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Guidelines for Designing Mobile Information Service Systems in a Value Network

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Guidelines for Designing Mobile Information Service Systems in a Value Network

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Abstract

The domain of mobile information services highlights the blurring of organisational boundaries in the telecommunications, IT and media industries. Various actors performing various roles have to collaborate in value networks to deliver those services. We formulated ten guidelines to support organisations creating these value networks. The backgrounds for these design guidelines are case study observations and literature studies from the fields of system engineering, process management and product design. The guidelines have been applied in an action research project in which a mobile information service was developed on a UMTS testbed and used by university campus visitors. The result of this test is that two guidelines were accepted without change and the others are adapted.

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 sectors are becoming increasingly interdependent. These three sectors are leveraging the flexibility of digital technology to offer services that go beyond their traditional sectors and target markets. Actors from these sectors have to fulfil the various roles to develop and deliver mobile information services, e.g. mobile operator, service provider, content provider, hardware and software providers. Furthermore there is the actor 'customer' and together they constitute a complex value network of actors who need to collaborate to deliver mobile information services. The transformation of the value chain into the value network for the delivery of these mobile services has been described in literature (e.g. Li and Whalley 2002; Maitland et al. 2002; Olla and Patel 2002; Sabat 2002; Ballon et al. 2002). There is all kind of interaction between the demand and supply side in these value networks and this is further complicated by the speed of the development of the technologies used in telecommunications networks, applications and devices.

The challenge is to design services with a variety of actors who have to collaborate in these complex value networks. Guidelines, together with activities and techniques, make up a design approach that can structure, guide and improve a (complex) design process. In this paper we focus on the guidelines. The objective of the research described in this paper is *'to develop and test guidelines to support organisations creating a value network for designing mobile information services systems'*.

The next section explains the background of this research. In section 3 we explain our framework of mobile information service systems. In section 4 the derived design guidelines are presented. In section 5 we describe the case study in which we applied the design guidelines and present the test results.

2 Background

Service design is a rather new research area with little theoretical or methodological support. 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. 1991). 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. Therefore we started this research by studying three mobile information service cases. These cases are the introduction of M-info, the first WAP service in the Netherlands; the Radio 538 ringtune i-mode service in the Netherlands; and the location-based i-mode service Finder in Germany (see Van de Kar 2004). These case studies showed that the design of mobile services might be considered as the design of mobile service systems considering the number of components required for mobile services and the complexity perceived by the actors in the mobile field. Relevant theories to design these systems are found in the domains of system engineering, process management and product design.

Systems' thinking is the underlying view for various design approaches like design of information systems and collaborative business engineering (CBE). CBE is especially relevant since we are looking at value networks in which partners have to cooperate. The CBE approach is aimed at dealing with solving ill-structured problems, as it allows for both radical and incremental change, combines the hard and soft system thinking from system engineering and enhances a prominent place for conceptual and empirical modelling (Den Hengst and De Vreede 2004). Literature on design of information technology applications is relevant for the information system aspects of designing mobile information services (Brown 2000; Davis 1989; Brigss and Gruenbacher 2002; Nielsen 1994, Boehm 1988; Isaacs and Walendowski 2002).
The focus of *process management* is on identification and implementation of changes and therefore actors and their values, language and argumentation are important. The core elements of process design are openness, protection of core values, speed and substance (De Bruijn et al. 2002).
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. Methods, rules and recommendations for product design are provided by Roozenburg and Eekels (1995); Buijs and Valkenburg (2000).
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 for mobile information service system design. In next section we further explain this domain.

3 Mobile Information Service Systems

To define mobile information service systems we combine the definition of e-services from Grönroos (2001) and Kasper (1999) with the definition of systems by Sage and Armstrong (2004) and extend this with the mobile aspect.

Mobile information service systems are:

- 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

So, a mobile information service is a complex system that consists of the 'hard' enabling information and communication technology and the 'soft' organisational part consisting of the value network of actors as core elements. An actor network perspective, including the wants and needs of the actor 'customer', is required. We translate this into a way of thinking framework, see Figure 1.

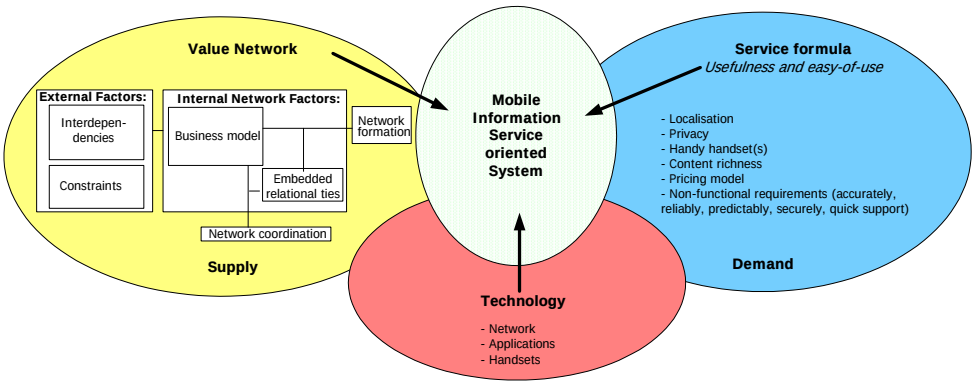

Figure 1: Mobile Information Service System framework

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.

We can only study the network creation and the coordination of the activities that take place between actors in the value network by taking into account the service formula and enabling technology. 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?'

"The research on network formation posits that a range of factors, both exogenous and endogenous to the network itself, drive the formation" (Maitland et al. 2003 referring to Hite and Hesterly 2001 and Gulati et al. 2000 among others). 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). 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. We use a model in which interdependencies and constraints drive the development of a business model, which is defined by actors and roles, by the benefits for the actors, the architecture of the service and the revenue model (Timmers 1998). The business model and the factor

'embedded relational ties' influence the network creation and the way the activities within the network are coordinated. These factors are summarised in Figure 2.

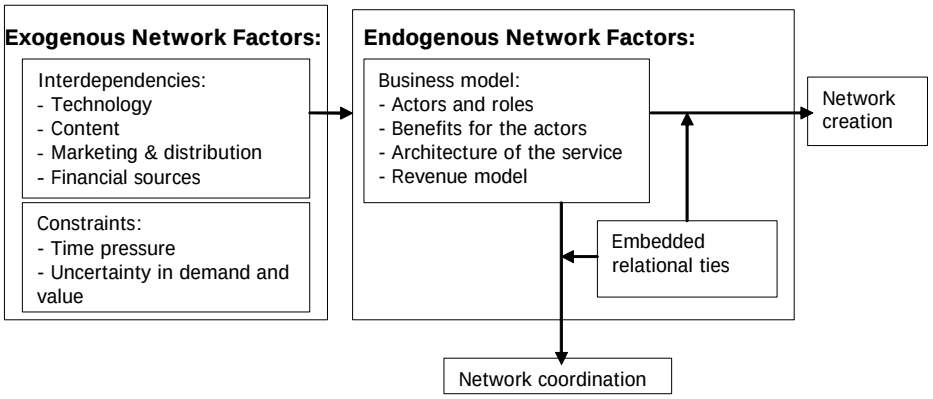

Figure 2: Influence of exogenous and endogenous network factors on network creation and coordination (based on Maitland et al. 2003)

This framework is the basis for the design guidelines which we will explain in next section.[1]

4 Guidelines

The design guidelines have to provide us with the do's and don't to deal with the trade-offs between the three elements in Figure 1. The interdependencies 'technology', 'content', 'financial sources' and constraint 'time pressure' are related to the trade-off between technology and value network. The other interdependency 'marketing & distribution' and the constraint 'uncertainty in demand and value' are related to the trade-off between value network and service formula. We discuss the internal network factors in subsection 4.3. The guidelines are denoted V1 to V10 using the letter V from Value network.

4.1 Trade-off between Value Network and Technology

The layers between the mobile service and the user are the content, servers, content platform area, gateways, networks and clients (Natsuno 2003). In all these layers (fast) technological innovation is taking place. Each of these layers has its own industry participants and together they produce mobile information services.

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 the service design process starts complexity has to be reduced and the specification should be made explicit (Roozenburg and Eekels 1995). The service should be assembled from robust components. This will prevent problems such as those that occurred in the first WAP services (Barnes 2003; Van de Kar 2002). Technical resource interdependencies are defined by the service requirements; existing technology often does not answer the

[1] We won't explain the trade-off between the service formula and technology in this paper since we focus on the value network aspects. We won't go into the interdependencies 'financial sources' and 'marketing & distribution' since these played no role in coming up with the guidelines.

customer's demands for useful and usable services. 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.*

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 the mobile network operator KPN Mobile with the broadcast station Radio 538 worked out well to reach a target group of people from an age range of 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.*

Constraint: Competitive and 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, there is time pressure when a firm wants to get a first-mover advantage in the upcoming UMTS competitive market. The process management elements openness, protection of core values, speed and substance mentioned in the theory of De Bruijn et al. (2002) are helpful here. 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.*

4.2 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 (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 (Grönroos 2001). These expectations are based on the customer's perception of the key benefits offered by mobility as communication features, flexibility, new dimensions of communication, and more effective use of time (Anckar et al. 2003).

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. The design approach should include elicitation of user requirements and have user's test prototypes (e.g. Den Hengst et al. 2004; Isaacs and Walendowski 2002). 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. Therefore, requirements of our design approach are 'starting the design process with customers' wants and needs in mind' and 'focussing on delivering value to the target group'.

→ *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 users means that designers can have their ideas tested by users in several phases of the design process.

4.3 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. (2003, 2005) have made a standard list of roles for actors involved in mobile information services. 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 which role has to be fulfilled depends on the kind of service. The role division can be used to determine the revenue flows.

→ *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.*

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 to launch a WAP

service on the Dutch market to present an innovative image. In the Radio 538 ringtune iMode service case, Radio 538 was involved to support their image. For non-operator actors 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.

→ *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.*

We found in the case studies that another strategic reason to be part of a network organisation 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.*

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 had good relationships in the past.

→ *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.

5 Test case

Delft University of Technology and the mobile operator T-Mobile organised a UMTS testbed at Delft, the Netherlands in 2003. This UMTS testbed provided us with the opportunity to apply the developed design approach. We decided to design a mobile information service for campus visitors and this was called '*MIES on the campus'*. MIES is an acronym for Mobile Information and Entertainment Services. The mobile information service system consists of the following service formula, technology and value network:

- The service formula was based on the following storylines: (1) finding the conference location, (2) update of the conference program, (3) finding people who match, (4) finding a nice restaurant, (5) killing time by playing a multi-user game, (6) guided campus tour, and (7) being in time at the right place for an appointment. These storylines were derived from brainstorm sessions with potential users (see Den Hengst et al. 2004).
- The available technical building blocks were a UMTS network in a testbed setting (see Westerveld et al. 2004); a UMTS phone viz. the Nokia 6650; a PDA, viz. an iPAQ 2210 including a navigation application; and a GPS receiver viz. a Pretec CompactFlash card. The available content was a database with geocoded information on Delft (e.g. restaurants), information from Delft University of Technology, videoclips and a multi-user game.

- The set of standard roles related to mobile services of Maitland et al. (2003) was used to search for actors that are necessary to create the value network. The actors and their roles that were part of the value network are shown in Figure 3.

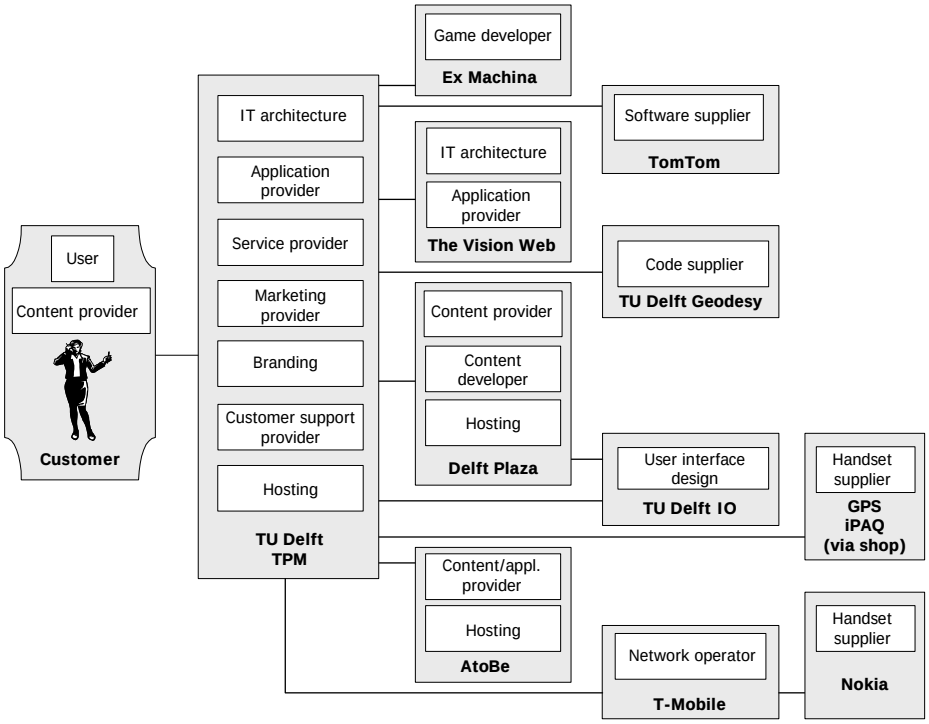

Figure 3: 'MIES on the campus' value network

5.1 Case study set up

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, documentation, archival records, questionnaires and interviews of both partners and test persons[2]. We interviewed 12 persons from the value network partners in structured interviews of about 2 hours each. During the interviews the 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. The partners were individually interviewed with two exceptions; two interviews were held with duo's who worked closely together. We interviewed the involved person from the network operator T-Mobile, the two user interface designers (as a duo), the two involved Delft Plaza content providers (as a duo), the IT architect of the Vision Web, the game developer from ExMachina, the hosting provider of the TU Delft, and four researchers of TU Delft who provided the IT architecture, applications and customer support. The twelve partner interviewees were asked to fill in a questionnaire on which they had 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 these partners' questionnaires, and this was completed using the qualitative feedback from the interviews and observations to get improvement ideas on the design approach.

[2] The questionnaires and interviews with test persons are not described in this paper.

5.2 Results

The results of the interviews with the twelve partners and the 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. We follow the same structure as in section 4 to provide the results of the findings on the guidelines.

5.2.1 Value network - technology trade-off

This subsection contains the discussion of the guidelines related to the interdependencies on technology and content, and the constraint of the time-to-market pressure.

Technology interdependencies
Guideline V1 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. E.g. there arose a problem since one actor programmed in ASP and another in the PHP language; this 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 states that the Service Provider, Mobile Network Operator and Content Provider are the triad that forms the core of the value network. We found that the needed roles varied depending on the design phase. In the service innovation phase (exploration) different roles are more important than in the business development phase (exploitation). 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. Furthermore, 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 and time-to-market pressures
There were only a few comments on guideline V3. The answers were in the middle (not strongly agree or disagree) and this can be interpreted to mean that 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 that includes the customer. The MIES project took about nine months in total, from April to December 2003. However, for most partners the project took place in September and October when they worked on designing and programming. The preceding analysis phase was not labour-intensive but it took 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 guideline V10.

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

5.2.2 Value network - 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 led to extremely different responses. For some people it is an open door that the targeted user is part of the design process; 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 guideline V5 on the start of the design project 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 guidelines V4 and V5 and derive the following guideline.

Improved guidelines 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.

5.2.3 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 on the actors, roles and their benefits. The revenue model was not elaborated enough to receive feedback from the partners.

Actors, roles and benefits
The partners agreed strongly on guideline V6 in theory, but not with how it was applied during the MIES project. This might have been caused by time pressure but also 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 on the reasons for companies to be part of a value network are related and discussed together. Some of the researchers did not answer these guidelines questions because they did not have an opinion on this. Research opportunity was the major reason for the research organisations. 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 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. In the short term value is gained from improving actors' image and gaining experience. Reasons such as getting experience, image and thus revenues in the long run were important for the corporate partners. Generating revenue is replaced by increasing profit since the reason to be part of a value network might also be to cut costs.

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.

Embedded relational ties

The interviewees strongly agreed on guideline V10, 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 on the disadvantage of this principle; personal relationships may influence professionalism.

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

6 Conclusion

Suppliers need to collaborate with other partners in a 'value network' to meet the challenge of designing mobile information services systems. We formulated design guidelines to deal with the factors that are related to the trade-offs between the value network and the service formula, and between the value network and the enabling technology and tested these in an action design project. Some observations to highlight how the guidelines had to be adapted are (1) the design process has to start with the investigation of the targeted user requirements and the in-between results have to be frequently tested with users; however the designers are the experts who take the design decisions. (2) the start of the mobile application technical design is the inventory of the available components and their constraints in stead of a proven service architecture; and (3) participation of firms in an innovative project is motivated by gaining experience, learning and establishing a reputation, nevertheless this has to lead to increased profit in the long run.

We went through the whole design process one time. For further research it is recommended that the design approach is applied in subsequent rounds to give a complete innovation process. This will provide insight into the working out of the design guidelines in the business development phase.

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