the GSM network, a second-generation technology, with SMS, CSD, or GPRS. GPRS is about five times as fast as the GSM speed of 9,6 Kbit/s. The customer needs a device that is prepared for WAP. Such a device must have a WAP browser and be able to interpret Wireless Mark-up Language (WML). A content provider offers its content on the Internet in HTML and on the mobile Internet in WML. WML takes into account the small screensize and limited graphical possibilities of WAP devices. The building blocks of a WAP service are the WAP client (browser in the handset), WAP gateway, Server, Network and Protocols. The WAP architecture is shown in Figure 5-2.

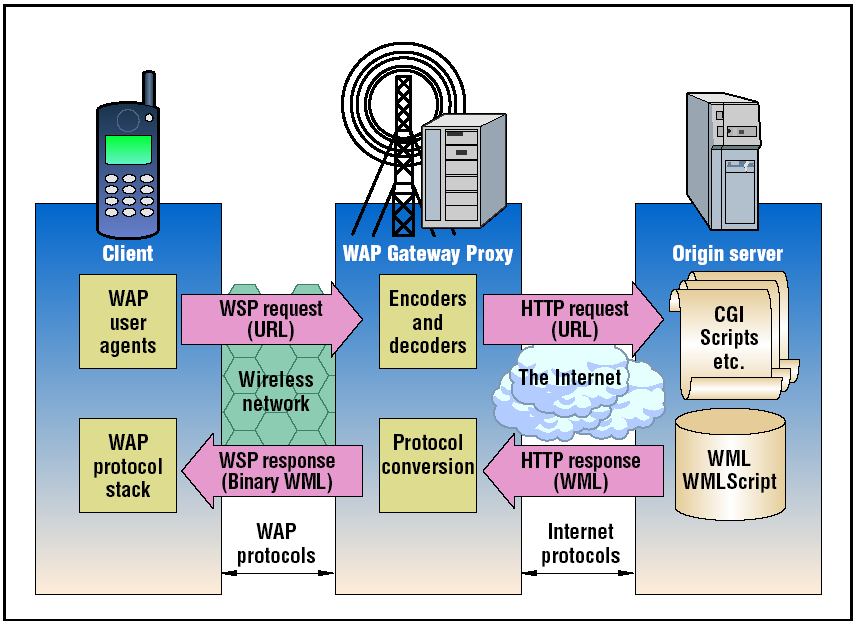


Figure 5-2 WAP network architecture (Kumar et al. 2003 referring to Cisco white paper)

The WAP forum developed Wireless Transport Layer Security (WTLS) to take care of the following security items.

- Confidentiality. The data that are sent between the browser and the WAP-gateway and between the WAP-gateway and the server is encrypted to guarantee privacy of the information.
- Data integrity. Integrity deals with ensuring that the data have not been tampered with. A hash value (control bits) helps to ensure that data is received as it was sent. Only the keys issued by the sender and receiver are able to open the enclosed hash value.
- Authentication. Digital certificates guarantee authentication of the server and the client. In the WAP 1.1 standard only server authentication is provided, WAP 1.2 also allows users to be authenticated.

The WAP Gateway solves end-to-end security between the Client and the Web Server technologically as displayed in Figure 5-2. This model fails to provide end-to-end security necessary to this kind of applications (Azzouz et al. 2003). People can interfere in processes that take place in the WAP-gateway. Therefore the security issue narrows to a trust issue, concerning assurance that parties in the chain can rely on each other's services. Generally speaking, people make more 'mistakes' than machines. WAP 2.0 tries to solve this by using certificates (WPKI solution), all the stakeholders should be able to authenticate themselves by presenting a certificate issued by a trusted third party.

Kumar et al. (2003) summarise the advantages and limitations of the WAP technology. The advantages are that (1) WAP saves time and money in field operations; (2) that there is no hardware obsolescence so that companies can save investments in handheld hardware; and (3) that WAP allows multiplatform functionality so little program modification is required to run WAP-based applications on traditional websites. The limitations Kumar et al. mention are the mismatch of WAP with current bearer technologies; the weak link of the gateway concerning security and the nightmare of all the different browsers in the devices. They argue that GPRS is a better bearer for WAP resource requirements and that there will be a future for WAP with faster bearer services like GPRS and UMTS.

5.3.3 Creation of and coordination within the value network

In Chapter 1 we described how the various viewpoints on value chains and value networks are presented in literature. Here we will describe the roles and actors of the M-info service in Table 5-1. In it we list the roles that have to be fulfilled to develop a mobile service. There are a lot of relationships and interdependencies and these have to be somehow coordinated. In the M-info case KPN Mobile was the central actor that directed the design process.

Table 5-1 Value chain of M-info

Roles in the value chain	Explanation	Actors for M-info	Roles that pay
Content provider	The content owner offers content for information, communication, transaction and entertainment services. In this definition, physical products offered for sale are also part of the content.	KNMI (weather), ANP (news), Bruna (books), AND (direction) KPN Telecom and its ISP's as Planet with own content.	End-user Advertiser
Hosting Provider (Web / Portal hosting)	The content is hosted on a WML server; database applications may be added.	The M-info portal is hosted by KPN Telecommerce. The WAP sites of the content providers are hosted by the providers or their hosting suppliers.	Content provider
Access Provider (for content provider)	This function is responsible for the content being accessible on the Internet. This company may have a proxy server.	The access provider for the M-info portal is KPN Telecommerce. Content providers have their own access providers.	Content provider

Roles in the value chain	Explanation	Actors for M-info	Roles that pay
Transaction provider	Company who handles the financial transactions.	Bebit and Nettransact (service of KPN Telecommerce) are intermediaries who take care of the clearing of the payment by the credit card company. On the Internet they offer several payment services, on the mobile Internet (with WAP) only credit card payment. The billing of the content is part of the M-info service executed by KPN Mobile.	Content provider Advertiser End-user
Content Organiser: **The portal**	Actor who organises content, in broadest sense, including i.e. products, for target groups in a Portal. They can integrate communication, transaction and content provision.	KPN Mobile	Content provider Advertiser End-user
Network Operator	Network Operators build and maintain the network. Their suppliers supply hardware and software.	KPN Mobile	Mobile Service Provider
Mobile Service Provider	Company who offers access for the user on the mobile network. The customer gets a subscription, bills and helpdesk, etc.	KPN Mobile, Talkline, Debitel	End-user
Handset provider	Manufacturers of WAP handset including a browser.	Nokia, Later: Ericcson, Alcatel, Motorola, Siemens, Sony.	End-user, possible subsidised by the network operator, service provider, or portal.

Table 5-1 shows that vertical integration takes place. The Network Operator fulfils the role of value chain integrator, banks are merely content providers (of financial news), and software companies become partners in the hosting provider business. Horizontal integration also takes place, i.e. a record company that starts organising pop concerts and a

television producer that produces theatre plays. All these kinds of content providers started to develop content for mobile Internet.

KPN Mobile decided to launch M-info as a service managed on an open model basis meaning that customers could also surf to other WAP sites. The only restriction was that KPN Mobile cannot bill the customer for content that is not on the menu. So, such information providers have to deliver their content for free. However, M-info was not a totally open model because KPN Mobile provided a menu and, in this way, made an attempt to control the quality of the content. KPN Mobile limited the use of M-info solely to KPN Mobile subscribers. Subscribers to competing mobile operators could not access M-info.

The open versus closed versus walled garden approach is an even more important issue on the mobile Internet than on the wired Internet. The characteristics of the mobile device, a limited keyboard and small screen, complicate navigation and demand a pre-formatted menu with easy to find quality content.

Revenue models

The roles that provide resources are identified in the last column of Table 5-1. These are the end-users, also called start-users or customers, and the business partners.

The revenue sources for M-info and KPN Mobile were the following.

- Connection and airtime fee, the end-user pays the normal phone tariffs for the airtime they use, not extra. The main revenue for KPN Mobile is the extra airtime they sell due to the use of M-info.
- Revenue per subscriber, not especially for M-info. The end-user is the subscriber who pays a Hi or FlexiBel subscription.
- Margin on content fee, for about half of the content end-users have to pay. KPN Mobile gets a margin of about 10 to 20% on these fees.
- Subscription of content providers, during the first period after the launch of M-info, content providers had to pay KPN Mobile a relatively small amount of about Euro 100 to be on the M-Info menu. This was phased out to improve the relationship with the content providers.

The revenue model for a new service is a key decision. Who pays money to whom? Does a customer pay for getting access to content? Does a content provider pay the access provider to have access to the customers? Does a content provider get money for its content? Is it a good idea to earn money with advertisements on a portal? Here we discuss the decisions made by the M-info marketers on the sources of revenue.

The customer did not have to pay an additional fee for using the M-info service, neither for registering as an M-info user nor for being an M-info member. This turned out to be a good decision since the service did not fulfil the expectations in the market and asking extra money could have meant that KPN Mobile would not have gained experience with this WAP service. The main source of income for KPN Mobile from M-info was the extra airtime sold

due to the use of WAP. The decision whether the customer had to pay for content or not had to be made by the content provider. KPN Mobile just offered the billing application. About half of the content providers asked the customers to pay for their content. KPN Mobile got a margin of 10 to 20%, depending on the contract conditions.

In the first months, the content provider paid a relatively small amount of money per month to be on the M-info menu on the WAP phone and on the M-info website. Later the marketers decided that this was not a successful strategy. One of the success factors of a mobile Internet service is the availability of content. KPN Mobile was working on new generations of mobile services enabled by technologies like GPRS, iMode and UMTS. A good relationship with content providers was crucial. Therefore, KPN skipped the fee content providers had to pay for being on the M-info menu and developed a new way of working with content providers.

A decision was made not to earn additional income from advertisement on the website or the WAP sites lasted. KPN Mobile never offered the opportunity to advertise on M-info, neither on the WAP sites nor the website. Because of this decision KPN Mobile was able to control the look and feel of the content available on their sites.

The revenue model of M-info was not profitable for KPN Mobile, exact numbers are not available for confidentiality reasons. However, KPN Mobile expected that using the experience gained with M-info for its successor services 'WAP on GPRS 'and' iMode would pay the investment back.

5.3.4 Market acceptance

The definition of an M-info user is someone who uses WAP at least once a month. 42% of the 9.000 people who bought a Nokia 7110 in the three months after the launch were actual M-info users. In December 2001, 3% of the people with a KPN Mobile subscription were actual M-info users (see also Figure 5-1). These people used M-info 5 to 6 times a month. The average use of M-info declined after the first year.

What was interesting was the use of M-info by a small group of people in foreign countries. In holiday periods the use of M-info rose. A possible explanation is that there are not so many alternative media to get access to Dutch news and email when you are abroad.

The actual use of M-info stayed lower than the projected figures, due to the limited availability of handsets during the introduction and the disappointing performance of the system, which caused innovators to wait for better technologies. These two points reinforce each other: the second WAP handset was not introduced until July 2000. At that time, the introduction of GPRS was in sight. Nowadays all new models enhance WAP.

KPN Mobile characterised M-info as a service with (1) useful information anytime and everywhere, (2) quality information brands and (3) easy to get and to use. At the end of 2001, "more than thirty phone manufacturers have deployed WAP-based microbrowsers in mobile phones and more than sixty wireless carriers world-wide have implemented WAP

"gateways" in their networks, which optimise the exchange of data between the Internet and WAP-based mobile phones. However, WAP has been under fire for proving to be too slow and cumbersome for most subscribers, and because few worthwhile services were made available" (Kalakota 2002). This general conclusion about WAP on GSM also counts for KPN Mobile.

M-info was extended in 2001 with WAP on GPRS. KPN Mobile organised a market pilot with a GPRS version of M-info. Based on this pilot the M-info service was improved in the following four ways: easier access to e-mail; improved structure of the menu; changes in the website and a more simplified procedure to get access to WAP. From then on, all the efforts of the service development of WAP were focused on WAP on GPRS. The technology behind WAP on GSM is considered to be too limited for offering a service that meets the requirements of the market. In April 2004 the brand M-info disappeared from the market.

5.3.5 Management of the design process

The management of KPN Mobile decided that a project organisation was the best way to realise the launch of a WAP service, instead of the 'normal' approach to have the work done by the 'line organisation'. The reasons for this were the narrow time schedule and the complexity of the service. Time-to-market was the most important issue of the project. The project team members were drawn from the KPN Mobile organisation. These were people from the product development department, e.g. overall projectleader and business developers; marketing, e.g. service marketing and communication; the business process group, e.g. technical project leader, process managers, IT architects and programmers; and sales & distribution, e.g. a product manager for the handsets and an account manager to recruit content providers.

An organisational chart of KPN Mobile[1] (as part of KPN Telecom) in 1999 with the relevant departments for this project is presented in Figure 5-3. The managers of the departments marked with a * formed the 'project action committee' (PAC) who came together once in two-weeks and made GO/NO GO decisions for the various phases in the project.

[1] In 1999 the mobile organization consisted of Business Unit Mobile and the Mobile Operator. Later, this became KPN Mobile. In this case we call the mobile organization KPN Mobile for reasons of simplicity.

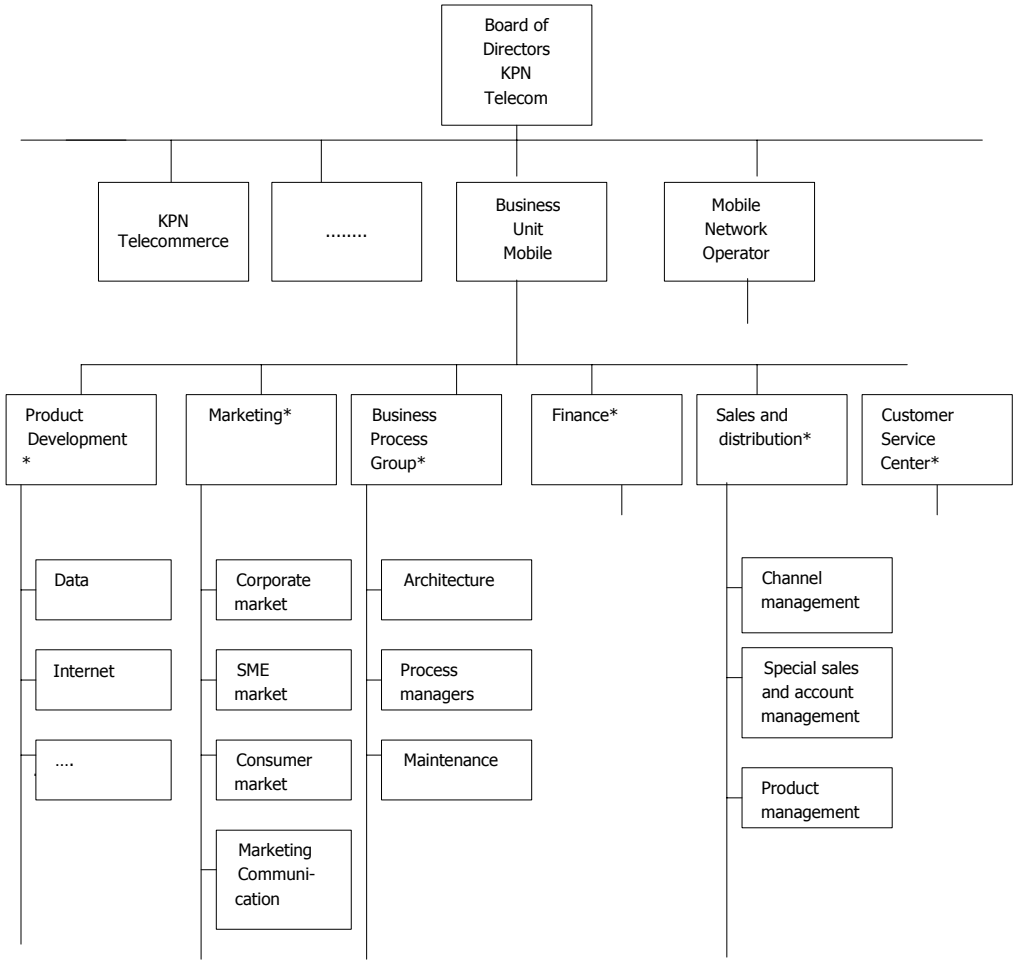


Figure 5-3 Relevant parts of organisational chart of KPN Telecom BU Mobile in the Netherlands, without international daughters and before the take-over of E-Plus.

KPN Mobile defines the various phases in a product innovation project as follows. Every phase has its own standard forms.

- IO: Idea to Opportunity. Every employee can submit an idea. An employee of the product development department can submit the idea to the PAC. First s/he has to check the idea with marketing. In the IO the innovative idea, the functionalities for the customer, the advantage for KPN Mobile, an indication for the target group, and a rough planning have to be provided.

- DJ: Decision to Justify. After the approval of the IO, resources from various departments are allocated to the project for this phase. The results of the phase should be a quick scan; a marketing and product description; and a project plan. The content of these deliverables are defined.
- DF: Decision to Fund. In this phase it has to become clear how the product can be technically realised, what it costs, and what the forecasted revenues are. The business case has to be built together with people from the financial department. Controllers have to comment on the case. A global process design and a technical description of the service have to be made. Furthermore a detailed project plan, with the approach that will be used to execute the project has to be submitted.
- DB: Decision to Build. After the DF has been taken the project members can start to build. Sometimes an extra decision to build is required. The building phase is long compared to the other phases. In this phase, the design, preparation, realisation and preparation for the introduction of the product takes place. The functional and technical specifications are prescribed per department.
- DP: Decision to go Public. This decision concerns the market introduction and the way to take the product into operation.

The project team needed to cooperate with external suppliers to develop the service. Some of them were active members of the team. The main suppliers were:

- Nokia: supplier of the gateway and handsets
- Agency.com: a webdesign agency that designed and build the web and wap site
- PMS: the advertisement agency who prepared the marketing communication campaign
- Lotus: supplier of the agenda and address book applications
- A large number of content providers like news agencies, financial institutions and etc.

Nokia and Agency.com were active members of the team. Furthermore, KPN Mobile worked together with colleagues from other KPN departments. KPN Telecommerce for example delivered hosting and access services.

In the beginning the M-info project-team consisted of less than 10 people, but at the moment of introduction more than 100 persons were involved. The first activity of the project team was to describe the business plan. The business plan includes the business case, service specifications, architecture and marketing. This activity took about two months (April and May 1999). The team based their plans on the experience with the WAP 1.0 trial, information from Nokia and WAP Toolkits. A WAP toolkit is a tool to simulate a WAP phone on a personal computer. The toolkit became available at that time.

The project team started to describe the service, as they would like to introduce it in the long run. After that they downsized the case towards what they could achieve in three months. When the deadline was set, the team did not spend time on anything that was not

directly targeted to achieve the deadline. Users were not involved during the development process. The internal goal was to launch in the beginning of October 1999. However, the introduction of M-info was announced in a press conference at the end of October and the actual launch was on November 25th. Management wanted to launch M-info before Sinterklaas[1]. The main reason for the delay, the end of November instead of end of October, was the late delivery of handsets. A second reason was a short delay in getting the gateway operational.

There was a tremendous drive at KPN Mobile to be the first on the Dutch market with a WAP service. The main reasons for wishing to be first were the desire to create an image of innovation and to gain free publicity. At the time WAP was being heavily hyped in the press. Earlier in the year 1999 Libertel[2], the main competitor of KPN Mobile, had introduced mobile services just before KPN Mobile; KPN managers believed that the market now perceived Libertel to be more innovative.

In November 1999, the availability of WAP handsets was still very low and KPN considered delaying the launch. The choice lay between a launch in late November and postponing it to February 2000. The reason for the delay was that it was strictly forbidden in the whole company to introduce new services in December 1999 and January 2000 due to the Millennium bug problem. Finally, it was decided to introduce WAP at the end of November.

A year after the introduction people raised the question whether it would not have been better to wait and introduce WAP only on GPRS and not on GSM. An option the decision-makers had not considered at the time of the M-info introduction.

5.3.6 Evaluation

Technology is often the driver to start designing new services. Looking back, the promising rumours surrounding WAP made telecommunication companies over-enthusiastic regarding its possibilities. Limited usability due to the technological characteristics of the service was one of the most criticised aspects of M-info. There was a long start-up delay and it took too much time to accomplish a simple task like finding a train departure time. The lack of guaranteed security also undermined people's confidence in the service.

KPN Mobile followed its general procedure for developing new services in the M-info project. This is a project management approach with a reporting procedure to get decisions from the management. The principle behind this design process is that one company develops the

[1] People give each other presents on this Dutch festival of the saint's name day on December the 5th. The retail industry always tries to launch new products in November so people can buy them as Sinterklaas and Christmas presents.

[2] Libertel was founded in 1995 with Vodafone as main shareholder. Their name in the press in 2001 was Libertel-Vodafone and from 2002 on Vodafone. On 13 January 2003, Vodafone Group Plc. announced its intention to make a public offer on the listed shares of Vodafone Libertel N.V. Effective from 9 April 2003, Vodafone Libertel N.V. was de-listed from Euronext Amsterdam, 8 April 2003 was the last day of trading. (www.vodafone.nl)

services and leads in directing suppliers. The standard procedure for innovation within KPN Mobile as applied for M-info was internally oriented, cooperation with external partners was not part of the process. External partners were expected to commit themselves to the procedure that KPN Mobile follows internally. The drawback to this approach is that the space for the participation of suppliers, and one can hardly call them partners, is limited. The consequence was that the integral service design process was not optimal, e.g. planning did not fit with the handset delivery, and the content providers knowledge of content was not fully exploited etc. There was friction between the opportunities for external partners to cooperate and KPN Mobile's project managers to negotiate sharply with these external parties on the one hand and the interest of the organisation in a stable and guaranteed decision making process route on the other hand. The M-info case showed a whole set of roles that have to be fulfilled to develop a mobile service. These roles cannot be performed in a linear value chain. There are a lot of relationships and interdependencies in such a situation and these have to be co-ordinated. In the M-info case KPN Mobile was the central actor and directed the design process.

KPN Mobile considered M-info to be the start of a development, not a finished product. Internet products and services are not kept in the laboratory until they are completely finished. Products are exposed to the market and the product/service is developed further in response to that market. This approach is quite new and challenging for management, especially for management of established companies like KPN. The product life cycle of mobile services is short. KPN used the experience with M-info for the development of (a) WAP on GPRS and (b) iMode. All the communication in the mass media was focussed on iMode from the year 2002.

5.4 Case 2: Radio 538 ringtunes iMode service

NTT DoCoMo, Japan's leading cellular phone operator, launched iMode in February 1999. Building on its early success in Japan, iMode began a strategy of market entry into the United States, Europe and parts of Asia through a set of key partnerships (Barnes 2003b). In 2000, NTT DoCoMo acquired a 15% interest in the Dutch operator KPN Mobile and that deal included the transfer of the iMode knowledge concept to KPN Mobile[1]; iMode was launched in the Netherlands in 2002.

One of the first services in the Dutch iMode portal was the Radio538 ringtune service. KPN Mobile is the only mobile operator in the Netherlands who can offer iMode services for the coming ten (after the launch in 2002), however, Radio538 can offer their ringtunes to other

[1] KPN Mobile comprises all KPN's mobile activities in Germany, Belgium and the Netherlands. At the end of 2002 KPN had a 97,84 % share in KPN Mobile N.V. NTT DoCoMo in Japan lowered its share and owns the remaining share of 2,16%. KPN Mobile N.V. is the 100% owner of E-Plus (Germany) and BASE (Belgium) and it has a 15% share in Hutchison 3G UK ltd. The company serves approximately 15.1 million customers in the Netherlands, Belgium and Germany (see www.kpn.com last accessed 31-05-2004).

operators. In the i-menu, 129 services are divided into nine categories, with the Radio538 ringtunes in the category 'melody & images' (www.imode.nl). From the beginning, the Radio538 ringtunes iMode service has been one of the most popular sites given its high ranking on the i-menu.

5.4.1 Service formula

Ringtone services are targeted at the age range of 12 to 30 years. Consumers want different ringtones to distinguish the sound their phones make from other phones; it is also a way of profiling themselves. The mobile handset and its gimmicks, including ringtones, are crucial for the identification of such users in their cultural context. Radio538 provides ringtones for the iMode service in the Netherlands. The distinctive characteristics of the Radio538 service are its brand recognition (Radio538 is a popular radio station), the alarmschijf/dancesmash[1] ringtunes and the DJ voices.

The menu of the Radio 538 site includes new tunes, the 'top 3' tunes, a list of all the tunes, a search facility, a subscribe/unsubscribe function, contact information and 'my 538 tunes' which provides a link to 'purchased' tunes, whether stored or not. A monthly subscription to the Radio 538 ringtunes service allows customers to download five ringtones from a variety of categories: music, voices and sounds. Radio 538 branded their service 'ringtunes' to distinguish the service from other 'ringtone' services on the KPN Mobile iMode portal. The service costs 2 Euro per month for five credits. The credits are used whenever a user downloads a tune, whether to store it or just to listen to it. Once a tune is 'purchased' it is possible to download it again for free to store it.

The uncertainty in demand for ringtunes was not very high since Radio 538 had already marketed ringtunes via SMS and GSM. Customers want to distinguish themselves by using ringtones of popular hit songs. One can say that a customer driven approach was followed and that it worked.

Since there are many ringtones it is important to differentiate from other ringtone services. For this, branding is an important issue; Radio538 is a popular radio station and their hit ringtunes and DJ voices distinguish them from other ringtones. KPN mobile and Radio 538 had a co-marketing agreement to reach specific target groups. This was satisfying for both partners.

5.4.2 Enabling technology

The iMode technical architecture contains three critical components: the handset, protocols and network architecture and data flows. The iMode handsets were specially designed for the service. For the launch of iMode in the Netherlands, KPN Mobile contracted NEC to produce a phone that contained a 256-colour screen, roughly the size of a credit card, which

[1] The 'alarmschijf' and 'dancesmash' are the terms used for the songs that are chosen weekly as 'best hit' song and 'best dance' song.

could display 8 to 10 lines of text at once and weighed between 80g and 120 g. The display makes use of the mark-up language compact HTML (cHTML), which was developed especially for small information appliances that typically have restrictions on memory, display size and fonts. cHTML has been submitted to the World Wide Web Consortium for standardisation and allows content developers to leverage their HTML skills.

The European version of the iMode service uses a GSM network for voice traffic and a GPRS network for data. The data transport occurs according to the Internet standards like HTTP and TCP/IP. The translation from wireless TCP to TCP is performed by the gateway.

The tasks performed by the iMode servers include delivering content to handsets, accessing e-mail and connecting handsets to the Internet. The iMode servers are directly connected to the servers of official content providers, while unofficial sites are connected through the Internet. The packet service enables the "always on" feature of the service, which is different from the dial-up connection required for WAP on GSM. To minimize download times and maximize handset performance, iMode sites are typically between 3 and 5kb in size and emails are restricted to a maximum of 1000 characters. In addition to performance, the small file size helps customers manage the data-volume sensitive tariffs. With data-volume tariffs, users can remain connected without charge, as long as they are not sending or receiving data.

The iMode handset, manufactured by NEC, allows customers to store a total of 13 polyphonic (16-chord) ringtones. The NEC handset, designed specifically for the European iMode service, allows the user to choose different ringtones for phone calls and mail/SMS. The ringtones downloaded from 538 are then stored along with those that come with the phone. Up to 13 tunes can be stored. Tunes can be allocated to particular phone numbers, thus identifying callers by the ring. The requirements for the mobile phone to play ringtunes are tight. The second iMode handset on the Dutch market was a Toshiba iMode handset. This handset could not handle the very popular DJ voice ringtones.

5.4.3 Creation of and coordination within the value network

KPN Mobile began early in the development of the Dutch iMode service with the creation of the network for offering ringtones to iMode subscribers in the Netherlands. Several roles have to be fulfilled to provide ringtone services. A service provider and ringtone developer are necessary to coordinate actions and organise access to the mobile network, customers, customer data, content (ringtones), content rights, specific applications & software platform necessary for the delivery of ringtones and for billing. The roles and relations of the various actors are given in Figure 5-4 and explained further below.

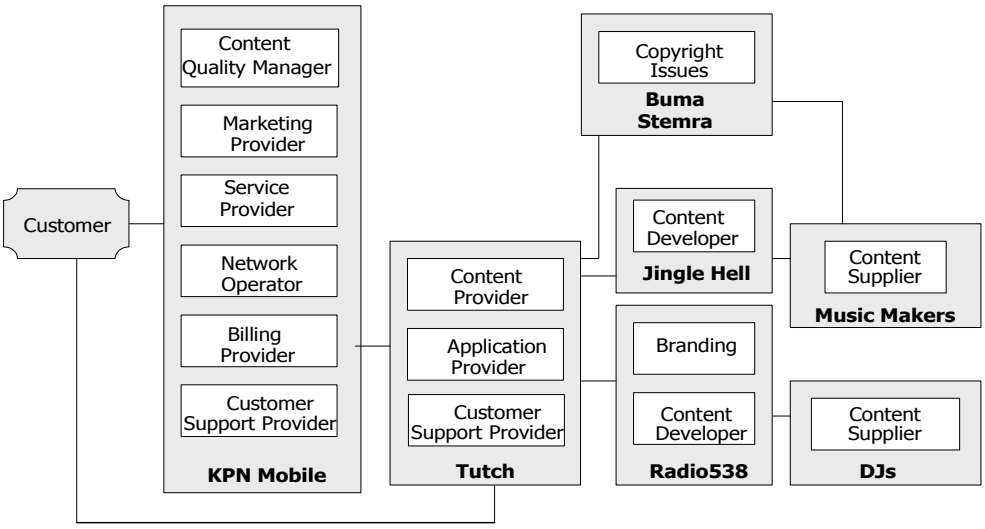


Figure 5-4 Actors and roles in Radio538 ringtune iMode service

The lines in Figure 5-4 reflect the flows between the actors. From the right to the left the actor provides value to another actor; from the left to the right the actor provides revenue to another actor. KPN Mobile provides iMode services to the customer and the customer pays KPN Mobile for this. The revenue streams are further explained in subsection below.

Radio538 owns and operates a privately held ('commercial') radio station in the Netherlands. Radio538 reported a market share of 10.3%, with 3.3 million listeners per week. Between 60 to 70% of their income stems from advertising (broadcast via their radio station). The remaining 30-40% of their income consists of royalties from the music industry, Internet revenues from banners, merchandising and organising parties such as ID&T Trance-energy. A very small part of their income comes from mobile services like SMS and iMode ringtones.

Radio 538 wants to be profiled as an innovative radio station. It was the first commercial radio station with their own website and the first with a chat function. Radio538 regard advertisers as their customers and radio listeners as their product and want to create as much brand recognition as possible. The introduction of ringtunes on iMode contributes to the image of the radio station and therefore fits into this strategy. The revenue they receive from the ringtunes is very small but the effect of the service on the image makes the service worthwhile. The contributions of Radio538 to produce the ringtunes include: access to the listeners of Radio538, knowledge of popular music, DJ voices and time on the air to advertise iMode ringtunes. This broadcasting time is either free or discounted for KPN Mobile.

KPN Mobile wanted to pursue a relationship with Radio538 because they have access to the targeted customers. Initially, the ringtones made by Radio538 were expected to match the tastes of the target market; subsequently the diversity provided by the DJs' ringtones added

to their popularity. However, there were other motives for pursuing a relationship with Radio538 given Radio538's national radio coverage and hence national brand recognition in the iMode target market. Radio538 has carried out projects with KPN Mobile in the past and they have a long term relationship. Radio538 likes the cooperation with KPN Mobile because of their strategy to create an innovative image.

Nevertheless, there are also a few areas of friction in the value network. Radio538's initial impression was that they would be the only commercial radio station and the exclusive provider of ringtones in the iMode portal. However, this is not the case because KPN Mobile did not want this. Furthermore, there was the problem with the new Toshiba iMode handset. The very popular DJ voice ringtunes could not be handled by this handset. KPN Mobile admits that this was a mistake in the process of developing the new handset.

Tutch Mobile Media B.V. makes ringtunes with the Radio538 brand, with its own brand, and for TMF. Developing ringtones is just one of the concept development and design activities of the firm. All the products of Tutch are mobile-centred and they divide them into three categories: mobile Internet service provider (WAP portal), content for SMS and 'new generation'. Ringtunes and iMode are part of this last category 'new generation'. There are three streams of revenues: traffic income from WAP, 0900 number revenues from downloading logo's and ringtunes via SMS and contributions from Network Operators for iMode and Vodafone live. Tutch' added value is that they understand all about the technology for producing content, including ringtones, on mobile platforms and devices, and they had the idea to use voices as ringtones. Tutch talk with chip manufacturers, handset suppliers and operators. Tutch manages three ringtone brands on iMode, Radio538, Tutch and TMF, which have varying popularity ranking on the iMode portal.

Tutch's business vision is that they want to keep their costs as low as possible. The whole business is based on revenue sharing and there are no fixed fee payments.

Tutch sees KPN Mobile as a professional partner. However, the iMode architecture is not plug and play and they consider it difficult to get access to the platform. At the start of the project, KPN Mobile held a general meeting for content providers in which technical issues related to service provision were discussed. There was no mention of difficulties concerning the technical architecture or integration of ICT between the actors within the value web. This may partly be due to the experiences in Japan where some of the problems of a new technology venture were resolved. Tutch argues that KPN Mobile could carry out the activities Tutch is currently doing but that KPN's company culture, of an established operator with more than 30.000 employees with a focus on cost reduction, is not appropriate for this kind of innovative content business.

When customers subscribe to a site, they gain access to the restricted area of Tutch's server. The information is sent to the billing system and appears on the monthly bill, along with the voice and iMode access charge. KPN Mobile collects the monthly subscription charge and a portion is distributed to the content provider. Building the interface between

the billing application in the network of KPN Mobile and the application of the content provider (Tutch) was one of the most difficult activities. Tutch built this part of the billing application its self. The content databases and billing application (Tutch part) are hosted by another company.

Buma/Stemra is a Dutch organisation that coordinates the copyrights for music and text for Dutch music composers. There are other institutions that can perform this task but at the time of the interviews Tutch only paid Buma/Stemra. For companies like Tutch, copyright of ringtones is quite a grey area and they need the help of a specialised lawyer to settle the legal issues.

Jinge Hell is the actor that turns music from *music makers* into ringtones. Furthermore there are actors not mentioned in Figure 5-4 that are not involved in the primary process. E.g. *Faith Inc.,* a Japanese music software developer that provides software for converting ringtunes for the iMode platform. There are also the actors involved in producing the handsets i.e. NEC, Toshiba and the handset chips, i.e. Yamaha.

Revenue streams

As described in the service formula, the subscription fee for the ringtune service is 2 Euro for 5 credits, thus 0,40 Euro per ringtune including 19% VAT. The revenue model for the Radio538 ringtunes case follows the standard iMode format with KPN Mobile keeping 14% of the subscription fees for billing. The remainder of the subscription fee is passed on to Tutch. Tutch makes a detailed report of the amount of downloads of hit-ringtunes, normal ringtunes and DJ-voices. This information forms the basis for the division of the revenues. Tutch divides this income between itself, JingleHell, Radio 538 and BUMA Stemra.

BUMA Stemra receives a charge for legal rights per ringtune (excluding the DJ voices). This percentage is 4.5% at the moment but will increase in the years to come. Legal issues play a significant role in the mobile ringtune service business. There are no fixed rules yet for the copyright fees on ringtunes, it takes some time to establish these legal right issues for new media outlets.

The remainder of the fee (2 euro minus 14% minus 4.5% minus 19%) is shared 50-50% between Tutch and Radio538 for hit ringtunes, 40-60% for DJ voices and >50% for the Tutch initiative ringtunes with the Radio538 brand name. Radio538 gives half of their revenues to the DJs who are running their own business with the DJ voices. Tutch pays an unknown percentage to Jingle Hell.

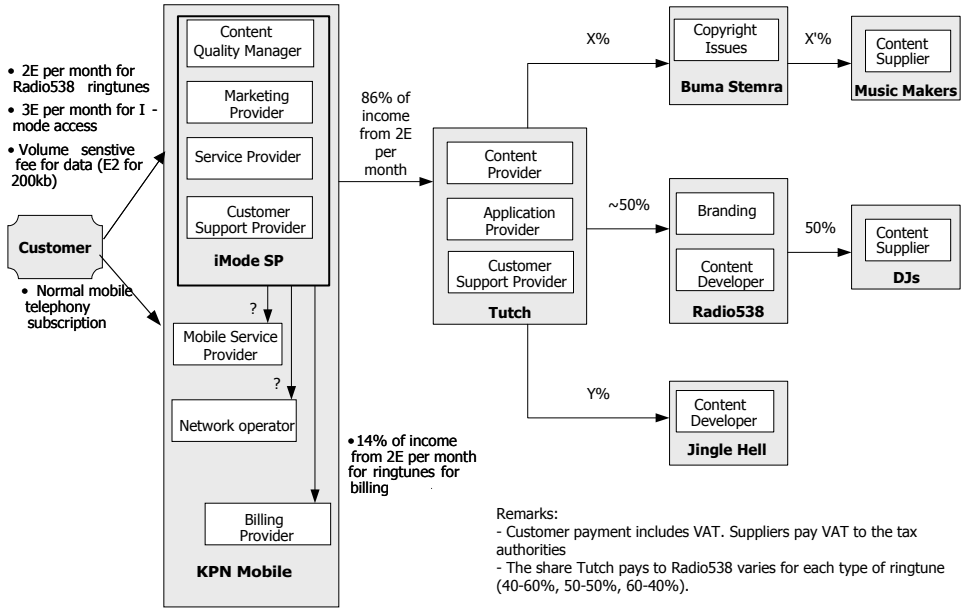


Figure 5-5 Revenue flows Radio 538 ringtune iMode service

5.4.4 Market acceptance

At the start of the mobile Internet period, ringtunes were one of the most popular services. Four of the top 10 services in the iMode menu were ringtunes. In 2002, 29% percent of the iMode subscribers used the Radio538 ringtune service. They downloaded music (60%), DJ voices (20%) and other sounds Tutch fabricated (20%).

5.4.5 Management of the design process

KPN Mobile follows the standard iMode development process initiated by NTT DoCoMo. Natsuno (2003) defines the Japanese iMode model as an ecosystem where the operator provides the business model, marketing, servers, network and clients. KPN Mobile cooperated with NTT DoCoMo to adapt the Japanese iMode for the European market during the development phase since it was in the interest of NTT DoCoMo to make the service a success since they had a 15% ownership stake. Later, NTT DoCoMo decided not to invest further and their share in KPN Mobile dropped. The iMode technology was already implemented and therefore tested and proven in Japan. This was a crucial advantage for the design process in Europe.

KPN Mobile delivers the iMode platform, including billing and technical support. The content providers have to deliver ready-to-use content. A managed portal improves the usability for accessing content via a mobile device. The quality of the content in this portal has to be

managed. In this case, the quality of the content was initially guaranteed during the approval process by presenting storyboards of the service idea to a panel of content managers. If they pass the content will be part of the official iMode menu. The CEO of Tutch argues that "KPN Mobile creates a culture in which content providers are important for the success of iMode; they understand well how to encourage content providers." In this case, Tutch is the content provider. They do not have a service development method but more a philosophy of 'bitesized content'. The content has to be a nice snack for the consumer. Later, the usage of the service determined its position in the i-menu.

The way of working at Tutch is that every Friday the Tutch co-workers evaluate the week and decide the priorities for the next week. They do only one project at a time and they prefer to do as much as possible themselves. Tutch only turns to another organisation if specialised expertise is necessary, for example for legal issues.

5.4.6 Evaluation

The value network in this case shows several critical roles. The actor KPN Mobile for example performs several roles. Each role has to generate revenues. For example, for 'billing' KPN Mobile receives 14% of the content subscriptions. Therefore it is important to separate critical roles. Within this network a leading actor is necessary, to provide a center of gravity from which to start. KPN Mobile proposed the iMode service concept to the other actors. Overall, the other actors are satisfied with the content governance model, with the uniform set of governance mechanisms. Several issues can be observed considering the creation of the network.

- Embedded ties were important in establishing the network. The people of KPN mobile and Radio538 already knew each other; the CEO of Tutch was the former marketing director of KPN Mobile.
- There was no exclusivity between portal providers and content providers. In the Dutch iMode portal there are nine ringtune providers, i.e. 538 ringtunes, Tutch for Tones, TMF ringtones, The Box Music, Jippii ringtones, Cool Spound, Joy Beat, Yamaha super RT and Jamba Ringtones. Tutch provides also ringtunes to other portals like Vodafone live.
- It is necessary to take organisational culture into account when deciding on who does what. Tutch does things KPN Mobile could do, however KPN Mobile lacks the culture of a small innovative risk- taking company.
- Each actor has its own business model but this should be seamlessly integrated in the business model for the service to be delivered. KPN Mobile sees the ringtunes service as part of the general iMode business model. Tutch approaches the ringtunes service as a contribution to operators, and for Radio538 the ringtunes services are a minor part of their entertainment services. The shared revenue models form the basis for content provision. All the actors involved in producing the ringtunes get a share of the 2 Euro monthly fee that the customer pays. The result is a 'dripping bucket' principle.

One complicated aspect of the technology is the billing application. This should not be underestimated since it is difficult to build and it is the nerve centre of the value network. The Telecom industry considers the billing application to be one of the most difficult applications due to the fact that it has to be integrated with all the processes. In a revenue sharing model, which is the case with iMode services, actors depend on it for their revenues.

5.5 Case 3: Finder iMode service

Finder is a location-based service offered through the E-Plus iMode service in Germany, it was launched at the CEBIT in March 2002. Webraska is the content provider that offers Finder via the iMode portal to the customers.

5.5.1 Service formula

Finder helps the consumer to locate the nearest hotel, restaurant, taxi and ATM. Within the iMode portal are nine categories: News/weather, Sport, Chat/mail/web, Freizeit/fun, Melody/pictures, Unterwegs, Finanzen, Shopping and Nachschlagen. Finder is in the sub-category 'Reisefuhrer' under the category 'unterwegs'. It is the third ranked service in this subcategory per October 2002. There are six LBS in the German iMode menu: Wetter.com (weather info), Battlemachine (game), Yellowmap routing (navigation) and three services in the subcategory Reisefűhrer: Traveltainment, Yellowmap CityGuide and Finder.[1] If a customer clicks on Finder he or she gets information related to their location because the service automatically provides you with your position, see Figure 5-6. The initial information is always based on this position, but you can choose to get information on another location. Finder is available throughout Germany.

Figure 5-6 Finder page on iMode

The advantage of using Finder instead of a map is that it is fast, correct, graphical, animated, and you can directly email the link with the map to another iMode subscriber. In the iMode focus groups (before launch), Finder was in the top 3rd and 4th place of favourite services. In the process of the development of iMode for the German and Dutch market, the Germans decided to launch a Location-based service in the iMode portal. Dutch marketers decided not to do this because they thought the technology was not advanced enough to meet the customers' demands. The Dutch were very sceptical due to their experience with WAP services, which were regarded as not user friendly enough.

[1] http://www.eplus.de/frame.asp?go=/-topnav_imode/imode.asp last accessed June 2004.

Find-the-nearest restaurant or taxi services may lead to more business for restaurants, taxis, shops, etc. However, this is not experienced nowadays since push services and tracking services are not available. The service provider (Webraska) argues that the reason is that operators do not offer the technology and the operator (E-Plus) argues that it takes too much investment.

Privacy of users was an issue considered by the service providers for push/tracking services, but it is not regarded as a problem as long as there is no resistance to their privacy policy. According to Webraska, the three rules on privacy are: (1) only the customer is allowed to decide if he or she wants their position to be known; (2) the customer should not be disadvantaged or harmed as result of using a positioning service and (3) considering 1 and 2 the industry should be allowed to create applications. It is not a problem to fulfil these rules since there are 1000 anonymous people in a cell. E-Plus states on the privacy issue that the user has to decide whether he or she wants to be located by others and also that E-Plus does not keep the location information longer than necessary in their system. So both companies do not see a privacy problem.

5.5.2 Enabling Technology

The three critical technical iMode components, handsets, network architectures and data flows are also applicable in this case. In this location-based service case the performance of the screen especially is an issue. The screen must be able to show graphical information like a map. Furthermore there is an interdependency between the accuracy that the technology offers and service quality. This is also related to the revenue model since the positioning information brings in revenue. The billing application has to be able to take this positioning information into account.

The Finder application runs on the SmartZone^{tm} platform of Webraska. Webraska integrates the content, geographical information and the location of the mobile phone to provide the desired information service. E-Plus handles the subscripting, rating and billing. No technical problems were mentioned and Webraska stated that installing the required technology for the system was one of the things that worked really well.

The Cell-ID technique was used for positioning. The location information consists of latitude and longitude coordinates according to the global wgs84 reference system**.** This means that after a data transformation the delivered location information consists of the local XY coordinates and a radius in meters. The radius is defined in a way that the probability that the end-user is within this radius is 76%. There are better technologies today, but they were not available on the German market during the iMode introduction.

The activities that the companies bring in, and their technological interdependencies, are displayed in the model in Figure 5-7.

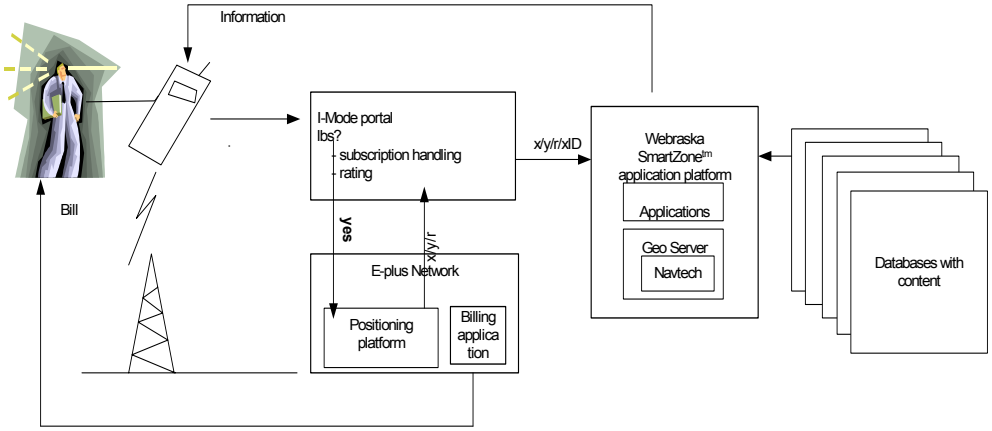


Figure 5-7 Technology interdependencies

The content has to be updated regularly. Navtech sends a weekly update to Webraska. Schober.com receives a weekly update of the content database from their mother company Schober international which are delivered monthly to their customers, like Webraska. However, Webraska only needs updates of this kind of content quarterly. Webraska requires updates from the content suppliers depending on the situation, once a week, a month or quarterly.

5.5.3 Creation of and coordination within the value network

The creation of the network for offering a location-based service (LBS) to iMode subscribers in Germany began early in the development of the iMode service by E-Plus. To provide a LBS, several roles have to be fulfilled. A service provider and LBS developer are necessary to coordinate actions and organise access to the mobile network, customers, customer data, content, geographical information, positioning information, and specific applications and software platform necessary for the delivery of the LBS and for billing. The roles and relationships of the various actors are given in Figure 5-8 and further explained below.

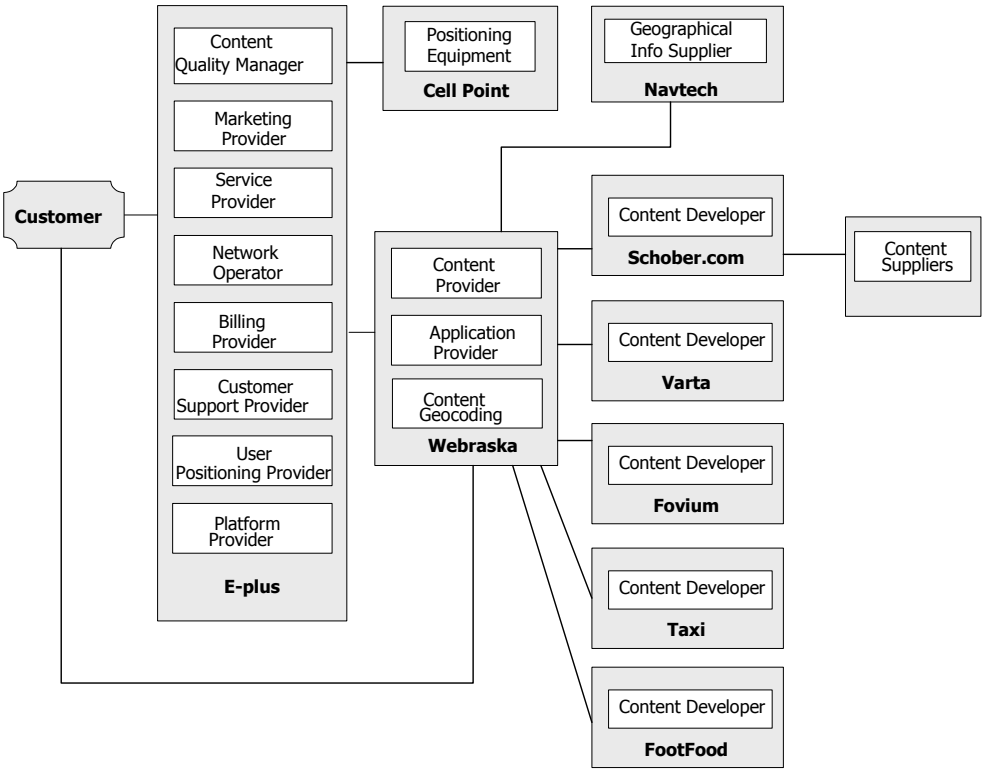


Figure 5-8 Actors and roles in Finder iMode service

The lines in this figure reflect the flows between the actors. From right to left, the content suppliers supply raw content to the content developers. The content developers provide content developed for iMODE to Webraska. Navtech provides geographical information to Webraska. Webraska aggregates and geocodes the content and provides this content with the application via the iMode menu to the customers. E-Plus provides customers access to the network, customer support, billing and the other roles that are mentioned in the figure above.

Webraska is a worldwide provider of location-based services and telematics software solutions. Webraska was founded in 1998 and began "with the pioneering vision that it could open new markets and revenue streams for its customers by integrating mobility, Internet technology and navigation. In September 2001, Webraska strengthened its market position via a merger with California-based AirFlash, a leading provider of location-based technologies and services for network operators and wireless service providers. Today, Webraska solutions support commercially available applications in several markets spanning

four continents. The company counts among its customers and partners blue-chip automobile manufacturers, telecom operators and technology and service providers.[1]"

E-Plus sees Webraska as one of the content providers. Webraska calls itself a service provider. They fulfil the place of the service provider in the full value chain of the mobile telecom provider, the service provider and the content provider. Webraska focuses on serving the mobile user with the *right* information on *time* and *location*. They want to deliver the complete information system: fast, up-to-date, correct time & location dependent information including a route for reaching a desired location taking into consideration the latest traffic information. Webraska buys the content from content providers and requires 100% coverage and actuality. They have relationships with five complementary content providers. The content providers for the Finder service are Schober, who owns a database containing nearly all German companies; FootFood, fast food restaurants; Varta, detailed information on restaurants; Fovium, financial information; and Taxi, with taxi information.

Schober.com is a B2B information provider. Schober.com decided to cooperate with Webraska because they were interested in the customers and in the new mobile business. They started to talk to each other in the second quarter of 2000 since Schober.com had the "feeling" that something was going to happen in the market. They wanted to be part of it, although the market did not develop as fast as they thought. Schober.com licenses the data from the Schober information group and optimises it for the use on the mobile Internet. Using special rules they created a mobile Internet database. In Germany they license this database to Webraska and also to Yellowmap and Winwalk.

Besides interesting content, Webraska also needs to up date geographical information to create a LBS. Webraska chose for *Navtech* because they are a major player in digital maps in the USA and Europe. Webraska could also have chosen to use local maps but they preferred Navtech: "Navigation Technologies is a global company with corporate headquarters in Chicago, Illinois, USA. Additionally, there are over 100 field offices in 18 countries. Privately held, Navigation Technologies was founded in 1985 and currently employs over 1,100 people[2]."

Cellpoint is the company that provides the positioning technology to E-Plus. CellPoint develops and implements software and services that enable Mobile Operators, ASPs, MVNOs and Portals to deliver location-based services to their business and consumer subscribers. Cellpoint is one of the infrastructure suppliers of E-Plus. Cellpoint provides the positioning platform. Other infrastructure providers are for example Ericsson and Siemens.

E-Plus, Webraska, Navtech and the content providers, like Schober.com, form the core of the network that 'produces' the Finder service. The companies have a relationship and, therefore, these companies are specific to the network. E-Plus takes the role of the network

[1] www.webraska.com last accessed 12 October 2004.

[2] www.navtech.com last accessed 12 October 2004.

operator, the marketer who sells the product to the end-customer, the billing provider who charges the end-customer for the use of the service, the provider of the positioning information, and the integrator of part of the technologies that are necessary to offer the service to the end-customer. Webraska performs the role of location-based service provider and is responsible for the development of the LBS, the applications and the integration of the different content databases.

E-Plus maintains contact with the customer. The customer is probably not even aware of a company called Webraska. If a customer finds an error in the information they send this information to E-Plus and E-Plus forwards it to Webraska. Webraska can change it itself, but it has to give the information to Schober.com to avoid a 'rechange' with the next data delivery. Schober.com brings this information to the original database. Profiles of the customer stay in the database of E-Plus.

Revenue streams

The revenue model for the Finder case differs from the general iMode model because the service was developed before the iMode content governance model was implemented. However, the E-Plus managers who took over the management of the iMode services from the initial projectleaders no longer regarded the initial agreements as relevant. E-Plus considered the initial business case to be wrong a few months after the launch. Therefore, they only explained the general revenue flow for an iMode location based service that is normally executed.

The iMode revenue model is similar in all countries: the content provider can ask between 0 and maximum 2 Euro a month for its content/service. The operator (E-Plus) keeps 14% for billing. So, for a service of 2 Euro the content provider gets 2 x 0.86 Euro and E-Plus shows the net amount and the tax on the credit note.

For location-based services E-Plus keeps 30 Eurocents for the positioning information. This 30 cents is per subscriber per month, independent of the fact of whether the end-user has used LBS ten or a hundred times. Figure 5-9 shows an overview of the standard LBS iMode services revenue flows and this shows that the price structure for the customer is quite complex.

E-Plus pays network equipment providers like Nokia, Siemens and CellPoint according to project prices. These negotiations are done within the E-Plus 'cloud' and not part of the standard iMode revenue model.

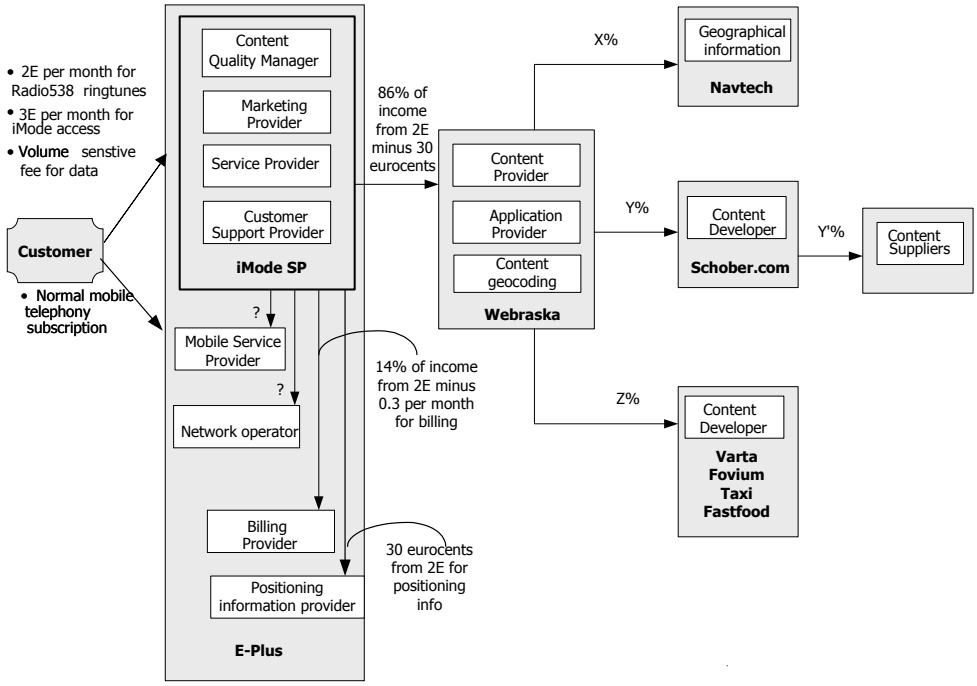


Figure 5-9 Revenue flows Finder iMode service

5.5.4 Market Acceptance

Original market research regarding what customers expect of iMode showed that the location-based services were regarded as attractive. In 2002, the E-Plus marketers mentioned that they were sceptical of this market research. People say they like to have maps on coloured displays but use is often disappointing because of the inaccuracy of the location information. At the end of 2002, the use of iMode in Germany was still behind expectation. E-Plus said that this had nothing to do with the LBS part. They argue that the LBS part of iMode is suffering because the whole of iMode is suffering because of the handsets.

E-Plus says that the popularity of LBS can be measured by the position of the service in the iMode portal. Every quarter E-Plus changes the iMode menu. The position of a service in the iMode menu depends on how many times it is requested.

Webraska mentions that location-based services in general are a success measured by usage, duration minutes and revenue. About 10% of the mobile phone users use a location-based service once a week for 2.5 minutes. The revenues are confidential. There were 123.000 iMode handsets in Germany at the end of 2002, this indicated that about 12.000 people use Finder once a week. Webraska argues that the acceptance of the services was good and that they are easy to use. Webraska offers only pull based location-based services

where users have to request a location-based service. The next step is push services, where users receive location-based services without first having to request the service at that specific moment, for example to warn a driver about traffic problems on your route. This was not possible on the network available in 2002.

There is no sign that the LBS business case as such is profitable as yet. E-plus regards the business model at the iMode level, of which location-based services are one of the services. E-plus emphasises that there is no business case for location-based services as such with the current positioning accuracy. Nevertheless, E-Plus decided to launch LBS due to the product managers' belief in LBS and the positive focus group results. This is in contrast to the situation in the Netherlands where the marketers decided not to launch LBS in the iMode portal.

5.5.5 Management of the design process

During the period Finder was developed, E-Plus was taken over by KPN Mobile and in the middle of a reorganisation process. The company had to change from a relatively small innovative operator to a company with working procedures. At the end of the reorganisation process there was a very strict process for developing a service. The whole process was divided into phases and at each phase different decisions had to be made. These phases are:

- marketing feasibility
- technological feasibility
- content
- implementation
- launch with final implementation

The crucial decisions were made after the technology feasibility phase. Details of the decisions were made after the content phase. A project team consisting of employees of both companies was formed to make the fit between the application and the network. The cooperation was intensive in the beginning; the team sat around a table and discussed the quality regularly. The contract between E-Plus and Webraska was made at the time of the launch of iMode in Germany and is still the basis of their mutual business.

Within E-Plus, the marketing department owns the money for developing new services. It all starts with a marketer presenting an idea to the innovation board and the creation of a core team of three responsible persons: the marketing manager, the innovation manager and a technical manager. The marketing manager has to find the target market and make the business case. The innovation manager is the technical coordinator and the interface between the marketing and technical department. The technical manager has to manage the supplies, programmers and all other technical issues. These three persons have to present the results of the different phases in the development process to a managerial

committee. There was very little time allowed in these meetings for presentation, discussion and decision taking. This committee took the go/no go decisions for each phase.[1]

The standard iMode contract between E-Plus and content providers defines 'what services we talk about, what are the duties of E-plus, what are the duties of the content provider, what is the availability of both sides and general things'. In addition there are five appendices.

- Appendix one: the storyboard describes very precisely what is the content, what is the stream flow, what is the idea of the content
- Appendix two: positioning in portal; deals with positioning and explains according to which rules the content is positioned within the portal
- Appendix three: covers the prices of the services
- Appendix four: consists of technical details
- Appendix five: contains additional rules for location-based services

5.5.6 Evaluation

The advantage of a location-based service on a mobile device compared to using a normal map should be that the information is obtained quickly, correct and animated. The demand for mobile services is historically difficult to predict (voice, SMS, WAP), and driven by a mix of market pull and tech push. There is little mass-market experience with LBS and the estimates of future market size vary widely. The users willingness to pay is still a relevant uncertainty. It is doubtful whether the current accuracy of location-based service is enough to deliver value to the customers. It is difficult to define the requirements due to the unknown user context, device diversity and ability to match with technical capabilities. Providing more accuracy than Finder requires investments that operators seem unwilling to afford at the moment.

E-Plus was the initiator of Finder and paid Webraska for the technology and provision of the service. Nowadays E-Plus does not develop these kinds of end-user services. They offer the iMode platform in conformation to the walled garden approach, and content providers deliver services within 4 weeks.

The walled garden approach leads to a broad range of content providers with a controlled level of quality. E-Plus can offer a broad range of content providers because they do not develop all the services in house and they can offer a certain level of quality because the portal is managed. This is the walled garden iMode approach. The German iMode portal offered by E-Plus also conforms to this model in which service providers can offer their

[1] The project manager of Finder emphasised the difference in working procedures and culture before and after the take-over of E-Plus. In his view, the more formalized working method after the take-over and the shift of initiation role from innovation to marketing limited the innovative power of the company.

services to the iMode platform in a very short time, in stead of the operator developing the services in-house (the closed model).

- There is no uniformity in the ways roles are indicated; e.g. E-Plus calls Webraska a content provider and Webraska calls itself a service provider. The actors E-Plus and Webraska perform several roles. Each role has to generate revenues. For example, E-Plus receives 14% of the content subscriptions for 'billing' and 30 Eurocents for positioning information.
- Embedded ties are important in establishing the network. Webraska and E-plus knew each other from former projects.
- There is no exclusivity between portal providers and content providers. In the German iMode portal are three location-based 'find-the-nearest' services. Webraska offers location-based services to several mobile operators. The same counts for the contracts between Webraska and content providers like Schober.com.

This case shows that 'time to market' pressure leads to different arrangements between partners than agreements that have been extensively thought through. The revenue model for the Finder case differs from the general iMode model because the service was developed under time pressure. This was before the iMode content governance model was implemented. Today, E-Plus considers the initial Finder business case to be no longer appropriate. Thus the current E-Plus managers are more content with the standard iMode shared revenue model.

5.6 Discussion and conclusions

The experience gained with M-info formed one of the pillars for the development of iMode. The other pillar was the Japanese iMode model, launched by NTT DoCoMo in Japan in 1999. KPN Mobile's management mentions the following differences between the M-info and iMode concept.

- One, the technology behind iMode enables a much better customer experience when using the mobile Internet; the device has a bigger screen with colour and good sound quality, and it is also faster.
- Two, the way of cooperating with content providers was one of the applied learning experiences. In the M-info period, a marketer had a lot of tasks of which one was recruiting content providers. The distinction between the responsibilities of content providers and KPN mobile was not completely clear. Having learned from M-info and NTT DoCoMo, KPN Mobile introduced the 'content governance' model', being the iMode model for cooperating with content providers. This is explained below in the issue on content quality.

- Three, KPN Mobile formulates the quality standards for the content. The procedure to be accepted as an iMode content provider has been standardised. The content providers have to deliver ready-to-use content. The quality of the content in this portal is initially guaranteed by presenting storyboards of the service idea to a panel of content managers. If they pass the content will be part of the official iMode menu. Later, the usage of the service determines its position in the i-menu. This way the customers decide by frequency of usage how they regard the quality of the content.
- Four, the marketing of iMode is focussed on the mass consumer market while M-info was targeted on the professional user. M-info was communicated as a wireless form of Internet; while iMode has its own propositions with typical mobile values like ringtunes.
- Five, the cost structure of iMode is roughly the same as that of M-info for the customer. A difference is that the customer has to get an iMode subscription that consists of access to iMode and to GPRS databundles. Customers do not pay for the time they have a connection but for the kilobytes they pull.

An overview of the characteristics of the three case studies is provided in Table 5-2.

Table 5-2 Overview of the case studies

	Case 1 **M-info**	**Case 2** **Radio 538 Ringtunes**	**Case 3** **Finder**
Status	On the market [1999-2004]	On the market [2002-….]	On the market [2002-….]
	Exploration/ Exploitation	Exploitation	Exploitation
Design process	Based on internal procedure of KPN Mobile.	Based on iMode content governance model.	Based on iMode content governance model.
Service Formula			
USP	Browsing on the Internet. Anyplace Anytime	Downloading popular tunes and DJ voices. Anyplace Anytime	Finding the nearest hotel, restaurant, taxi or ATM. Anyplace Anytime
Target group	Young professionals	Radio 538 audience (12-30 years)	Consumer market (broad)
Location-based	No	No	Yes
Technology			
Mobile network	GSM	GPRS	GPRS
Positioning info	-	-	Cell ID
Application(s)	Web browsing with WAP	iMode Ringtune downloading	iMode Location finding
Handset(s)	WAP enabled mobile	iMode mobile phone	iMode mobile phone

	Case 1 **M-info**	**Case 2** **Radio 538 Ringtunes**	**Case 3** **Finder**
	phone		
Value Network			
Network organisation Centre of gravity	No, Hierarchical organisation oriented. Two-way relationships Mobile operator	Yes, Network organisation oriented. Three way relationship Mobile operator, Application Provider and Branding partner.	Yes, Network organisation oriented. Three way relationship Mobile operator and Application Provider
Governance model	Managed portal and access to other sites.	Walled garden	Walled garden
Governance mechanisms	By contract	Revenue model	Revenue model

The three case studies provide interesting lessons to be learnt. Despite the fact that during the M-info design process some elementary rules of service design, like involving the user in the service design process, were violated and iMode did not reach its own targets in the Netherlands and Germany in 2003. We structure the lessons based on the way of thinking, way of controlling, way of working and way of modelling (see Section 4.1). The *way of thinking* consists of the framework with as core elements the service formula based on the customer's needs, the 'hard' enabling information and communication technology and the 'soft' organisational part consisting of the value network of actors. We reflect on the way of thinking lessons below followed by a discussion of their impact on the way of controlling, working and modelling.

Way of Thinking - Service formula

An organisation has to deal with the uncertainty in demand and value when designing mobile information services. Questions regarding this uncertainty are: Is the consumer willing to pay for these kinds of services? What budget does the target group have to spend on this service? User experience is key: Who are your users? Define the target group for which the service is meant. Does the service replace other services or is it really new? What is the surplus value of the service compared to existing services or resources currently in use? What is the estimation of the frequency of use, by how many people, how important is the function provided by this service? What is the current spending on telecommunication services?'

Besides having to make decisions regarding the target group and the pricing model, designers have to decide on the look and feel of the mobile information service. The observed features in the case studies were localisation, privacy, handsets choice and content quality and richness. Non-functional requirements like the responsiveness in the M-info case are also important for the customer's satisfaction. The non-functional requirements

are related to the service process quality that has to be enabled by the technology. We see the following lessons for the service formula:

- Pilots, or even free connection plans to allow customers to explore services can help companies to find answers to these questions.
- It is important to prevent first negative impressions becoming public as in the WAP case.
- The Radio 538 ringtune case was the most successful and it has the most distinctive target group. There might be a correlation.
- Localisation, privacy, handsets choice, content quality and richness and non-functional requirements have to be considered as part of the service formula issues in the design process.

Way of Thinking - Technology

The limited capacity of the technology used for M-info reduced the usability of the service and subsequently users first impressions were negative. The devices used had limited processing power, battery life and memory. This has improved but limitations remain. The network had, and has, limited bandwidth and latencies. The limitations of enabling technology cannot be neglected in the decision making process concerning a target group and market launch. This has to be taken into account when formulating the service process quality requirements. In Chapter 2 we formulated reliability, responsiveness, user interface, trust and customisation as parameters for the service process quality requirements. The level of quality has to match with the customer demand, and what has been promised must be technologically feasible. The lesson regarding the way of thinking of the technology is:

- Build only services based on robust components. Do not promise more than is technologically feasible.

Way of Thinking - Value Network

Concerning the organisational issues we see the following in the case studies. The success of iMode in Japan is credited to the three-way relationship between DoCoMo, the content (application) provider, and the customer (e.g. Vincent 2001). The Radio 538 ringtune case also shows the importance of the bundling of the service with the handset; thus the relationship between the service provider and the handset manufacturer.

- Co-development of services with operators, content providers, IT application providers and handset providers seems to be a must.

The reasons for organisations to participate in a network of organisations that start innovative services is in the short run more related to image and learning than profit. E.g. KPN Mobile regards its experience with M-info as useful for further mobile Internet services; Radio538 wants to profile its company as an innovative firm.

- Organisations participate in a consortium to develop innovative services for reasons more related to image and learning than profit.

Embedded relational ties heavily influence the choice of partners. Radio538 had already done projects with KPN Mobile, the CEO of Tutch is the former marketing director of KPN Mobile, and E-Plus had done projects with Webraska.

- Embedded relational ties heavily influence the choice of partners.

These way of thinking lessons express the perspective in the case studies on the applied mobile information services design approach.

Lessons on way of controlling, working and modelling

Revenue models are an important governance mechanism in value network coordination. In the exploitation phase the shared revenues cause a constant information and revenue flow between firms. The revenues are related to the roles instead of the actors. In the Finder case, the actor 'operator' takes 14% for its role 'billing' and 30 cents for the role of 'providing positioning information'. Therefore, it is important to separate roles and assign the revenues to those roles instead of the actors. Creating a win-win situation is necessary for players who have a shared revenue model. As explained in Section 4.2, this has to be highly controlled in the exploitation phase when the frequency of interaction is low. The shared revenue model is a way of doing this. Creating the win-win situation starts in the exploration phase when the new innovative service is developed and when the stability of the network structure is limited but when the trust and openness is high. An internally oriented control mechanism like that used the M-info case shows shortcomings that hinder trust and openness.

Concerning the way of working we observed that inclusion of the user was missing in the M-Info case. This led to the launch of a service on the market with disappointing market acceptance. We will not argue for the product design approach to develop a service that is only determined by the customer wants and needs since this is not possible with disruptive technologies (Christensen 1997 see Section 1.2). However, the case studies show that the user should be included in the design process to test a service before it is launched on the market.

During the interviews a few ways of modelling were mentioned. The WAP toolkit to test WAP pages on a PC. This is also called an emulator. Furthermore, storyboards in the content approval procedure for iMode were mentioned. These storyboards have the same function as art impressions used in product design. Probably more models were made but did not appear prominently.

We will abstract from this descriptive empirical model (case studies) lessons to derive a descriptive conceptual model in the next chapter.

6 Towards a mobile information service design approach

In this chapter we reflect on the former chapters and formulate the requirements for a design approach. This builds further on the overview of design theories presented in chapter 4 and is refined with the case study findings given in Chapter 5. The analyses for designing mobile information service systems are grouped according to the four ways framework, i.e. way of thinking, way of controlling, way of working and way of modeling. Design tools to support the 'ways of' are added as the fifth element. An expert meeting in the GDR was used to check and sharpen the first ideas for the prescriptive design approach.

6.1 Designing mobile information service systems

The design theories from Chapter 4 can be applied on mobile information service systems. We do this in this chapter and complement it with our case studies analyses and recently published articles on designing mobile services.

6.1.1 Way of thinking

An ICT based mobile service is part of a system. Definitions of systems have been described in Chapter 4. Systems are often classified by their ultimate purpose: service-oriented systems, product-oriented systems, or process-oriented systems. Definitions of services are given in Chapter 2. The keywords in these service definitions are intangible and interaction or transaction. If we combine these definitions on systems and services and add a mobile component the following definition on mobile service systems is derived:

A mobile information service system is '*a group of components that work together for delivering (a series of) activities of an intangible nature when the customer is mobile and a mobile telecommunications network supports the interactions through an Internet channel between customers and service employees (or systems of a service provider) which are provided as solutions to customer problems'.*

We start the definition with 'a group of components' because the services systems we want to design are based on fast changing technology. Organisations have to be able to react rapidly to those changes in technology and also to changes in business. "Component based development provides higher productivity in system development through reusability, more effective system maintenance, higher quality of solutions and possibility for parallel work. More over it provides better system adaptability through replaceability of parts, localisation and better control of changes, system scalability, and possibility of using legacy assets" (Stojanovic 2002).

The case studies show that services offered via the (mobile) Internet are unlikely to be produced by a single organisation or business unit, they are more commonly produced

within a complex value network in which business units within and between several organisations have to work together to share necessary (technical and other) resources and capabilities. Christensen (1997) describes the concept of a values network as "the context within which a firm identifies and responds to customers' needs, solves problems, procures input, reacts to competitors and strives for profit". Christensen argues that firms faced with disruptive technologies must examine the implications of innovation for their relevant value networks.[1] Therefore we argue that an *actor network perspective* is necessary. It takes the well-coordinated effort of a number of companies to ensure the delivery of valuable mobile services to the customer. This actor network perspective is related to business model literature. The same kinds of elements are found in business model definitions. A business model is the organisation (or 'architecture') of product, service and information flows and the sources of revenues and benefits for suppliers and customers (Timmers 1998). As such a business model has limited scope and does not include, for example, the overall marketing strategy or general strategic orientation of an organisation. Other elements found in business model literature are of a financial and operational nature (Timmers 1998; Hedman and Kalling 2003; Osterwalder and Pigneur 2002a; Haaker et al. 2004). Financial issues are related to the user value and the organisational issues. How much do customers pay for the value offered? How do the suppliers share the revenues? The operational issues are related to the technology and the organisational issues. How is the technology distributed among the actors? Who will do what, what are the interdependencies?

In developing the business model for iMode, DoCoMo's management looked at some of the most successful business models on the Internet; and especially that of America Online. These business models are characterised by network externality, high customer retention rates and economies of scale[2]. Economists use the term network effects or positive feedback to describe this phenomenon (e.g. Saphiro and Varian 1999). The value of a product that exhibits network effects is a function of the number of users of which there are direct and indirect effects. The telephone, facsimile and e-mail exhibit direct effects. The more people you can call or send e-mail to, the greater the value of these products. This concept is also of importance for the mobile industry. When a new user joins the network, his or her action creates incremental benefits for all users in the network. After a critical mass is reached, there is added incentive for new consumers to come in, and thus the network continues to grow. To reach a mass market the service has to become a commodity and therefore it has to become fashion. A mobile information service will only be popular if customers can choose between varieties of handsets to use. From very simple to

[1] "The key considerations are whether the performance attributes implicit in the innovation will be valued within the networks already served by the innovator; whether other networks must be addressed or new ones created in order to realize value for the innovation; and whether market and technological trajectories may eventually intersect, carrying technologies that do not address customers' needs today to squarely address their needs in the future" (Christensen 1997).

[2] http://www.ebstrategy.com/mobile/case_studies/-ntt_docomo.htm last accessed 12 October 2004.

very advanced to very 'trendy', depending on the target group. To reach this a certain degree of standardisation is necessary. Component based development supports this. Then, economies of scale can be reached and the cost of supporting new content providers, users and new technology diminishes.

Way of Thinking recap

In Chapter 4 we stated that a combination of hard and soft thinking is the basis for the way of thinking in a systems approach. The system in view is a mobile information service oriented system and this system should consist of the service formula for the demand side, the enabling technology and organisation of the supply side. Together these elements result in a mobile information service oriented system. The first element is related to the service concept that addresses the value for the customer. Value has to be delivered to the customer in such a way that it takes his or her context into account. This is similar to the principle in product design theory that emphasises to start with the customers' wants and needs. In marketing literature we see this value expressed in terms of the 4P's: product, price, promotion, place (Kotler 1991). Together this reflects the intended customer value of the service. We described these values in Chapter 2. These factors are incorporated into what is known as the *service formula*, which includes the service's price, the way it is promoted and how it is delivered to the market.

The second element is the *technology* that is the driving or enabling factor for the development of the mobile services. Providing new mobile services is possible via new network technologies, protocols, handsets and location techniques.

The third element is related to the organisational issues. Different firms in the supply market have to cooperate to develop and launch the service. This might be called a value chain or more appropriate, as shown in the next subsection, a *value network*.

We incorporate financial and operational issues in the service formula, technology and organisational issues. Figure 6-1 shows the three elements we see as the mobile service system elements.

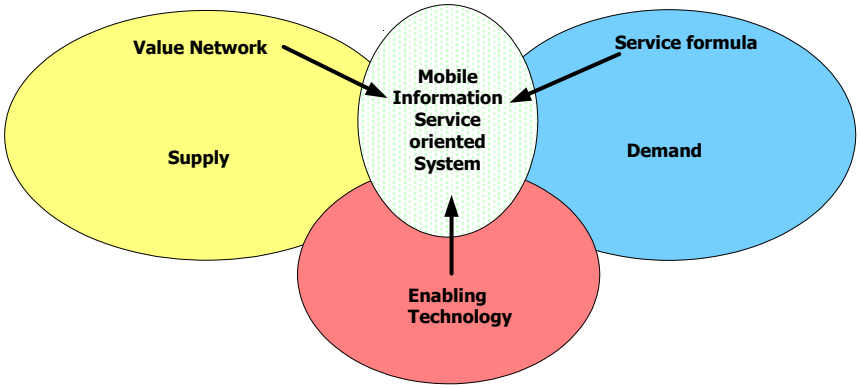


Figure 6-1 Way of thinking framework

These elements are defined as follows.

- **Service formula:** the differentiating value proposition demanded by the end-user.
- **Value network:** the configuration of activities between organisations and the correlated relationships, revenue models and cost structures.
- **Enabling Technology:** the service architecture providing the necessary technical functions to realise the service.

6.1.2 Way of controlling

As described in Table 4-1 in Chapter 4, the network features differ in the phases of exploration and exploitation. Exploitation entails improvements with respect to established practice, while exploration entails the development of new practices. In the exploitation phase firms have to cooperate, as in a network and their activities need to be coordinated. It is not always possible to make a clear distinction between the exploration and the exploitation phase. E.g. KPN Mobile used experiences gained with M-info and iMode in Japan for the development of iMode services in the Netherlands and Germany. The first iMode applications were new practices; successors became more an established practice and were absorbed in the iMode ecosystem. We first discuss the exploration phase and then the exploitation phase.

Exploration phase

The value network has to be formed in the exploration phase. Compared to the exploitation phase the structure of the network will be dense, and ties will be strong on various aspects (Nooteboom and Gilsing 2004; see also Chapter 4). The case studies in Chapter 5 show that embedded relational ties are often a reason for choosing partners.

During the exploration phase, the design principles of process management help to keep the actors involved and help them to reach decisions. These design principles are openness,

protection of core values, speed and substance (as described by De Bruijn et al. 2002; see also Chapter 4). Process management is without doubt useful in complex projects where stakeholders have conflicting interests e.g. when building infrastructures. In the situation of designing mobile information services there are different stakeholders involved and these stakeholders have to cooperate. However, the probability of conflicts of interests is not very large. The stakeholders have a joint goal in designing a service that will be adopted on the market. There might be disputes regarding the division of the costs and revenues. For example, the revenue share that mobile network operators pay to the content providers. The stakeholders might also have different opinions on the user requirements since these are quite uncertain (see Chapter 3). However, the design process of a mobile information service is orderly compared to e.g. building large and controversial infrastructures like railroads. Therefore, the more hierarchically oriented decision-making approach 'project management' suffices to a fair extent. This approach, added together with some elements of process management to guarantee the speed of the process, is helpful for designing mobile information services. The elements of De Bruijn et al. related to speed are:

- the process should create prospects of gain and incentives for cooperative behaviour
- the participants should have commitment power
- the environment should enable the process to be speeded
- conflicts should be transferred to the periphery of the process
- command and control should be used as an incentive to speed up the process.

This last point connects nicely with project management techniques like clear goals & targets and a time schedule. The M-info case however shows that a speedy process should not be the only goal. The network organisation is created in the exploration phase. All three design theories as presented in Table 4-2 provide insights for the managerial aspects needed for this: an adaptive strategy with cooperation of the experts, focusing on following agreements including the above mentioned speed related process management elements, interdisciplinary teams and project management.

Exploitation phase

We showed the value chain of M-info and the value networks of two iMode services in Chapter 5. We observed the roles mentioned in Chapter 1, the mobile network operators, service providers, content providers and hardware providers and IT organisations. We are looking for guidelines for the coordination mechanisms in these network organisations.

The value chain is a model that enables the organising of operations around the value adding activities that result in a better service or product (Porter 1985). Olla and Patel (2002) use this value chain model as a basis to present a framework to deliver technologies that boost earnings. When discussing the value chain surrounding location-based mobile services, we have to deal with the 'telecommunication' value chain, 'Internet' value chain and more specifically the location-based services chain.

Traditionally, the telecommunication business works along a managed model (closed) with a guaranteed quality of service, while the Internet operates on the basis of an unmanaged model (open) in which actors offer best-effort quality of services based on market demand (Van de Kar and Bouwman 2002). The telecommunication value chain and the Internet model converge in mobile Internet services, making use of location-based services. In models defined and dominated by the telecom operator the n internal service departments of the telcos will mostly offer the services, or these departments will contract third parties. In an open model, initiatives by for instance MVNO's (Mobile Virtual Network Operator) or Internet Service Providers get a better chance of positioning themselves within the value chain of mobile location-based services (Bouwman and Van de Kar 2000). The revenues will be determined depending on the position in the value chain, the choice of network used to offer the services (GPRS; UMTS; WLAN) and the customer's terminal (GSM with SMS or WAP, PDA's, laptops, etc.). The differences between services, on a network for which a license is needed, and the services based on networks that make use of unlicensed frequencies might be decisive with regard to the potential viability of mobile services. This concerns for example, the differences in the revenue models for WLAN based services versus the revenue models for mobile network based services like M-info and iMode.

In addition to the value chain for mobile communication a value chain for location-based services can be distinguished. The value chain of location-based services is related to the chain of mobile telecommunication and of Internet services. For location-based services ISP's must make use of location information. Application developers have to use location technology. Handset providers have to offer their customers a device with positioning ability. Alternatively, network providers may provide this functionality. Mobile devices must be able to retrieve this type of information from the network. In the latter situation, network operators play a major role because they own the cellular location information, as in the Finder case study.

When GPS is used as a location technique the value chain looks different. In its simplest form, e.g. a hiker using GPS to determine his or her position in the middle of nowhere, the customer buys a device and uses the device to determine his or her position. The GPS infrastructure is paid for by the USA's defence industry.

In these value chains, the revenue model for the manufacturer is quite clear and hardly the subject of discussion. However, the mobile network operators, service providers and content providers can play different roles and have different revenue models. Mobile operators often take the most dominant position, as showed in the case studies in Chapter 5 (see also Wehn de Montalvo et al. 2004). The revenue streams for the mobile network operators may be airtime and connection fees (subscription and/or utility model), service fees, commissions on transactions and income out of content management.

The position of service providers is less clear. There are different kinds of service providers, such as Mobile Virtual Network Operators (MVNOs), Application Service Providers (ASPs) and Internet Service Providers (ISPs) that can provide customers with access to location-

based services. The opportunity for MVNOs and ASPs to offer this type of services depends on the operators' access strategies. Mobile operators might work according to the open, closed, or 'walled garden' model. The case studies in Chapter 5 showed that the iMode services are managed along the 'walled garden' model and the M-info service is a managed portal. This portal can be considered as a closed model but since customers can also access other WAP sites it can also be seen as an open model. Internet Service Providers may also be in a threatened position if operators take over their role (Bouwman and Van de Kar 2000; Maitland et al. 2002). In the iMode and M-info case studies the Mobile operators fulfil the role of ISP. Possible revenue streams for service providers are subscriptions, extra service fees, airtime and connection fees and commission on transactions. If service providers also offer a portal and fulfil the role of portal provider they can also earn money via the advertising model.

In a managed model the freedom of the customers might be limited. If service providers want to limit the freedom of their customers they have two ways of realising this. The first is by implementing a 'walled garden' and the second is by installing a WAP-lock. Allowing customers access only to certain sites and denying them access to all others creates a walled garden. Customers are free to surf within the garden but are walled in. A WAP-lock achieves the same result by locking the mobile phone to a single portal, thus making it impossible for the customer to access another one. There have been cases where cartel authorities have sanctioned companies that installed WAP locks, e.g. France Telecom by the French Cartel (Vos and De Klein 2002).

The presently dominant business model for WAP service provision involves mobile operators aggregating content and services from third-party partners and providing these services directly to their subscribers (Barnes 2003). In this situation content providers are obliged to reach customers through the proprietary network of the operator. However, Barnes (2003b) argues that as the diffusion of WAP accelerates and consumers begin demanding services independent of the operator, the open unmanaged Internet model is likely to emerge. Kumar et al. (2003) argue that there only will be a future for WAP if, besides solving the technical problems, there is a proper consumer-oriented business model. This business model should embed an efficient mechanism to solve the problem of the lack of coordination among handheld providers, browsers, emulators and WAP and the problem of the missing mechanism to establish fair revenue sharing with content providers.

From value chains to value networks[1]

Value chains are helpful in identifying value-adding activities, but the complexity and radical changes in the merging telecommunication and media sectors are disregarded in these chains. In particular, the traditional telecommunications value chain is increasingly being deconstructed, which is leading to the development of a complex and rapidly evolving value

[1] Based on Maitland, Van de Kar, Wehn de Montalvo and Bouwman (2003b).

network that consists of a myriad of network relationships (Li and Whalley 2002). So currently, the rapid change in mobile telecommunication technologies, which in turn creates opportunities for new services, is increasing the interdependency of firms in the mobile sector. This increasing interdependency is one of the most frequently cited reasons for firms coming together to form cooperative relations (Gulati and Gargiulo 1999). In addition to the resource interdependencies human resource constraints, compounded by time-to-market pressures, are driving the creation of inter-organisational networks for the provision of information services to mobile devices. While these networks are being formed to make innovative mobile services possible, they must also meet the requirements of a successful business venture. As mobile services such as M-info demonstrate, this can be quite a challenge. Thus, at the same time as mobile service networks are formed to overcome resource constraints they must also ensure that the overall venture is successful for the individual members while delivering highly valued services at the right price to the customers.

Governance mechanisms are needed to control this emerging value network and its interwoven relationships between the different value chains. These governance mechanisms have to support the emerging business models that are rising in the value network. We see the business model as key to shaping an important network characteristic, its governance. The need for governance stems from the special problems of adapting, coordinating and safeguarding exchanges created by networks of ties. It has been proposed that network forms of governance can overcome these problems by using social mechanisms rather than authority, bureaucratic rules, standardisation, or legal recourse (Jones, Hesterley et al. 1997). Given the network nature of mobile communications services and the position of the network operator in the industry, operators will act as the triggering entity, gathering partners to fulfil the roles necessary for provision of the service. These roles are filled in accordance with the evolving business model that defines the revenue model and the benefits to various members. This is illustrated by the revenue flows in the Radio 538 Ringtune and Finder cases in Figure 5-5 and Figure 5-9.

Natsuno (2003) describes the iMode ecosystem as a model centred on subscribers and content. In the middle is DoCoMo with a coordinating function that mediate between the subscribers and the content. The coordinating role of DoCoMo in the ecosystem is to provide the business model, the marketing, servers (billing system), network and clients (mobile phones). The user experience is the critical factor in this complex ecosystem.

iMode changed the traditional two-way business relationship between the service provider and the subscriber by adding a third player in the form of the content (or application) provider. In the Radio 538 ringtune service this player is Tutch with Radio 538 for the branding. In the Finder service Webraska is the third player. Clearly this three-way relationship is not the telecommunications norm and iMode provides the business model approach that supports the creation and sustains of the growth of applications and services with a rich user experience (Vincent 2001).

iMode services are offered through an operator-run portal and are implemented through a business model that aims to establish a uniform set of governance mechanisms across a broad range of operator-content provider relations. As shown in the Radio538 ringtune and Finder case, the revenue model is one of the governance mechanisms in the value network.

Way of Controlling recap

There are differences in the way of controlling for the exploration and the exploitation phase. Project management and speed related process management arrangements are useful during the first stages of the service design process, the exploration phase. Value network issues are important in the exploitation phase. These issues consist of external and internal network factors. Resource interdependences and constraints are external network factors. The business model is one of the internal network issues in the creation of the value network, e.g.: Which actor fulfils what role, and how are the revenues shared? Another factor that influences the creation of the network are the embedded relational ties, actors prefer to collaborate with actors with whom they have a positive working experience. The exploitation and exploration phase meet in this network creation process.

6.1.3 Way of working

The tasks that have to be carried out in the design process are prescribed in the way of working. A variety of series of tasks are shown in the different theories presented in Chapter 4. The problem solving cycle of BSE consists of "conceptualise problem; diagnose problem; construct models; choose preferred solution; implement solution; and ex-post evaluation". The design cycle of products consist of the phases "analysis, synthesis, simulation, evaluation and decision"; another variation is "analysis, synthesis, materialisation and optimalisation". Quality Function Deployment is a product design approach that also takes organisational issues into account. Useful approaches from the information system literature are the spiral and the waterfall model. In the component based approach the series "understand the context, define the architecture and provide the solution" are presented. Before we derive a way of working for designing mobile information services we will briefly present two other research findings that applied QFD to mobile applications.

Herzwurm et al. (2002) developed a special variant of QFD for building m-commerce applications based on the spiral model of Boehm (1988), see Section 4.3.2, and QFD, see Section 4.5. Herzwurm et al. argue that QFD provides a systematic but more informal way of communication between customers and developers and that QFD is aimed at software that fits its use instead of presenting all technically possible characteristics. Herzwurm et al. argue that incremental planning and implementation cycles are needed concerning the characteristics of m-commerce applications caused by high innovation and risk, i.e. unclear and dynamic customer requirements and product characteristics and time pressure. Furthermore they state that employing Information Technology and the use of templates are basic elements. This leads them to the concept of Continuous QFD (CQFD), see Figure 6-2 (Herzwurm et al. 2002).

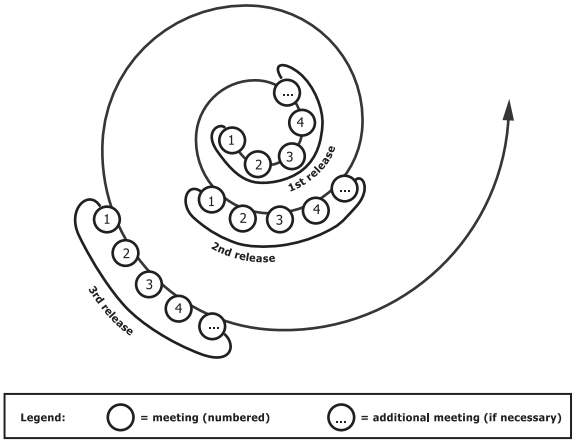


Figure 6-2 Lifecycle of a CQFD project (according to Boehm's spiral model) (Herzwurm et al. 2002)

Androu et al. (2003) developed a design and development methodology for m-commerce services based on a Web engineering process (Andreou et al. 2002). Their modified WebE process includes the six phases of a) formulation, b) planning, c) analysis, d) engineering, e) service implementation and testing and f) user evaluation; see Figure 6-3.

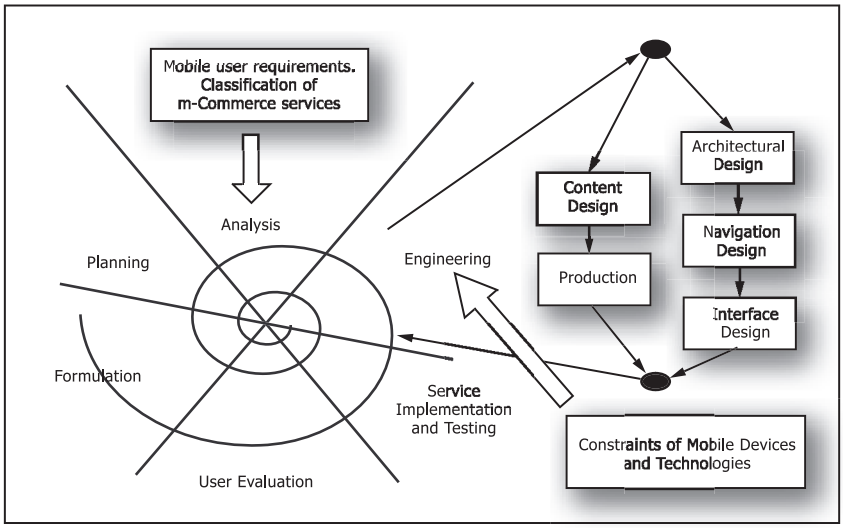


Figure 6-3 The modified WebE process for m-commerce services and applications (Androu et al. 2002)

The combination of a series of tasks and a spiral are shown in Figure 6-3. The spiral reflects that the approach should be incremental. In the case studies in Chapter 5, in particular the

M-info and the Finder case studies, we described how the design projects were divided into phases. These phases consist of series of activities with go/no go moments between the phases. We also saw that the user should be included to test the mobile information service in various phases of the development. The spiral model consisting of a stage-by-stage model combined with an evolutionary approach might be a solution for this.

Way of working recap

The requirements for the way of working for mobile information services can be summarised as follows.

- There should be a series of activities such as analysis, preparation, synthesis and implementation; testing should be an integral part of this iterative cycle.
- Since the user requirements are uncertain there should be interaction with the user and the approach needs to be incremental. However as described in Section 4.3.3 and repeated in Table 4-2, a radical approach will help the designers to innovate at the start of the process.

6.1.4 Way of modelling

The way of modelling can be derived from the way of thinking. Concerning our design goal we focus on modelling to back up designing mobile information services. In all three elements of the way of thinking framework, i.e. the value network, the service formula and the enabling technology, models might be helpful. Checkland (1999) explains the roles of models in his article Soft System Methodology as models that are relevant to debate about the situation perceived as problematic. "Those models do not purport to be representations of anything in the real world, they are thus not models *of* …. anything." This also counts for the models we are looking for to apply in mobile information service system design. Models allow us to get a grip on a problem; they make it possible to study the behaviour of not yet available or accessible material by means of experiment. Another function of models is that they contribute to the insight into the design factors and environmental variables that determine the imitated behaviour. Furthermore models can be used to describe and visualise situations. This makes it possible to discuss a scenario with other people involved (Roozenburg and Eekels 1995).

The service formula can be modelled using use cases. "The Use Cases package specifies the concepts used for definition of the functionality of an entity like a system. The elements in the Use Cases package are primarily used to define the behaviour of an entity, like a system or a subsystem, without specifying its internal structure. The key elements in this package are UseCase and Actor. Instances of use cases and instances of actors interact when the services of the entity are used. The purpose of a use case is to define a piece of behaviour of an entity without revealing the internal structure of the entity. The entity specified in this way may be a system or any model element that contains behaviour, like a subsystem or a class, in a model of a system. Each use case specifies a service the entity provides to its

users, i.e. a specific way of using the entity. The service, which is initiated by a user, is a complete sequence" (OMG 1999).

Designers develop use cases during the design process of the service. However, these UML models are useful for designers but not suitable to use in tests with customers. Therefore, we need iconic models, like storyboards and prototypes. Iconic models are material models that can be used to conduct experiments (Roozenburg and Eekels 1995). Van den Anker (2003) introduces 'usage scenarios' to communicate with users. These scenarios support the design process by concretising the envisioned changes and fit very well to the early stage of design with analysis activities, where high level of requirements and concepts are generated as a precursor to prototyping and design specification. These usage scenarios are adapted in the context of cooperative work mediated by mobile communication. These are internal scenarios that have to be distinguished from external scenarios. External scenarios give a description of possible futures that are representatives for a range of potential future developments and their outcome. These external scenarios were used in the MOBUS project, see Chapter 3. The initiator can use external scenarios to generate ideas for possible services. To model the service during the design process for communication with the user usage scenarios, storyboards and prototypes can be used.

Actor and role models are useful for modelling the *value network*. An advanced way of modelling actors and roles is to play a game. Gaming might be useful to validate process steps in a social context. When the weighing of the interests is limited this is probably overkill.

The technology itself is not the object of design in this research. The aim is to assemble existing technology pieces in such a way that a service is useful; to use existing building blocks. As described by Brown (2000), see subsection 4.2.3, it has to be handled in a component-based manner. The components architecture modelling of mobile information services can be structured in layers: the telecommunication network, the middleware, the applications and the presentation layer.

Way of modelling recap

In the design process models help us to describe and visualise what is meant. This can be used to support communication and debate between designers and in test settings with users. Modelling of the value network is helpful to get an overview of the network's actors and roles.

6.2 Supporting design tools

Many supporting tools can be found in the academic literature and in handbooks for business practitioners. Supporting tools vary from pencil & paper to advanced software programs. An example of a tool for controlling the effect of programming mobile applications is the emulator. Using an emulator the screen of the mobile device is shown on a desktop. This is also handy in usage studies since it is critical to start usage studies very

early when you have just enough functionality working to make it possible to do a basic set of meaningful tasks (Isaacs and Walendowski 2002)[1].

Group Decision Room for user requirements[2]

An often-mentioned supporting environment from the BSE literature is the Group Decision Room (Den Hengst and De Vreede 2004). The Group Decision Room is equipped with Group Support Systems. Group Support Systems (GSS) are designed to improve the efficiency and effectiveness of meetings by offering a variety of tools to assist the group in the structuring of activities, generating ideas, and improving group communications (Nunamaker et al. 1991). Previous studies on GSS have reported labour cost reductions averaging 50% and reductions of project calendar days averaging 90% (Grohowski et al. 1990; Post 1992). The success of GSS meetings is often attributed to specific GSS characteristics (De Vreede and Muller 1997): anonymity, parallel input and group memory.

- *Anonymity*: being able to enter ideas and votes anonymously, silent or shy participants are more encouraged to participate, other group members cannot dominate. Ideas are, therefore, judged on their merit, not on the personality or position of the person that submitted it. This characteristic is of less importance in groups without conflicts, which will often be the case in service design sessions with users.
- *Parallel input*: generating ideas and communicating them in parallel, participants get equal time, preventing production blocking, so that participants can spend more time on generating new ideas. Working in parallel allows groups to generate more ideas. It is as if all people in the meeting are talking at the same time.
- *Group memory*: during an electronic meeting, all ideas and votes are stored electronically. Hence, little time is needed to produce meeting minutes and previous meeting results are readily available in follow-up meetings. Moreover, the meeting record is untainted in nature and also describes the evolution of a group's position over time.

Although these factors are often reported as success factors, we can find some conflicting results when comparing the performance of GSS's in the literature (Briggs et al. 2001). Briggs et al. (2003a) counter this problem and propose another unit of analysis, labelled ThinkLets as an approach to produce far more predictable and repeatable results. ThinkLets describe in detail how a certain activity can be realised. Briggs et al. (2003a) have identified seven basic activities: divergence, convergence, organization, elaboration, abstraction, evaluation and building consensus. These basic activities can be used to design a repeatable process for user requirements elicitation. ThinkLets can be attached to these basic activities to create a successful repeatable process. ThinkLets must be defined at least in terms of the tool used, the configuration of this tool and the facilitation script. The tool component

[1] Isaacs and Walendowksi make a distinction between usability testing and usage studies.

[2] Based on Den Hengst, Van de Kar and Appelman (2004).

describes the specific version of the specific hardware and software used. The configuration specifies how the hardware and software were configured, and the script describes the sequence of events and instructions given to the group. The use of ThinkLets makes it possible to develop a GSS session for user elicitation sessions that can be easily repeated and facilitated by different facilitators.

Group Decision Room for stakeholder negotiations

GSS systems can also be used in the design process to manage complexity with more stakeholders than only users. An example of this is the EasyWinWin methodology. Briggs and Gruenbacher (2002) combined the spiral model of Boehm (1988) with collaborative knowledge techniques and automation of a Group Support System and created the EasyWinWin methodology. The purpose of this methodology is to create an acceptable set of system requirements.

Usage studies

The rise of the Internet has caused a whole library of books and articles to be written on the design of computer software, electronic gadgets and online services (see e.g. Isaacs and Walendowski 2002 who emphasise how designers and engineers can collaborate). The appliance of user centred design for interactive systems can be considered to be a constant factor. The principles are explained in Nielsen (1993), Norman and Draper (1986), and also published by the International Organization for Standardization (ISO 13407 1999). Shortly, human-centred design is more or less common sense in the human-computer interaction research field. Publications on user-centred design of mobile devices that focus on the usability of the navigation and interface design also appear (e.g. Smailagic and Siewiorek 1999; Kjeldskov and Stage 2003).

The layout and navigation structure of (mobile) websites can be examined in usage studios. The concept behind a session is to "stress that customers and technology-providers jointly explore the possibilities and constraints of a technology using of simulation (hands-on experience) and developing scenarios"[1]. The session is a participative evaluation process in which the users actively participate in evaluating and defining usability problems. The scope of an evaluation may range from direct evaluation of human-computer interaction to evaluation of all aspects of the service influencing the perception of the user.

6.3 Feedback of expert session

Based on all the aforementioned theories and practices we developed ideas for service design approaches. We held an expert session to improve our mobile information services design approach ideas. We had this session in July 2002 with seven people: two researchers, in business engineering and in strategic network creation, two persons with a combined research/telecommunication industry background, two persons from the

[1] www.witlab.nl last accessed 12 October 2004.

telecommunication industry and one consultant who is a specialist in networking. The set-up of the session was as follows.

- Introduction.
- Exercise to get familiar with the electronic system that used to support the session.
- Brainstorming on question: 'What activities do you have to do if you want to develop a mobile information service?' There were already some predefined steps and the participants commented on these and added new activities.
- Categorise activities; the activities had to be positioned in customer, technology, or organisation.
- Scenario 1; the participants had to consider an operator driven scenario and had to make changes in the activities. This scenario was described as a closed market place with monopolies and oligopolies and stable value chains.
- Scenario 2; the participants were asked to determine the changes required for an intermediary driven market situation. This is characterised by an open market place, dynamic cooperative network and a lot of small companies.
- Evaluation of the session.

Interesting outcomes of this session were:

User formula:

- The target group is the starting point and leading principle for the whole design process. You cannot specify service requirements without knowing your target group.
- You should investigate the market need at every step; the closer to the market introduction the lesser the uncertainty and the better the predictability.
- Focus your tests on user experiences.

Technology:

- The problem with advanced technologies is that there are many 'promises' and only a few 'realities'.
- Estimate the technology gap, the difference between the market demand and the available technology.
- Consider the technical architecture as given. In the operator-driven approach proprietary technology might be an advantage since the operator can control the value chain and raise barriers for new entrants.

Organisation:

- Determine the ambitions of the possible stakeholders and look at how they can add value to a concept. Analyse in the beginning what you can do on your own and what you want to be done by others. Keep controlling the partner choice during the whole process. In the operator-driven approach: choose for large suppliers for economy of scale advantages and standardisation reasons.

- Content providers are not only profit organisations they are also communities of people. A large company could approach the ten largest content providers and the rest will come to you.
- In the first phases of the project contracts with partners are not necessary. Trust is more important. Letters of intention might express this. You should establish the power structure on a meta level. Determine the governance model and the rules of engagement. Be a director. This is different in the operator-driven approach and the intermediary-driven approach. Create lock-ins between suppliers and operator in the operator driven approach. Make special deals per partner regarding each actor's interest.
- Do not forget to equip your own organisation; the presented approach seems only dealing with the inter-organisational issues.

Design method:

- The strategy of the firm and its mission determine the service development strategy. This is different for large firms and small and medium sized companies.
- The design process should not be linear but rather iterative or incremental. A phase should end with a goal. Every phase should contain loops that can be linked with other phases.
- Be careful with investigating best practises and worst practises. This leads to incremental thinking and in the beginning you want to think lateral, broadly. In the operator approach best practices will be focused internally.
- Make continual cost and benefit updates and adjust these if necessary. This might lead to the decision to stop.
- Have a party with all the involved actors this is important to build relationships. This is even more important at the beginning of the project, as a kick-off, than at the end.
- Make a contingency plan for the rollout.

This input from business practitioners and researchers will be processed in the prescriptive design approach.

6.4 Requirements for the design approach

In the last section of this chapter we abstract from our findings in the literature, case studies and the expert session and derive a descriptive conceptual model. We provide this below in the form of an overview of the requirements for the 'ways of' framework elements. This is completed with elements that we chose from the existing design approaches in the literature, see Table 4-2, and which we think are useful for mobile information service oriented system design considering the lessons we have learned from our case studies.

- Way of thinking: a mobile information service system should be assembled by the components service formula, enabling technology and a network organisation.

  - CBSE: approach mobile information service design as incremental change *with* radical change. The design of mobile information services should be considered as designing a complex system with resource interdependencies and constraints that have to taken into account when creating the network organisation. Build further on robust components to prevent the introduction of services like WAP with limited usability due to technological characteristic.
  - Process management: a network perspective should be taken in both the exploration and exploitation phase. It is important to incorporate dynamics and creating a network organisation, an ecosystem, can do that.
  - Product design: reducing complexity, making explicit specifications at the start and establishing balanced design choices are important. Start with customers' wants and needs focussing on delivering value to a target group.

- Way of controlling: the design process should be managed as a project, although process management elements are also needed to commit participants and create an inspiring environment. During the exploitation phase governance mechanisms are needed to support the business models in the value network.
  - CBSE: the collaboration of actors is very important. The control of this collaboration differs in the exploration and exploitation phase considering the different features of the network organisations, see Table 4-1.
  - Process management: use agreements, meetings and negotiations aiming towards the creation of win-win situations, trust is important in the exploration phase and contracts in the exploitation phase. Reducing uncertainty is possible using established relational ties when creating the value network. Prevent publicity for first negative impressions.
  - Product design: use a project management approach with interdisciplinary teams where the different roles with their skills are represented like creative content developers, innovative application builders and structured operators.

- Way of working: phases in the design approach can be distinguished. A combination of radical thinking, structured tasks and an evolutionary approach is recommended.
  - CBSE: use an incremental and structured work method for example a spiral model as introduced by Boehm (1988). Make testing an integral part of an iterative cycle, i.e. technological testing and user tests aimed on offering added value and usability.

  - Process management: openness and integrity, e.g. same shared revenue model for all content providers as in the iMode services, are important. Use incentives for continuation like learning and reputation in the exploration phase and revenues in the exploitation phase.
  - Product design: manage the design project in phases e.g. analysis, preparation, synthesis, implementation and test.

- Way of modelling: in the design process models help us to describe and visualise what is meant. This can be used to support communication between designers and in test settings with users.
  - CBSE: conceptual modelling of the value networks is helpful to get an overview of the network's actors and roles. Use object oriented dynamic modelling for the applications. ThinkLets are helpful to model group sessions.
  - Process management: if situations with conflicts of interest arise it can be considered to use gaming as a way of modelling.
  - Product design: useful ways of modelling are scenarios, storyboards, prototypes and emulation such as a WAP toolkit.

- Support: during the design process we need support to facilitate the design process. These supporting tools vary from a simple pencil to advanced usability laboratories and Group Support Systems for user elicitation and supplier negotiation.

The above forms the basis for our theory formulation presented in next chapter.

7 Mobile Information Service System Design approach

An approach for designing mobile information services is provided in this chapter. The approach is based on the 'ways of' framework. The way of thinking is used to provide guidelines that can be used as leading principles for the design activities. The ways of working, controlling and modelling consist of these design activities. The activities are divided into the phases analysis, preparation, synthesis, implementation and test. The triad value network, enabling technology and service formula is taken into account in each of these phases.

7.1 The framework

In Chapter 4 we showed that the 'ways of' framework can be used to help us analyse design approaches. Chapter 6 ended with an overview with the requirements for the design approach organised along the 'ways of' framework. In this chapter we will use this framework to describe a design approach for mobile information service systems. First, we repeat the definition of mobile information service systems given in subsection 6.1.1.

Mobile information service systems:

- a group of components that work together
- to deliver (a series of) activities of an intangible nature
- when the customer is mobile and a mobile telecommunications network supports the interactions through an Internet channel between customers and service employees, or systems of a service provider
- which are provided as solutions to customer problems

An overview of the design approach for mobile information service systems based on the 'ways of' framework, the literature review, case study experiences and expert session as abstracted in Section 6.4 is provided in Figure 7-1. The yellow parts are related to the value network; the blue parts to the service formula and the red parts to the technology. The light bulb is used to express an idea that might come from radical thinking and that starts the design process.

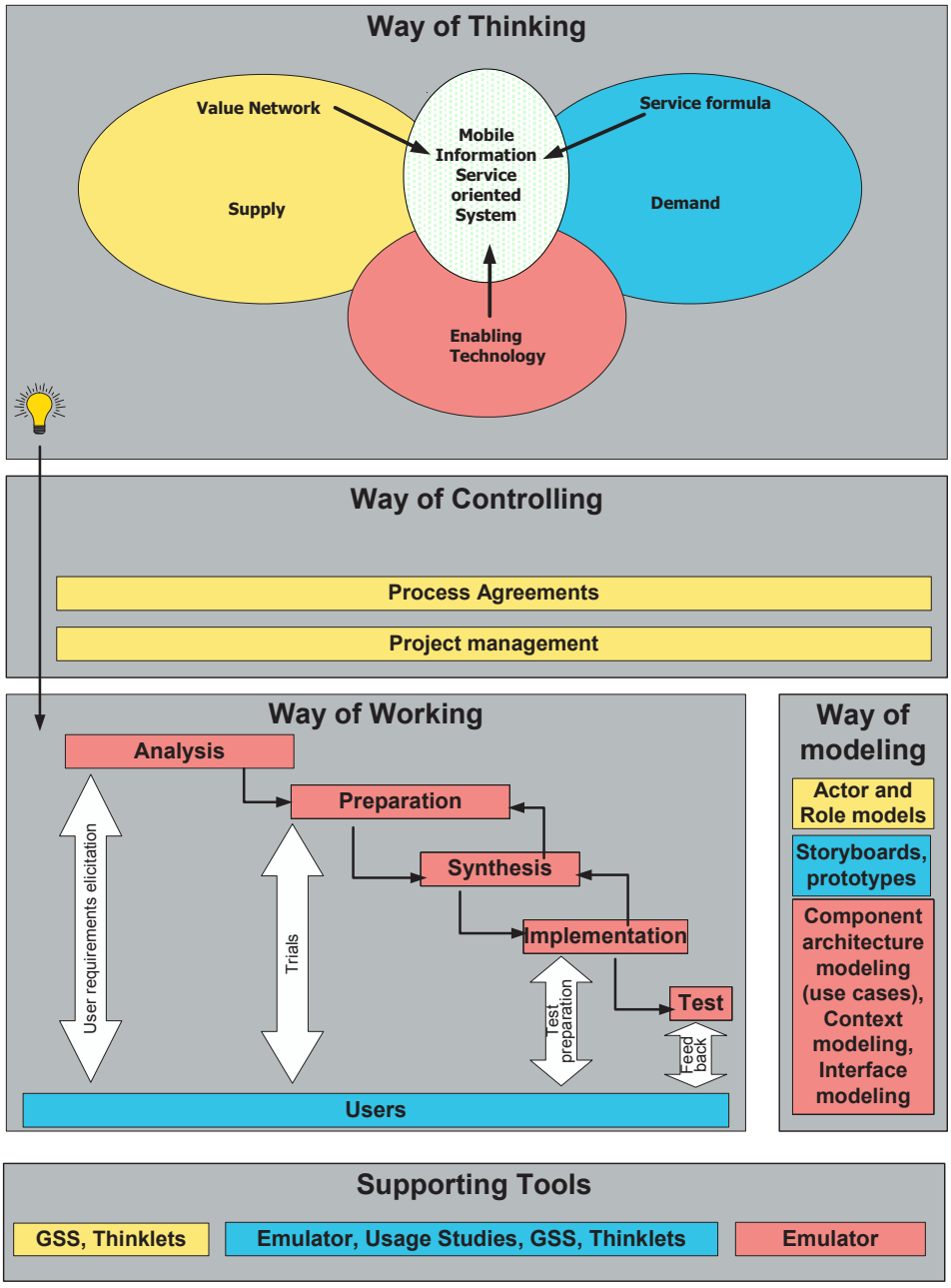


Figure 7-1 An overview of the design approach for mobile information service systems

This design approach will be further explained in the next sections. The 'way of thinking' which includes the formulation of design guidelines is discussed in Section 7.2. The ways of

working, controlling, and modelling are combined in Section 7.3 to give a kind of manual in which models and tools are combined. Suggestions for tools are listed in Appendix B.

7.2 The way of thinking

Mobile Information Services result from combining enabling technology, a service formula demanded by users and this service being supplied by a network organisation. This model was introduced in Chapter 1, in this chapter we refine the model using knowledge gained from available literature, case studies and expert sessions, see Figure 7-2 .

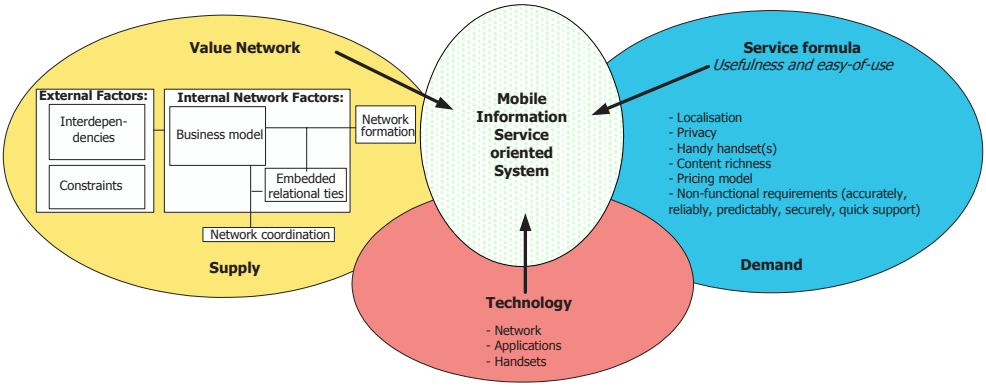


Figure 7-2 Way of thinking

The focus of the research presented in this thesis is network creation and the coordination of the activities that take place between actors in the value network. We can only study this by taking into account the service formula and enabling technology, and there are areas of trade-off between all three elements. The first trade-off concerns the service formula and the technology: 'How can we get the enabling technology to support a service that fulfils the demand of the users?' The second trade-off concerns the technology and value network 'How can we get a value network in place to provide the necessary technology?' The third trade-off concerns the value network and the service formula 'How can we create a network of actors and coordinate the activities of these different actors to deliver value to the user?' We consider the value network of actors to be most important for reaching the objective and thus we will focus on this. Maitland et al. (2003a; referring to Hite and Hesterly 2001 and Gulati, Nohria et al. 2000 among others) argue that research on network formation posits that a range of factors, exogenous and endogenous to the network drive the formation. This is related to trends in organisational forms and economic change. In particular, high environmental uncertainty, changes in the transaction atmosphere, i.e. technological progress, etc., and market entry barriers due to lack of capital or know-how may all lead firms to seek partners (Wigand et al. 1997). These forces in turn lead to interdependencies, a key driver for network formation (Gulati and Garguilo 1999). In this

research we use a model in which interdependencies drive the development of a business model, which is defined by actors & roles, by the benefits for the actors, the architecture of the service and the revenue model (Timmers 1998). The interdependencies among firms in the mobile information services sector have two facets: resource interdependencies and financial interdependencies. The resource interdependencies concern the assets of the company: mainly technology, content and marketing & distribution. Furthermore there are the constraints of time pressure and uncertainty in demand and value. These factors are summarised in Figure 7-3 . The arrows between factors mean that the one factor drives the factor that the arrow points to.

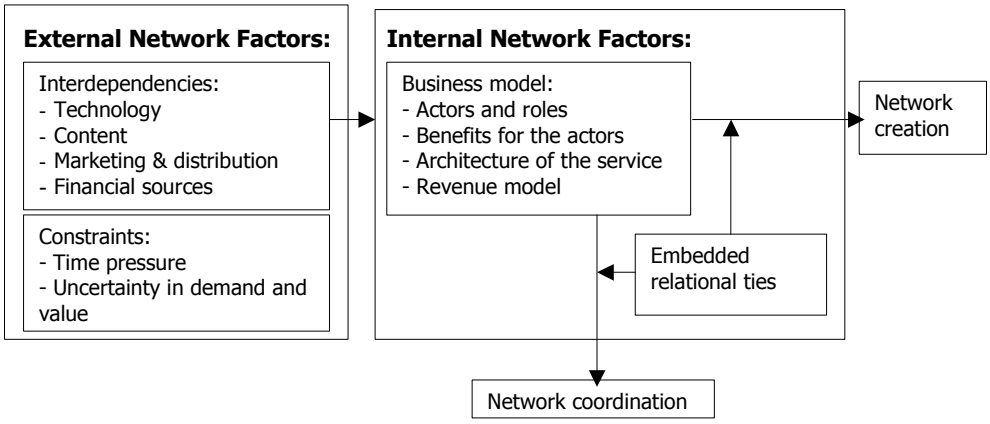


Figure 7-3 Influence of external and internal network factors on network creation and coordination (based on Maitland, Van de Kar, Wehn de Montalvo 2003a)

We explain the interdependencies 'technology', 'content', 'financial sources' and constraint 'time pressure' in subsection 7.2.2 where we look at the trade-off between technology and value network. This is followed by subsection 7.2.3 on the trade-off between value network and service formula. There we discuss the other interdependency 'marketing & distribution' and the constraint 'uncertainty in demand and value'. We discuss the internal network factors in subsection 7.2.4. We start with the trade-off between the service formula and technology.

7.2.1 Trade-off between Service Formula and Technology

Reaching service quality is complicated due to unclear user requirements, fast developing technology and a large number of involved stakeholders. Here we look at the trade-off between the first two causes. These trade-offs become visible in the following aspects of the value proposition: localisation, privacy, handy handsets, content richness, and the pricing model. Besides these service outcome quality aspects also the service process quality dimensions are also important, see Chapter 2. We gather them here and present them as non-functional requirements.

- **Localisation.** One of the big advantages of mobile services is that they can be adapted to the setting of the user. You can use mobile services anywhere, anytime, real time and with these services you can find your location and locate other persons, locations and machines. This has given rise to many service concept ideas (see table 2-2). The technology to enable localisation is available but it either does not offer the demanded quality (as in the Finder case) or it has not been introduced on the market. Adoption likelihood is sensitive to critical mass and anticipation of future network size (Shapiro and Varian 1999). A certain mass of users is necessary to exploit successfully LBMS like e.g. 'friend finder' services. The technology should enable easy-to-use mobile services according to the context of a user. The context of a user consists of an unlimited number of variables and the 'right' variable need to be identified (Carlsson 2003). Localisation should be an integral part of context aware services. The development of context aware services is in its early days and there are many technological related and customer behaviour issues that need to be further explored. One of them is privacy.
- **Privacy.** Privacy sensitivity is context dependent and changes according to the intensity of media reaction and focus on specific "cases" (Ng-Kruelle et al. 2003). In the interviews for the location-based service Finder we discussed the privacy issues with the interviewed manager. The managers mentioned that customers should have the option to be not positioned and that customers should not be damaged or harmed by their position becoming known against their wished. Location privacy is explicitly mandated In the Directive on Privacy and Electronic Communication (DPEC) of the European Union. The article requires that "location data may only be used with the consent of the subscriber while ensuring users are given a simple means to temporarily deny processing of their location data. The only exceptions to this are the use of location data for emergency services, public and national security, and criminal investigations".[1] Technology should be ready to enable users to change their settings temporarily.
- **Handy handsets.** In the conclusion of Chapter 5 we stated that a critical mass is needed to create network effects and to achieve economy of scales. To create a mass market suppliers have to offer a variety of different handsets and content styled for different target groups. In the early phase of a product life cycle a customer's critical determinant of choice is price, availability and quality; beyond this customers determine value when they have a wide range of choice (Keen and Macintosh 2001). So, mobile services will be a mass-market product if they become fashionable and customers are able to choose the devices and services that fit to their lifestyles. Mobile information

[1] DIRECTIVE 2002/58/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications) http://europa.eu.int/eur-lex/pri/en/oj/dat/2002/l_201/l_20120020731en00370047.pdf last accessed 12 October 2004.

service will be popular if customers have a variety of 'trendy' handsets they can choose from. To reach this a certain degree of standardisation is necessary, and the standardised WAP versus the 'proprietary' i-mode is an issue. Furthermore, the installed base of handsets already in the market may hamper the use of services that require the newest technology.

- **Content richness.** A mobile information service can only be context aware if there is enough right content. In this regard, however, it is also important to manage the expectations of the customer. The *Mobile* Internet is not the Mobile *Internet*. The richness of the content on Internet is just not available on the mobile phone. Of course, it is not desirable that the complete content on the Internet is available on the mobile. People on the move do not want to read large documents on a mobile device. The mobile feature means that rich content should be available that is adapted to the context of the user.
- **Pricing model.** Pricing is a reflection of user value. Pricing is not only about 'how much' it costs; it is also about the price structure. We will not go into acceptable price levels for mobile services since this is always debatable and will be decided in the market. However, the pricing model (structure) should be part of the design process. Decisions have to be made regarding paying per minute or per data package and paying per subscription or per use. The option to pay per minute or data is also dependent on the chosen technology. The call to provide price transparency for customers has not yet been met.
- **Non-functional requirements.** The trade-off between the service formula an technology is manifest in the non-functional requirements. The M-info case showed that the technology behind the service should offer the technology necessary to offer the promised value to the user. The user's opinion was that the start-up took *too much time* and that it was too *difficult* to accomplish simple tasks. The poor *security* around WAP was more an issue mentioned by experts than users but this did, of course, influence public opinion. The Finder case showed that a service has to be sufficiently accurate. The impression we got from the market reaction is that the service is not sufficiently *easy-to-use* and *accurate*.

The creation of the network organisation has to control the trade-off between the service formula and technology. We look at the trade-offs between the value network and these two elements in the following two subsections. In these subsections we will also provide guidelines for our design process since the actors in the value network have to deal with the trade-offs, including the service formula – technology trade-off, and because value network creation and coordination is the focus of this research. The guidelines are denoted V1 to V10 using the letter V from Value network.

7.2.2 Trade-off between Technology and Value Network

Fast developing technology is present in all layers involved in producing mobile information services. The layers between the mobile service and the user are the content, servers, content platform area, gateways, networks and clients (Natsuno 2003). Each of these layers has it's own industry participants and together they produce mobile information services. In the last few years new technology in all the layers enabling new services have came onto the market. Improved technology with regard to the client and the network has had the most impact on service development. On the *client* side new phones have appeared and continue to do so, that are smaller and lighter and have colour displays, built-in cameras, sound chips for playing polyphonic ringtones, wireless connectivity to other devices, and software to connect the device to the Internet. The *network* has evolved, from analogue, to GSM, HSCSD, GPRS, EDGE, and UMTS, and now provides the user with higher transmission speeds and shorter downloading times. To profit fully from the capabilities the client side and network offer, the *gateways*, *content platforms,* and *servers* also have to evolve. If the various firms involved in this process manage to cooperate, the new technology will enable new services that will be adopted by users.

Technology interdependencies

The technical architecture consists of the software, hardware, and netware that enable a service to be delivered. The need for the flexible creation of a value network puts a large demand on the supporting technical systems. New services and processes for service provisioning should be created using a pool of existing and new components and web-services. Openness of the standards used for this is key in being able to couple various services. A radical innovation might originate from a new technology. However, as required in subsection 6.4, before the service design process starts complexity has to be reduced and the specification should be made explicit. The service should be assembled from robust components. This will prevent problems as occurred in the first WAP services.

Technical resource interdependencies are defined by the service requirements; existing technology often does not answer the customer's demands for a useful and easy-to-use service. The technology interdependencies are extensive; companies have to cooperate to make a service work technically, and such technological interdependencies require a new form of coordination where a proven service IT architecture leads the various applications and content providers in the value network.

→ Guideline V1: actors in the network can only start to design applications if a proven service IT architecture is provided by the leading actor as basis for the various applications.

This guideline applies for both the exploration and the exploitation phase but is especially important if actors start to work on the exploitation phase.

Content interdependencies

The ability of mobile networks to deliver content to customers via mobile handsets has created a demand for content from network operators. However, the skills or human assets of media firms, also referred to as content providers, are not present in the operator's organisation. At the start of the (mobile) Internet it was speculated that operators might try to develop this expertise in-house but time has proven that this model is not sustainable. Operators need the knowledge of content providers like media firms, as these organisations understand the market segments, therefore the cooperation of KPN Mobile with Radio 538 worked out well to reach a target group of people from 12-30 years. Thus, mobile network operators and content providers are mutually dependent in their goal to create demand for mobile information services. It is one of our requirements to create a network which functions like an ecosystem with complementary skills. The interdependency goes beyond the mobile network operator and the content providers. Since delivering content to customers is key to mobile information services, all actors that have a relationship with the user are dependent of the content provider, and vice versa: the content provider, mobile network operator and the service provider are interdependent.

→ Guideline V2: the Service Provider, Mobile Network Operator and Content Provider are the triad that forms the core of the value network.

The 'core' of the network means that the mentioned actors are in the heart of the network organisation, this is especially the case during the exploitation phase.

Financial sources interdependency

In Chapter 3 we stated that 'economic growth' uncertainty is a very relevant issue. High investments have to be made upfront in the mobile services design process. There are big differences in the time required to develop new network technologies and services. The innovation cycle for radio network technologies is about 10 years, for applications it is several years and for services about 1 year[1]. The involved actors, like the operators, application developers and content providers, have to invest in the technology necessary to deliver their contribution to customer value. On the one hand this means that the risk is spread between different players but on the other hand it means that the different players are dependent on each other; and this is further complicated by the different innovation cycle periods. The revenue models will often not be established at the time investments have to be made. In the Finder case study we saw that the operator paid the application developer beforehand for the development of the application. However, this was an exception and later the shared revenue model was introduced as used for all iMode services. A consequence of financial resources interdependency for the design approach is that risk analyses have to be made by the actors during the development process, for example as done in Boehm's spiral model (see subsection 4.3.2).

[1] Presentation of Mobitel; 22 June 2004; Bled Slovenia.

Constraint: Competitive & time-to-market pressures

The mobile industry in general faces a number of competitive pressures. The new technology faces competition from other wireless technologies. This means that firms must get services to market quickly to forestall the potential that the technology in which they have invested heavily is bypassed. This pressure is either compounded by or mediated by a firm's general innovation strategy, whether it prefers to develop first-mover advantages or to observe and enter a market later. There are also time pressures related to network rollout requirements that governments place on network operators when granting a license. Although not a direct mandate to cooperate, deadlines for a network rollout often do not allow an operator the time to develop all of the competencies in-house and thus firms are forced to turn to cooperative relationships to procure services. However, the increasing involvement of companies outside the traditional (mobile) telecommunication industry creates longer timeframes for establishing cooperative relations. Thus, despite the increased time-to-market pressure, the development of innovative services across traditional industries takes time. It takes time to establish cooperative relations. Yet time pressure is the case when attempting to get a first-mover advantage in the upcoming UMTS competitive market. The process management elements mentioned in subsection 4.4 are helpful here. As mentioned in subsection 6.4, incorporating dynamics is required when creating the network.

→ Guideline V3: take your time to establish a value network and speed up the development process when that is in place.

This guideline expresses the transition of the exploration phase into the exploitation phase. In the exploration phase it takes time to establish a network organisation in which to fulfil the requirements to create speed in the value network as formulated in subsection 6.1.2. If this is in place, the other design activities in the exploration phase and subsequently in the exploitation phase can continue.

7.2.3 Trade-off between Value Network and Service Formula

The partners in the value network have to agree on the service formula, the differentiating value proposition offered to the customer. The service formula is determined by dominant actors' decisions along the dimensions of their business models (after Pedersen and Methlie 2004). Together they have to decide on the value proposition and this can only be based on their perception of the customer's expectations[1]. These expectations are based on the customer's perception on the key benefits offered by mobility as communication features,

[1] Grönroos (2000) explains the conceptual model service quality of Zeithalm et al. In this model gaps are shown between (1) customer's expected service and marketer's perception of customer expectations; (2) marketer's perception of customer expectations and the translation of these perceptions into service quality specs; (3) translation of these perceptions into service quality specs and actual service delivery; (4) service delivery and external communication to customers and (5) the customer's perceived service and expected service. This is even more complicated in the situation of mobile information services when marketer's from more than one organisation are involved!

flexibility, new dimensions of communication, and more effective use of time (see Section 2.4 referring to Anckar et al. 2003). What the demand of these uncertain values will be is also uncertain. We discuss this constraint below as well as the marketing and distribution interdependencies. Marketing is crucial for handling the perceived customer value.

Constraint: uncertainty in demand and value

The uncertainty in demand causes anxiety levels to rise as it occurs at times when operators are under financial strain. We already concluded in Chapter 3 that the design approach should include elicitation of user requirements and have user's test prototypes. The market failure of the M-info service, which was not extensively tested by potential users, confirms this. Users cannot be regarded as one big amorphous group. First, different target groups have to be distinguished and representatives of these target groups have to be involved in the design approach. In Section 6.4 we concluded that starting the design process with customers' wants and needs in mind and focussing on delivering value to the target group is one of the requirements of our design approach.

→ Guideline V4: the targeted user has to be part of the design approach in all phases of the design process.

→ Guideline V5: the design approach has to start with the investigation of the targeted user's context, wants and needs.

We argue that the targeted user has to be involved as much as possible during the design process in the exploration and the exploitation phase. However, this does not mean that experts only do what users tell them to do. The experts have to be creative and hopefully come with great ideas and designs. The designers need to have knowledge of the performance of the available technology. Involving the users means that designers can have their ideas tested by users in several phases of the design process. We will elaborate on how to do this in the way of working.

Marketing and distribution interdependencies

The company that has a billing relationship with a customer is often considered to be the 'owner of the customer'. This owner takes care of customer relationship management. The operators almost always have the billing relationship in the case of mobile information services. This makes the other actors in the network dependent on the operator. The operator can decide to do the marketing and branding together with the content provider, for example as in the Radio 538 ringtune iMode service case. The operator has the power to decide. This is different if an independent service provider has the relationship with the customer. A service provider might decide to keep the brand of the operator hidden. They can start their own marketing campaign or join with a distributor with a known reputation in the targeted customer market, e.g. a supermarket. Another example is the marketing and distribution of a mobile service packaged with a holiday or conference offer.

7.2.4 The internal network factors

What drives firms to form interorganisational ties? People and firms need outside sources of cognition and competence to complement their own. That is the fundamental reason why inter-firm linkages are important, especially for innovation (Nooteboom 1999). Companies cooperate because they lack certain resources in their own company. This is related to the business model for the service that is the object to be delivered on the market. We consider the business model at the level of the service network and not at a one-company level.

A variety of business models are used in the provision of mobile services the role divisions vary, the revenue models differ and the benefits or value for being part of the network differ for each involved actor. Maitland et al. (2003a) have made a standard list of roles for actors involved in mobile information services based on case studies among which the iMode services presented in Chapter 5; see Table 7-1.

Table 7-1 Roles (Maitland, Van de Kar and Wehn de Montalvo 2003a)

Roles	Explanation
Functionality related roles	
Service provider	Provides billable service to the end consumer
Network operator	Operates the mobile telecommunications network over which the data (service) is transmitted
Platform provider	Provides the software that defines the general platform on which a variety of services are run
Application provider	Provides the software that makes a service possible and that sits on top of the platform
Web hosting/presence provider	Operates and maintains the server that hosts a website that is an integral part of the service, particularly relevant to the further development of content
Content supply chain roles	
Raw content supplier	Supplies content in a format unusable for the mobile service & terminal
Content developer	Transforms raw content into content appropriate for the service and the mobile terminal
Content provider	Provides 'appropriate'/transformed content to the service provider
Content aggregator	Serves as an intermediary between the service provider and the content providers
Hardware roles	
Equipment provider	Provides the hardware, physical components of network
Handset supplier	Supplies platform or service-specific handsets

Customer relation roles	
Billing provider	Provides billing services to collect revenues from end consumers
Marketing provider	Markets the service
Customer support provider	Point of contact for customer queries regarding the service; responds to customer queries
Content quality manager	Monitors and improves content quality
LBS roles	
Content geo-coding provider	Adds x/y coordinates to the content
User positioning	Provides the position information of the mobile device
Positioning technology vendor	Supplies user positioning equipment
GIS provider	Provides geographical information, and GIS services, necessary to indicate location information of relevant content

Which roles have to be fulfilled depends on the kind of mobile information service. For example, the LBS roles are only relevant for location-based mobile services. So it depends on the kind of service which role has to be fulfilled. This counts for both the exploration and exploitation phase.

→ Guideline V6: at the start of the project the role list must be checked and it must be decided which roles have to be performed and which actor(s) will fulfil which role.

The case studies show that the revenue flows between the actors are often based on the roles. E.g. the role of providing the user positioning is rewarded with 30 cents per month per user in the Finder case. The role of billing provider is worth 14% of the monthly subscription fee in the iMode cases. The role division can be used to determine the revenue flows.

An important aspect of value is the *value of network membership* to each of its members. In the M-info case, KPN Mobile wanted to be the first mobile operator that launched a WAP service on the Dutch market to show an innovative image. In the Radio 538 ringtune iMode service case, Radio 538 was drawn to participate simply to be involved in an innovative undertaking to support their image. For non-operator actors particularly the revenues that are generated do not appear to be large and hence such actors are likely to be placing strategic goals ahead of financial ones. For some, being affiliated with large operators lends prestige to their portfolios and may provide a basis for eventually offering services to other operators, this happened for example with Tutch in the Radio 538 ringtune case.

→ Guideline V7: take into consideration when creating a value network that the purpose of network membership and working with partners in an innovative undertaking is not to generate revenue.

→ Guideline V8: take into consideration when creating a value network that the value of network membership and working with partners with an established reputation in an innovative undertaking is that it supports a firm's image.

These guidelines are more applicable in the exploration phase than in the exploitation phase. However we like to stress again that the boundaries between these phases are not sharp. Another strategic reason to be part of a network organisation, mentioned in the conclusions of Chapter 5, is to learn and to achieve a competitive advantage.

→ Guideline V9: take into consideration when creating a value network that the value of network membership in an innovative undertaking is to learn and to achieve a competitive advantage.

This guideline applies in the exploration and exploitation phase. The partners will learn in the exploration phase from user tests and in the exploitation phase from market reactions.

The effects of embedded relationships and social ties on firm relations are well known (Granovetter 1985; Uzzi 1996). A way to reduce uncertainty when creating the value network is to collaborate with companies with whom the company or managers have former good relationships. This is also one of the requirements in subsection 6.4.

→ Guideline V10: reduce uncertainty by using embedded relational ties when creating a value network.

All these internal and external factors influence the creation of the network and the coordination within the network.

7.3 Ways of controlling, working and modelling

The guidelines listed in Section 7.2 outline the way of working, controlling and modelling. These 'ways' consist of design activities. These design activities are divided into phases, as required in Section 6.4, i.e. Analysis, Preparation, Synthesis, Implementation and Test. In each of these phases we have to deal with the trade-offs between the value network and the service formula, the value network and the technology and service formula and technology (see introduction of Section 7.2). Since we are dealing with a multi-actor environment it is important to pay attention to process management. It is necessary to explore the opportunities with the commissioning parties, scan their agenda's, share dilemmas, fix a common agenda and establish the rules of the game (see Section 4.4 referring to De Bruijn et al. 2002). As stated as a conclusion for the way of controlling in Chapter 6, the whole design process can be managed as a project combined with the process management elements. Risk assessment is also one of the process management issues regarding the financial interdependencies mentioned in subsection 7.2.1. The way of working covers the tasks that have to be carried out in the design process. This block might be regarded as the third quadrant of Boehm's spiral model (see subsection 4.3.2 referring to

Boehm 1988). Elements of the waterfall model can be recognised but evolutionary elements also play a part since many feedback loops are present; see Figure 7-1.

The project and process management activities, i.e. way of controlling, are related to the value network; and the design activities, i.e. way of working, are related to the service formula and enabling technology. The deliverables of each design element in each phase are described in Table 7-2.

Table 7-2 Deliverables per phase

Element: **Phase:**	**Value network**	**Enabling Technology**	**Service Formula**
Analysis	Letters of intention	Overview technical options	Rough service description
Preparation	Network creation	Functional and technical design	Detailed service description
Synthesis	Work procedures	Prototype	Communication formula
Implementation	Established relationships and processes	Operational	Launched for usage
Test	Evaluation	Evaluation	Evaluation

We describe the design activities per phase below. The activities are visualised in diagrams for each phase. We number the design activities with first the letter of the phase followed by the letter of the element and at the end the number of the activity in this combination. A timeline is drawn on the left side of the diagrams, for example M1 is Month 1. This has to be read as an indication since this might change depending on sense of urgency, number of resources, unexpected incidents and other variables. Models are mentioned if recommended for an activity in the activity description. An overview of the tools that can be used in the design activities is provided in Appendix B.

The 'APSIT' method described below for mobile information services can be used as a starting design approach. Activities can be added in each of the phases depending on the project specific circumstances. It is important that the triad 'value network, technology and service formula' is always taken into account. The deliverables mentioned in Table 7-2 are also mentioned as the deliverables in Figures 7-4 to 7-7. The exact form of these deliverables depends on the project specific circumstances. It is important to decide on the start of a project what the form and content of the deliverables will be.

7.3.1 Analysis

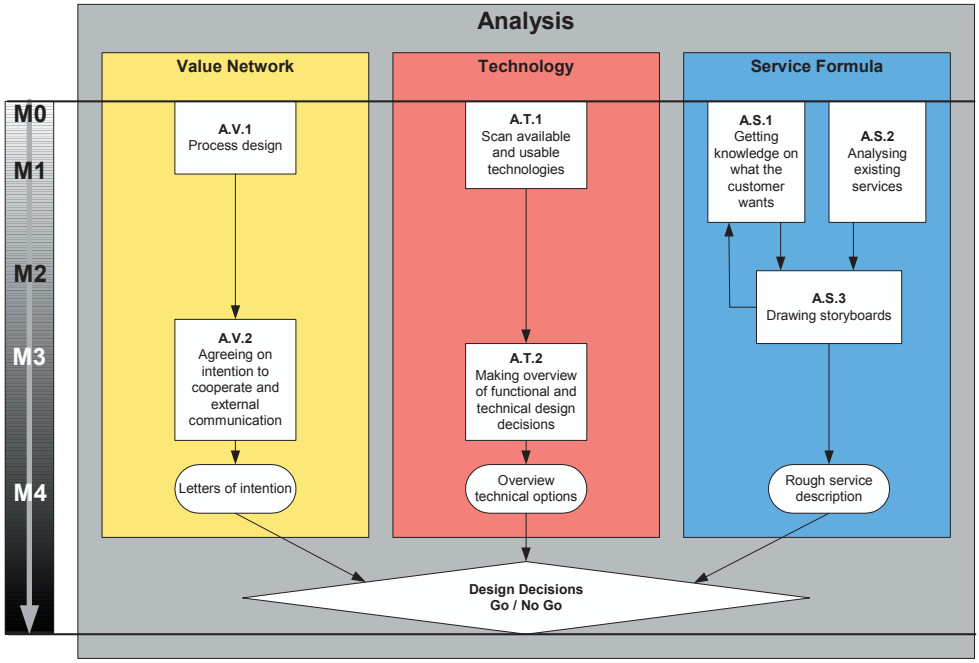


Figure 7-4 Analysis

A.V.1 Process design

First, the process for forming the network of actors has to be run through. It is important to incorporate dynamics in this process and to do this carefully (guideline V3). The creating of the value network can be done by executing the following sub activities (based on De Bruijn et al. 2002).

- Exploring the problem; although the process involves several actors, the start of the process will be the concern of one actor or a limited number of actors. If there is a vague idea of the service that will be designed it is time to investigate the available actors that are in the market and willing to participate in the project. The initiator will first discuss the idea with actors that it knows and trusts (guideline V10).
- Actor scans; it takes quite some time to figure out what kinds of expertise will be needed and with what actors 'it clicks'. Since the service provider, operator and content provider will form the core of the network they have to be scanned (guideline V2). In innovation projects the drivers for firms to participate are to support the firm's image, to learn and to achieve a competitive advantage (guidelines V8 and V9). Therefore it is interesting to approach firms for which the above count. The table of roles (Table 7-1) can be used as a checklist to figure out whether the necessary roles are fulfilled.

- Quick scan of configurations; there might be conflicting views held by actors that the initiator has to deal with. The initiator can nominate a process architect to deal with this when the initiator has too great a part of the process. The conflicts should be formulated as dilemmas where possible, as framing a conflict as a dilemma has positive effects on the process (De Bruijn 2002).
- Process dilemmas and fixing the rules of the game. The initiator has to make sure that the dilemmas are solvable to an extent that they will not hinder the result. Dilemmas in the exploitation phase might be centred on the revenue model. Is revenue sharing an option if the result is an uncertainty? If the initiator is a large company the situation is different from that where the initiator is a small and medium sized enterprise (SME). In the first case, the initiator might speed up the process by having a governance model in place, like used for iMode. However, this might hinder open cooperation.

When it becomes clear what the network will look like agreements have to be made regarding entry and exit rules, decision-making rules and project management issues such as the organisation of the project, i.e. chairman, steering committee, workgroups, secretariat and the planning and budget. It is recommended that sufficient time is taken to establish the network as this prevents problems later (guideline V3). The way of modeling can help here with actor and role diagrams. See e.g. Figures 5-7 and 5-11 showing the actor/role diagrams in the Finder and Radio538 ringtune iMode services cases.

A.V.2 Agreement on intention to cooperate and external communication with main actors

At the point that actors express their intention to participation it is necessary, and important in this early phase, to make clear what information is confidential and what can be made public. It is also necessary to agree on which actor is going to communicate what externally, to the press and so on. One of the requirements in Section 6.4 is to prevent negative publicity regarding first reactions. In innovation projects agreements on confidentially and communication have to be made at the start. This activity is related to the process of formulating the storyboards (A.S.3) and the technical and functional design decisions (A.T.2) since the output of these activities are resource and knowledge.

A.T.1 Scan available and usable technologies

It is a time consuming task to figure out a good combination of handsets, applications and the network. The innovation cycle for each of these differ substantially (see Section 2.3 and subsection 7.2.2). As mentioned in guideline V5, the design approach has to start with the targeted user's context. However, since the services are driven by the technology that enables these services, it is necessary to investigate the availability of technologies that are reliable and robust enough to function as an enabler. This also sets the boundaries for how advanced the service will be.

A.T.2 Making an overview of functional and technical design decisions

Between the service and the user is the layered structure of the Internet that consists of the content, servers, content platform, gateways, networks and clients (Natsuno 2003). The details of this structure will be defined in the preparation and synthesis field. However, based on the output of activity A.T.1, the initiator will have ideas regarding which functionalities and technologies it absolutely does not want to use and which it absolutely does want to use. The output is an overview of remaining options to discuss with the other partners when the value network of actors has been formed. Examples are mobile network technology, i.e. GSM, GPRS, UMTS, WLAN or combinations there of, positioning technology, i.e. network-based, satellite-based or hybrid and the application protocols, i.e. WAP, iMode or Java (see Section 2.3).

A.S.1 Getting knowledge on what the customer wants

The design approach starts with deciding which target group to address and then with asking the target group about the problems they want to be solved in a certain circumstance. For this, a Group Support Session is a good supporting environment as described in Section 6.2. We designed a repeatable process for mobile information services' user elicitation that has to be executed at least two times with different groups. These sessions are modelled with thinklets and the supporting tool is Group Support Systems. An overview is presented in Appendix B and the method is described in detail in Den Hengst, Van de Kar and Appelman (2004).

A.S.2 Analysis of existing services

If the initiator has any idea of the offer she or he has to find out whether the offer is readily available from competitors. The business strategy is different if the mobile service proposition is completely new or has some new service features. The service might also be innovative regarding the underlying technology of the target group in relation to context or the business model. For any of these situations it is recommendable to do market research. Reasons for doing market research might include to monitor competitive activities, stay on top of industry events, analyse new business opportunities, or to search out strategic alliance partners (Vassos 1996). The market research will provide insight into the uniqueness of the mobile service idea and might provide ideas for partners and service features. The Internet can be a powerful resource to find out what is going on in the market. The Internet can be used to conduct primary research and to access market research that has already been completed by other organisations or government agencies (see Vassos 1996). As remarked in the expert session (Section 6.3), it is important to take care that the market research and found service ideas do not hinder lateral thinking.

A.S.3 Drawing storyboards

Professionals add their knowledge, expertise and creativity to develop storylines based on the output of the GDR sessions. Model techniques originating from product design theories are helpful here (see use of storyboards in iMode design approach described in the Finder

case study and the requirements in Section 6.4). The terms storyboards, storylines and scripts can be used. The case studies in Chapter 5 showed that the service formula issues to consider are localisation, privacy, content quality and richness, and non-functional requirements. The result of this activity should provide the first ideas for this and these issues have to be further elaborated in next activities. Usage scenarios can be used (see 6.1.4) to model the service in the context of many interactions. Otherwise, storyboards satisfy. Making photographs, describing text and drawing pictures can be used to create storyboards.

7.3.2 Preparation

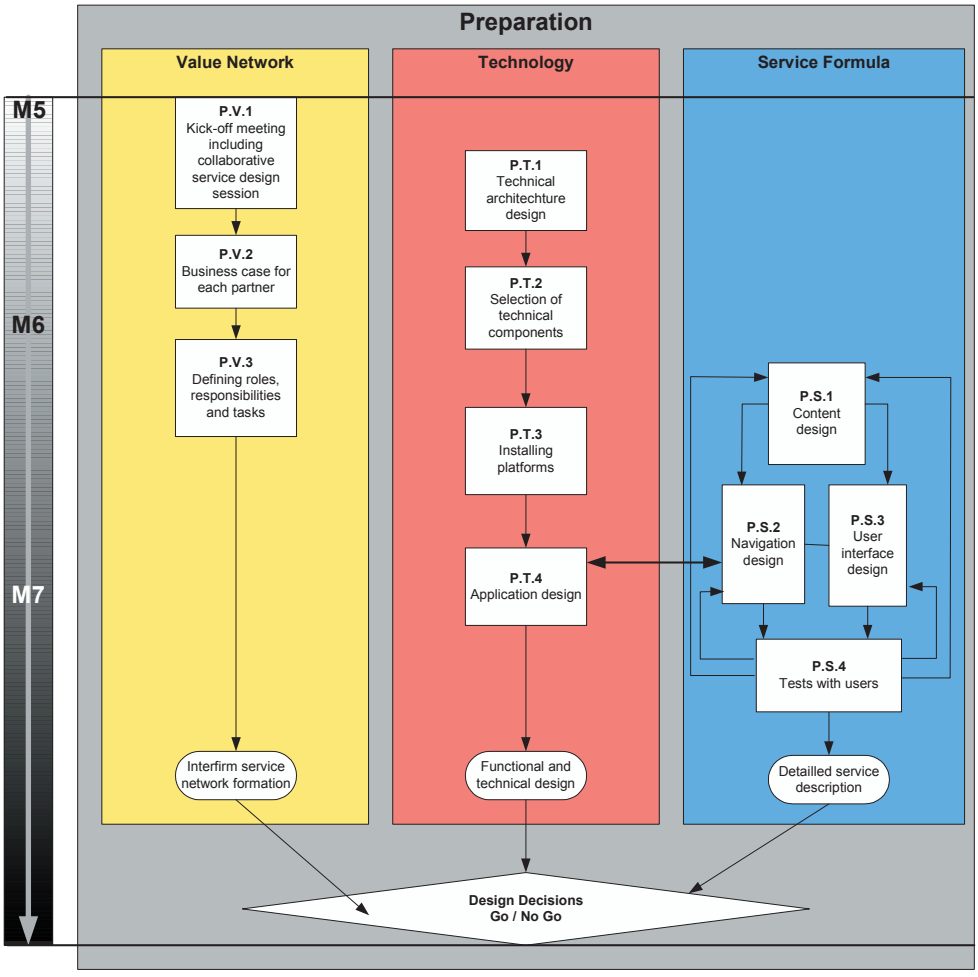


Figure 7-5 Preparation

P.V.1 Collaborative service design session

Once the value network actors are known a kick-of meeting can be organised. This can be combined with a collaborative service design session to deal with the complexity of the information service requirements. One of the objects of this should be to come to a shared vision of what the delivered customer value will be. As stated in Chapter 6, EasyWinWin methodology with GSS can be used for this. An overview of the design of such sessions has been published by Briggs and Gruenbacher (2002).

P.V.2 Business case for the network and for each partner

During the preparation phase the final decisions are made as to which actors are partners in the project. Every partner has to decide: 'What is in it for us?'; 'What risk are we taking?'. Each partner must develop a kind of business case. In the exploration phase especially the partners' benefits are beyond financial figures (guidelines V7,V8,V9). Partners that are enthusiastic about the project have 'to sell' participation within their company; they have to explicate the benefits of participation. Based on Afuah and Tucci (2001); Hedman and Kalling (2003) and Timmers (1998) we suggest the following business model components to use as 'hard' evaluation criteria. Be aware that this is NOT on the level of the individual organisation but on the level of the value network designing the mobile information service.

- Potential benefits: Are the partners strategically interesting? What is the relative benefit of participating in the value network? Is there an advantage for each partner regarding reputation or learning?
- Cost structure and revenue source models: Is there concordance concerning the division of the needed investment and revenue flows? What is the outcome of a risk analysis?
- Connected activities: Do the partners have complementary resources and skills? Is the partnership good for each partner's reputation?
- Scope: What is the scope of the service development purpose? What is the scope of the market to reach?
- Implementation: Which organisational structure, systems and skills are necessary and available to execute the project?
- Capabilities: What are the capabilities of the value network? What are the shortcomings? Can they be overcome?
- Sustainability: Is it hard to imitate the value network? Is there a competitive advantage of the network organisation?

P.V.3 Define roles, responsibilities and tasks

The roles, responsibilities and tasks for the building activities have to be decided in this phase. The checklist in Table 7-1 can be used to check if the roles are covered. During the design process specific design roles like application design have to be fulfilled. It is important to communicate clearly to all project members which actor is expected to fulfil which role (guideline V6). At the same time co-development of the services between

operators, content providers, application developers and handset providers is a must, as shown in Chapter 5. It is not recommended to control this process too strongly during an exploration phase. This is a situation with a network structure that has a high density, limited stability and low centrality; therefore the duration should be limited and the frequency of interaction high (see Section 4.2 referring to Nooteboom and Gilsing 2004).

Process management elements in the way of controlling are required to guarantee speed (see also subsection 6.1.2 referring to De Bruijn 2002):

- the process should create prospects of gain and incentives for cooperative behaviour
- the participants should have commitment power
- the environment should enable the process to be speeded process up
- conflicts should be transferred to the periphery of the process
- command and control should be used as an incentive to speed up the process.

P.T.1 Technical architecture design

The overview of the whole technical architecture has to be designed from a top-down perspective and then filled in. The architecture can be structured into at least three logical layers: the presentation layer, business logic layer and data access layer. Jagoe (2003) presents examples of a simple LBS infrastructure and of a J2EE application server that delivers characteristics that are very useful for building mobile location services.

As presented in subsection 4.3.2 we propose using the component based development (CBD) approach of Brown (2000) to develop the mobile information service system. The three phases of the CBD approach are understand the context, architect the solution and provision the solution. In this APSIT activity we need modelling techniques for architecting the solution. The modelling consists of 'component architecture modeling', where a collection of related components are proposed and redefined, 'context modeling', to understand the scope of the system to be developed, and 'interface modeling', in which the interfaces are described in detail. UML techniques such as use cases, sequence diagrams and component diagram can be used for CBD.

P.T.2 Selection of technical component suppliers

Once the technical architecture has been made the different components have to be chosen. Decisions have to be made as to which components to use and where to get them. What components are in-house and what need to be bought? This has to be discussed and negotiated with possible suppliers. These suppliers might become part of the value network and of the team designing the new mobile information service. Components have to be integrated to deliver mobile information service that take care of the following.

- End-to-end security: as described in subsection 5.2.2 there are still problems with the end-to-end security between the terminal and the server in the WAP model. Depending on the security required for the service formula it might be a problem if end-to-end security is not available.

- Authentication, authorisation and access: one-time password authentication is one of the desired features for mobile phone customers as personalisation further develops (Salonen and Karjalainen 2003). This is not just for security reasons; it is also to facilitate customers by making the use of mobile services easier. As explained in subsection 5.1.3. this requires a high level of coordination between the different players in the mobile field.
- Personalisation and profiling; customer profiles are nothing more than a database of information with defined fields (Hagel and Singer 1999)[1]. A profile system allows you to personalise services. This often raises concern over privacy abuses. One of the challenges in personalisation and profiling is to provide a simple method for users to tell service providers the information they are willing to share, and under which conditions they are willing to share this information (Jogoe 2003).
- Positioning: it must be possible for LBS to look up and pinpoint a user's location. Different technological solutions for this exist, as described in Chapter 2. However, there is still research necessary to find the optimal solution for the consumer market. One of the solutions is Smartzone of Webraska as described In the Finder case study.
- Billing; the billing system will be related to the chosen pricing model. The current billing systems of operators are mostly designed for postpay voice billing, quite straight forward and leave little room for service providers to introduce innovative billing systems. The iMode model is one of the first that gives content providers the opportunity to earn some revenues. Billing systems should be able to handle pre-pay customers, and billing based on number of bytes transferred, URL accessed, application accessed and even quality of service delivered (Jagoe 2003). The first sophistical billing products that provide for this are beginning to appear on the market.

P.T.3 Installing platforms

- It is necessary to choose platforms on which to run mobile services. Kalakota and Robinson (2002) introduce the following four 'breakthrough platforms' for mobile business.
    - Client-side software platform; consisting of operating systems such as Palm, Windows CE and Symbian; and browsers with markup languages like WML, cHTML, GML and other XML variants.
    - Device platforms; like cell or mobile phones, smart phones, handlheld organisers and pagers, specialised industrial handhelds and Pocket PCs like the iPAQ. In the future we might see both single terminals and pervasive terminals, as described in Chapter 3.
    - Hardware platforms; the business-to-business industry with e.g. microprocessor and chipset manufacturers. The major challenge is to

[1] Hagel and Singer (1999) provide a method for the user profiling process; Jogoe (2003) has adapted this for locations based mobile services.

standardise the technology. If the mobile service architecture consists of interchangeable hardware and software building blocks it will be able to support a wide range of services across devices, networks and platforms.

- Web services platform; runtime environments, to deploy these applications have to be in place, e.g. JAVA and Microsoft .NET.

A number of designs decision on these platforms have to be taken before deciding on an application.

P.T.4 Application design

When the decisions regarding the platforms have been made, several people may design the various applications. Two standards that provide application-level support for wireless networking are mobile IP and Wireless Application Protocol (Stallings 2002). An application server provides a server-side platform for building and deploying business logic and can provide many technical benefits (Jagoe 2003). The application design depends heavily on the choices made in P.T.1, P.T.2 and P.T.3. The application designers should facilitate the performance of the service formula issues localisation, privacy, content quality and richness and non-functional requirements (as mentioned in Chapter 5 and A.S.3).

P.S.1 Content design

This activity is closely related to the application design and navigation design. The content depends on what the users will trigger. The term content should be understood as referring to text, emails, web pages, graphics, audio and video. In this activity the storyboard is further designed to show what the service will look like. This design has to be rich and provide a 'feel-good' impression, the required content is also described in this activity, e.g. the geographical information, databases with restaurant information, games, etc.

P.S.2/P.S.3/P.S.4 Navigation design, User interface design and Tests

A simplified view of the user-centred design process is to conduct user research, set usability goals, design, model and test the user interface; and specify the user interface (Wiklund 1994). The design, model and test of the user interface should be repeated until the user is satisfied. The navigation design leads for the application design. The user interface design determines the 'look and feel' of the service. The designers develop the font, colour, icons and text. The underlying process of getting a user interface that is usable is a user-centred design process; the targeted user has to be part of the whole design approach (guideline 4). Usefulness and the ease of use has to be tested by potential users to determine whether the designers are still working according the users' requirements. This is a repetitive activity. The concept behind it is to "stress that customers and technology-providers jointly explore the possibilities and constraints of a technology using simulation (hands-on experience) and developing scenarios" [1]. As described in Section 6.2, the session

[1] www.witlab.nl last accessed 12 October 2004.

is a participative evaluation process in which the users actively participate in evaluation and defining usability problems. These aspects can be technical, i.e. a slow device, but also to aspects such as perceived usefulness, i.e. functionality that is not perceived as useful. Different methodologies in usability labs for evaluation may be practiced, including customer field studies, competitive analysis, contextual inquiry, surveys, usability focus groups, participatory design, exploratory lab studies, expert ("heuristic") evaluations, and more[1].

Ways of modeling are prototyping to get hands-on experience and emulation to test the Graphical User Interface (GUI).

7.3.3 Synthesis

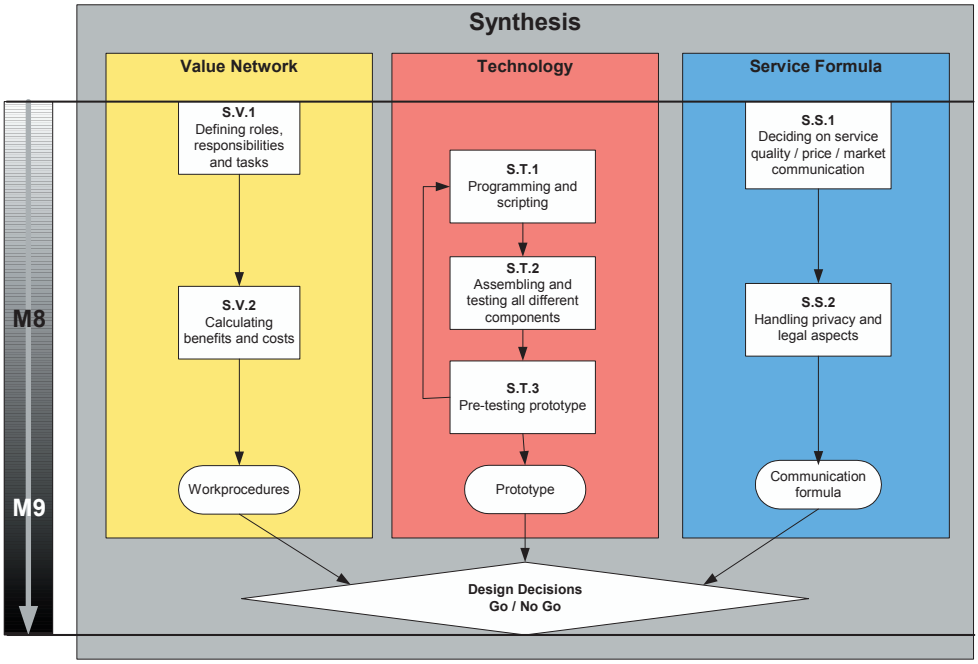


Figure 7-6 Synthesis

S.V.1 Define roles, responsibilities and tasks

In the synthesis phase the roles, responsibilities and tasks that have to be done during the usage during the test of the service have to be decided. The procedure for the test of the service that will be executed in next phase has to be completely clear for everybody. This includes the test scenario; it should be clear which researcher does what, when and how

[1] www.sun.com/usability last accessed 12 October 2004.

they will guarantee that the test results are valid. Workflow models can support this. To run a usage test you need to organise willing participants, a prototype, a way to make the prototype available to participants, mechanisms for collecting data and a process for interpreting feedback (Isaacs and Walendowski 2002). Practical details like detailed planning for providing and receiving the equipment, a manual for the users, questionnaires, and contracts, the support, etc. also have to be planned. Arrangements have to be made for the operationalisation of the test. What if a server goes down? What if the network goes down? Who is the first line support for the user?

S.V.2 Calculating benefits and costs

The results of the preparation phase have to provide an overall overview of the service system design, while during the synthesis phase, the system has to be built and this costs money. In this phase investments have to be made in the network, in hardware and software. In the benefit and cost model the investment for the next phase, the implementation and test phase, has to be calculated. The risk will vary depending on the size of the test group. The benefits and the costs will be of a financial and a non-financial nature, for example time and reputation.

S.T.1/S.T.2/S.T.3 Programming, scripting, assembling and testing

Many books have been written on developing Internet applications (e.g. Ince 2004). These are also applicable in the mobile field. Concerning a value network of various actors that will be located in different places it is recommendable to have a work method that is suitable in a distributed environment. A team of programmers in a distributed environment can do the programming if the software is well tested and documented. In the open source development communities, programmers have the adagio 'code somewhere and deploy everywhere'[1]. First the various completed parts have to be tested. Emulators might be helpful here, as mentioned in Section 6.4. Next the tested parts have to be assembled and the whole system has to be technically tested. The deliverable of this activity is labelled a 'prototype'. The advancedness of the prototype depends on the evolutionary stage of the project. Just before the market launch the prototype should perform in the test as the final service.

S.S.1 Decide on service quality and how to manage the market communication

Grönroos (2001) argues that better quality leads to higher customer retention rates and more profit. The perceived value of the total service offering to the customer has to be calculated during the design process. The developers can calculate the revenue benefit, cost benefit and investment per feature, see Grönroos (2001). The further the service is matured the more detailed the calculations will be. Decisions have to be made regarding communication with the users. This is crucial for a market launch, and also for prototype test decisions have to be made regarding attracting users and how to communicate with

[1] www.sun.com last accessed 12 October 2004.

them. How will the service be branded, priced, etc.? The whole process of communication with the (prototype) users has to be managed and this can be modelled using the Relationship Dialogue Process Model (Grönroos 2001). The privacy of the participants also has to be taken care of by making sure that they understand what data you will collect and how the information will be used (Isaacs and Walendowski 2002).

S.S.2 Handling privacy and legal aspects

Before the implementation starts it is necessary to check whether all legal aspects are covered. This ranges from issues like 'can you ask a test person to be personally liable for a piece of technology for if it is stolen?' to 'is the mobile information service completely legal?' As mentioned in subsection 7.2.1 there is privacy legislation and this is an issue for mobile information services that needs to be carefully checked, especially for location-based services. For example the Consent Provider Model can be used to manage privacy (Ali Eldin and Wagenaar 2004).

7.3.4 Implementation and Test

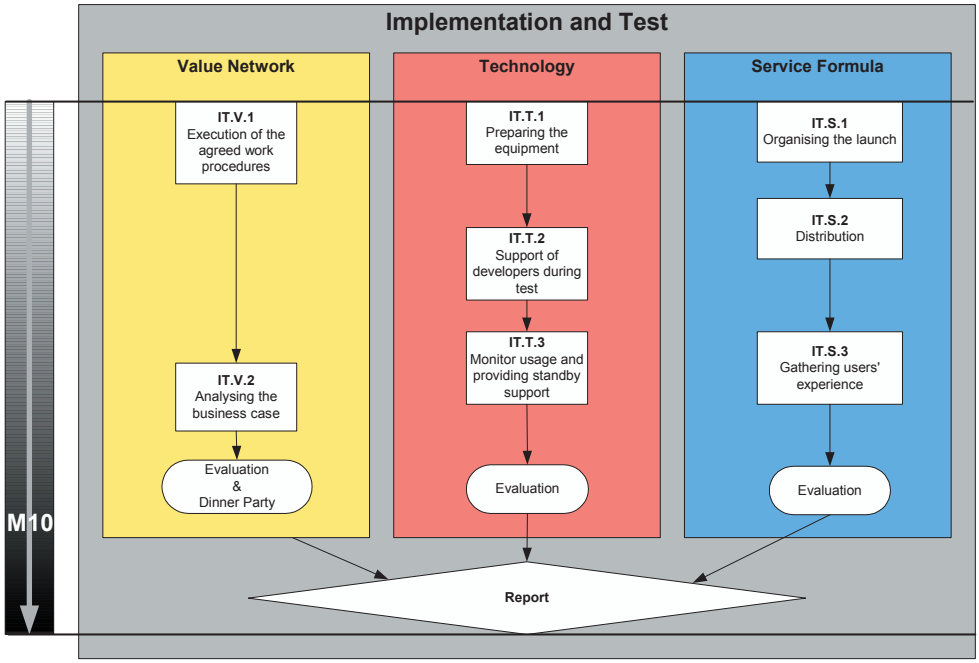


Figure 7-7 Implementation and Test

IT.V.1 Execution of agreed work procedures

The implementation and test plan as mentioned in S.V.1 is executed in this activity.

IT.V.2 Analysing the business case

The business partners then evaluate their benefits from participating in the design project. They decide if they are willing to participate in the next round. They might use predefined criteria with a 'hard' and 'soft' character to estimate the chances for success. The parameters formulated in P.V.2 can be validated once again. At this stage the partners can also better judge the more 'soft' characterised criteria, as mentioned in P.V.3, and answer questions like 'Was there a good atmosphere?' And 'Are the partners reliable?'

IT.T.1 Preparing the equipment

Depending on the amount of users in the test group this might be a rather labour intensive activity. The devices have to be pre-installed; a manual with instructions also has to be written.

IT.T.2 Support by developers during test

The application developers can sometimes solve problems that pop up during the test. This is also an opportunity to have informal conversations with the users and get a better understanding of the usage.

IT.T.3 Monitor usage and evaluation

The usage of the network, platform and applications has to be logged. The operators can test the load and peak load on the network. The service providers can use the log files to scale the necessary capacity on the servers. At the same time, the usage designers can use these log files to evaluate the usage, see IT.S.2. Observation is also important for evaluation. Questions that are important to answer for the evaluation of the technology are:

- Is the technology reliable, robust and scalable?
- In what phase of the innovation life cycle is the deployed technology? In other words, Is there an expectation that the technology will become obsolete in the near future?

IT.S.1 Organising the launch

The launch might concern a first version or a ready-for-market version of the service to the customers. The contact with the customers should be carefully managed. Results of former tests form the basis for addressing target groups and triggering values of the service. Publicity can be organised when all involved actors are confident with the outcome of the test users' experiences (see requirements Section 6.4).

IT.S.2 Distribution

The relationship with the customers starts once the service is distributed. In test situations the test subjects will receive the equipment, receive instructions and have to sign some form of consent regarding participation. This activity is related to the marketing of the service. One of the issues, for example, is whether the service will be distributed as part of a service bundle. This issue becomes more important closer to a mass-market launch.

IT.S.3 Gathering user experiences

Data collection begins at the first moment the users start to use the service. It is recommended to use a combination of multiple sources to get good feedback on the usefulness and usability of the service. Questions that need to be answered are: 'what are the users willing to pay for the service?', 'is the service evaluated as useful and easy-to-use by the targeted users?' and: 'is it clear who the target group is and what the size of this target group is?' As mentioned lesson from the case studies, pilots and free connection plans allow customer to explore the services and help companies to find answers to these questions.

7.4 Next phases

The design approach can be reiterated after a first round has been completed and a test group has used the service. In the second round some activities may be modified and might be done quicker. After each round the service can be distributed towards a larger test group. After two or three rounds the object of the approach will be the market launch and the start of exploitation. In the last round before exploitation more emphasis should be paid to the business model of the service and the business cases for the various partners. Exploitation might start with only a small part of the target group. After the first real market experience more market exposure risk can be taken. The number of necessary rounds will vary per situation.

The whole design approach spiral is presented in Figure 7-8. The light bulb is used to denote that the whole process has to start with radical and lateral thinking. Iterative design steps should be taken within each round. And after each round follows an incremental step towards the next round. In next chapter we apply the first round of this design approach in an action research case.

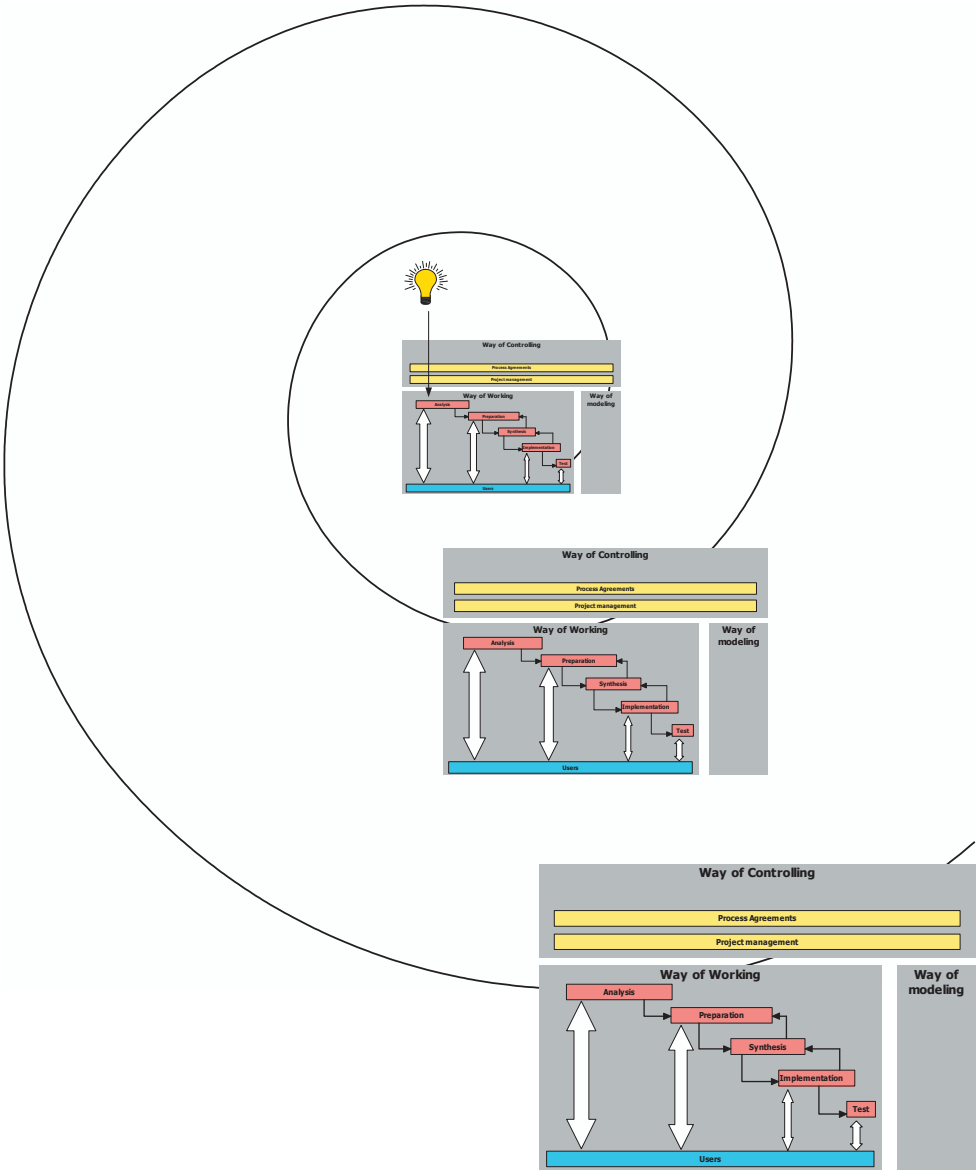


Figure 7-8 Design approach spiral

8 Case 4: MIES on the campus

The action research case in which the developed design approach was applied is described in this chapter. A mobile information and entertainment service (MIES) was designed, built, implemented and tested on a UMTS testbed at Delft University of Technology.

8.1 Occasion

The roll-out of UMTS started in the Netherlands in 2004. The operators involved were looking to generate revenues on the network, a network for which they had paid huge license fees. However, it is questionable whether the potential customers are waiting for broadband mobile services, or whether the performance of the new UMTS network will meet expectations. In sum, an excellent challenge to test our design approach for mobile information services.

Delft University of Technology and the mobile operator T-Mobile organised a UMTS testbed at Delft, the Netherlands, for the period April 2003 - April 2004. This UMTS testbed provided us with the opportunity to apply the design approach as outlined in Chapter 7. We decided to design a service for campus visitors and this was called '*MIES on the campus'*. MIES is an acronym for Mobile Information and Entertainment Services. This project was just one of the working packages run on the UMTS testbed. The service '*MIES on the campus'* used the features offered by UMTS, as the purpose of the UMTS testbed was to show the public the advantages of UMTS. The working package started "beyond technology push" with researchers getting to know the wishes of potential users.

The set up of the research project is explained in the following section. This is followed by a description of the results of the project phases analysis, preparation, synthesis, implementation and test in Section 8.3. The findings of the design approach experience, users experience and partners experience are given in Section 8.4. We end the chapter with conclusions and suggestions for further research in Section 8.5.

8.2 Set up of the project

The set-up of the project is described following the structure of the case studies set up in Chapter 5, e.g. the design of the project, criteria for site selection, collecting evidence and data analysis. The last two case study tactics are combined.

8.2.1 Design of the action research project

The goal of this project was to practice our design approach as presented in Chapter 7. At the beginning of the project we made the assumption that '*it is achievable to develop a mobile service under time pressure, that provides value to the users because we follow a design approach that balances the service formula, technology and value network'.* In this project the researcher acted as the innovator to develop and launch a mobile information

service in an inter-organisational setting using the predetermined design approach given in Chapter 7.

The service we developed was for visitors to the campus of the TU Delft. Following the design approach given in Chapter 7, the research started with determining the target group. This was followed with three group sessions supported by Group Support Systems (GSS). Based on the output storylines were developed as input for the service descriptions. At the same time the available technology was investigated since the aim was to work with existing building blocks. This led to a network of actors being created. We needed a mobile network operator, application developer(s), content provider(s), service provider, hosting provider and handset provider(s). We wanted to answer the questions: 'to what extent is it possible to apply the design approach as explained in Chapter 7'? and, 'when do we have to deviate from this design approach and why?'.

8.2.2 Criteria for site selection

The aim of the project was to develop and test a mobile information service in a setting that fulfilled the following criteria.

- To provide a mobile information service that facilitates conference visitors by being useful and usable
  The first criterion concerns the *usefulness and usability* of the service. For mobile services this is based on needs and the service must be usable in a setting where the situation of the user is critical concerning location and timing (see Chapter 2). For this project this was translated into the following goals. Firstly, the service must be useful and clear to the user, secondly, the speed and capacity of the UMTS-testbed network is sufficient, thirdly, it must be a location-based service, and finally the service should add value, a user must be willing to pay extra for this service.
- Innovative
  The *innovativeness* of a service can be either related to the technology used, target group in relation to context, the business model used or new service features/application. The innovativeness of MIES arises from the combination of the network technology UMTS with GPS. In the project a prototype was developed and tested by people willing to act as test users. The service was offered free and therefore it was impossible to test the influence of the revenue model on the adoption of the service. The participating firms also worked mainly for free which means that it is not possible to reflect on a 'real' business case. However, it was possible to make cost based calculations based on costs and invested time.

- Making use of existing building blocks as much as possible
  The concept of the project was to use existing *building blocks* and assemble them in a short period of time. This resulted in a service application consisting of user requirements, available building blocks and some software applications that were feasible to program using the available resources.
  The available building blocks were:
    - all kind of content about Delft
    - a multi user game for GPRS
    - contact information for all TU Delft employees on a LDAP server
    - GPS Navigation software
    - video clips suitable for UMTS
    - the Internet, i.e. those Internet pages that are suitable for the iPAQ.
- Multi actor environment
  The last criterion concerns the *multi actor environment*. We worked with the following partners:
    - a mobile network operator that maintained and tested the UMTS network
    - an IT consulting company that participated with architectural and software development knowledge
    - content developers and software programmers from a content development organisation
    - junior researchers in the ICT field that were studying IT architectures and enthusiastic programmers
    - students studying user interface design and multimedia design
- Time pressure
  The aim of the project was to develop a service in a relatively short period of time. The time available to develop this service was less than five months (May, June, September, October in 2003; hardly any work was done in the holiday months July and August).

8.2.3 Collecting evidence and data analysis

The design approach as explained in Chapter 7 was the outline for this action research project. To collect evidence on (a) what activities we had/had not performed and (b) on what worked well and what did not work well, we used data triangulation by using multiple sources of evidence to test the design approach (Yin 2003). These sources were:

- participant-observation, the investigator also had the role of service provider
- documentation, e.g. letters, administrative documents like reports of visits to possible suppliers, minutes of meetings
- archival records, e.g. personal records like diaries and calendars, email correspondence
- questionnaires and interviews of 12 partners
- questionnaires and interviews of two groups of test subjects

The analysis of case study evidence is one of the least developed and most difficult aspects of doing case studies (Yin 2003). This was also the case for this applied case study project, also called action research. Two general data analysis strategies Yin (2003) describes are 'relying on theoretical propositions' and 'developing a case description' of which the first is the most preferable. We followed this first strategy by using the guidelines from Chapter 7 as guidance for the case study analysis. We further explain the last two data sources concerning the partner and the test subjects. To get feedback on the design approach partners were asked to comment on the actors and role analysis, to discuss the guidelines and asked to explain the benefits of the project for them and their existing relationships with other participating actors. They were also asked about their view on customer value (interview protocol in Appendix D). The twelve partner interviewees were asked to mark on a 1 (strongly agree) to 5 (strongly disagree) scale their opinion regarding the guidelines, in theory and as applied in the MIES project. We did a quantitative analysis of the data collected with the partners' questionnaires, see Table D-3 in Appendix D, and this was completed using the qualitative feedback from the interviews and observations to get improvement ideas on the design approach. The qualitative feedback on how the process went came from observation and interviews.

Two groups of test subjects used the service. The first group consisted of 15 real conference visitors and the second group of 22 students. After using *'MIES on the campus'* the test subjects had to fill in a questionnaire based on a System Acceptance Questionnaire from the HUSAT Research Institute[1], this form of questionnaire is used in our faculty for usefulness and usability research. The questionnaire consisted of several parts. First, six dimensions were mentioned: usefulness, clarity, efficiency, support/help, satisfaction and visual qualities. Each dimension consisted of 4 – 8 statements. Then thirteen statements about the MIES functions were introduced to the user. After that, seven statements regarding privacy and two about pricing were introduced. The respondents were asked whether they agreed or disagreed with the statements. Then a part followed where some open questions were asked such as: what is your favourite MIES function?' and what problems did you have with MIES? Some background questions were also asked so that the demographics of the users could be described, see Appendix C for the questionnaire. We did a quantitative analysis of the data collected with the user's questionnaire and this was completed using the qualitative feedback from the interviews and observations to get service improvement ideas. When the test subjects handed in their questionnaires they were interviewed on the items about which they held a strong opinion. During the first interviews it became clear that sometimes respondents answered a question on a function without having really used it. Therefore, a second version of the form was developed to determine which functions the respondents had used. In the second test we did not interview the respondents but instead discussed the results in a group discussion.

1 http://www.lboro.ac.uk/research/esri/hfdc/index.htm

8.3 'MIES on the campus' project description[1]

In this section we describe result of the activities regarding the service formula, technology and value network for each phase of the project on the university campus. The phases are 'Analysis', 'Preparation', 'Synthesis', 'Implemention' and 'Test' (APSIT). See Figure 8-1 for an overview of the planning of these phases during the project.

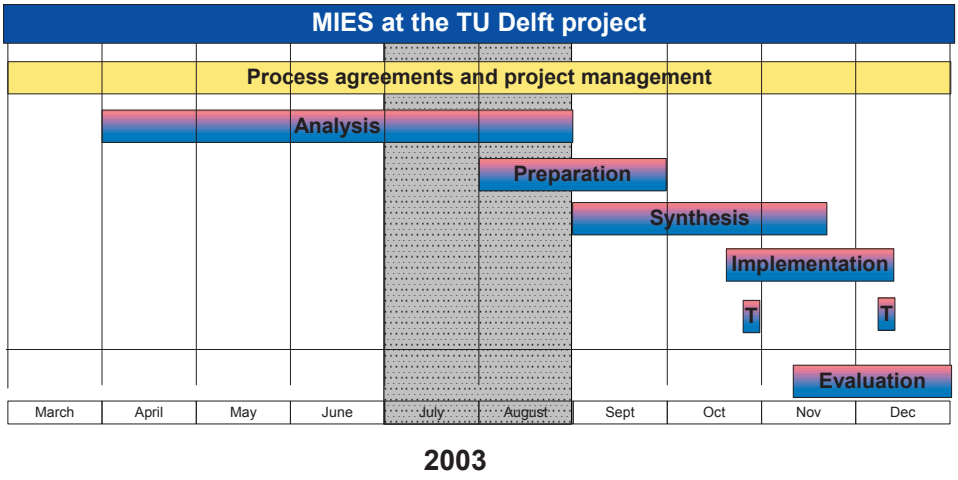


Figure 8-1 Planning overview (July and August were very quiet due to holidays)

8.3.1 Analysis

Result of service formula activities in analysis phase

In the *'MIES on the campus'* project the GSS sessions were applied as follows: as *'MIES on the campus'* targets at visitors to the campus, three different groups of participants were defined: foreign academics (n=10), Dutch academics (n=14), and Dutch practitioners (n=8). A GSS session was executed for each group to make user requirements elicitation more accurate,. As a warm up question we asked the participants what irritates them about mobile phones (step 0). Next, we asked the participants to think of questions about problems they encounter when they visit Delft in three subactivities, being identifying problems, formulating the most important problems and selecting the most important problems with the group (step 1). Later on we focused on possible solutions to these questions and problems (step 2). We demonstrated UMTS from the network technology and the user perspective and showed video clips with possible UMTS services (step 3). Finally, we asked the participants to redefine the solutions (step 4). The result of the selection of

[1] More information on the project can be found on www.miesonumts.nl including the report Van de Kar (2004). The UMTS testbed project overall is described in Westerveld (2004); User Requirements Elicitation with GSS Design in Den Hengst et al. 2004; and the user center design approach of MIES in Van de Kar et al. (2004).

the most important problems is shown in Table 8-1. The number of votes is the number of participants that voted for that problem as an important one.

Table 8-1 Contexts for which we decided to find a solution (service)

Session 1 Foreign academics (n=10)		**Session 2 Dutch academics (n=14)**		**Session 3 Dutch practitioners (n=8)**	
# Votes	Contexts (top 10 of 13 ideas)	# Votes	Contexts (top 10 of 42 ideas)	# Votes	Contexts (top 10 of 20 ideas)
6	Local logistics by public transport; when, where, how?	10	Do I have to walk or is there a bus or a taxi and how expensive is a taxi? Personal up to date route planner	4	Details on the appointment location, time, attendees
5	Where can I find information about educational things?	9	Information on courses subject, time, place, teacher	2	Information on other people around the campus
5	Where do I get emergency help and medical care and do I need it?	6	What events are going on where?	2	Where is the closest parking space?
3	What's the weather forecast?	6	What are the facilities of the restaurants?	2	Information on courses (subject, time, place, teacher)
3	Where can I find information about cultural / recreation / sports?	4	What facilities can I use?	2	Where am I? Tracking and tracing
2	Can I get an update on new rooms/apartments in Delft?	4	How can I find my way within the faculty?	2	Audio/video conference facilities
2	How do I process my resident/stay permit?	3	Can I find a person with the same interests and meet this person?	2	Where can I find food and drinks and what are the prices?
2	What's the latest news local / international?	3	What are people doing at the TU Delft, in general and specifically	2	News, actualities and specialties
1	Where and which famous professors are or were teaching at the TU Delft?	3	Information for invitees like location, time, changes	2	How do I get from the station to my destination?
1	What is the structure of the administration of the TU Delft?	2	Where is the faculty that I am looking for?	1	Where can I find a place to work in silence?

The overall conclusion was that the participants were satisfied with the product and the process based on measurement of the satisfaction of the participants using four 7-point Likert questions (see Den Hengst et al. 2004). The outcomes and the repeatable process were also satisfying for the purpose of this research alhough it was difficult to extract user requirements. Key issues to be addressed with a mobile information service were identified and criteria for using such a service were defined. Based on the results of the sessions we developed storylines as input for the service descriptions.

Seven storylines were formulated based on the outcome of the GSS sessions. To make the storylines realistic a situation was based on a fictive person. This description was as follows.

'A researcher, 'Mabel Jones' from Great Britain, visits the conference on simulation from 26-29 October 2003 in Delft. Mabel arrives on the 25th of October at hotel Dish in Delft and receives a package at the reception desk with a UMTS device, iPAQ and gps receiver that together provides the 'MIES on the campus' package.

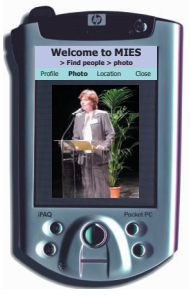
Storyline 1: find the conference venue

The next day, Mabel reads the instructions and starts using MIES to figure out where she is, where the conference location is and how to get there. She could walk, take a taxi or go by public transportation. The answer is that it is a 10 minutes walk. So she starts walking using the handheld device to help her find the route. She easily finds her way.

Storyline 2: find the right session

Mabel arrives at the venue and registers. She can choose between three parallel sessions that start in 15 minutes. Two of them are relevant for her. Mabel uses MIES to download the abstracts of the papers from the two relevant sessions and she makes a choice. She decides to plan the rest of the sessions she wants to attend later. During the morning session she receives an update of the program. One session is cancelled; another one delayed and there is another keynote speaker.

Storyline 3: find the right people



The morning sessions are over and lunch starts. Mabel wants to find some people who are involved in the same research issues as she is. She starts MIES 'getting in touch' module and searches for people based on key words she enters in the search fields. She receives pictures and descriptions of people that match her request. She recognizes Juan Gonzales from Spain and sends him a message inviting him to sit next to her at lunch. The lunch is held at the conference venue and Juan and Mabel have an interesting talk during lunch. They exchange business cards via their devices.

Storyline 4: find a nice restaurant

The first day there is no dinner organised by the conference committee. Mabel and some other conference visitors decide to go into Delft to have dinner. They search with the help of MIES for a nice restaurant. They want an informal restaurant with a reasonable priced menu in the center of Delft. They can choose between several places, one of them has a webcam and they can have a look at the actual situation at that time in that place. They decide to go there and call the restaurant to make a reservation. MIES advises them to take the bus to the restaurant and MIES provides them the bus number, where and at what time the bus departs and how to get to the bus stop.

Storyline 5: tour through the campus

The second day in the afternoon there is no session that Mabel and Juan like and they decide to discover the TU Delft campus. The MIES service has a tour that guides them through the campus and that provides interesting information on the buildings, e.g. about the library and faculty buildings; where famous professors work and their research fields; the current courses available at the university; and they find they can download a preview of a lecture from a professor they know. Practical information like where there are coffee machines, copiers, ATM's and lunch facilities is also available.

Storyline 6: more time to kill

They end the tour and still have some time to kill before the official conference gala dinner. They decide to play some multi user games on the mobile. Then they receive a message that there is an extra social meeting at Speakers, a big pub/dancing place downtown, that they can attend along with people from the conference. They take a look at the situation via a webcam in Speakers, and they see what appears to be a good party. They decide to go there and get directions via MIES.

Storyline 7: appointment info

Next day the conference is over but Mabel has an appointment with an assistant professor at the Faculty of TPM. The appointment is at 09:00 o'clock. Mabel is late because she slept through the alarm (due to the party the night before?). She phones a taxi and sends a message to her appointment that she is late. In the taxi she has a quick look at the profile of the person she will visit. Thanks to MIES she can easily find the room in the TPM building where the meeting is. She recognises the person from having seen her picture on MIES.

Result of technology activities in analysis phase

T-Mobile provided the conditions and determined what technologies we could use regarding the network and the handset. We refer to Westerveld et al. (2004) for a description of the cellular network consisting of GSM and UMTS connected to Internet and PSTN.

It was a difficult task to figure out what the best technological solution was for localisation. Cell ID was not available. This meant that we chose GPS. We compared a server-based solution from Ericsson, the Arcpad solution from our colleagues at the faculty of Geodesy and the TomTom application. One of the decisions that had to be made was the choice between a client or server based application. Both have advantages and disadvantages. A big advantage for a server-based solution is that the information can always be updated, e.g information on roadwork provided as and when necessary. A disadvantage is that the user always has to go online via the mobile network, which costs money, can cost extra time and has a chance of failure.

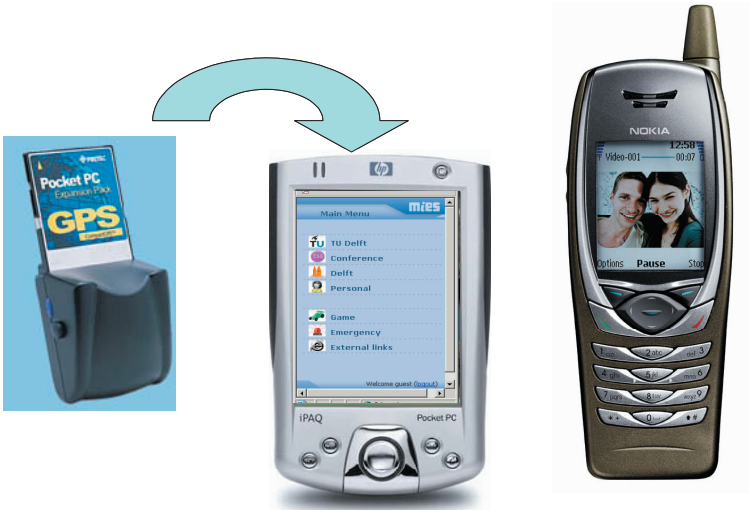


Figure 8-2 Chosen handsets

It was a time consuming task to figure out a good combination for handsets and the UMTS network. The starting point was to determine what is available on the market. E.g. a UMTS phone with integrated GPS was not available. The UMTS phone Nokia 6650, the iPAQ2210 and a GPS receiver were the devices chosen to enable the service. The connection between the Nokia and the iPAQ was via Bluetooth. The GPS receiver was a CompactFlash card that fits the iPAQ, see Figure 8-2. These handsets were chosen for the following reasons. The Nokia 6650 was the only available UMTS device when we had to make the decision regarding devices. Since the Nokia 6650 has only a WAP 1.2 browser, no xHTML, no WAP 2.0 and a very small screen another device was needed as a user interface. A laptop was too big, heavy and expensive, thus we chose a PDA. The iPAQ2210 was chosen because it

had just been launched on the market with a Pocket PC 2003 operating system. A GPS receiver was necessary for localisation; and there are many brands and models on the market. Based on price and ease of use the decision was made to use a CompactFlash receiver. For a long time we preferred a wireless GPS receiver with a Blue tooth connection, but due to the risks involved with the two bluetooth connection (the Nokia and iPAQ connection was also bluetooth) we decided to go for the CompactFlash which was also much cheaper.

Result of value network activities in analysis phase

The set of standard roles related to mobile services, presented in Chapter 7, was used to search for actors to build MIES. Embedded relational ties were without doubt a very important factor in the network formation. Everyone involved in the project knew at least on other person involved in the project, as a teacher, (former) colleague, business partner or personally. T-Mobile was already involved because they had already worked on the initiative of UMTS testbed at the campus with colleagues from Delft University of Technology. T-Mobile was also the connection to the handset suppliers and video application provider. A content provider for offering local content on Delft and a multi-user game developer were found via the personal relationships of researchers at the TPM faculty. The IT organisation was a former employer of the researcher. Expertise of researchers of other faculties at the large Delft University of Technology was determined via personal relationships. Only TomTom was chosen for experience with their product, at the time of starting the project nobody knew anybody in the company personally. This influenced the cooperation with them, we only had contact a few times by phone and email and they did not really participate in the design project. For the testbed project more companies were contacted than those that actually participated. The reasons to choose for not participating with certain companies were not enough time to get familiar with the technology (Ericsson, ArcPad), nobody had experience with the company and they asked too much money (Mobilsoft), or we simply did not get in touch with them. Embedded relational ties also influenced the coordination activities in the network. Some participants mentioned that it is more difficult to refuse a bad proposal as you may disturb a good atmosphere. The network was recognisable as an exploration network with high trust/openness and low control (see Table 4-1). None of the actors asked for a letter of intention during the network creation phase.

8.3.2 Preparation

Result of service formula activities in preparation phase

Based on the storylines and the available raw content, user interface designers made the navigation structure and user interface for MIES. Websites for tourists, e.g. of London and Rotterdam, were also checked. The design was made in a few iterations, where users provided feedback between results. Two user test sessions with three test subjects each session took place (for a complete report on the user interface navigation design see the

report of Weenk and Schiffers 2003). The first session was a user studio sessions with three test subjects taking around 30 minutes for each test. The pictures in Figure 8-3 illustrate the project's usage studio session. This was the first test to get feedback on the navigation structure after two weeks of designing. A test subject in a separated test-room was filmed, together with what was happening on the screen of the iPaq (see Figure 8-3 right). One designer guided the test-subject. In the control-room other designers registered and evaluated what the test subject did see (Figure 8-3 left).

Figure 8-3 Control-room and Test-room

A few weeks after the studio sessions we did the second user test session that was a field test with three different test subjects. For this test all content was available and the test subjects walked outside so that the designers could observe *'MIES on the campus'* being used in the field.

The number of tests in the usage studio and the field were seen as sufficient since 'between three and five test users per test is recommended as a way of simplifying user testing while gaining almost the same benefits as one would get from more elaborate tests with large number of subjects' (Nielsen 1994).

Various content providers, who sometimes use raw content from other suppliers to develop content, were involved. As much as possible, the content was presented on the same template to stress that it was one service for campus visitors. Exceptions were the Razor game, provided on the Nokia, the TU Delft employee information, via the LDAP server and the navigation information, TomTom program. There was also a list of interesting external links in the MIES homepage and, of course, these Internet pages have their own design. MIES was not a direct translation of the different storylines but one integrated service.

An overview of the first and second tier pages of the MIES menu during the test on the ESS conference and the SSE course is provided in Table 8-2[1].

[1] The webpages of MIES are accessible via www.miesonumts.nl. Be aware that the navigation software is not on the web! It is only reachable on an iPAQ with a GPS receiver.

Table 8-2 Overview MIES menu

ESS conference	SSE course
TU Delft	**TU Delft**
People (LDAP server)	People (LDAP server)
Locations	Locations
Facilities	Facilities
Transport	Transport
Campus Tour	Campus Tour
Conference	**SSE course**
News	Check News
Schedule	Schedule
Find people	Find people
Locate people	Locate people
	Send messages
Locations	Locations
Transport	Transport
Chat	Chat
Delft	**Delft**
Find a restaurant/pub	Find a restaurant/pub
Locate restaurant	Locate restaurant
History	History
Walk in Delft	Walk in Delft
Sports	Sports
Other	Other
	Personal
	Update my Profile
	Receive message
Other	**Other**
Game	Game
Emergency	Emergency
External links (webbrowsing)	External links (webbrowsing)
	Video clips
Check email	Check email
Other	Other

One path for the first four categories in the MIES menu is presented to give an idea of the MIES iPAQ websites. These four categories are TU Delft, Conference, Delft and Personal to

give an idea of the service. An example is given for TU Delft. MIES users could find information about TU Delft on people, locations, facilities and transport, and it provided access to the campus tour. Some screens of facilities and locations are shown in Figure 8-4.

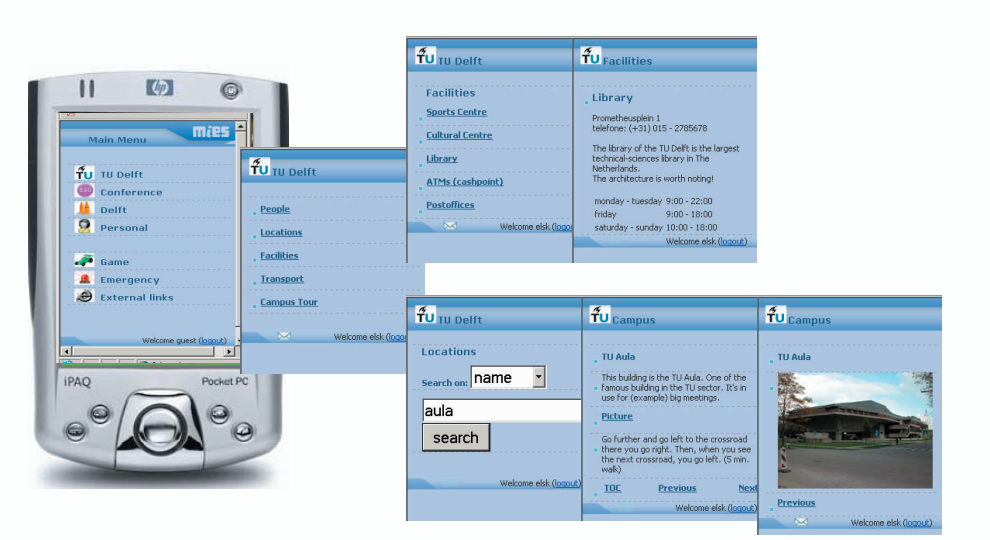


Figure 8-4 'MIES on the campus' screen dumps – example path of TU Delft submenu

Result of technoloy activities in preparation phase

The functional and technical design was one of the most difficult parts of the MIES project. The functions of MIES are ordered in a Presentation-Logic-Data architecture, see Figure 8-5. This overview was made as a start for the technical design of the MIES service. The presentation layer is on the client side (plain); the data is on the server site (dots) with the exception of the TomTom maps that are on the client site. Satellites provide the GPS data (plain white) and these data are converted by a script to GIS coordinates. This is further explained below regarding localisation. The logic layer (stripes) describes the actions between the client and the server. Again, the logic that is only related to TomTom is completely on the client site (plain). The data layer was extended with content from other content providers who joined the MIES portal later, e.g. the videoclips of AtoBe. This layer can be endlessly extended.

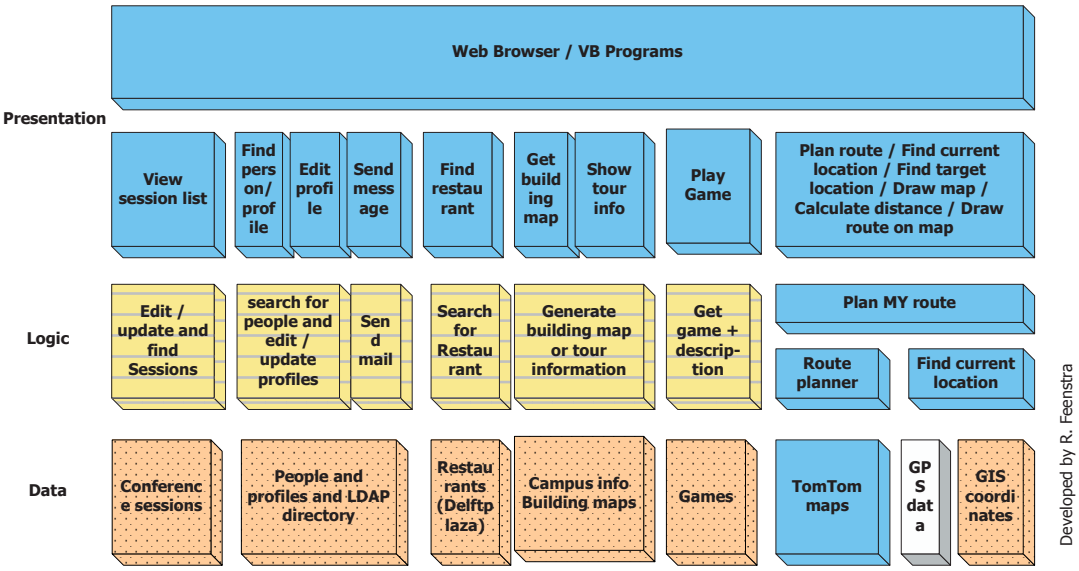


Figure 8-5 Presentation-Logic-Data architecture

The MIES Technical Architecture consisted of all the technical infrastructure components of MIES. They were ordered in three layers from top to bottom with user equipment as an extra element, see Figure 8-5. The three layers are the following.

- The UMTS network, provided by a mobile service provider with a UMTS license. For the MIES project this role was fulfilled on the TU-Delft campus by T-Mobile. Due to its higher bandwidth than GPRS, and also GSM on which it is based, the UMTS network is a 3G broadband packet-based transmission of text, digitised voice, video and multimedia at data rates up to 2 Megabits/second theoretically; in practice the maximum is much lower.
- The Internet was the second layer of MIES. It fulfilled a central role in MIES: all information to be retrieved through the MIES portal was requested and provided via the Internet.
- Multiple content providers made their content available for the MIES portal via a connection from their private network (via a firewall) to the Internet. Of course, this required the right configuration of various network equipment, e.g. routers, firewall, at the content provider's network and the telecom provider's network.

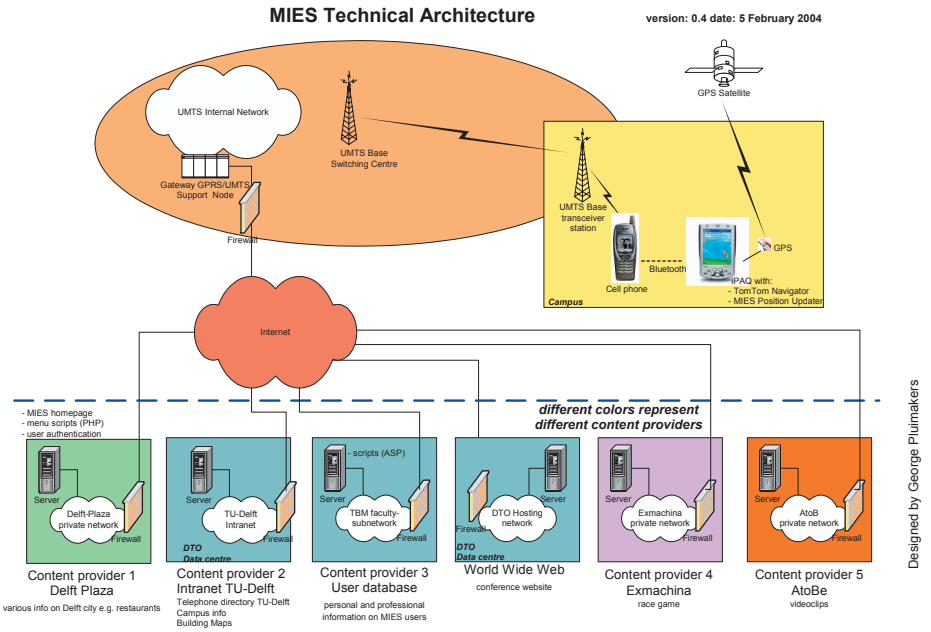


Figure 8-6 Technical architecture

The MIES technical architecture is flexible: new content providers can be added to the webportal, they can be "clicked into the value network" easily.

MIES enabled users to find another person (finding people) and to find buildings (finding a restaurant). For both of these functions the users had to know what their current position was and receive the requested location. We chose a client-based solution for the location-based function to MIES users. There were more standard components available for this and we chose the TomTom Navigator, a standard navigation package for iPaq users. The maps are all stored locally on the iPAQ. However, we still needed to do some programming. We had to design a program to (1) send the current GPS location of the iPAQ to a webserver, and receive a (latitude, longitude) position from the webserver in return and (2) when the webserver returned a position the TomTom Navigator map-view had to show the (latitude, longitude) location on the screen. A PhD student formulated requirements for the following functionalities:

- user authentication
- look and feel management
- separation of the business logic from the look and feel by means of templating
- MySQL database connection

We further explain this in the synthesis phase on technology.

Result of value network activities in preparation phase

Figure 8-7 shows the result of the value network creation for the MIES service.

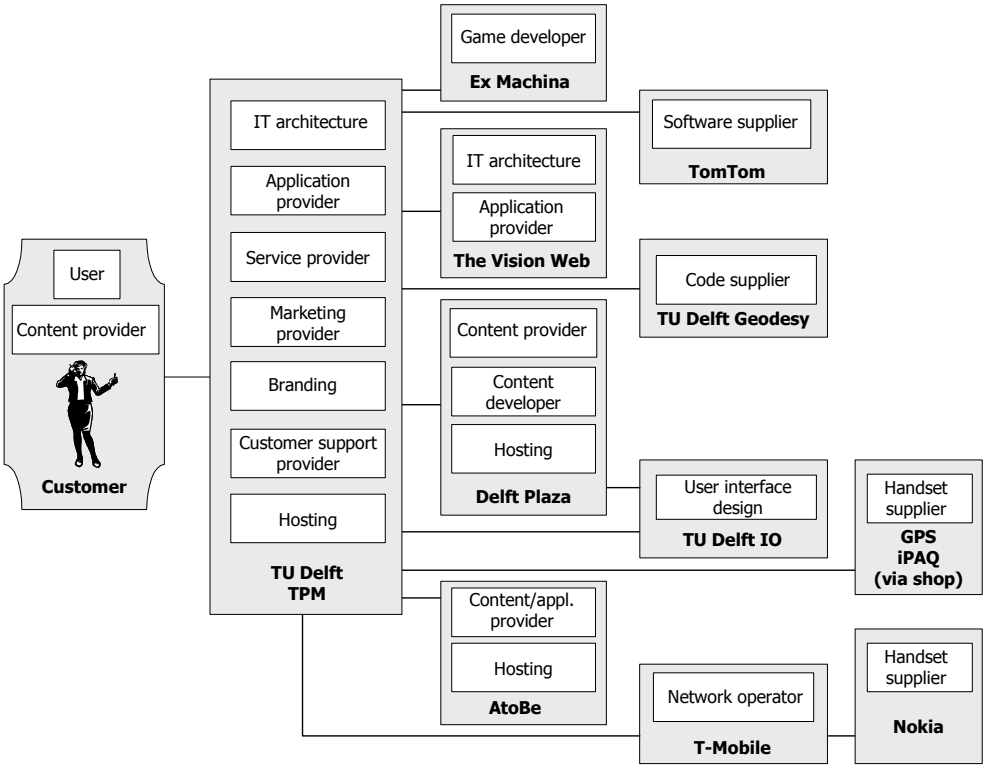


Figure 8-7 MIES value network

We did not really have a collaborative service design session as prescribed for this phase since some actors had already started to work on some solutions. However, at the start of the project we organised a kick-off meeting, including drinks afterwards, with all involved actors. They told their background and plans and hopes for the project. Researchers of the Faculty of TPM presented the first ideas for solutions. As shown in Figure 8-7, many roles were provided by this organisation. A consultant from The Vision Web, an IT architect, was appointed technical project leader. He organised a meeting every week and made minutes providing action points for all these meetings. Two application programmers of The Vision Web later contributed to the programming work that had to be done. Ex Machina had developed a multi-user game on GPRS and wanted to test this for UMTS. They hired a student to do this as a project for school. Delft Plaza is the local content provider in Delft it maintains a website for inhabitants and tourists. Their business model is that they are paid by shops etc. for the companies to be mentioned on the Internet. They considered offering their content on the Mobile Internet as a good extension of their business. This project was

a good experiment to start to gain experience. T-Mobile offered the UMTS network in the overall UMTS testbed project of which 'MIES on the campus' was a subproject. In this subproject T-Mobile's role mainly dealt with choosing and arranging for availability of handsets and keeping the network 'in the air' during the experiments. T-Mobile was also the actor who brought in AtoBe to test videoapplications in the project since videoapplications are suitable for testing the specific features of UMTS such as speed. The navigation program of TomTom was first just bought at the shop but when it became clear that we needed licenses for all the iPAQs we approached them and asked whether they could sponsor these software packages, and they did. The faculty of industrial design participated in the navigation and user interface design. Two students worked on this as a study project under the supervision of an associate professor. They collaborated intensively with programmers of Delft Plaza who had to convert their Internet content to the mobile Internet. Researchers of the Faculty of Geodesy were involved in providing knowledge on GIS and GPS conversion.

More detailed information on which actors fulfilled which roles in the MIES case is listed in Table D-1 in Appendix D. The research findings regarding the external and internal network factors, including the organisations and personal motivations to participate, are further described in research findings of the value network (subsections 8.4.2, 8.4.3 and 8.4.4.)

8.3.3 Synthesis

Result of service formula activities in synthesis phase

The following service applications were developed based on the storylines and using the available building blocks and resources.

Goal 1: Finding locations. This functionality was supported by a navigation program, called TomTom, that runs on the iPAQ. The GPS knows the location of the user and the user can insert the address he or she wants to go to and TomTom will then show the route. The locations relevant to the conference visitors were pre-installed as favourites in the TomTom program. Since GPS does not work within buildings it is not possible to guide users once inside buildings.

Goal 2: Update of the conference program. There was up-to-date information about the conference program provided via the Internet on the *'MIES on the campus'* PDA pages. There was also a function to alert people to important information.

Goal 3: Finding people who 'match'. People could search for other people who share the same interest, research field or speak the same language. In the first prototype of the service, users were able to search for other subscribed users only, while in the second prototype, they could search for other subscribed users and send messages. A privacy control functionality was embedded in this service (see Ali Eldin and Wagenaar 2004). To facilitate users finding people easily the 'MIES Position Updater' (MPU) script was installed on the iPAQ. The MPU fulfilled two functions: it sent the current GPS location of the requesting iPAQ to a webserver, and received the GPS location of the searched iPAQ from

the webserver in return. When the webserver returned this GPS location to the MPU it opened the TomTom navigator map-view and showed the requested location on the screen.

Goal 4: Finding a nice restaurant. If you are in a strange environment you need help to find restaurants, shops, hotels etc.. A selection of information that was already in the database with local content of an Internet content provider, and all that was relevant for conference visitors, was translated into English and formatted into the right format for the *'MIES on the campus'* PDA pages; including search functions, information and pictures of the restaurants and the locations. As described above, the MPU took care of providing the requested location to the user.

Goal 5: Killing time: playing games. Mobile games are played on mobile phones and not on PDAs. Part of the MIES project was a multi-user game called Razor. It was not interesting for a game developer to invest time in developing a game for the PDA. Thus, Razor ran on the UMTS phone instead of on the iPAQ. Users anywhere on the campus could race against each other. The game was already available on GPRS and was adapted for UMTS. The advantage of UMTS for multi-user games is the improvement of the latency. This is more important than the availability of more bandwidth.

Goal 6: Guided campus tour. The guided campus tour consisted of information about the buildings of TU Delft presented on the *'MIES on the campus'* PDA pages. Part of the information was instructions on how to walk round the campus to view the various buildings. This could also be viewed using the TomTom navigation program. A Delft city tour was also developed in addition to the campus tour.

Goal 7: Being on time at the right place for an appointment. Address information including phone numbers and room numbers of TU Delft employees were obtainable on the iPAQ via the LDAP server of TU Delft. However, it was not feasible to give direct access to the agenda of the people. Thus this storyline was only partly executed.

With regard to the test subjects the decisions were made to test the service using attendees to a technically oriented conference. The reasons were twofold: first, the service was still in the prototype phase and technically oriented people are not afraid to experiment with 'beta-version' applications. The second reason was more opportunistic. Our own faculty had organised the conference and the participants were well known to the conference organiser. We could easily make a list of potential test subjects and mail them a request to participate. The test subjects did not have to pay for the service. They only had to sign a contract in which it was stated that they should take good care for the equipment. They would not be liable for any equipment damage that was not to the test subject's fault.

Result of technology activities in synthesis phase

Various programmers from different organisations worked on the programming of the functionalities as presented in the architecture (Figure 8-5). The functionalities related to finding people and finding buildings were supported by the Mobile Position Updater (MPU).

The MPU is a program written in Embedded Visual Basic that runs on an iPAQ pocket PC. The program name is "MIES Position Updater.vb". The following software had be installed on the iPAQ: the eVB Runtime, TomTom activeX control and the program file to run it. The MPU fulfiled two functions: it sent the current GPS location of the iPAQ to a webserver, and received a position from the webserver in return. If the webserver returned a position to the MPU it opened the TomTom Navigator map-view and showed the requested location on the screen. The setting screen and the information flow between the iPAQ and the webserver for finding a person are shown in Figure 8-8.

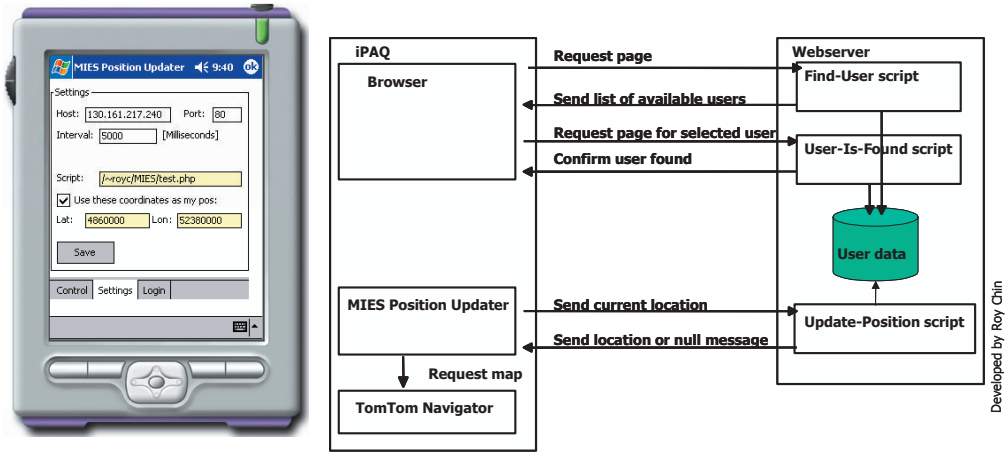


Figure 8-8 MPU setting screen and locating persons information flows

The same principle as shown in Figure 8-8 was used for locating buildings. The difference was that the information on these buildings is held in a database. The database of Delft Plaza is the information on restaurants including the XY coordinates according to the GIS standard. This GIS information had to be converted to the GPS standards longitudes and latitudes so that the MIES Position Updater could request the map in the TomTom navigators.

The PHP scripting was implemented in the following webpages 'Login screen', 'Main page', 'Finding other user's locations' and 'Chat'. The vAuthenticate system was downloaded and used for user authentication. This is a ready-to-use user management system that supports a number of levels. Furthermore it comes with some code to check user permissions for every page that has to be protected. User data on the client side is stored in cookies. These PHP scripts were assembled using the PHP scripting of Delft Plaza that made their content available for the iPAQ. The Vision worked on an ASP application for the personal settings. This was a standalone solution that also was stored on another server. The multi-user game Razor was programmed standalone for the client side, the Nokia.

Result of value network activities in synthesis phase

The interdependency of the technology and the value network was very clear during this part of the project. Part of the programmers wanted to program in Java, some in PHP and some in ASP. In the end it turned out that some actors programmed a part of MIES in PHP and other actors another part of MIES in ASP. This was not the preferred choice, however considering the available resources this was the best available in the allocated time span. The consequence of this was that two servers were needed, a Unix and a Windows environment, and two similar templates had to be made. In the second version of MIES for the student test we decided to program everything in PHP. This meant that the ASP partner left the project.

Ex Machina worked stand-alone. This was not a problem for the service since the game was a client side solution on the Nokia but this situation was not so nice for the programmer. This was a student who wanted to learn from the project and as such was hindered since there was not much collaboration with him.

People worked under time pressure in this synthesis phase and it was very hectic to get the designed service ready in time. For example, T-mobile ordered 20 iPAQ's but somehow the order did not come through. One day before the implementation was supposed to start we drove to a shop with enough stock and bought the iPAQs. None of the actors bothered about calculating benefits and costs because everybody's focus was on realising the service.

8.3.4 Implementation and Test

Result of service formula activities in implementation and test phase

The prototype test was organised in the implementation phase. As described in subsection 8.2.3 we organised two test occasions. For the first test round attendees at the 15th European Simulation Symposium (ESS) in Delft were asked to use and test the MIES service for three days. The ESS conference is a conference on simulation and all the attendees were researchers in this field and can thus be considered to be early technology adapters. This was a good group of people for a prototype test. The 15 test subjects came from all over the world, had different ages and were mainly male.

After analysing the results from the first test round we decided that we wanted more data. Therefore, a second test round was organised. Master students taking a course on Service System Engineering performed the second test. One of the assignments in this course is to design a service. Testing MIES for a week allowed the students to experience the complexity of putting ideas into practise. There were five weeks between the two tests; these were used to provide some quick wins for MIES. The 22 students following the course were divided into pairs of two for the test.

In this phase test persons were invited, a manual was written and the equipment was tested technically and found to be fit to provide to users. Privacy issues came under consideration in the implementation phase because users private information such as

personal and location information would be collected. Prior to using *'MIES on the campus'*, users were asked to fill in their privacy preferences via the web. Private information collected by *'MIES on the campus'* was not made available to third parties and was only used by the system developers to enhance the services. The ways used by *'MIES on the campus'* to deal with the information that was collected were published online in a privacy policy statement.

The equipment was distributed to the conference visitors during the opening drinks the night before the conference started and during registration the first day of the conference. They got a short introduction in which we explained the service to each individual. The students were given the equipment during class and were given a group explanation. The experiences of the test persons with the service formula are described in subsection 8.4.1.

Result of technology activities in implementation and test phase

Two people dealt with the pre-installing of the test equipment and wrote the manual. This was done interactively so the manual text could be checked for accuracy. This took two people about a week. Then, the applications had to be installed on the iPAQ's and the Nokia's; the three devices had to be connected and tested; all the terminals had to be put in special bags and the manual had to be added. This was a very labour intensive task that had to be done precisely. Four student assistants spent an entire day on this for 18 sets, see Figure 8-9.

Figure 8-9 Pre-installing the equipment

Result of value network activities in implementation and test phase

During the tests there was a first line and a second line help function in place. Sometimes the test subjects needed help with the software settings etc.

The partners did not make the analysis of the business cases separately. Theoretically the initiator did make a start with looking at the revenue model for the service. The flows of revenues were difficult to evaluate since the project was no further than a prototype. However, based on the questionnaires we make an attempt.

We asked the test subjects how much they would be prepared to pay for the service by showing them a graduated calculation of interest (see questionnaire in Appendix C). The test subjects answered that they would pay between 5 and 20 Euro extra for a conference if they had access to the MIES equipment and service. Some people might have their own handsets and want to use these. This means that two situations could occur: rental and non-rental.

- Rental; in this situation the MIES service provider must provide stock equipment and maintain it. This equipment has to be purchased and kept up-to-date. This is labour intensive since the equipment must be checked after every rental; contracts have to be made that deal with legal and insurance issues. The easiest way to handle the costs for traffic is for the MIES service provider to buy data from the operator (T-Mobile) and provide the data via prepay cards to conference attendees. If the attendee wishes to have more data they can buy more prepay cards.
- Non-rental; in this situation people will use the information as they would use a website. A service provider might consider asking a fee for the information and provide the user with a personal login on payment of a fee. However, this does not seem to be realistically achievable since most respondents answered that they would not pay extra if they had their own equipment. The MIES service provider revenues must come from the extra attractiveness of the conference.

The revenue model is shown in Figure 8-10. The dotted lines are for the 'rental situation'. In the other situation users pay directly for the traffic to their operator and buy the handset themselves.

The revenue model of the service could only be tested in the sense that we asked the users what they were willing to pay for the service. As explained in subsection 8.4.1, some users made the reservation that the price should be part of the conference package, the MIES case study confirmed that the revenue model must be carefully chosen. No attention was paid to the revenue flows from the service provider to the other partners. Again, this is relevant in the next phase of the project when the service is beyond the 'innovation phase' and in the 'business realisation' phase.

The question is whether the content providers want to receive money from the MIES service provider. Another business model is that they want to attract visitors to their content and get paid for this by their content suppliers. E.g. shops in Delft pay Delft Plaza for providing information on the Internet regarding their shops. The shops might pay extra for a presence on the mobile web.

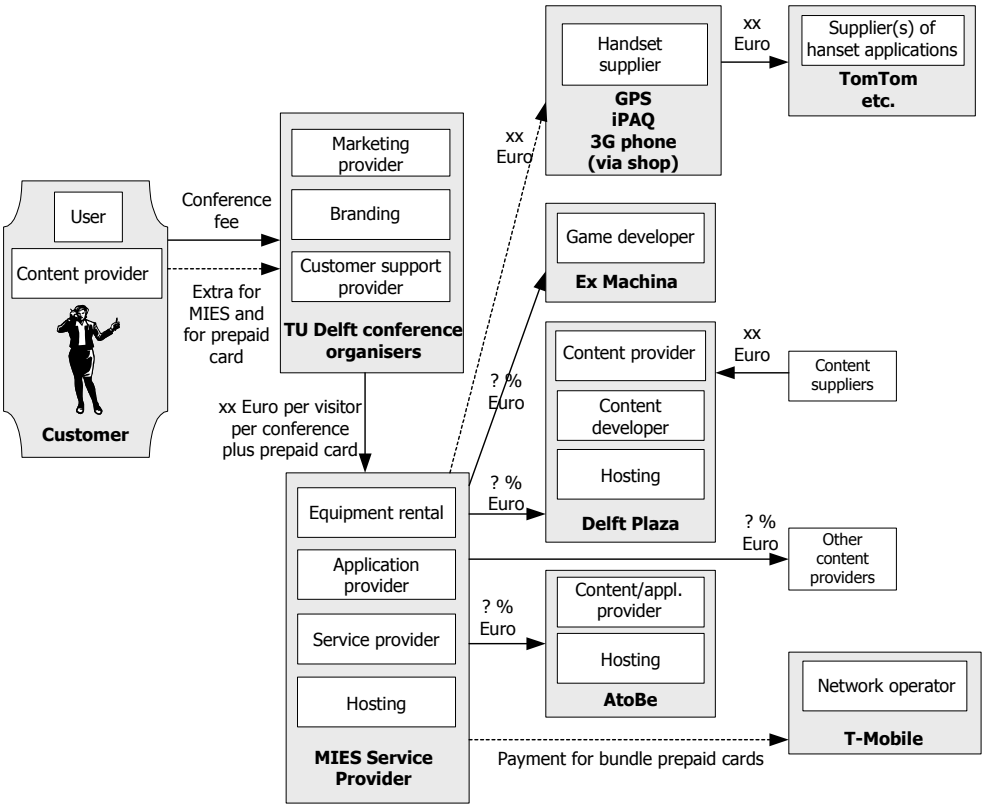


Figure 8-10 MIES revenue model options

8.4 Research findings

We present our findings on the way of thinking as described in Chapter 7. We will divide this into the external network factors, describing the three trade-offs, and the internal networks. We end with an overview of the ways of working, controlling and modelling as presented in the APSIT approach in Chapter 7.

8.4.1 Service formula – technology trade-off

We discuss this issue using the feedback on the service formula we received from the test subjects. The experiences of the test subjects were gathered using questionnaires, interviews and observation; see subsection 8.2.3. We start discussing the results of the questionnaire.[1]

[1] See the report of Van den Bosch (2004); 'System acceptance of Mobile Information and Entertainment Service' for all the details of the user test results.

The extent to which the test subjects felt MIES was useful is shown in Table 8-3 on a scale of 1 to 7. Note that '7' means that they strongly agree that it is useful. The first round test subjects gave a 5.4 for usefulness; this is good since it is more than the neutral 4.

Table 8-3 *MIES on the campus'* service performance results

	First Test (mean; n=15)	**Second Test (mean; n=22)**
Usefulness	5.4	2.3
Clarity	5.1	4.4
Efficiency	4.9	3.8
Support/help	4.8	3.8
Satisfaction	5.2	3.9
Visual qualities	5.0	5.1

Table 8-3 shows that the first round test subjects answered all service performance parameters positively, meaning better than the neutral 4. This was not the result of the second round test group. There is a big difference in the results between the groups regarding the usefulness of the service. The fact that the first group was the real target group (conference visitors) and the second group not (the students) seems to have had a big impact on the usefulness judgement. This emphasises how important it is to design a service for a specific target group.

Besides the more general service performance, the test subjects were also asked to give their opinion on specific MIES functions. The users' opinions on specific MIES functions are shown in Table 8-4.

Table 8-4 *MIES on the campus'* function results

	First Test (mean; n=15)	**Second Test (mean; n=22)**
Finding buildings	5.2	4.2
Finding people	4.5	4.1
Finding restaurants	4.7	4.8
Campus tour	5.2	3.5
Razor game	4.3	4.6
Finding employees	-	3.5
Finding location	-	5.1
Delft city tour	-	3.9
Sending messages	-	4.1
Browsing the Internet	-	5.1
Chatting	-	3.8
Video clips	-	4.3

In the second test round more questions on specific functions were asked. Here we see that some items were given a negative answer by the test subjects; finding an employee, the Delft City Tour and Chatting all had a mean below 4.

We had to decide whether we could lump the two sets of data we got from the questionnaires for the two test rounds together. We looked at the 11 dimensions that are the sum of the 6 service performance results in Table 8-3 and the five functions results in Table 8-4 that both groups had answered.[1] For this we had to test if the means were equal ($\mu_{1=}\mu_2$). This can be done using a t-test if the data are normally distributed. We therefore first had to determine if the data were normally distributed using a Kolmogorov-Smirnov test and this was the case. The outcome of the t-test was that only 5 of the 11 dimensions that were asked in the two tests could be taken together, and for these 5 dimensions it is also debatable whether the outcomes of the two rounds could be taken together since the data set is quite small. The 5 dimensions are visual qualities, finding buildings, finding people, finding a restaurant and the razor game. Thus we will give the outcomes for all dimensions separately for each round.

The test subjects were asked, using open questions, to say what was their favourite MIES function and what function(s) they missed. Favourite functions of both groups were access to the Internet and the ability of find locations with the navigation program. The conference visitors also mentioned as a favourite the up to date conference information while the students liked the chat function. Functions mentioned that could be improved were the automatic functioning of the login settings and the MIES position updater, the integration of the Internet browser and the navigation program, the possibility to update personal information for example to personalise the conference schedule, content richness for example on health care and museums. Also some recommendations to improve the navigation were also provided.

The general impression is that the test subjects were quite positive about MIES. Despite the fact that there were some technical problems, not all the intended features worked as well as they were intended to and the test subjects had to carry a bag with the devices and chargers, the users loved playing with the equipment; the possibility to access the Internet anyplace, anytime especially was consistently mentioned as a good functionality. The TomTom navigator was found to be a favourite function, this was a surprise since the program needs some time to get to know it.

As in Chapter 7, we will discuss the following aspects of the value proposition: localisation, privacy, handy handsets, content richness and the pricing model. Next we discuss the service process quality dimensions reliability, responsiveness, trust, user interface and customisation.

[1] We also looked at four privacy parameters, which we do not discuss here, but we refer to Ali Eldin and Wagenaar (2004).

Localisation. In studies of location based mobile services using Cell-ID as the location technology, the accuracy of the location information was found to be an important issue for the value proposition. With GPS accuracy is not a problem but GPS does not work within buildings. At conferences especially, in large buildings and in bad weather, it is hard to find people since they are most of the time inside buildings. There are other technologies available for positioning within buildings; this is a topic for future research.

Privacy. Two ways of involving users regarding privacy were applied in MIES (Ali Eldin and Wagenaar 2004). Firstly, an automatic control where test subjects only set pre-defined privacy preferences and based on which a consent decision is automatically generated by the consent provider model. Secondly, a manual control set by the test subjects through messages. The two ways could to some extend reduce privacy problems, allowing more flexibility by controlling which information type could be sent to which users. Neither a completely automatic control nor a completely manual control was highly recommended by the users. The former reduces user involvement, which might threaten users regarding their highly private information. The latter annoys users with a message each time a request is made. It also causes some delay for the requesting user till s/he gets a response.

Handy handsets. A combination of the following equipment was used: an iPAQ PDA, a Nokia 6650 UMTS telephone and a GPS CompactFlash receiver for the MIES experiment. This package of three different devices in a bag was not a handy set. The first devices that integrate mobile telephone and GPS have appeared on the market. Combinations of PDA and GPRS based mobile telephony are also available on the market. UMTS telephones are emerging slowly and the implementations of features like web browsing, Java compatibility, streaming video browsing are slowly realised (Westerveld at al. 2004). It will take a few years till an ample choice of handy handsets with the combination PDA, UMTS and accurate localisation will be on the market.

Another remark on the handset is the problem with the iPAQ memory. When the batteries are empty all the installed software disappears. Since the users did not use the iPAQ in combination with the laptop (to synchronize it or have an image as back-up) this was a major problem. This problem can only be solved by the iPAQ supplier (Hewlett Packard).

Content richness. People are spoiled with the content on Internet and dissatisfied if they cannot find what they want on the mobile Internet. The problem with this is that a lot of web pages are not readable on PDAs and mobile phones. Internet Explorer was one of the favourite features that many of the subjects tried to access, but many Internet pages do not have the right size for the iPAQ screen. The problem will be solved when there is enough demand from customers since only then will content providers start to adapt the web pages. This is a problem beyond the control of the project, in general this is also beyond the control of a service provider when an open platform is offered.

Pricing model. The ESS conference visitors were asked whether they would be willing to pay extra for this service. For most ESS conference visitors the willingness to pay for the

service, including rental equipment was between 5-20 Euros. Some suggested that the cost should be part of the conference fee. Willingness to pay for the service when they have their own equipment was much lower; most people did not want to pay anything in this case. The student test was not suitable for this question. The users' willingness to pay, expresses their appreciation of the service. It was encouraging that the ESS conference visitors said that they would be willing to pay for the service. The reservation that the price should be part of the conference package emphasises the fact that the revenue model for how the service is offered to the customer must be carefully chosen.

Non-functional requirements

- **Reliability.** The performance of the network, applications and devices was an issue. GPS was a welcome addition to the service when it worked. It took a long time to set up GPS, you had to be outside for nearly half an hour before you were able to use it for the first time, and sometimes it did not work, but when it worked it proved to be very welcome. The students were disappointed if the addresses of buildings on the campus walk were not pre-installed in the TomTom application. Pre-programming more addresses would easily solve this problem. UMTS functioned well but not always as fast as expected, see also responsiveness. The Razor game was technically not very reliable, sometimes users had to try five times before being able to play. More programming to make the software more robust would solve this problem.
- **Responsiveness.** Many test subjects from the ESS conference complained about the speed. The students were less negative on this item. Overall we can say that users' expectations of UMTS speed have to be managed at present since the high expectations on response speeds can not be met.
- **Trust.** The feeling of confidence and trust regarding privacy and security and freedom of risk when using MIES was not a problem in the test. There was a small group of test subjects who were all very familiar with the test organisers. Some questions were asked about the security of accessing personal email via the web exchange server on the iPAQ.
- **User Interface.** The structure of the iPAQ sites was quite straightforward and the test subjects appreciated this. Users had a few problems with the layout of the service, e.g. the back buttons, resizing, and the exit-possibility. There were big problems with the 'external web pages', pages that were not presented in the format of the *'MIES on the campus'* project.
- **Customisation.** The information in *'MIES on the campus'* was updated for each test, but this is not something that we would label customisation. In this project the information presentation was not tailored for the user's preference e.g. by using different formats. Users could upload their profile via the Internet so that other users could find them based on search criteria. Different information was presented at the

searchers according to the user's profile privacy settings. This quality parameter has to be further exploited in future research.

This action research project showed that the trade-off between the service formula and technology is severe.

8.4.2 Technology - value network trade-off

The results of the interviews with 12 partners and participant-observation provided essential information that allowed us to gain an understanding of the partner's point of view regarding the value network related issues. This subsection contains the discussion of the first three guidelines, related to the technology interdependencies, content interdependencies and time constraint.

Technology interdependencies

Guideline V1: actors in the network can only start to design applications if a proven service IT architecture is provided by the leading actor as basis for the various applications.

This guideline was found to be unclearly formulated. What is exactly meant by 'proven Service IT architecture'? An often-made remark is that you should have space to start an experiment in innovative projects; and that a guideline like this might hinder evolutionary developments. One person mentioned that projects are often too hectic to work according to this guideline. The principle in the MIES project was that we did not want to develop new technology but to use existing technology. In the mobile environment many technologies are available but they are not robust or they are not fully proven as yet. This principle cannot be followed completely if you want to fulfil user requirements. We had to investigate what was available and then get started. So this guideline has to change. It should reflect the idea that design has to start with user requirements and technical decisions have to be considered along with system constraints (Isaacs and Walendowski 2002). If conflicts arise, collaboration is needed to achieve an alternative and acceptable design. The problem of the programming in both ASP and PHP language shows that it is important to decide on the web services platform.

Improved guideline V1: Actors in the network can only start to design mobile applications if it is clear which components are available for providing a mobile information service, what the components' constraints are (e.g. accuracy of location) and to what extent the components fulfil the service requirements. The user interface, navigation and application designers must collaborate intensively to achieve an acceptable solution.

Content interdependencies

Guideline V2: the Service Provider, Mobile Network Operator and Content Provider are the triad that forms the core of the value network.

The needed roles (see Table 7-1) vary depending on the design round. In the service innovation phase different roles are more important than in the business development

phase. In this case study we saw that the application developers are very important during the design activities. The actor who also fulfils the role of service provider might perform this role but this does not have to be the situation. The mobile operator is important in both the service innovation and business development phase. The role of the content provider is different in both phases. The content has to be developed, including the navigation and user interface design during the design process. In the business development phase this has to be maintained. An interviewee correctly added that the customer is also part of the core value network!

Improved guideline V2: the Service Provider, Mobile Operator, Content Provider and Customer are the core of the value network during the exploitation phase. The Application Provider, Mobile Operator, Content Developer and Customer are the core of the value network during the exploration phase.

Competitive & time-to-market pressures

Guideline V3: take your time to establish a value network and speed up the development process when that is in place.

There were only a few comments on this guideline. The answers were in the middle and this can be interpreted as the interviewees did not have a strong opinion. One comment was that the service design process should start with the user and not with the firms. This guideline might give the impression that a design process should start with the establishment of a network of firms but we mean a value network including the customer. The MIES project in total took about 9 months, from April to December 2003. However, for most partners the project took place in September and October when they worked on the Preparation and Synthesis activities. The analysis phase was not labour-intensive but it took time. The GDR sessions with users could have been organised in a shorter time period, but getting the network of actors together could not be done in a shorter time. It takes time to scan the market for partners, to make appointments, to get to know each other, trust each other, etc. Working with familiar people can shorten this time. This is related to the guideline on embedded relational ties, see subsection 8.4.3. This guideline is accepted.

8.4.3 Value network - service formula trade-off

The results of the interviews with 12 partners and participant-observation provided essential information on the value network and service formula trade-off. This subsection contains the discussion of the guidelines related to the uncertainty in demand and value constraint.

Uncertainty in demand and value

Guideline V4: the targeted user has to be part of the design approach in all phases of the design process.

This guideline led to extremely different responses. For some people it is an open door; for others it is not true. One person stated that if you want to fulfil all the users' wishes you would get a bad project. An expert has to make decisions. Another remark was that users

cannot be involved in building activities like application programming. A remark concerning the application of this guideline in the MIES project was that users could have been more involved in design decisions during the MIES project. This guideline was not accepted and it was combined with the following guideline.

Guideline V5: the design approach has to start with the investigation of the targeted user's context, wants and needs.

Most partners agreed or strongly agreed with this guideline. Only one person stated that user requirements should also be regarded from a technology push point of view. There is some validity in this since we can only design services for which technology is available. We combined the feedback on V4 and V5 and derive the following guideline:

Improved guideline V4 and V5: the design approach has to start with the investigation of the targeted user requirements and these must be matched with the capabilities of the available components. During the design process users must frequently test the in-between results of design decisions and provide feedback on this to the designers. The designers are the experts who decide how to process the feedback.

8.4.4 Internal network factors

The internal network factors consist of the business model and the embedded relational ties. We will discuss the business model by expounding the actors, roles and their benefits. The revenue model was not elaborated enough to receive feedback from the partners.

Actors, roles and benefits

Guideline V6: at the start of the project the role list must be checked and it must be decided which roles have to be performed and which actor(s) will fulfil which role.

The partners agreed on this strongly in theory but not with how it was applied during the MIES project. This might have been caused by time pressure but could have been a result of the group dynamics. One person mentioned that working with powerful actors means that roles may change. Most people stated that it is important to agree on the role division at the start of the project. We keep this guideline with the statement that roles might change during the design process. If this is the case, this change of role should be clearly communicated to the project team.

Improved guideline V6: at the start of a project the role list must be checked and it has to be decided which roles have to be performed and which actor(s) will fulfil which role. Roles might change during the design process and this has to be communicated to all the involved actors.

Guidelines V7, V8 and V9 are related and discussed together.

Guideline V7: take into consideration when creating a value network that the purpose of network membership and working with partners in an innovative undertaking is not to generate revenue.

Guideline V8: take into consideration when creating a value network that the value of network membership and working with partners with an established reputation in an innovative undertaking is that it supports a firm's image.

Guideline V9: take into consideration when creating a value network that the value of network membership in an innovative undertaking is to learn and to achieve a competitive advantage.

Not all interviewees answered these guidelines because some researchers did not have an opinion on this. It is evident that there should be a win-win situation for all participants. In the long run this win has to be expressed in a financial way. In the short term value is gained from improving actors image and gaining experience. One respondent remarked that there are partners with an established reputation, but that this might be a reputation with which you do not want to be associated. E.g. when a small company wants to establish an innovative, entrepreneurial image, it might not want to be associated with a (large) firm with an established but conservative image. All the involved firms were asked what the benefit was for them to participate. In the short term earning revenues was not an option for any of the partners since they were not paid and a market launch was not planned. Nevertheless they saw other benefits that made them decide to participate. The research opportunities were the major reason for the research organisations. Reasons such as getting experience, image and thus revenues in the long run were important for the corporate partners. An important reason to participate for the consultancy firm The Vision Web was that T-Mobile is one of their most important customers. An overview of the interviewees' answers is provided in Table 8-5.

Table 8-5 Benefits for participating organisations

Benefit	**Organisation**
Innovative project that support business goal	TVW
Chance to get experience, to learn, to bring ideas into practise	Ex Machina TUD section ICT Delft Plaza T-Mobile
Imago, reputation	Ex Machina TUD section ICT Delft Plaza
Revenues in the future	TVW TUD section ICT
Research opportunity	TUD faculty of IO TUD section SK
Nice project for trainee	Delft Plaza
Feedback from positive critical users who search for limitations	T-Mobile
Preparing for commercial launch	T-Mobile

We also asked the interviewees to give their personal reasons for participating. Most people answered that the company benefits also counted for them personally. Other personal benefits that were mentioned were it is my job and I was available (3 times); it is my expertise and I've an affinity with the subject (3); a nice and different project (1); to test my ideas (2); to get experience (2); nice on cv (2); study points (3); to work with other persons (1); to help a colleague (1) and to build relationships with some of the other people on the project (1).

Improved guidelines V7, V8 and V9: take into consideration that in the end the value of network membership in an innovative undertaking with partners is increasing profit. This might start with a project on innovation where participating is motivated by gaining experience, learning and establishing a reputation.

Generating revenue is replaced by increasing profit since the reason to be part of a value network might also be to cut costs.

Embedded relational ties

Guideline V10: reduce uncertainty by using embedded relational ties when creating a value network.

The interviewees strongly agreed on this guideline, in theory and even more so for the MIES project. They argued that especially in innovative projects under time pressure it is important to know the right people if you are searching for some knowledge. This guideline is related to guideline V3. There were also warnings of the disadvantage of this principle; personal relationships may influence professionalism. This guideline is accepted.

8.4.5 Confrontation with the prescriptive way of working, controlling and modelling

In this subsection we look back at the collected evidence on how the project went and compare this with the design approach described in Chapter 7. Some design activities were executed satisfactorily, some were not executed, and some were not satisfactorily executed.

Table 8-6 Confrontation prescriptive conceptual and empirical model

	Activity	Done	Remark
A.V.1	Process Design	Yes	The actors' scope rested heavily on the embedded relational ties. Remarks for organising the project management: • plan go/no go moments more explicitly • keep track of design decisions made, make them explicit and communicate them to all involved actors • defining roles, responsibilities and tasks is important in every phase.

	Activity	Done	Remark
A.V.2	Agreeing on intention and external communication	Yes	Besides agreeing on participation it is already necessary in this phase to make clear who is going to communicate what externally, to the press etc. The mobile operator especially required communication contracts.
A.T.1	Scan available technology	Yes	The available technology was to a great extent determined by the mobile operator.
A.T.2	Overview functional/technical design decisions	Not explicitly enough	The storylines were not specific enough as a basis for functional requirements. One of the important lessons learnt is that the functional requirements should have been clearer. One supplier mentioned that technical requirements are not formulated in projects under time pressure. He advocated that the only thing that counts is to make it work and people use the trial and error method.
A.S.1	User requirement elicitation	Yes	A very important activity. This activity was academically very interesting; we published a paper on this activity and got ideas for further work. A remark on activity A.S.1 was that users should get feedback on what is done with the outcome of the GDR sessions. Asking for feedback on design decisions for users would do this. This should be added as a process control activity.
A.S.2	Analysing existing services	Yes	Navigation designers investigated other visitor/tourists sites before they started their design.
A.S.3	Drawing storyboards	Yes	We made storylines with little stories and pictures. We had leaflets and posters with these storylines and this worked really well.
P.V.1	Kick off meeting incl. Collaborative design session	Yes/No	A kick off meeting to get to know each other is important. We organised such a meeting with drinks. The planned collaborative service design session with partners was not executed. One of the partners mentioned

	Activity	Done	Remark
			that he would have liked a GDR session as done with the users but then with all the partners. This confirms that activity P.V.1 including a collaborative service design session should have been taken place.
P.V.2	Business case for each partner	Yes/No	The partners did this more implicitly. All had their own reasons to participate. T-mobile had a planned budget for the whole UMTS testbed. The investments of the other partners were relatively low and they decided to spend time or money when a decision had to be made. Their benefits are mentioned in subsection 8.4.4.
P.V.3	Defining roles, responsibilities and tasks	Yes/No	The project initiator took care of the coordination of the activities to keep the network intact. This also included social activities like a kick-off meeting and a dinner at the end. The governance model to manage the content providers can be described as a 'thin-walled-garden' model managed by the Service Provider. The project leader for technology was explicitly appointed and he organised weekly sessions to discuss design decisions and the progress of the project. A service project leader was missing and critical comments on this were made during the interviews.
P.T.1	Technical architecture design	Discus-sion	Figure 8-5 was the object of discussion for some weeks and later people also mentioned that they had missed a more detailed overview.
P.T.2	Selection of technical components	Yes	Not all components as mentioned in P.T.2, were build in this project. The billing system was not part of the project. Security also did not get explicit attention. Both these system components have to be taken care of in a next design round.

	Activity	Done	Remark
P.T.3	Installing platform	Not at first	This was not been done properly. During activity S.T.1 different teams did the programming for the privacy and the localisation application. It turned out that they had used different software languages and the impact of this was that different servers were needed. The solution in the first version of MIES (for the ESS test) was that templates had to be copied and if one team changed something in the template the user saw differences in the MIES menu. This was of course not what was wanted. In the second version of MIES all applications were reprogrammed to the same language.
P.T.4	Application design	Yes	This was difficult for some designers because they missed a more detailed technical architecture design, see P.T.1.
P.S.1	Content design	Yes	The various content providers designed their part of the 'MIES on the campus portal'. None of them used the planning matrix of QFD.
P.S.2/ P.S.3/ P.S.4	Navigation, User Interface, Test	Yes	The different content ingredients were integrated in this activity. This was very well done; see the report of Weenk and Schiffers (2003).
S.V.1	Defining roles, responsibilities and tasks	No	All the tasks were executed in an informally managed way.
S.V.2	Calculating benefits and costs	No	Too much time pressure.
S.T.1	Programming and scripting	Yes	Different persons designed different applications, see P.T.3. There were two kinds of comment on this activity related to 'writing documentation'. Some programmers said that this should be done automatically. There are programs for software programming that automatically produce the documentation. Other partners argued that this is never done during work on a project

	Activity	Done	Remark
			under time pressure but it is a task that should be done afterwards.
S.T.2	Assembling and testing different components	Yes	One day all the programmers sat together and assembled all the building blocks and solved any problems that appeared.
S.T.3	Pre-testing prototype	Not enough	An important test for the mobile operator was to put all the UMTS devices on at the same time. This went well. Many technical problems appeared during the test subject's test that could have been avoided by better technical testing of the applications.
S.S.1	Deciding on service quality and customer communication	Yes	This was done without problems for the purpose of the test in which branding of the service and the communication with the users could take place on a very low level. This activity requires much more attention in a second round of the design approach.
S.S.2	Privacy and legal aspects	Yes	Privacy was handled as a separate project (See Ali Eldin and Wagenaar 2004). Legal aspects concerning liability were taken care off.
IT.V.1	Execution of tasks	Yes	All the tasks were executed in an informally managed way.
IT.V.2	Analysis of the business case	No	The partners reported individually on the benefits they got out of the project. The first plan was to organise a meeting with all partners to discuss the joint business case for the service and to discuss how cost and revenues could be divided into the exploitation phase. However, since no exploitation plans were in place such a meeting was not worth the time and investment.
IT.T.1	Preparing the equipment	Yes	Activity executed under heavy time pressure by very inventive students who solved all the problems creatively.
IT.T.2	Support of developers during test	Yes	No remark, activity executed without problems.
IT.T.3	Monitor usage and	Yes	No remark, activity executed without

	Activity	Done	Remark
	providing standby support		problems.
IT.S.1	Organising the launch	Yes	No remark, activity executed without problems.
IT.S.2	Distribution	Yes	No remark, activity executed without problems.
IT.S.3	Gathering user's experience	Yes	No remark, activity executed without problems.

8.5 Conclusions and suggestions for further activities

Most elements of the design approach were prescribed and well executed. The prescriptive design approach needs to be applied to more cases before it can be said to be a 'validated' design approach. However, the 'MIES on the campus' action research project was a worth while first time application of the prescriptive design approach given in Chapter 7. Some design activities were prescribed but not well enough executed or were not executed as all, as explained in above in Table 8-6. Based on the interviews with the partners we will discuss the activities that might improve the design approach further if they are well executed in future projects.

- An overview of technical and functional design decisions. We found that the gap between the storylines and the programming required for 'MIES on the campus' was too big. The overview we had of the technical functions and the technical architecture design was not clear enough for the programmers. The technical project leader argued that functional design and technical design can only be done later in circumstances of time pressure since you cannot build a service fast if you first have to build a detailed technical architecture. The discussion reflects the contrast between proponents and opponents of rapid application design. It is a challenge to find a way to do this satisfactorily during the design phase. [A.T.2 and P.T.1]
- Collaborative service design session with all partners. It was intended to hold such a session, based on the EasyWinWin approach from Briggs and Gruenbacher (2002), at the start of the project. However, somehow it did not happen. This may have been due to bad time management ('there was no time') or due to a lack of interest on behalf of the partners. It would be worthwhile to do a follow up project with this activity explicitly included. [P.V.1]
- Installing the platform. The installation of the web services platform was not well orchestrated. This taught us that it is very important to make a centralised decision on runtime environments. [P.T.3]

- Business case analysis. One of the important value network issues is related to the revenue model. The test subjects were asked how much they were prepared to pay for the service. This has to be assessed by estimating the costs necessary to develop and maintain service, the expected amount of users and the price they want to pay for the service. These revenues and costs from input for the revenue model, which shows how these costs and profits are divided among the participants. Such a revenue model must be negotiated with all the involved partners. [IT.V.2]

Improvement of a design approach is an ever-continuing activity and interesting suggestions for further research can be found, both for the service 'MIES on the campus' and the design approach.

Research into improving the 'MIES on the campus' can be summarised by recommending more research into the development of more advanced context aware mobile services. Recommendations of test subjects in the 'MIES on the campus' project were related to the automatic functioning of the login settings, the integration of the navigation program and web browsing, optimalisation of handy handset usage, localisation within buildings, the functioning of personal profiles and the richness of the available content.

Further research on the design approach should focus on improving the first three above-mentioned activities since these were considered as activities that might improve the design result substantially. The last activity falls in the next round of the design approach. This should be organised with the intention of taking a closer look at the business model of 'MIES on the campus'. Under what conditions do the partners want to launch this service on the market? Do the partners forecast a good business case for their role in the value network that offers the service? A whole round of the APSIT approach needs to be repeated, this should be easier than the first time. After the second round it should become clear if it is necessary to go through the APSIT approach for a third time before the market launch.

9 Epilogue

In this research we explored an approach to design mobile information services. We summarise the main research findings of our search in this chapter. Furthermore, we reflect on our research strategy and research instruments. Finally we present an agenda for further research.

9.1 Research findings

The objective of this research was:

'To develop and test an approach for designing mobile information services, which can be used to support organisations creating a value network and to coordinate activities within that value network.'

We formulated a central research question supported by three underlying research questions to help us achieve this research objective. We will answer the underlying research questions in subsection 9.1.2 and the central research question in subsection 9.1.3. First, we will discuss our application domain findings.

9.1.1 Application domain

The telecommunications industry wants customers to embrace mobile data solutions since it has invested so heavily in its mobile networks. In Chapter 3 we showed that this process is surrounded with many uncertainties. We regard the search for the so-called 'killing app' as not very fruitful. In stead we argue for a systematic analysis of mobile services to derive guidelines for designing mobile services. Our application domain involves the design of mobile information services with a particular interest in services that comprise the location feature; the location-based mobile services. In this study we carried out four case studies. The services that we selected for our case studies were all based on new mobile technologies at the time of the study while at the same time making use of existing building blocks. We did not study the development of new technologies like WAP and UMTS but how they were applied in service design. The user requirements of all four services were uncertain. Various actors needed each other to design a service and bring it on to the market, mostly under time pressure.

The first case study dealt with the M-info service, launched by KPN Mobile under enormous time pressure in 1999. In fact, the technology was too limited to respond to the user requirements. The perceived failure of WAP had a boomerang effect on the whole mobile information services industry. M-info was on the Dutch market from 1999 until the first of April in 2004 and the case nicely illustrates the evolution of mobile information services in that period. The design approach of this service was based on a way of working that KPN Mobile was used to. At that time there was no special policy for dealing with other actors

like content providers. They made contracts as they always did in 'normal' business. The appearance of the Japanese iMode services changed this.

The success of iMode in Japan made the mobile operators in Europe think about how to cooperate in the merging sector of telecommunication, IT and media. NTT Docomo became a shareholder in KPN Mobile. Japanese and European business developers, product innovators and marketers started to work together on the launch of iMode in the Netherlands and Germany; using the content governance model or ecosystem approach of NTT Docomo as a basis (Natsuno 2003). We took a closer look at two of those iMode services in our second and third case studies. Since we are especially interested in location based services we searched for such a service. This was not available in the Netherlands so we went to Germany. The development of this location-based iMode service, Finder, deviated from the standard iMode approach. This was because of a lack of experience with location-based services in combination with time pressure due to the fixed goal to launch a location-based iMode service at the CEBIT in 2002. The other iMode service, Radio 538 ringtune, was developed to conform to the iMode model without any serious problems. The key actors KPN Mobile, Tutch and Radio 538 already had experience with doing business together. All three were also very experienced in the role they had to perform, their core business. In this case other problems arose like handsets that could not support some ringtune applications and legal issues around music rights.

The last case study concerns the pilot of a UMTS service. During the time of the pilot UMTS was not available on the market and European mobile operators were all busy starting up and executing UMTS pilots; T-Mobile's UMTS testbed at the campus of Delft University of Technology was one such pilot. This was a good occasion to get experience with our developed design approach. It fulfilled the requirements of a new technology, a multi-actor situation and unknown user requirements. The project also fitted to our criterion to work under time pressure since we had our sights set on a conference to be held a few months after the first contact with T-mobile.

An overview of the case studies is provided in Table 9-1.

Table 9-1 Overview case studies

	Case 1 **M-info**	**Case 2** **Radio 538** **Ringtunes**	**Case 3** **Finder**	**Case 4** **MIES on the campus**
Status	On the market [1999-2004]	On the market [2002-….]	On the market [2002-….]	Pilot [Oct/Dec 2003]
	Exploration/ Exploitation	Exploitation	Exploitation	Exploration
Design process is based on	Internal procedure of KPN Mobile	iMode content governance model	iMode content governance model	Chapter 7
Service Formula Anyplace Anytime	Browsing on the Internet	Downloading popular tunes and DJ voices	Finding the nearest hotel, restaurant, taxi or ATM	Access to information and entertainment during visit
Target group	Young professionals	Radio 538 listeners (12-30 years)	Consumer market (broad)	TU Delft Campus visitors (very specific)
Location-based	No	No	Yes	Yes
Technology				
Mobile network	GSM	GPRS	GPRS	UMTS
Positioning info	-	-	Cell ID	GPS
Application(s)	Web browsing with WAP	iMode Ringtune downloading	iMode Location finding	Web browsing, location and people finding, game.
Handset(s)	WAP enabled mobile phone	iMode mobile phone	iMode mobile phone	UMTS phone, iPAQ and GPS receiver
Value Network				
Network organisation	No, hierarchical organisation oriented. Two-way relationships	Yes, network organisation oriented. Three way relationship	Yes, network organisation oriented. Three way relationship	Yes, network organisation oriented. Relationships not crystallised
Centre of gravity	Mobile operator	Mobile operator, application provider and branding partner.	Mobile operator and application provider	Service provider
Governance model	Managed portal and access to other sites.	Walled garden	Walled garden	Managed portal and access to other sites.
Governance mechanisms	By contract	Revenue model	Revenue model	Not established

As can be seen from Table 9-1 there is a difference between the first three inductive case studies and the last test case study. The last service was only used in a pilot and the first three were launched on the market. This has implications for the observations that can be made, e.g. the relationships in the 'MIES on the campus' case were not crystallised in such a way to allow the network organisation and governance mechanisms to be established. The setting of the case was truly in the exploration phase with all the characteristics of low control and low centrality. The last case is the only case where the centre of gravity is not the mobile network operator but the service provider. There are not many examples of mobile information services launched on the market where the operator plays a minor role. It is worth investigating the reasons for this. The differences between the case studies also imply limitations for our research.

1. In the first three case studies we did not include the user experiences. The studies focussed on the supplier's point of view and the question remains how useful and easy-to-use these services were from the user's point of view. It is clear from the market response to M-info that users did not accept the service. The information on the usage of Radio538 ringtunes and Finder is not sufficient to draw any conclusions.

2. In the last case study 'MIES on the campus' we did not go into the phase of establishing the business model. The actors participated for other reasons than financial profit as explained in Chapter 8. It would have been nice to negotiate the business case with them for the service. Since the only option was to do this as a hypothetical situation we decided to postpone this for further research.

9.1.2 Research questions

Before we answer central research question we will look at our findings for the three underlying research questions.

Research question 1: What are mobile information services and how do they evolve?

We started by defining mobile information services based on definitions of services and e-services. After looking at uncertainties concerning mobile information services we argued that mobile information services should be regarded as systems. In Chapter 4 we argued that the design of mobile information services is actually the design of mobile information service oriented systems since the characteristics of systems, as described by Sage and Armstrong (2000), are in force on mobile services We derived a definition of mobile information service systems based on the definition of systems and the mobile information service definition.

A mobile information service system is *'a group of components that work together for delivering (a series of) activities of an intangible nature when the customer is mobile and a mobile telecommunications network supports the interactions through an Internet channel*

between customers and service employees (or systems of a service provider) which are provided as solutions to customer problems'.

The technology that enables mobile information services evolves very fast and the lack of standardisation causes confusion in the market. This counts for all the layers that form the mobile service system, e.g. the telecommunications network and the webservices platform, consisting of operating systems and browsers with markup languages. A variety of devices is available such as mobile phones, smart phones and Pocket PCs like the iPAQ. The introduction of new services enabled by new technology is mostly hampered by the limited capacities of the handsets at present available in the market (Carlsson et al. 2004). One of the major challenges is to standardise the technology. If the mobile service architecture consists of interchangeable hardware and software building blocks is will be able to support a wide range of services across devices, networks and platforms.

One of the features of mobile information services is that they can use the position of the customer to leverage value. Several technological solutions exist to provide positioning information that is necessary for location-based services. The choice of which technical solution to use is related to standardisation, investments and market expectations. Although an increase in the use of GPS based navigation systems in cars could be observed in the market in 2004, the provision and adoption of location-based mobile services was slow to take off between the years 2000 and 2004.

Research Question 2: What are the methods currently used for designing services? What are the advantages and disadvantages?

Since we decided that mobile information services can be regarded as mobile information service systems we take a system's thinking approach. System engineering is ambiguous and many system-engineering approaches exist. The common notion is that it deals with complex systems and that many issues from different disciplines have to be dealt with. An overview of applicable design approaches, which have systems thinking as underlying view, is presented in Chapter 4. An overview of design approaches for Collaborative Business System Engineering, Process management and Product design is provided in Table 4-2. These design approaches are complementary and together provide useful elements for a service system design approach. What is essential to such an approach in a multi-actor setting is that actors should collaborate. In Chapter 1 we wrote that this research builds further on the collaborative business engineering (CBE) approach as applied in case studies for over a decade and described by Den Hengst and De Vreede (2004). We want to have both the terms 'collaborative' and 'systems' added to business engineering since both the collaborative aspect and systems thinking aspect are important for our research purpose. Information system theories are also useful and the waterfall and spiral model especially are worth mentioning as ingredients for our design approach (see Boehm 1988).

We base our theory on CBSE and explicitly add process management ideas to deal with the strategic behaviour of the actors during the creation of a network. De Bruijn et al. (2002)

position process management versus project management. We argue for the best of the two worlds for mobile information service design. We need project management to manage the actual design activities, for the application design, content design etc. For these activities we borrow from the product design theories of Roozenburg and Eekels (1995).

Research question 3: What are the critical elements when designing mobile information services and what are the possible solutions?

Mobile service designers must have knowledge of customer values and fast developing technology, and at the same time be able to create a network organisation with benefits for the participating actors. These are three critical elements that we further explain below.

- Unknown user requirements, caused by fast developing technology and a lack of knowledge on what value propositions, with which pricing model, are rewarded by customers. User requirements differ per target group, so it is important to decide the target group upfront. Decisions have to be made on: the extent to which localisation is offered, privacy is dealt with, handsets are available that support the services, and the quality and richness of the content.
- Fast developing technology with non-standardised components. Technology that develops fast often lets users down. Technology can still be considered as an enabler but with limitations. It is critical that the technology supports services that users can perceive as reliable, responsive, with easy to use user-interface, to be trusted and customised. Expectations should be managed since technology is limited.
- Large number of involved stakeholders. Organisations with different resources need each other to work together to design a mobile information service. They have to collaborate in what we call a 'value network'. The mobile operator, content provider, service provider and customer are dependent on each other. In the design phase there are even more actors like the handset provider, IT company and hardware suppliers. Resource and financial interdependencies drive suppliers to develop a business model together. Furthermore there are constraints related to time to market pressure and the above-mentioned uncertainty in demand that influences organisations to work together.

The solution for dealing with these critical elements in a design approach is to consider mobile information services as systems. The above three mentioned perspectives have to be embraced to design these systems. The design approaches found in literature partly offer means for the design approach. The solution we offered started with the combination of choices of elements drawn from the mentioned theories on CBSE, process management and product design, which we further enriched to provide a design approach for mobile information service systems.

9.1.3 Designing mobile information services

The central research question in this thesis is formulated as:

'How can interdependent actors in a network organisation design mobile information services that can be used anytime, anywhere, personally, and location-based?'

The answer to this question is a design approach that we will formulate as a way of thinking, controlling, working and modelling.

The *way of thinking* delineates how we observe the application domain of the design method. This application domain consists of mobile information service systems that are the result of the design activities in an environment with trade-offs between (a) service formula and technology, (b) technology and value network and (c) value network and service formula. Technology has to support the services customer demand, but this demand is uncertain and technology often cannot meet the customers' requirements. These requirements are related to localisation, privacy, handsets, content richness, pricing model and non-functional requirements like reliability, responsiveness, user interface, trust and customisation. Suppliers need to collaborate with other partners in a network organisation or 'value network' to meet the challenge of designing mobile information services that fulfil these requirements. The creation of such a network is influenced by external network factors and internal network factors. The external network factors consist of resource and financial interdependencies, and constraints. The internal network factors consist of the business model and the embedded relational ties. We formulated the following design guidelines to deal with the factors that are related to the trade-offs between the technology and the value network, and the value network and the service formula.

- Actors in the network can only start to design mobile applications if it is clear which components are available for providing a mobile information service, what the components' constraints are (e.g. accuracy of location) and to what extent the components fulfil the service requirements. The user interface, navigation and application designers must collaborate intensively to achieve an acceptable solution.
- The Service Provider, Mobile Operator, Content Provider and Customer are the core of the value network during the exploitation phase. The Application Provider, Mobile Operator, Content Developer and Customer are the core of the value network during the exploration phase.
- Take your time to establish a value network and speed up the development process when that is in place.
- The design approach has to start with the investigation of the targeted user requirements and these must be matched with the capabilities of the available components. During the design process users must frequently test the in-between results of design decisions and provide feedback on this to the designers. The designers are the experts who decide how to process the feedback
- At the start of a project the role list must be checked and it has to be decided which roles have to be performed and which actor(s) will fulfil which role. Roles might change during the design process and this has to be communicated to all the involved actors.

- Take into consideration that in the end the value of network membership in an innovative undertaking with partners is increasing profit. This might start with a project on innovation where participating is motivated by gaining experience, learning and establishing a reputation.
- Reduce uncertainty by using embedded relational ties when creating a value network.

The *way of controlling* differs in the exploration and the exploitation phase. In the exploration phase theories of project management and process arrangements are helpful. Process management is especially helpful for the phase of creating the value network. If the network is established, project management helps companies to reach the goals agreed on during the network creation process. In the exploitation phase governance mechanisms such as contracts and revenue models can be used to control the value network.

The *way of working* activities can be categorised into analysis, preparation, synthesis, implementation and test. User requirements are uncertain and therefore the inclusion of users is mandated. Before the very first activity starts radical thinking is necessary to come up with the first idea. For this a combination of creativity and uncertainty reduction is required. Next, the way of working consists of a combination of an iterative and incremental working method. Within a phase there might be iteration between design activity steps like preparation and synthesis. When a phase is completed, e.g. when a prototype is tested or a first version of a service is launched on the market, the initiator may choose to undertake an incremental improvement of the service. We refer to Section 7.3 for more details.

Taking into account that the *way of modelling* was not the focus of the research we will now mention some models we came across during the research process, in the literature and during the case studies. Models are helpful means interacting with users; examples are storyboards and prototypes. Other useful models that can be used in the design process are component architecture modelling, context modelling and interface modelling. The organisation can be modelled using actor and role models. The way of modelling in service design requires much more explanation and we recommend this as a field for further research.

9.2 Research approach

In this section we discuss the research strategy and research instruments used to obtain the results of the study. The nature of our research was exploratory, focussing on building a new body of knowledge for designing mobile information services that arise in the merging sectors of telecommunication, IT and media. Therefore, to pursue our research objective we followed an inductive-hypothetic research strategy. Following this strategy we performed empirical studies. The research retained an exploratory character throughout. A variety of research instruments were used throughout this PhD thesis. We held experts sessions, performed case study research and did action research. We provide an overview of these research instruments in Table 9-2 and further reflect on this below.

Table 9-2 Overview research instruments

Instruments	Expert input MOBUS	Expert input Survey	Case 1 M-info	Case 2 Radio 538 Ringtunes	Case 3 Finder	Expert input GSS session	Case 4 MIES on the campus
Described in	Chapter 3 pp. 32-34	Chapter 3 pp. 35-38	Chapter 5 pp. 62-76	Chapter 5 pp. 76-84	Chapter 5 pp. 84-93	Chapter 6 pp. 112-114	Chapter 8 pp. 145-182
Setting	Six workshops [2001]	Surveys [2003]	Action research Project [1999] Interview [2002]	Interviews [2002]	Interviews [2002]	Facilitated GSS session [2002]	Pilot on testbed [2003]
Research **- Phase** **- Method** **- Role of researcher**	 Initiation Focus group Participant	 Initiation Survey research Pollster	 Initiation Action research Participant-observation	 Initiation Case study Interviewer	 Initiation Case study Interviewer	 Abstraction Focus group Problem owner	 Implementation Action research Initiator and Participant-observation
Participants and respondents	10 participants from 6 organisations.	9 original MOBUS participants and 9 other experts.	One company, many project members	3 respondents from 3 companies.	4 respondents from 3 companies.	7 participants	12 interviewed participants from 7 organisations
Objective	To generate and work out new ideas for UMTS based services	Update of uncertainties two years later	Get hands-on experience with mobile service design	Collect experience from directly involved managers	Collect experience from directly involved managers	Improvement of preliminary design approach ideas	Validate developed design approach
Outcome relevant for this study	List of uncertainties.	Updates list of uncertainties.	Insight in design issues	Insight in design issues	Insight in design issues	Feedback	Experience with developed design approach

The three instruments used to gather expert experience are shown in Table 9-2. From experts sessions during the MOBUS project we derived insight into mobile data solutions in the future. The project was aimed at developing services for the financial sector, but for the purpose of this research we used the findings in the project related to uncertainties for mobile information services. This list of uncertainties was so interesting that we wanted to find out the experts' opinion two years later and arranged a survey, as described in Chapter 3. The role of this information in this research was to provide background information, and to provide insight into the more long-term issues relevant in the development of mobile information services. The last expert session was focused on the design approach. Experts came together in a Group Support System session facilitated by a professional facilitator. First sketches on the design approach, pre-pre-precursor versions of Chapter 7, were presented and the session participants provided feedback. A characteristic of this type of information gathering is that it relies on the participation of people in the actual application field. The output depends heavily on the knowledge, experience and ideas of the participants. Another group of participants might lead to different feedback. Nevertheless the session went well in terms of participants and problem owner satisfaction. The session delivered valuable ideas for the design approach. It is probably superfluous to say this but we would like to mention that the survey and group sessions can only be used to gain indications about the direction of opinions and may not be used for statistical generalisation.

We used case study research and actions research as the main research instruments to collect empirical data. The weakness of these instruments is that the findings are based on limited practical situations and cannot be generalised. We therefore chose not to go for a single-case study but for multiple-case studies, this was not to obtain statistical significance but to provide representative power to answer the 'why?' and 'how?' questions. The three inductive case studies, M-info and the two I-mode services, fit into this objective. The fourth case study 'MIES on the campus' is unmistakably an action research project with the purpose of providing feedback on the 'how to?' question. We wanted to know if the developed design approach was applicable. Therefore we took the initiative for the project and had a dual role. "A dual role as participant and observer enables researchers to study unique situations, but also creates the potential for bias, because the researchers can become advocates for the groups or phenomena under study" (Yin 2003). During the 'MIES on the campus' project we asked the test users to fill in questionnaires to receive feedback on the service formula and we discussed the results with them. The partners who were engaged in designing the service were interviewed based on a protocol; in this way we avoided the potential for bias.

Finally, we would like to make some remarks on literature research. We can distinguish two kinds of relevant literature, general academically accepted literature and mobile domain specific publications. The first kind was useful to gain a better understanding of system engineering and design theories for organisations and products. The literature on strategic management, (service) marketing and innovation delivered material for a more

comprehensive understanding of value creation in mobile business. Literature specifically focussed on the mobile domain is relatively new but expanding fast. Established conferences have recently initiated tracks on mobile commerce, e.g. HICSS, Bled, AMICS and ECIS. Journals have released special issues on mobile services, e.g. e-services journal and IEEE transactions on systems, man and cybernetics. Conferences and journals dedicated to mobile business have also begun to appear, e.g. the International Conference on Mobile Business and the International Journal of Mobile Communications (IJMC). The question is whether the mobile domain is rigorous enough to survive as an academic field.

9.3 Research agenda

This study taught us many lessons regarding the design of mobile information services and also gave rise to new questions. We developed guidelines and recommendations for work methods to design mobile information service systems. Nevertheless we argue that every situation will be different and that creativity and flexibility to deal with this are the most important ingredients for success. Academics and practitioners would benefit from more research in this emerging field where both parties might gain from cooperation. The research questions that we still want to answer are related to the design approach and to the mobile information services. We divide future research recommendation on the design approach into three parts.

Future research on the design approach for first round appliance

In the 'MIES on the campus' case we applied the design approach presented in Chapter 7 for the first time. The approach should be tested, improved and tested again a number of times to perfect it. The following aspects of the design approach came up in the 'MIES on the campus' case as interesting subjects for future research.

- How should the bridge between the service formula and application design be made? For example, should we first make an elaborated technical architecture design, or use a more rapid application design approach with a lot of iteration?
- What is the effect of collaborative service design session with the key partners involved? Do we still want to apply the easy winwin method (Briggs and Gruenbacher 2002) or a variation of it on mobile information service design?
- How can we optimise the way of modelling in the design approach? E.g. the use of storyboards for services.

In short, we recommend the refinement of our design approach by paying attention to (i) the start of the application design, (ii) collaborative service design sessions with suppliers (e.g. winwin approach) and (iii) the way of modelling.

Future research on the design approach for next rounds appliance

Chapter 7 ended with a spiral to illustrate that more than one round has to be gone through in a design process. In the 'MIES on the campus' project we went through one round. For future research it is recommended that the design approach is applied in subsequent rounds

to give a complete innovation process. In these following rounds more emphasis has to be placed on the business model of the service and the business cases for the various partners than in the first round. An important issue in this exploitation phase is the governance model. The advantages and disadvantages of the open model, walled garden model and closed model are not completely clear as yet. What is the best way to organise the value network that exploits mobile information services on the market? Some partners will be structural partners, some contributing partners and some just supporting partners (Wehn de Montalvo, Van de Kar and Maitland 2004)? There are two ways to study this. The first is an action research project in which the 'MIES on the campus' project is extended by continuing to go through the rounds of the spiral (Figure 7-8). The second is to do case study research on mobile information services that are on the market.

To answer these research questions it is also possible to ally with other research that is currently taking place in the mobile field. [E.g Knutsen and Overby (2004) are carrying out research on the supply and demand-side implications for m-business offerings. Pedersen and Methlie (2004) are doing research to explain "with an analytical perspective the lack of a bridge between the theories dealing with the user and theories of dealing with the business model". The research in the Netherlands on balancing requirements on customer value, financial aspects, strategic interests and technological aspects of mobile services, see Haaker et al. (2004) and Faber et al. (2004). For the customer part it is interesting to follow the research findings of the MCAST (mobile multicasting service development and field trial) project, that provides a continuous customer integration approach and applies established methods of market research to the creation of mobile services (Brodt and Heitmann 2004).]

In sum, we recommend applying our design approach in a second round and using the experience to refine the design approach for the business development phase. An alternative way of doing research is to do more case study research and ally with other research currently taken place. One major issue is the governance model viz the walled garden versus the open versus the closed model.

Future research on the connection between the phases in *a complete innovation process*

In Chapter 3 we positioned Service Innovation between Research and Development and Business Development. The rest of the thesis was focussed on Service Innovation with some attention to the Business Development phase in the case studies in Chapter 5. In this respect we made a distinction between the exploration phase in which new practices are entailed and the exploitation phase in which existing practices are entailed. It is an assumption that networks for exploration mainly can be found in Research and Development and in Service Innovation and networks for exploitation in Service Innovation and Business Development. Our recommendation is to explore further the connection and dependencies of the service formula, technology and value network in these three phases. We initiate this with a set of catchwords:

- Research and Development; one to twenty years
- Service Formula: market research
- Technology: laboratories
- Value Network: consortia like OMA, innovation funds from government
- Service innovation; quarter to a year
- Service Formula: prototyping, testing
- Technology: assembling components
- Value Network: creating the value network and coordination of design activities
- Business development; continuously, on daily basis
- Service Formula: customer relationship management
- Technology: robust, scalable
- Value Network: governance model, revenue models

In sum, we recommend investigating on the complete innovation cycle, in an inductive study of the complete innovation phase from Research & Development to Service Innovation to Business Development in which the balance of the service formula, technology and value network is the focus. We do not expect this innovation cycle to be a linear process, rather we expect it to be iterative with many feedback loops.

Future research directed towards design of *context aware mobile information services*

With regard to delivering customer value we think that a lot of work still has to be done to deliver services that people can use on any mobile device in a real-time, anytime, anyplace manner and that are useful and easy-to-use. The recommendations of test users in the 'MIES on the campus' project, for example, were related to the automatic functioning of the login settings, the integration of the navigation program and the web browsing, localisation within buildings, the functioning of personal profiles and the richness of the available content. Developing more advanced context aware mobile services could solve this.

People do not want to hassle to retrieve information on their handheld. Therefore it is important to take into account the technology constraints, like bandwidth and minimal device features, and constraints on the way of using, since the user is possibly moving and (s)he needs information right away that is as accurate as possible. We recommend starting a project to design and implement an information retrieval service in mobile settings that uses dynamic context-aware information to provide necessary information, that is provided as fast as possible and is as accurate as possible. If this is realised the user can make his or her decisions and solve potential problems in real-time settings without the trouble of handling huge amounts of unstructured and unwanted retrieved information. The Smartamlets proposal of Carlsson et al. (2003) is an example of such a project.

In brief, we recommend more research towards context aware mobile information services.

Mobile information services really offer value in today's society where mobility and time critical situations are becoming increasingly common. We provided a design approach that offers value to business practitioners and researchers who intend to design mobile information services. We invite them to apply the approach and to test it further.

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Appendix A Results uncertainty questionnaire

Table A-1 Results from MOBUS group two years later

(n=9)	Is this still an uncertainty?			If it is not an uncertainty:	Relevance (1-5 scale)			
Uncertainty	**Yes**	**No**	**don't know**	**what will it be?**	**Ave-rage**	**Min**	**Max**	**Stdev**
1. Will there be high or low economic growth?	5	4	0	4 x low	4,1	3	5	0,6
2. Will private and professional life mix increasingly?	6	3	0	2x it won't happen, 2 x mix	3,1	1	5	1,4
3. What will be the quality of UMTS?	3	6	0	3 x negative (disappointing, bad, takes time), 2 x positive	3,8	2	5	1,0
4. What will be the structure of UMTS service provisioning: open or closed?	2	5	2	4 x closed, 1 open	3,7	3	5	0,7
5. How high or low will be the user's willingness-to-pay?	4	5	0	3 x it will be low, 1 x it will be high	4,1	3	5	0,8
6. Which kind of exploitation strategy will mobile telco's apply?	1	8	0	6xall usage based!, 1x both, 1 x flat rate	2,9	1	4	0,9
7. Will digital signatures be accepted?	5	4	0	4 x accepted	2,7	1	3	0,7
8. Will mobile data services be developed by a technology push or by a market pull approach?	1	7	1	4 x techn push, 1 x market pull, 2 x both	2,8	1	4	1,1
9. What will be the market penetration of UMTS-based ICT?	8	1	0		3,7	2	5	1,1
10. Will mobile interfaces be advanced or not?	1	7	1	3 x advanced, 3 x simple, 1 x no change	3,7	2	5	1,0
11. Will localisation be important for mobile data services?	3	5	1	4 x important/will play a role, 1 x not important	3,4	1	5	1,1
12. Will mobile data services generate revenues by direct or indirect income?	1	7	1	6 x direct income! 1 x both	3	1	5	1,2
13. Will mobile payment technology be used in the market?	2	6	1	5 x yes, 1 x depends	4,1	3	5	0,8
14. Will people and/or consumers be social or individual by nature in 2005?	4	3	2	2 x no change	2,8	1	4	1,2

(n=9)	Is this still an uncertainty?			If it is not an uncertainty:	Relevance (1-5 scale)			
Uncertainty	**Yes**	**No**	**don't know**	**what will it be?**	**Ave-rage**	**Min**	**Max**	**Stdev**
15. Will people and/or consumers be active or passive by nature in 2005?	5	2	2	1 x no change, 1 x active	2,7	1	4	1,2
16. Will mobile data services be voice or data based?	1	8	0	6 x data, 2 x both!	2,9	1	5	1,3
17. Will mobile services be multimedia based or not?	0	9	0	9 x multimedia!	4	3	5	0,7
18. Will intelligence be in the (mobile) network or in the devices?	2	6	1	5 x both, 2 x device	3,1	2	5	0,9
19. Will there be a single terminal or will terminals be pervasive?	1	6	2	2 x single, 4 x pervasive	3,6	2	5	1,0

Table A-2 Results from non-MOBUS group two years later

(n=9)	**Is this still an uncertainty?**			**If it is not an uncertainty:**	**Relevance (1-5 scale)**			
Uncertainty	**Yes**	**No**	**don't know**	**what will it be?**	**Ave-rage**	**Min**	**Max**	**Stdev**
1. Will there be high or low economic growth?	6	2	1	2 x low	3,7	2	5	1,1
2. Will private and professional life mix increasingly?	1	6	2	3 x mix, 3 x no/less mix	2,6	2	4	0,9
3. What will be the quality of UMTS?	5	4	0	3 x high, 1 x takes time	4,4	4	5	0,5
4. What will be the structure of UMTS service provisioning: open or closed?	1	7	1	3 x closed, 3 x open, 1 x both	3,8	3	5	0,7
5. How high or low will be the user's willingness-to-pay?	6	2	1	1 x will be low, 1 x ?	4,3	3	5	0,7
6. Which kind of exploitation strategy will mobile telco's apply?	5	4	0	2 x both, 2 x usage	3,2	1	5	1,2
7. Will digital signatures be accepted?	6	2	1	2 x accepted	3,2	2	5	1,1
8. Will mobile data services be developed by a technology push or by a market pull approach?	1	6	2	2 x techn push, 3 x both, 1 x market pull	2,6	1	4	1,0
9. What will be the market penetration of UMTS-based ICT?	4	2	3	1 x low, 1 x business applications	3,7	2	5	0,8

10. Will mobile interfaces be advanced or not?	1	5	3	2 x not advanced, 3 x advanced	3,4	1	5	1,2
11. Will localisation be important for mobile data services?	2	6	1	4 x important, 2 x not important	3,2	2	4	0,7
12. Will mobile data services generate revenues by direct or indirect income?	5	4	0	1 x direct, 3 x both	3,4	2	5	1,1
13. Will mobile payment technology be used in the market?	4	5	0	5 x yes	2,9	1	4	1,1
14. Will people and/or consumers be social or individual by nature in 2005?	3	4	2	1 x stay indiv, 1 x no change, 1 x social, 1 x both	2,8	1	4	1,2
15. Will people and/or consumers be active or passive by nature in 2005?	0	5	4	3 x passive, 1 x active, 1 x both	2,6	1	4	1,2
16. Will mobile data services be voice or data based?	0	4	5	4 x data	2,8	1	4	0,8
17. Will mobile services be multimedia based or not?	0	9	0	9 x multimedia!	3,7	1	5	1,1
18. Will intelligence be in the (mobile) network or in the devices?	6	2	1	2 x both	3,3	3	4	0,5
19. Will there be a single terminal or will terminals be pervasive?	3	5	1	2 x pervasive, 1 x only few function., 2 x both	3,2	2	5	1,1

Table A-3 New uncertainties two years after the initial project

MOBUS group:	**Non-MOBUS group:**
What will be the visible added value of UMTS?	Which role will issues like security and safety play for UMTS?
What will be the impact of new alternative technologies such as WIFI on UMTS?	Which business or market player will determine the rules of the game?
Are people willing to change to UMTS given the fact that GSM and GPRS can fulfill may types of services?	Will handset-subsidizing play a role?
Will UMTS take-off fast enough? That is, before operators go down.	How will the industry co-operate with regard to the introduction of UMTS?
Will privacy become a boundary for the take-off of UMTS?	What will be useful applications?
Will national and European governments invest money in the mobile telecommunication industry?	How will the mobile telecom industry partner with other industries?
What will be the consequences of the growing gap between Europe and the USA with regard to, for instance, standardization?	What will be the financial position of telco's?
What will be the coverage of UMTS? Just urban areas?	What will be the impact of the competition of WIFI and other technologies on UMTS?
What will roaming look like?	What will be the impact of health issues (such as radiation)?
	How will the realization of standards of interfaces between systems of different manufacturers take place?
	How will governmental regulation respond to the the possible increase of market power by pan-European operators?
	What will be the integration of UMTS with WLAN?
	What will be the impact of security on UMTS?
	What will happen with mobile spam?
	Will WLAN become a dominant technology?
	How will telco's go about in consolidating?
	How will competitors behave and what are the risks?
	What will be the developments around Digital Right Management (DRM)?
	What is the added value of multimedia applications for busines users?

Appendix B Design approach tools

Tools that support the design approach are listed below, including the design of GSS sessions mentioned in the approach.

Analysis

A.V.1 Process design

- Role checklist, see Table 7-1.
- Project management tool, for example MS Project.

A.V.2 Agreement on intention to cooperate and external communication with main actors

- Standard letter of intention with confidentiality arrangements.

A.S.1 Getting knowledge on what the customer wants

We present an overview of the design of the Group Support System sessions, the thinklets are mentioned between the brackets.

- Warm-up (free brainstorm).
- Problem analysis
- Identify problems in current situation (free brainstorm).
- Formulate the most important problems (fast focus).
- Select the x most important problems (broomwagon).
- Solution generation (leafhopper).
- Demonstration of future scenarios (presentation). The input for this presentation is the result of activity A.T.2. There has to be some idea of the solutions offered by the technology that the designers have in mind.
- Redefinition of solutions (one-up).

A.S.2 Analysis of existing services

- Web search tools

A.S.3 Drawing story boards

- Photo camera, drawing tools

Preparation

P.V.1 Collaborative service design session

Here we present an overview of the design of the Group Support Systems sessions designed by Boehm and Gruenbacher (2002), the thinklets are mentioned between the brackets.

- Engage the success-critical stakeholders
- Refine and Expand Negotiation Topics (review/reverse)
- Brainstorm Stakeholders Win Conditions (free brainstorm)
- Converge on Win Conditions (fast focus)
- Define a Glossary of Key Terms (dim sum)
- Prioritise Win Conditions (straw poll)
- Surface Issues and Constraints (crowbar)
- Identify Issues (brand Builder), Propose options (brand Builder) and Negotiate Agreements (chauffeurs list)
- Check completeness (popcorn sort, bucket walk)

P.V.3 Define roles, responsibilities and tasks tools

- Role checklist, see Table 7-1
- Project management tool, for example MS Project.
- Tools of the project management approach 'Six Sigma' and structured product development approach 'QFD' might be helpful, although these methods are very detailed, strict and require discipline (see sections 4.4 and 4.5 referring to Cohen 1995 and Creveling et al. 2003).

P.T.1 Technical architecture design tool

- Unified Modeling Language (UML; see OMG 1999; Chappell et al. 2001) with Visio, Rational Rose, etc. as tools.

P.T.3 Installing platforms tools[1]*:*

- Java platforms from Sun Microsystems. E.g. J2ME technology consists of a Java virtual machine and a suite of interfaces that are designed to provide customized run-time environments for embedded and consumer electronics (Jagoe 2003:115). See www.java.com with Java Tools like the Sun Java Studio Mobility 6 Early Access (http://developers.sun.com/prodtech/javatools/jsmobility/index.html).
- You need development tools, resources and programs to develop and deliver innovative Windows Mobile applications. (http://msdn.microsoft.com/-windowsmobile/).
- Tools for location interoperability: the OMA Location Working Group (LOC) continues the work originated in the former Location Interoperability Forum (LIF) and Location Drafting Committee of the former WAP Forum. They offer Mobile Location Protocol Specification (TS 101) The Challenge with Interoperability in Location Services (TD 201); Location Services Interoperability Test Specification in GSM (TS 202) and Privacy Guidelines (TR 101) (http://www.openmobilealliance.org/tech/affiliates/lif/-lifindex.html).

[1] Mentioned Internet pages are last accessed 04 July 2004.

- Platform for Privacy Preferences (P3P; www.w3.org/TR/P3P) an emerging industry standard promoted by the W3C for automating and giving users more control over the use of personal information at the web sites they visit. This document, along with its normative references, includes all the specification necessary for the implementation of interoperable P3P applications. There have been efforts to extend P3P to the mobile environment. However more work is required before the P3P protocol becomes widely applicable for the mobile environment (Ali Eldin and Wagenaar 2004).

P.S.1 Content design tool:

- Planning matrix of QFD. The planning matrix addresses the following questions for each customer need: "How important is this need to the customer?'; 'How well are we doing in meeting this need today?'; 'How well is the competition doing in meeting this need today?' 'How well do we want to do in meeting this need with the product or service being developed?' and 'If we meet this need well, could we use that fact to help sell the product?'. By filling in the planning matrix including the goal, improvement ratio, sales point and raw weight it is possible to calculate the normalized raw weight with the in QFD provided formulas. (Cohen 1995: 92-122)

P.S.2/P.S.3/P.S.4 Navigation design, User interface design and Tests tools

- Graphic design programs like Director; Illustrator, Photoshop.
- Test and control rooms.

Synthesis

S.T.1/S.T.2/S.T.3 Programming, scripting, assembling and testing tools

- To prevent a lot of documentation work afterwards tools like Concurrent Version Systems (CVS) take care of the documentation during the programming work (www.cvshome.org).

Implementation and Test

IT.S.3 Gathering user experience tools

- The Planning matrix of QFD, see P.S.1. could be filled again.
- Possible sources for gathering the user experience are (Isaacs and Walendowski 2002:243-273):
- Logging user activity.
- Formal observation and videotaping.
- Informal observation and conversation.
- Surveys.

Appendix C Users' questionnaire for MIES

Dear Participants,

The System Acceptance Questionnaire (SAQ) is a tool designed to assess user acceptance of the Mobile Information and Entertainment Service (MIES). The questionnaire consists of three parts. Following closed ended questions about the usefulness, clarity, efficiency, support/help, satisfaction, visual quality, functions, privacy and pricing of MIES in the first part, open ended questions are directed to identify the favourite functions of MIES, its missing characteristics and any problems faced during usage. In order to gather demographic information about participants, background questions are asked in the last part of the questionnaire. The results of the questionnaire will be used only for academic purposes. We thank you for your help and cooperation.

Part 1

Please indicate how much you agree or disagree with each of the following statements by marking the proper point on the right hand scale.

Usefulness	Strongly agree						Strongly disagree
1. MIES is useful for me	7	6	5	4	3	2	1
2. MIES has functions that I need	7	6	5	4	3	2	1
3. I do not see any advantage in using MIES	7	6	5	4	3	2	1
4. I can see a lot of possible ways to use MIES	7	6	5	4	3	2	1
5. I would prefer to achieve the same task without MIES	7	6	5	4	3	2	1
6. MIES does not really do what I want	7	6	5	4	3	2	1
7. The GPS receiver is useful	7	6	5	4	3	2	1

Clarity	Strongly agree						Strongly disagree
8. The navigation structure is clear	7	6	5	4	3	2	1
9. The interface explains itself at the beginning	7	6	5	4	3	2	1
10. The instructions in the manual are understandable	7	6	5	4	3	2	1
11. It is not always obvious what to do next	7	6	5	4	3	2	1
12. The interface seems to work in a logical way	7	6	5	4	3	2	1
13. The functions of the buttons are clear	7	6	5	4	3	2	1
14. The icons are clear and universal	7	6	5	4	3	2	1

Efficiency	Strongly agree						Strongly disagree
15. I feel I can achieve tasks quickly using MIES	7	6	5	4	3	2	1
16. I cannot easily find the information and entertainment I want	7	6	5	4	3	2	1
17. I feel in control of MIES	7	6	5	4	3	2	1
18. I am able to move around the interface as I wish	7	6	5	4	3	2	1
19. I have to go through a lot of irrelevant stages to get to the	7	6	5	4	3	2	1
20. The menu driven interface helps me find the information	7	6	5	4	3	2	1
21. I can easily correct my mistakes while using MIES	7	6	5	4	3	2	1
22. Using MIES is a waste of time	7	6	5	4	3	2	1

Support/Help	Strongly agree						Strongly disagree
23. The interface is good at indicating what to do next	7	6	5	4	3	2	1
24. The interface does not seem to help me in the way that I	7	6	5	4	3	2	1
25. The interface often leaves me unsure how to continue	7	6	5	4	3	2	1
26. I have to ask others if I get into difficulties using MIES	7	6	5	4	3	2	1
27. I feel confident of overcoming any problems I have with MIES	7	6	5	4	3	2	1
28. I need the manual whenever I use MIES	7	6	5	4	3	2	1
29. I do not need help in using MIES as I generally use the same	7	6	5	4	3	2	1

Satisfaction	Strongly agree						Strongly disagree
30. MIES is interesting to use	7	6	5	4	3	2	1
31. I often get frustrated when using MIES	7	6	5	4	3	2	1
32. It will take a long time for me to learn how to use MIES	7	6	5	4	3	2	1
33. I would like to learn more about MIES	7	6	5	4	3	2	1
34. Using this interface and MIES gives me a sense of	7	6	5	4	3	2	1
35. Working with the interface is enjoyable	7	6	5	4	3	2	1

Visual Qualities	Strongly agree						Strongly disagree
36. MIES is aesthetically pleasing	7	6	5	4	3	2	1
37. MIES looks like a product of the latest technology	7	6	5	4	3	2	1

MIES functions	Strongly agree						Strongly disagree
38. MIES has an interesting campus tour	7	6	5	4	3	2	1
39. I can easily find buildings using MIES	7	6	5	4	3	2	1
40. MIES helped me to find an employee in the TU Delft	7	6	5	4	3	2	1
41. MIES is good for finding people in the group	7	6	5	4	3	2	1
42. MIES is helpful for finding a location	7	6	5	4	3	2	1
43. MIES guided me on a nice Delft city tour	7	6	5	4	3	2	1
44. MIES helped me to find a nice restaurant	7	6	5	4	3	2	1
45. MIES helped me to get easily to the restaurant location	7	6	5	4	3	2	1
46. It is nice to send messages through MIES	7	6	5	4	3	2	1
47. It is easy to browse on the internet using MIES	7	6	5	4	3	2	1
48. MIES is good for chatting with people	7	6	5	4	3	2	1
49. It is nice to watch the video clips on the iPAQ	7	6	5	4	3	2	1
50. It is fun to play the game Razor in MIES	7	6	5	4	3	2	1
51. I've experienced many technical problems with the game	7	6	5	4	3	2	1
52. Multiplayer gaming is more exciting then single player gaming	7	6	5	4	3	2	1

MIES privacy	Strongly agree						Strongly disagree
53. I could easily define my privacy settings	7	6	5	4	3	2	1
54. People could contact me, though I didn't ask for that	7	6	5	4	3	2	1
55. MIES should always and automatically handle users requests	7	6	5	4	3	2	1
56. MIES should always ask me before letting others contact me	7	6	5	4	3	2	1
57. I need to add new privacy preferences to MIES	7	6	5	4	3	2	1
58. Using MIES, I am able to control my privacy myself	7	6	5	4	3	2	1
59. My privacy is guaranteed with MIES	7	6	5	4	3	2	1

Part 2

60. Do you have a favourite MIES function? If yes, please explain.
61. Is there anything that you miss in MIES? If yes, please explain.
62. Did you have any problem with MIES? If yes, please explain.
63. Can you give an explanation for the questions that you answered with either a 1 or a 7?
64. What did you think of the speed with which you could use the service? Can you make a distinction between the network and the applications?
65. Do you have any further remarks and/or suggestions about MIES?

Background questions

I am a:

- ❑ Man
- ❑ Woman

My age is: _____

I have experience with the following **mobile** services and devices:

- ❑ Voice services (on the mobile phone)
- ❑ SMS
- ❑ PDA
- ❑ Internet access
- ❑ Email via a mobile device
- ❑ Localisation based services (with GPS or cell based)
- ❑ I work professionally with mobile services. My activities in this field are ……
- ❑ Others, like ……..

I have experience with the following Internet services:

- ❑ Email
- ❑ Web browsing
- ❑ Collaboration via the internet
- ❑ I work professionally with Internet services. My activities in this field are ……
- ❑ Others, like ……

The level of my English is:

- ❑ Poor
- ❑ Moderate
- ❑ Good
- ❑ Native speaker

My nationality is …….

I come from ……..

My profession is ……

Appendix D Interview protocol for MIES partners

You were part of the MIES design team. I will now ask you some questions about the process. The outcome of the interviews will be used to improve the MIES design approach.

0. Background questions

Name:

Organization:

Role in project:

Time spend on MIES project:

1. Way of thinking

1.1 Actors/roles

- Comment on the drawing of the value network in the start situation and in the realisation situation.
- Do you agree with the role mentioned for you in the actor/role analysis; see Table D-1.
- Can you specify the activities you did?

1.2 Discussing the design guidelines and propositions

- We like your reaction on guidelines/propositions we used to express the way of thinking in this project. Please say for each proposition/guideline what you think of it in theory and or how we followed this proposition/guideline in the MIES project. See Table D-2 for questionnaire and Table D-3 for the answers.

1.3 Benefits

- Why did your organization decide to participate in this project? What were the advantages?
- Why did you personal participate?

1.4 Embedded relational ties

- Was there already a relationship between your organization and TPM?
- Did you already personal know another person involved in the project? If yes, who?

1.5 Perceived customer value

- What do you think is the value of this service for the customer

2. APSIT: the Way of Working and Way of Controlling

We will discuss the APSIT approach (see Chapter 7).

Please mark:

- Which activities you did in this approach.
- State activities you did but that are not in the approach?
- What else do you miss? Which activities did you not do, that are not in the approach but should be added?

3. Way of modeling

3.1 Use cases

- Do you have experience with use cases?
- Do you think that they are necessary when designing mobile information and entertainment services?
- What do you think of use cases in MIES?

3.2 Storyboards

- Do you have experience with storyboards?
- Do you think that they are necessary when designing mobile information and entertainment services?
- What do you think of the storylines used in MIES?

3.3 Architectural modeling

- Do you have experience with modelling service architectures? If yes, what kind?
- What do you think of the modelling of the MIES service architecture?
- How was it modelled in your opinion?
- What was good? What did you miss?

3.4 Other

- What models did you miss in the project?

4. Tools

4.1 Which tools did you use in the MIES project?

4.2 Which tools worked well for you?

4.3 What did you miss?

5. Is there anything else you like to mention to improve the MIES design approach?

Table D-1 Actors and roles

Providing Role	Definition	Explanation for developing	Organization
Functionality related roles			
Service provider	Provides billable service to the end consumer	Service development	TU Delft TPM * Service will not be billable.
Network operator	Operates the mobile telecommunications network over which the data (service) is transmitted	Designing and building the network	T-Mobile
Platform provider	Provides the software that defines the general platform on which a variety of services are run	Preparing servers	Delft Plaza TU Delft TPM
Application provider	Provides the software that makes a service possible and that sits on top of the platform	Application development: personalized applications location based applications game web application	 TVW and TU Delft TPM TU Delft TPM Ex Machina Delft Plaza and TU Delft TPM
Web hosting/presence provider	Operates and maintains the server that hosts a website that is an integral part of the service, particularly relevant to the further development of content	MIES website hosting MIES finding people hosting (ASP) MIES finding people hosting (PHP) Game hosting	Delft Plaza TU Delft TPM (server witlab) Server at TU Delft TPM (Section ICT) Ex Machina
Content supply chain roles			
Raw content supplier	Supplies content in a format unusable for the mobile service & terminal	Supplying content for MIES website Supplying content for Game Supplying Location information	TU Delft Marketing and Communicatie TU Delft DTO (phone guide) Bouwkunde Users Municipality, KvK (raw content providers behind Delft Plaza) BluTarsky Players Tomtom

Providing Role	**Definition**	**Explanation for developing**	**Organization**
Content developer	Transforms raw content into content appropriate for the service as well as the mobile terminal	Developing MIES website Developing personal information sites Developing Game Filtering existing information and make it suitable for MIES	Delft Plaza TU Delft, faculteit TBM Ex Machina TU Delft, faculteit IO
Content provider	Provides 'appropriate'/trans-formed content to the service provider	Providing MIES website Providing user data in a way that it fits in MIES Providing Game Providing video clips	Delft Plaza TU Delft, faculteit TBM Ex Machina AtoBe
Content aggregator	Serves as an intermediary between the service provider and the content providers	Navigation design User interface design	TU Delft IO
Hardware roles			
Equipment provider	Provides the hardware (physical components of network)	For the UMTS Network Server Server Server Server	Via T-Mobile TU Delft, faculteit TBM (witlab) Delft Plaza Ex Machina TU Delft, faculteit TBM (ICT section)
Handset supplier	Supplies platform or service-specific handsets		Nokia 6650: via T-Mobile IPAQ 2210: paid by T-Mobile; bought at shop GPS receiver; paid by TUD; bought by shop
Customer relation roles			
Billing provider	Provides billing services to collect revenues from end consumers		Not applicable
Marketing provider	Markets the service		Not applicable

Providing Role	**Definition**	**Explanation for developing**	**Organization**
		Agreement on external communication	TU Delft, faculteit TBM and T-Mobile
Customer support provider	Point of contact for customer queries regarding the service; responds to customer queries	During the test Ex Machina and TU Delft, faculteit IO were standby to answer questions	TU Delft TPM
Content quality manager	Monitors and improves content quality		TU Delft TPM Delft Plaza
LBS roles			
Content geo-coding provider	Adds x/y coordinates to the content		Delft Plaza
User positioning	Provides the position information of the mobile device		Via GPS + application of Roy
Positioning technology vendor	Supplies user positioning equipment		Not applicable; done by GPS
GIS provider	Provides geographical information (and GIS services) necessary to indicate location information of relevant content		TomTom Delft Plaza

MIES guidelines/propositions to discuss with partners

This questionnaire is intended to get feedback of the suppliers of MIES on the design approach used to develop a Mobile Information and Entertainment Service
Please mark on the scale to indicate how much you agree or disagree with each of the following statements.

	What do you think of:	In theory					In the MIES project				
		strongly agree	agree	neutral	disagree	strongly disagree	strongly agree	agree	neutral	disagree	strongly disagree
V1	*Actors in the network can only then start to design applications if a proven service IT architecture is provided by the leading actor as basis for the various applications.*	1	2	3	4	5					
V2	*The Service Provider, Mobile Operator and Content Provider are the triad that forms the core of the value network.*	1	2	3	4	5					
V3	*Take your time to establish a value network and when that is in place: speed up the development process.*	1	2	3	4	5					
V4	*The targeted user has to be part of the design approach in all phases of the design process.*	1	2	3	4	5					
V5	*The design approach has to start with the investigation of the targeted user's context, wants and needs.*	1	2	3	4	5					
V6	*At the start of the project the role list must be checked and it must be decided which roles have to be performed and which actor(s) will fulfil which role.*	1	2	3	4	5					
V7	*The value of network membership and working with partners in an innovative undertaking is not generating revenue.*	1	2	3	4	5					
V8	*The value of network membership and working with partners with an established reputation in an innovative undertaking is that it supports a firm's imago.*	1	2	3	4	5					
V9	*The value of network membership in an innovative undertaking is to learn and to achieve a competitive advantage.*	1	2	3	4	5					
V10	*Embedded relational ties heavily influence the network creation.*	1	2	3	4	5					

EvdK; version 13 November 2003

Table D-3 MIES guidelines answers

	What do you think of the following guidelines:	**In theory**					**In MIES project**			
	(n=12)	**ave-rage**	**min**	**max**	**stdv**		**ave-rage**	**min**	**max**	**stdv**
V1	Actors in the network can only then start to design applications if a proven service IT architecture is provided by the leading actor as basis for the various applications.	2.8	1	5	1.2		3.4	1	5	1.2
V2	The Service Provider, Mobile Operator and Content Provider are the triad that forms the core of the value network.	2.3	1	4	0.9		2.6	1	4	1.1
V3	Take your time to establish a value network and when that is in place: speed up the development process.	2.7	1	4	1.1		3.0	1	4	1.1
V4	The targeted user has to be part of the design approach in all phases of the design process.	2.8	1	5	1.5		2.7	1	5	1.4
V5	The design approach has to start with the investigation of the targeted user's context, wants and needs.	2.1	1	4	0.9		2.1	1	5	1.1
V6	At the start of the project the role list must be checked and it must be decided which roles have to be performed and which actor(s) will fulfil which role.	1.4	1	2	0.5		2.8	1	4	1.2
V7	The value of network membership and working with partners in an innovative undertaking is not generating revenue.	3.1	2	4	0.9		2.8	1	4	1.2
V8	The value of network membership and working with partners with an established reputation in an innovative undertaking is that it supports a firm's image.	1.9	1	4	0.9		2.7	2	4	0.9
V9	The value of network membership in an innovative undertaking is to learn and to achieve a competitive advantage.	1.9	1	4	0.9		2.1	1	4	1.1
V10	Embedded relational ties heavily influence the network creation.	1.7	1	3	0.6		1.6	1	3	0.7

List of Abbreviations

2G	Second Generation
3G	Third Generation
4G	Fourth Generation
APSIT	Analysis, Preparation, Synthesis, Implementation and Test
ARPU	Average Revenue Per User
ASP	Applications Service Provider
ASP	Active Server Pages
b2b	business to business
b2c	business to consumer
b2e	business to employee
b2g	business to government
c2c	consumer to consumer
BD	Business Development
BE	Business Engineering
CBD	Component Based Development
CBE	Collaborative Business Engineering
CBSE	Collaborative Business System Engineering
CEO	Chief Enterprise Officer
CDMA	Code Division Multiple Access
cHTML	Compact HTML
CSD	Circuit Switched Data
DECT	Digital Enhanced Cordless Telecommunications
CQFD	Continuous Quality Function Deployment
DSDM	Dynamic System Development Method
e2c	employee to consumer
EDGE	Enhanced Data Rates for GSM Evolution
ESS	European Simulation Symposium
ETSI	European Telecommunications Standards Institute
g2b	government to business
g2c	government to consumer
GIS	Geographical Information Systems
GPRS	General Packet Radio Services
GPS	Global Positioning System
GSM	Global System for Mobile
GUI	Graphical User Interface
HSCSD	High Speed Circuit Switched Data
HTML	HyperText Markup Language
IP	Internet Protocol

ISP	Internet Service Provider
ICT	Information and Communication Technology
IT	Information Technology
ITU	International Telecommunications Union
J2ME	Java 2 Platform, Micro Edition
LBMS	Location Based Mobile Services
LBS	Location Based Services
LDAP	Lightweight Directory Access Protocol
MIES	Mobile Information and Entertainment Service
MMS	Mobile Multimedia Messaging Service
MNO	Mobile Network Operator
MPU	Mobile Position Updater
MVNO	Mobile Virtual Network Operator
OMA	Open Mobile Alliance
OMG	Object Management Group
PDA	Personal Digital Assistant
PHP	Hypertext Preprocessor (recursive acronym)
PSTN	Public Switched Telephone Network
QFD	Quality Function Deployment
R&D	Research and Development
RAD	Rapid Application Development
SI	Service Innovation
SMS	Short Messaging Service
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TDMA	Time Division Multiple Access
UML	Unified Modeling Language
UMTS	Universal Mobile Telecommunications System
VOIP	Voice Over IP
VPN	Virtual Private Network
W-CDMA	Wideband Code Division Multiple Access
WAP	Wireless Application Protocol
WCDMA	Wideband CDMA
WLAN	Wireless Local Area Network
WML	Wireless Mark-up Language
WTLS	Wireless Transport Layer Security
XML	Extensible Markup Language

Summary

Designing Mobile Information Services

An Approach for Organisations in a Value Network

Els van de Kar, December 2004

Domain and research objective

The domain of mobile information services highlights the blurring of organisational boundaries in the telecommunications, IT and media industries. The roles needed to develop and deliver mobile information services are these of the mobile operator, service provider, content provider, hardware and software providers and, last but not least, the customer. Together they constitute a complex value network of actors who need to collaborate to deliver mobile information services. There is all kind of interaction between the demand and supply side further complicated by the speed of the development of the technologies used in telecommunications networks, applications and devices.

The customer value of mobile information services is determined by a range of conditions like mobile situations (independence); time critical arrangements and spontaneous decisions and needs (immediacy); and efficiency ambitions (to be realised by location awareness among others); furthermore users might 'have the need' for some entertainment, to kill time. The value of location awareness has given rise to location-based mobile services, a category of mobile information services that exploit the information of where a device is located. There have been high expectations for location-based mobile services since the nineties. However, mass-market acceptance remained uncertain for longer than expected. The development of mobile information services and its subcategory, location-based mobile services, is characterised by many uncertainties. These uncertainties are related to the technology, the demand side of the market, the supply side of the market and the interaction between these demand and supply sides.

Within this setting the objective of the research was *'to develop and test an approach for designing mobile information services, which can be used to support organisations creating a value network and to coordinate activities within that value network'.* We pursue the research objective by undertaking a literature search of (mobile) services and the current state of the art of their development (Chapter 2), by participating in an expert project to shed light on the uncertainties surrounding the development of mobile services (Chapter 3), by a literature study of design theories (Chapter 4), by exploring the design of mobile information services in practice (Chapter 5), by abstracting from the case studies and assessing the theory in the mobile field (Chapter 6), by developing the desired design approach (Chapter 7), by applying the design approach in an action research project

(Chapter 8) and by reflecting on the whole research and providing recommendations for future research (Chapter 9).

Research strategy

We applied an inductive-hypothetical research strategy that is suitable to support theory building and for studying ill-structured problems. This strategy consists of the phases initiation, abstraction, theory formulation, implementation and evaluation.

After formulating initial theoretical notions on mobile information services and designing them we participated in a research project to get a grip on the uncertainties surrounding the development of mobile information services. Parallel to this we started a literature exploration to get an overview of useful elements of existing design theories. A design approach is commonly understood to be a coherent set of activities, guidelines and techniques that can be used to structure, guide and improve a (complex) design process. Design approaches can be expressed as a way of thinking, way of controlling, way of working and a way of modelling. Before developing such a design approach we executed three inductive case studies. We describe them in the following section.

Inductive case studies: M-info and iMode

The advent of the Wireless Application Protocol (WAP) made it possible to use existing GSM mobile devices and networks to surf on the Internet without being connected to a wire. Other concepts like iMode followed later. A case study on a WAP service is presented to explore the issues that are dealt with in the design process. This concerns the first Internet based mobile service in the Netherlands, namely the M-info service launched by KPN Mobile in 1999. Two years later KPN Mobile and its daughter E-Plus introduced iMode. Case studies of the Radio538 ringtune iMode service in the Netherlands and the location-based iMode service Finder in Germany are presented.

The three case studies provided interesting lessons.

- Regarding the service formula designers have to make decisions on the target group, the pricing model, and on the look and feel of the mobile information service. Features that were passed in review are localisation, privacy, handsets choice and content quality & richness. Non-functional requirements related to the service process quality are also important and these have to be enabled by the technology.
- The limited capacity of the technology used for M-info reduced the usability of the service and subsequently users first impressions were negative. The devices used had limited processing power, battery life and memory. The network had, and has, limited bandwidth and latencies. The limitations of enabling technology cannot be neglected in the decision making process concerning a target group and market launch. This has to be taken into account when formulating the service process quality requirements. These can be categorized according to the SERVQUAL parameters for e-services, i.e. reliability, responsiveness, user interface, trust and customisation.

- The three case studies also provided lessons regarding the creation of the value network. The success of iMode in Japan is credited to the three-way relationship between the mobile operator, the content (application) provider and the customer. The Radio 538 ringtune case also shows the importance of the bundling of the service with the handset; and thus of the relationship between the service provider and the handset manufacturer. Co-development of the services with operators, content providers, IT application providers and handset providers seems to be a must. We saw that the reason for companies to participate in a network of firms building innovative services is, in the short run, more related to image and learning than to making profit. Radio538 for example wanted to profile its company as an innovative firm. KPN Mobile regards its experience with M-info as useful for further mobile Internet services. It showed that embedded relational ties heavily influence the choice of partners. The managers involved had already done a project together or were former employees. Regarding the coordination within the value network we saw in the iMode services case studies that revenue models are an important governance mechanism. In the exploitation phase the shared revenues cause a constant information and revenue flow between firms. The revenues were related to the roles instead of the actors. The actor 'operator' takes e.g. 14% for its role 'billing' and 30 cents for the role of 'providing positioning information'. Therefore it is important to separate roles and to assign the revenues to those roles instead of the actors.

Concerning the design approach we observed that the three case studies showed a design process in phases. The design approach of M-info can be characterised as a project management approach. This is not enough to guarantee co-development. A design process in phases is possible, however it should be extended with mechanisms to coordinate activities during the exploitation phase. The iMode content governance model is an example of this. To find answers to questions related to market acceptance customers must be involved in the design process, e.g. in pilots, or even using free connection plans. It is important to prevent publicity about first negative impressions, as in the WAP case.

Design approach

Based on the initial design theories and inductive case studies we developed a design approach. The starting point was that we see mobile information services as systems. We define mobile information service oriented systems as *'a group of components that work together for delivering (a series of) activities of an intangible nature when the customer is mobile and a mobile telecommunications network supports the interactions through an Internet channel between customers and service employees (or systems of a service provider) which are provided as solutions to customer problems'.* We used the ways of thinking, controlling, working and modelling as a framework to describe the design approach.

The way of thinking consists of the research framework with the service formula, enabling technology and a value network of actors. These terms are defined in subsection 6.1.1. There are trade-offs between all three elements. The service formula cannot offer more than the available technology can enable. Decisions have to be made on: the extent to which localisation is offered, privacy is dealt with, handsets are available that support the services, the quality and richness of the content and the pricing model. It is critical that the technology supports services that users can perceive as reliable, responsive, with an easy to use user-interface, which can be trusted and customised. Expectations should be managed since technology is limited.

We formulated guidelines to create the value network and coordinate activities in the value network. The framework behind this is that the internal network factors 'business model of the service' and 'embedded relational ties' influence network creation and network coordination. These internal network factors are influenced by external network factors. The external factors are interdependencies between technology, content, marketing & distribution and financial sources, and constraints regarding to time pressure and uncertainty in demand and value.

The guidelines to deal with the value network and the technology tensions related to the technology, content and financial sources interdependencies and time to market pressure are the following.

V1→ Actors in the network can only start to design applications if a proven service IT architecture is provided by the leading actor as basis for the various applications.

V2→ The Service Provider, Mobile Network Operator and Content Provider are the triad that forms the core of the value network.

V3→ Take your time to establish a value network and speed up the development process when that is in place.

The guidelines to deal with the value network and the service formula tensions related to the uncertainty in demand and value are the following.

V4→ The targeted user has to be part of the design approach in all phases of the design process.

V5→ The design approach has to start with the investigation of the targeted user's context, wants and needs.

The guidelines to deal with internal network factors are the following.

V6→ At the start of the project the role list must be checked and it must be decided which roles have to be performed and which actor(s) will fulfil which role.

V7→ Take into consideration when creating a value network that the purpose of network membership and working with partners in an innovative undertaking is not to generate revenue.

V8→ Take into consideration when creating a value network that the value of network membership and working with partners with an established reputation in an innovative undertaking is that it supports a firm's image.

V9→ Take into consideration when creating a value network that the value of network membership in an innovative undertaking is to learn and to achieve a competitive advantage.

V10→ Reduce uncertainty by using embedded relational ties when creating a value network.

We described the activities belonging to the way of controlling, working and modelling as the APSIT approach. APSIT is the acronym for the phases: analysis, preparation, synthesis, implementation and test. Design activities regarding the triad value network – technology and service formula have to be done in each of these phases. Tools are available to support these design activities. The activities are described in Section 7.3 and the tools in Appendix B.

The design approach can be reiterated after a first round has been completed and a test group has used the service. In the second round some activities may be modified and might be done quicker. After each round the service can be distributed towards a larger test group. After two or three rounds the object of the approach will be the market launch and the start of exploitation.

Implementation

A mobile information and entertainment service (MIES) was designed, implemented and tested on a UMTS testbed at Delft University of Technology in an action research case study project. The roll-out of UMTS started in the Netherlands in 2004 and one Dutch operator, T-Mobile, decided to pilot their UMTS network at Delft University of Technology. This was an excellent challenge to test our design approach for mobile information services. We decided to design a service for campus visitors and this service was called '*MIES on the campus*'. The design approach, described in Chapter 7 and summarised above, was applied in this project over a period of about ten months. The project is described in Chapter 8.

The action research project delivered valuable information to improve the service and the design approach. Recommendations of test users in the 'MIES on the campus' project regarding the service formula and technology were related to the automatic functioning of the login settings, the integration of the navigation program and the web browsing, localisation within buildings, the functioning of personal profiles and the richness of the available content.

Twelve of the partners were interviewed on their experience with the design approach. Based on this and observations during the project some design guidelines were sharpened. These changes are related to how to start the project, e.g. not with a proven architecture but with an investigation of available components that match the user requirements (V1, V4,

V5); a distinction in the core of the value network in the business development and service innovation phase (V2); roles that might change during the process (V6); and that in the long term network membership is motivated by increasing profit (V7, V8, V9).

Reflection

The application area can be divided into the development of services in the exploration and exploitation stage. The design issues differ in these stages. We first did three case studies of services that were exploited on the mass market. For these case studies we did not include the user experiences. The focus of the studies was the supplier's point of view and the question remains how useful and easy-to-use these services are from the user's point of view. In the last case study 'MIES on the campus' we got feedback from users on all aspects of the service, but in this case we did not go into the phase of establishing the business model. The partners participated for other reasons than financial, e.g. learning, getting experience, research opportunity, and reputation. The potential future income from commercial mobile services was a derived motivation. It was an advantage that we performed case studies in the exploration and in the exploitation phase because we got information on the differences of service design in these phases. The drawback is that it was more difficult to compare them.

The nature of our research was exploratory, focussing on building a new body of knowledge for designing mobile information services. Therefore we pursued our research objective by following an inductive-hypothetic research strategy. The research retained an exploratory character throughout and a variety of research instruments were used throughout this PhD thesis. This study answered a number of questions and gave rise to new questions that we will discuss below.

Recommendations

Future questions to answer are related to the design approach and the design approach result, i.e. the mobile information services. The design approach in the exploration phase can be refined with attention paid to (i) the start of the application design, (ii) collaborative service design sessions with suppliers (e.g. winwin approach) and (iii) the way of modelling. Next, we recommend applying the design approach in the business development phase. One major issue is the governance model, viz walled garden versus open versus closed model. A third research direction concerns the transitions between different phases in the complete innovation cycle from Research & Development to Service Innovation to Business Development. Lastly we recommend starting a project to design and implement an information retrieval service in mobile settings that uses dynamic context-aware information to provide necessary information as fast and accurately as possible. Building and testing this in an action research project like 'MIES on the campus' would significantly reduce the gap between imagination and reality.

Samenvatting

Het ontwerpen van mobiele informatiediensten

Een ontwerpmethode voor organisaties in een waardenetwerk

Els van de Kar, december 2004

Onderzoeksdomein

De ontwikkeling van mobiele informatiediensten speelt zich af in een domein waar telecommunicatie, informatietechnologie en mediabedrijven steeds meer afhankelijk van elkaar worden en waar de grenzen tussen organisaties vervagen. Voor het ontwikkelen van mobiele informatiediensten zijn de volgende spelers noodzakelijk: de mobiele operator, service provider, content provider, hardware- en softwareleverancier en natuurlijk de klant. Bedrijven die één of meer van deze rollen vervullen vormen samen een waarde netwerk van actoren. Zij moeten samenwerken om te komen tot de ontwikkeling van mobiele informatiediensten. Er zijn veel vormen van interactie tussen de vraag- en aanbodkant van de markt en dit wordt gecompliceerd door de snelheid waarmee de technologie van de telecommunicatie netwerken, applicaties en mobiele toestellen zich ontwikkelt.

De technologische mogelijkheid van plaatsbepaling heeft geleid tot de ontwikkeling van mobiele diensten die gebaseerd zijn op deze plaatsbepaling, kortweg mobiele locatiediensten genoemd. Sinds de jaren negentig zijn er hoge verwachtingen voor mobiele locatiediensten. Acceptatie in een massamarkt duurt echter langer dan was verwacht. De ontwikkeling van mobiele informatiediensten en haar subcategorie mobiele locatiediensten is omgeven door tal van onzekerheden. Deze onzekerheden zijn gerelateerd aan de technologische ontwikkeling, vraag uit de markt, organisatie van aanbod in de markt en de interactie tussen deze vraag en aanbod kant.

Onderzoeksvragen en doelstelling

Tegen deze achtergrond hebben we de volgende onderzoeksvraag geformuleerd: '*hoe kunnen van elkaar afhankelijke actoren in een netwerk organisatie mobiele informatiediensten ontwerpen die op elk moment en op elke plaats gebruikt kunnen worden, gepersonifieerd zijn en gebruik maken van plaatsbepaling?'* Om deze centrale onderzoeksvraag te kunnen beantwoorden dienen allereerst de volgende drie vragen te worden beantwoord:

1. Wat zijn mobiele informatiediensten en hoe hebben die zich de afgleopen jaren ontwikkeld?
2. Welke aanpakken voor het ontwerpen van diensten zijn beschikbaar en wat zijn hiervan de voor- en nadelen?

3. Wat zijn de kritieke onderdelen bij het ontwerpen van mobiele informatiediensten en wat zijn hiervoor de oplossingen?

De antwoorden op deze drie vragen en de centrale onderzoeksvraag moet leiden tot het uiteindelijke doel van dit onderzoek: '*het ontwikkelen en testen van een aanpak om mobiele informatiediensten te ontwerpen die gebruikt kan worden om organisaties te ondersteunen bij het creëren van een waarde netwerk en het coördineren van activiteiten in dat waarde netwerk*'.

Onze aanpak betreft de ontwikkeling van diensten in een network van organisaties waarbij het leveren van een waardevolle dienst aan de klant als uitgangspunt wordt genomen. We streven deze doelstelling na door literatuuronderzoek te doen naar diensten en mobiele diensten en hun laatste ontwikkelingen (hoofdstuk 2), door deel te nemen aan een expert project waarin onderzocht werd wat de onzekerheden zijn bij het ontwikkelen van mobiele diensten (hoofdstuk 3), door een literatuurstudie naar ontwerptheorieën (hoofdstuk 4), door de ontwikkeling van mobiele diensten in de praktijk te bestuderen (hoofdstuk 5), door te abstraheren van de ontwerptheorieën en praktijkervaringen te vertalen naar ontwerpeisen voor mobiele diensten, door de gewenste ontwerpaanpak te ontwikkelen (hoofdstuk 7) en toe te passen in de praktijk en vervolgens te evalueren (hoofdstuk 8). De onderzoeksresultaten worden samenvattend gepresenteerd in de epiloog inclusief reflectie en aanbevelingen voor nader onderzoek (hoofdstuk 9).

Onderzoeksbenadering

Om de onderzoeksvragen te beantwoorden is gekozen voor een inductief-hypothetische aanpak omdat deze geschikt is voor theorieontwikkeling en het bestuderen van slecht gestructureerde problemen. Deze strategie bestaat uit vijf stappen. We starten met een verkenning die bestaat uit literatuurverkenning en deelname aan expert sessies. Dit resulteert in een grof initieel theoretisch raamwerk. Dit raamwerk geeft richting aan onze observaties in drie verkennende case studies (beschrijvende empirische modellen). Vanuit deze praktijksituaties, resultaten van aanvullend literatuuronderzoek en een discussie met experts zijn conclusies geabstraheerd die leiden tot een aantal eisen voor onze ontwerpaanpak (beschrijvend conceptueel model). Op basis hiervan is een ontwerpaanpak geformuleerd (voorschrijvend conceptueel model). De ontwikkelde aanpak bestaat uit een denkwijze met richtlijnen, een beheerswijze waarin proces en projectmanagement aan bod komt, een werkwijze bestaande uit stappen en activiteiten, en tenslotte modellen. De ontwerpaanpak is vervolgens toegepast in een actie onderzoek project (voorschrijvend empirisch model). In dit project hebben we gebruik gemaakt van verschillende manieren om onderzoeksresultaten boven tafel te krijgen en de ontwerpaanpak te evalueren, namelijk observaties, documentatie zoals notulen, archiefmateriaal zoals e-mailcorrespondentie, vragenlijsten, interviews en een groepsdicussie. Op basis hiervan zijn vervolgens de resultaten geëvalueerd door ze te leggen naast het voorschrijvend conceptueel model.

Inititiële ontwerptheorieën

Een ontwerpaanpak wordt over het algemeen beschreven als een coherente samenhang van activiteiten, richtlijnen en technieken die gebruikt worden (wordt?) om een ontwerpproces te structuren, richting te geven en te verbeteren. Ontwerpaanpakken kunnen uitgedrukt worden in een denkwijze, beheerswijze, werkwijze en modelleerwijze. We bestudeerden literatuur om op voort te bouwen met als doel om een ontwerpmethode te ontwikkelen voor mobiele diensten in een inter-organisationele context. Allereerst bekeken we daarvan organisatietheorieën. Netwerkorganisaties blijken te preferen boven organisaties die hiërarchisch of via marktprincipes gestructureerd zijn. De eigenschappen van netwerkorganisaties verschillen voor organisaties die nieuwe activiteiten ontplooien (exploratie) en organisaties die bestaande activiteiten uitbouwen (exploitatie).

Vervolgens keken we naar literatuur gerelateerd aan systeemkunde omdat mobiele informatiediensten zodanig complex zijn dat ze als een systeem beschouwd moeten worden. Van belang zijn theorieën over systeemontwerpen, informatiesysteemontwerpen en business engineering. 'Collaborative Business Engerineering' (CBE – vrij vertaald participatief ontwerpen van bedrijfssystemen) is een managementaanpak om het ontwerp van ICT, processen en structuren te integreren (Den Hengst en De Vreede 2004). Een andere bruikbare theorie is process management (De Bruin et al. 2002). De focus van deze theorie betreft het identificeren en implementeren van veranderingen en daarom zijn actoren, hun identiteit, cultuur en argumentatie van belang. Ten derde kijken we naar productontwerp-theorieën die zich bezighouden met het voorschrijven van de structuur, de constructie en het gebruik van fysieke producten (Roozenburg en Eekels 1995; Buijs en Valkenburg 2000). Meestal is er hier een conflict tussen de noodzaak tot creativiteit en het reduceren van onzekerheid. Daarnaast hebben we ook recente publicaties specifiek gericht op het ontwerpen van mobiele diensten en locatiediensten bestudeerd om domeinspecifieke inzichten te verkrijgen.

Het onderscheid tussen de exploratie- en exploitatiefase is belangrijk voor de beheerswijze van de ontwerpaanpak. In de exploratiefase zijn theorieën betreffende project management en process management toepasbaar. In de exploitatiefase zijn business model- en waardenetwerkconcepten bruikbaar. Voor de werkwijze leveren de bestudeerde theorieën inzicht in het iteratief structuren van activiteiten en het betrekken van gebruikers in het ontwerpproces om problemen die rijzen uit de onzekere vraag te voorkomen. Modellen zoals storyboards en prototypen zijn nuttig om te communiceren tussen ontwerpers en om te interacteren met gebruikers.

Verkennende case studies: M-info and iMode

De komst van het Wireless Applicatie Protocol (WAP) maakte het mogelijk om internetpagina's te raadplegen zonder een vaste verbinding, en wel via het GSM netwerk. Later volgden andere concepten zoals iMode. We presenteren een case studie van de eerste op WAP gebaseerde dienst in Nederland: M-info. Deze dienst werd in 1999 als eerste WAP-

dienst in Nederland geintroduceerd door KPN Mobile. Twee jaren later introduceerde KPN Mobile en haar dochter E-Plus iMode in Nederland en Duitsland. We presenteren twee iMode case studies, de Radio538 ringtune iMode service in Nederland en de mobiele locatiedienst Finder iMode service in Duitsland.

We kunnen interessante lessen trekken uit deze drie case studies. Ten aanzien van de formule van de dienst zien we dat ontwerpers keuzes moeten maken betreffende de doelgroep, prijsstructuur en vormgeving van de mobiele informatie dienst. Belangrijke functionele eigenschappen van de diensten bleken lokalisatie, privacy, keuze voor toestel en kwaliteit en rijkheid van de content te zijn. Ook niet-functionele eisen gerelateerd aan de kwaliteit van het proces van de te leveren dienst zoals accuraatheid en snelheid zijn belangrijke kwaliteitsparameters. De gebreken van de technologie voor M-info, zoals het beperkte procesvermogen, batterijduur en geheugen van de eerste mobiele WAP toestellen, bleken de gebruiksvriendelijkheid van de dienst in de weg te staan.

De case studies leren ons ook lessen ten aanzien van het creëren van een waardenetwerk van organisaties. Het succes van iMode in Japan wordt toegeschreven aan de driehoeksrelatie tussen de mobiele operator, content provider (soms de applicatie provider) en klant. Met name de Radio 538 ringtune-dienst laat zien dat het in het ontwerpproces van belang is om in ogenschouw te nemen dat de klant de dienst gebundeld met het toestel gebruikt. Daarom is ook de relatie tussen de applicatie provider en de toestel-leverancier van belang. Samenwerking tussen mobile operators, content providers, IT applicatie providers en toestel-leveranciers blijkt een noodzaak te zijn. We zagen dat redenen voor bedrijven om te participeren in een samenwerkingsverband op korte termijn meer te maken heeft met imago en leren dan met geld verdienen. De keuze voor actoren wordt vaak ingegeven door bekende relaties, bijvoorbeeld met bedrijven van voormalige werknemers of bedrijven met wie eerder is samengewerkt. De coördinatie van activiteiten tijdens de exploitatiefase verschilde bij de M-info en iMode diensten. Bij de M-info dienst werden individuele contracten afgesloten tussen marketing managers van KPN Mobile en de content providers. bij de iMode diensten vond de coördinatie binnen het waarde netwerk plaats via de zogenaamde verdienmodellen (revenue models). De opbrengsten bleken gerelateerd te zijn aan rollen in plaats van actoren. De actor 'operator' bijvoorbeeld krijgt een percentage van de omzet voor de factureringsrol en een bedrag voor het vervullen van de rol van leverancier van positioneringsinformatie. Daarom is het van belang om zorgvuldig rollen te onderkennen en benoemen zodat de omzetverdeling op basis van deze rollen gedaan kan worden.

Ten aanzien van het managen van het ontwerpproces in de drie casussen kunnen we het volgende zeggen. In alle drie de case studies is het ontwerpen van de dienst in fasen verlopen. Het managen hiervan kan bij de M-info dienst gekarakteriseerd worden als project management, en deze aanpak bleek geen garantie voor samenwerking te zijn. Het is wel mogelijk een ontwerpproces in project fasen te managen maar het moet uitgebreid worden met mechanismen om samenwerking te coördineren. Het iMode besturingsmodel waarin de

samenwerking tussen de operator en de content provider wordt geregeld waarbij de kwaliteit van de content gewaarborgd wordt is hier een voorbeeld van. Om vragen te beantwoorden ten aanzien van de adoptie van de diensten door de markt moeten klanten nauw betrokken worden in het ontwerpproces, bijvoorbeeld in proefonderzoeken en gratis probeermaanden. De M-info casus laat zien dat het belangrijk is om de publiciteit pas te zoeken als een dienst postitief gewaardeerd wordt door klanten.

Ontwerpmethode

De eerste aanname gebaseerd op de theorie en de verkennende case studies is dat mobiele informatiediensten als systemen beschouwd moeten worden. We definiëren mobiele informatiedienstsystemen als *'een groep componenten die samenwerken om te komen tot het leveren van activiteiten als oplossing voor problemen van klanten op het moment dat de klant mobiel is en waarbij een mobiel telecommunicatienetwerk de interacties tussen klanten en de service provider ondersteunt via een Internet kanaal'.* Onze ontwerpaanpak voor dit systeem wordt beschreven aan de hand van het raamwerk bestaande uit een denkwijze, beheerswijze, werkwijze en een modelleerwijze.

De denkwijze is gebaseerd op drie pijlers die het onderzoeksraamwerk vormen in dit proefschrift: de formule van de dienst, de technologie die de dienst mogelijk maakt en het waardenetwerk van actoren.

- De formule van de dienst is gedefinieerd als 'de onderscheidende waarde propositie die gevraagd wordt door de gebruikers'. De gebruikerseisen verschillen per doelgroep en zijn onzeker.
- De technologie die de dienst mogelijk maakt wordt gedefinieerd als 'de service architectuur die de noodzakelijke technische functies verschaft om de dienst te realiseren'. De technologie in het mobiele domein ontwikkelt snel maar de technologische componenten zijn niet gestandaardiseerd. De technologie is dan wel de facilitator van de dienst maar de grenzen van de technologische mogelijkheden moeten niet onderschat worden.
- De definitie van het waardenetwerk is 'de configuratie van activiteiten tussen organisaties en de bijbehorende relaties, verdienmodellen en kostructuren'. Er is een groot aantal organisaties betrokken bij het ontwerpen van diensten die moeten samenwerken.

Tussen deze drie elementen moeten afwegingen gemaakt worden. De formule van de dienst kan niet meer inhouden dan de technologie kan bieden. Er moeten beslissingen gemaakt worden over lokalisatie, hoe er met privacy wordt omgegaan, beschikbaarheid van toestellen voor de dienst, kwaliteit en rijkheid van de content en de prijsstructuur. De technologie moet de diensten zodanig ondersteunen dat gebruikers de dienst ervaren als correct, accuraat, direkt ontvankelijk, gebruiksvriendelijk (user interface), betrouwbaar, veilig, en aangepast aan de (persoonlijke) omstandigheden. Omdat de technologie nog

beperkt is moeten de verwachten omtrent de formule van de dienst zorgvuldig gemanaged worden.

De afwegingen tussen enerzijds het waardenetwerk en de formule van de dienst en anderzijds het waardenetwerk en de technologie zijn vertaald in ontwerprichtlijnen. Deze ontwerprichtlijnen betreffen het creëren van het waarde netwerk en het coördineren van activiteiten in het waarde netwerk[2]. De netwerkcreatie en -coördinatie worden beïnvloed door het business model van de dienst en bestaande relatiestructuren. Dit zijn twee interne factoren. Deze twee interne factoren worden beïnvloed door externe factoren. Deze externe factoren zijn de wederzijdse afhankelijkheden tussen de technologie, content, marketing & distributie en financiële middelen, en beperkingen voortkomend uit tijdsdruk en onzekerheid over de marktvraag.

De volgende ontwerprichtlijnen hebben betrekking op de afweging tussen het waardenetwerk en de technologie en zijn gerelateerd aan de afhankelijkheden tussen technologie, content en financiële middelen en de beperking tijdsdruk.

Ontwerprichtlijnen

V1→ Actoren in een netwerk organisatie kunnen alleen beginnen met het ontwerpen van diensten als er een robuste IT architectuur ter beschikking is gesteld door een leidende actor die als basis kan dienen voor de diverse applicaties van de dienst.

V2→ De driehoek Service Provider, Mobiele Operator en Content Provider vormen de kern van het mobiele informatiediensten waardenetwerk.

V3→ Neem de tijd om een waardenetwerk te formeren en ga snelheid maken als het waardenetwerk is ingericht.

De volgende ontwerprichtlijnen hebben betrekking op de afweging tussen het waardenetwerk en de formule van de dienst en zijn gerelateerd aan de beperking veroorzaakt door de onzekerheid over de marktvraag.

V4→ Gebruikers uit de beoogde doelgroep van de mobiele informatiedienst moeten in alle fasen van het ontwerpproces deelnemen.

V5→ De ontwerpaanpak moet beginnen met het inventariseren van de context, wensen en benodigheden van de gebruikers uit de beoogde doelgroep.

De volgende ontwerprichtlijnen hebben betrekking op de interne networkfactoren.

V6→ Bij de aanvang van het ontwerpproject moet de lijst van rollen gecontroleerd worden en bepaald worden welke rollen vervuld moeten worden en welke actoren die rollen moeten invullen.

[2] De ontwerprichtlijnen beginnen met een V omdat ze betrekking hebben op het waardenetwerk, in het Engels '**V**alue network'.

V7→ Houd er bij het formeren van het waardenetwerk in een innovatief project rekening mee dat het doel van deelname aan het waardenetwerk voor organisaties **niet** omzet genereren is.

V8→ Houd er bij het formeren van het waardenetwerk in een innovatief project rekening mee dat het verhogen van reputatie de waarde is van deelnemen aan een waardenetwerk waarin ook partners met een gevestigde repuatie deelnemen.

V9→ Houd er bij het formeren van het waardenetwerk in een innovatief project rekening mee dat de waarde van deelnemen aan het waardenetwerk voor organisaties is om te leren en concurrentieel voordeel te behalen.

V10→ Reduceer onzekerheid door bij het formeren van een waardenetwerk bestaande relatiestructuren te gebruiken.

Deze ontwerprichtlijnen waren leidend bij het komen tot de beheerswijze, werkwijze en modelleerwijze van de ontwerpaanpak. De hierbij behorende ontwerpactiviteiten zijn gestructrureerd in de fasen Analyse, Preparatie, Synthese, Implementatie en Test; afgekort de APSIT aanpak. In iedere fasen moeten activiteiten uitgevoerd worden waarbij afwegingen worden gemaakt ten aanzien van de driehoek dienstenformule, technologie en waardenetwerk. Deze activiteiten zijn verder uitgewerkt in sectie 7.3 en de bijbehorende hulpmiddelen zijn vermeld in Appendix B.

Implementatie

Ons praktijkonderzoek was een actie-onderzoek waarin we een mobiele informatie en entertainment dienst ontwierpen, implementeerden en testten op het door mobiele operator T-mobile gebouwde UMTS testbed bij de Technische Universiteit in Delft. T-Mobile had begin 2003 besloten tot een pilot van haar UMTS netwerk ter voorbereiding van een landelijke uitrol van UMTS in 2004. Dit was een excellente mogelijkheid om onze ontwerpaanpak voor mobiele informatiediensten te testen. We besloten om een dienst voor bezoekers van de campus te ontwerpen en we noemden deze dienst 'MIES op de campus'. MIES is een acronym voor Mobiele Informatie en Entertainment Service. In een periode van ongeveer 10 maanden volgden we de ontwerpaanpak zoals beschreven in hoofdstuk 7.

In de analysefase organiseerden we 3 computerondersteunde brainstormsessies met in totaal 32 potentiële gebruikers verdeeld over buitenlandse academici, Nederlandse academici en deelnemers uit het zakenleven. Het doel van deze sessies was om de eisen te inventariseren die deze potentiële gebruikers stellen aan de diensten. Op basis van de informatie uit de sessies formuleerden we 'storylines' en inventariseerden we welke technologieën er beschikbaar waren. Verder startten we met het formeren van het waarde netwerk van actoren, voornamelijk via bestaande relaties. De storylines betroffen het vinden van conferentielocaties, interesante sessies, bepaalde mensen en restaurants, een campustoer, een multi-user spel en informatie ten behoeve van afspraken.

In de preparatiefase ontwierpen en testten we de user interface en de navigatie structuur. Technische ontwerpers ontwikkelden een drielagenarchitectuur bestaande uit de

presentatie-logica-data lagen en een technische architectuur. Het waardenetwerk van actoren werd vastgesteld en bestond uit 20 personen van 9 organisaties, 6 bedrijven en 3 onderzoeksinstellingen. Zes potentiële gebruikers waren betrokken bij een test van tussenresultaten van het navigatie- en user interface-ontwerp.

In de synthesefase bouwden de programmeurs de applicaties gebaseerd op beschikbare standaard-componenten. Dit was de enige fase waar de gebruiker niet bij betrokken was. De afhankelijkheid tussen de technologie en het waarde netwerk kwam duidelijk naar voren toen we een softwaretaal moesten kiezen aangezien dit ook de keuze voor bepaalde kennis en kunde inhield.

In de implementatiefase testten we de dienst in twee situaties. De eerste situatie was de 15e ESS conferentie in Delft. Vijftien testpersonen uit de hele wereld gebruikten 'MIES op de campus' voor 3 dagen. De tweede situatie betrof een test met 22 studenten die het vak 'Service System Engineering' volgden en in het kader hiervan een week de dienst gebruikten. Alle testpersonen vulden een vragenlijst in en zijn geïnterviewd. Over het algemeen waren de testpersonen redelijk positief over 'MIES op de campus', voornamelijk over het navigatie programma en surfen op Internet. We interviewden ook 12 partners uit het waardenetwerk over hun ervaringen met de ontwerpaanpak.

Evaluatie

Het actieonderzoek leverde interessante informatie op om de dienst en de ontwerpaanpak te verbeteren. De verbeterpunten voor de dienst betreffen het verder automatiseren van de login-procedure, de integratie van het navigatieprogramma met het web browsen, het lokaliseren binnen gebouwen, het functioneren van de persoonlijke profielen en de rijkheid van de beschikbare content. De aanpassingen van de ontwerpaanpak betreffen aanscherping van ontwerprichtlijnen en aanbevelingen voor nader onderzoek ten aanzien van ontwerpactiviteiten die niet of nog niet tot tevredenheid zijn uitgevoerd. De aanpassingen in de ontwerprichtlijnen betreffen de start van het project, namelijk niet beginnen met een bewezen architectuur maar met het inventariseren van beschikbare componenten die de eisen van de gebruikers kunnen inwilligen (V1, V4, V5); onderscheid aanbrengen in wat de kern van het waardenetwerk is in verschillende fasen van dienstontwikkeling. In de innovatiefase is dit anders dan bij het exploiteren van de dienst op de markt (V2); rollen kunnen wijzigen gedurende het proces (V6); en een motivatie voor het deelnemen in een waardenetwerk van een innovatief project kan voor de lange termijn gelegen zijn in het verhogen van de winst (V7, V8, V9). Ontwerprichtlijnen V3 en V10 zijn niet veranderd naar aanleiding van het project.

Reflectie

Het toepassingsdomein in dit onderzoek is onderverdeeld in de ontwikkeling van diensten in de exploratie- en exploitatiefase. De diensten in de eerste drie verkennende case studies waren en zijn daadwerkelijk op de markt geëxploiteerd. De focus in ons onderzoek in deze case studies betrof het gezichtspunt van de aanbiederskant, we hebben niet de

gebruikerservaringen onderzocht. Informatie over de waarde en de gebruiksvriendelijkheid van deze diensten hebben we via de aanbieders verkregen. In het laatste actieonderzoek 'MIES op de campus' hebben we wel direct gebruikerservaringen onderzocht, maar deze dienst bevond zich in de pilot fase en is niet op de markt geëxploiteerd. Het is een voordeel dat we case studies hebben gedaan in zowel de exploratie- als de exploitatiefase omdat we inzicht hebben gekregen in de verschillen tussen de ontwerppunten in deze twee fasen. Het is daarentegen een nadeel dat het moeilijker is om de case studies te vergelijken.

In dit onderzoek hebben we een een inductief-hypothetische onderzoeksstrategie gevolgd. Via deze strategie zijn we erin geslaagd een een aanpak voor het ontwerpen van mobiele informatiediensten te ontwikkelen en toe te passen. Dit leidt weer tot nieuwe onderzoeksvragen.

Aanbevelingen voor nader onderzoek

Vier aanbevelingen voor nader onderzoek zijn opgesteld waarvan drie de ontwerpaanpak betreffen en één de mobiele informatiedienst zelf.

1. De ontwerpaanpak voor de exploratiefase kan verfijnd worden door verbeteringen van de volgende ontwerpactiviteiten. Allereerst lijkt er een leemte te zitten tussen de activiteiten 'storylines beschrijven' en 'applicatie ontwerpen', die gedicht moet worden. Ten tweede zou het effect van het organiseren van een 'collaborative' ontwerpsessie met de partners onderzocht moeten worden. Als laatste is er nog veel te verbeteren door het toepassen van modelleren van bij het ontwerpen van diensten.
2. Het toepassen van de ontwerpaanpak in een tweede en derde ontwerpronde en zodoende de mobiele informatiediensten te verfijnen ten behoeve van exploitatie in de markt.
3. Onderzoeken van de complete innovatiecyclus van mobiele informatiediensten, van R&D tot service innovatie tot marktexploitatie. In ieder van deze fase spelen de formule van de dienst, technologie en actoren in het waardenetwerk een rol. In dit onderzoek hebben we ons gericht op de service innovatie fase. De andere twee fasen en met name de interactie tussen de drie fasen vergen meer onderzoek.
4. Het verbeteren van de mobiele informatiedienst zelf door het 'context aware' te maken. Hierdoor wordt het voor klanten makkelijker gericht en snel de juiste informatie in de betreffende omstandigheden te verkrijgen. Het is belangrijk om daadwerkelijk de dienst te bouwen en testen en zodoende een brug te slaan tussen verbeelding en realiteit.

De eigenschappen van mobiele informatiediensten zijn zodanig dat deze diensten daadwerkelijk waarde kunnen bieden in onze huidige maatschappij met steeds meer mobiliteit en tijdskritische situaties. In dit onderzoek hebben we inducatief en explorerend onderzoek verricht naar het ontwerpen van mobiele informatiediensten. We wiillen van harte de praktijk uitnodigen om deze ontwerpmethode toe te passen en zodoende nog meer waarde toe te voegen aan de ontwerpmethode.

Curriculum Vitae

Elisabeth A.M. van de Kar (Els) was born in Eindhoven on 15th of April 1965. After graduating from the 'Stedelijk Gymnasium' in 's-Hertogenbosch in 1983 she studied Industrial Design at Delft University of Technology (1983-1986) and Business Administration at the Rotterdam School of Management, Erasmus University (1986-1989). After getting her master's degree she worked for eight years for KPN Telecom, where she developed several Telecommunication and Internet Services. From 1998 on she worked as a consultant in the field of strategic Internet marketing, first independently and later in cooperation with The Vision Web. In November 1999 she took up an offer to combine her consulting work with a position as an assistant professor at the Faculty of Technology, Policy and Management (TPM) of Delft University of Technology, becoming a fulltime assistant professor in 2003 and working on European and national research projects and supervising students. The focus of Van de Kar's research and teaching is e-business and mobile commerce.