Designing Mobile Information Services

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This abstract is based on a Phd Research conducted in the period 1999-2004.

1 Initiation, Research question and Research approach

At the start of the 3rd millennium, Service Design was a rather new research area with little theoretical or methodological support. This PhD took place during this period and contributed to the theory development of Service Design. It took place at Delft University of Technology in the System Engineering section where we used the term Service System Engineering. This included various aspects as service quality, user behavior, service architecture, business models, organizational networks. All important aspects for developing new services. The article describes the research as described in the PhD thesis (and related articles and book (see references)) and focuses on Mobile Services.

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 is *'to develop and test guidelines to support organisations creating a value network for designing mobile information services systems'.*

2 Contributing to a body of knowledge

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.

3 Exploring a field

A key enabler for successful services is the move from a technology-centric world, where technology develops almost independently, to a user-centric world, where the development and use of technology originate from user needs. In this user-centric world companies with different backgrounds such as telecommunication, information technology, and media, have to cooperate to deliver services for these user needs.

3.1 What are Services and Service Systems?

Over the past decades, the nature of organisational work has changed. The manufacturing industry is no longer dominant. Today, the services industry, producing non-tangible goods, provides the majority of all jobs. In the OECD countries services in general account for 70% of total value added, and market services for 50% (OECD, 2007, p.48). However, the amount of research aimed at the design, development and management of services is low. A key characteristic of the services industry is the high information content of its products, showing the potential for the application of information and communication technology (ICT). Where ICT was traditionally considered a driver for changes in organisational and inter-organisational processes, its role is now moving towards becoming an enabler for creating innovative service-related concepts. Innovation has been recognised as a key to growth, but the role of service-sector innovation has long been under-appreciated (OECD, 2007). It is not even clear how to measure service innovation, because service is also a very broad concept, see also (Tidd & Hull, 2003).

There are several definitions of a service, which highlight its main characteristics. Existing definitions refer to specific characteristics of a service, e.g., the intangibility .of the service, the interaction between producer and consumer when the service is created, the fact that a service cannot be stored after production to be delivered at a later time, and the fact that it is difficult to guarantee the quality of a service in advance.

We view services from a systems engineering perspective, and therefore study service systems which include the user needs translated into performance criteria and operational processes, the information and communication technology to deliver the service, and the (inter)-organisational setting needed to develop and deliver the service. Designing effective service systems represents a challenge given the convergence in the service industry: the design object (the service system) represents an amalgamation of the service concept itself, the related organisational structure and the supporting information technology architecture. Focusing engineering efforts in an isolated

fashion on one of these three elements is very ineffective, because the boundaries between the aspects of the service system are not clear and because they are reciprocally interdependent. Hence, there is a need for innovative engineering approaches, including design theories, design heuristics, modelling techniques and environments (laboratories) in which new organisational arrangements for services delivery can be tested and evaluated from a strategic, operational and technological perspective. In general, there is a need to integrate soft knowledge (e.g. the managerial perspective, trust issues, human factors) and hard knowledge (e.g. designing systems, identifying performance indicators, and developing state-of-the-art process simulations).

Although service jobs are predominant in western economies, the methods and tools for developing and assessing services are lagging behind in comparison with methods and tools to develop products and infrastructures. This can be seen in several application domains, where organisations have big problems in, for instance, defining new services based on high bandwidth mobile networks. In spite of the available bandwidth, and the availability of necessary hardware, the services that sensibly utilise this bandwidth are only appearing slowly. We see this, for instance, in the logistics and transport domain, where a shift is visible from purely distributing goods to offering door-to-door services that span several nodes of the supply chain. Transporters and goods are 'on the move', but the services to support real-time decision making in supply chains are almost unavailable. Services that really help the users with the right information at the right time in regular situations (e.g. during travel) or in exceptional situations (e.g. during a catastrophic event) are also hard to define, design, and deploy.

More recent studies focus more in the differences between processes involved in the provision of services on the one hand, and those involved in the manufacturing of products on the other. The differences turn out to be smaller than it appears. Service systems usually involve a number of organisations (or actors), and can therefore be characterised as inter-organisational systems. Inter-organisational systems are extremely hard to design, implement and manage, because there is not one 'governing' organisation that can command the others to comply with the same ideas and standards. A second factor that complicates the deployment of these services in practice is the inherent distributed character of inter-organisational services. Information and communication technology is needed to bridge the physical and cultural distances between the different organisations, both during the design and during the deployment phases. Standard ICT solutions to accomplish this are, however, still lacking, and the effectiveness of the solutions that exist is largely unknown, and therefore needs careful attention. Furthermore, the organisations involved are usually from different domains with their own habits and cultures. It takes time for these organisations to develop a common language. Strategic behaviour of the individual organisations might influence or even overrule the common interest of the network organisation.

3.2 Mobile Services Systems

In mobile service systems, all the components, such as handsets, content, applications, networks, user interfaces, and involved organisations, such as operators, content providers, service providers, have to work together to provide a mobile service to the users that adds value. If we combine the definitions on systems and services, and add the mobile component, the following definition for mobile service systems is derived:

A mobile service system is a group of components that work together for delivering a coherent set of activities of intangible nature that provide added value for a mobile user using a mobile network.

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.

4 Creating a generic understanding

The realisation of innovative mobile service systems demands multidisciplinary research and development that crosses scientific and industrial boundaries. We aim to contribute to this by addressing the design issues for mobile service system from a socio-technical perspective.

Many of the problems regarding mobile, IT-based services can be solved by targeting the distributed nature and isolated deployment of mobile applications, by increasing the ease of use given the fact that screens and keyboards are small, and by providing business models that facilitate the linking of the applications and services of service providers when more providers are involved. One of the most promising ways to create viable services for mobile devices is to add extra intelligence to the services, both at the back-end and in the mobile device itself. The extra intelligence has to limit the cumbersome user interaction with the mobile device, speed up the handling of the transactions and ease the integration of different services that need to be accessed in order to complete more complex transactions. Intelligent services should be adaptive and intelligent ("smart") software modules, which are bundled from the perspective of the user and controlled by the context of the user. These software modules should be able to operate in a heavily distributed and multi-provider environment, and depend on mobile communication. With this type of services it should be easy for any person at any place, independent of preference, age, gender, education, background and nationality, to access services and complete transactions using a mobile device in an easy and efficient way.

In order to realise the rich mobile services landscape, the availability of intelligent software will be a critical success factor that can hide the complexity for the user, possess learning capabilities and so enable context aware personalised services.

Intelligent information management also implies a much higher level of user modelling than is currently the case, for the organisation, processing and presentation of data. Most current projects implement user *profiling* where the user's likely behaviour is inferred from a set of keywords. The challenge is to move to the next stage – user *modelling* – in which a much richer representation and processing capability will be required. Representation needs to be more than attribute – value pairs, for example hierarchies of interests, and user models that are themselves programs. It also needs to model "usual" as well as definite preferences – for example, a hotel booking system should know that I prefer a room that is single-bedded (normally, but this is not a strong preference), non-smoking (always) with breakfast included (but I like this to be an option to be decided according to my schedule).

Another aspect of the representation that needs to be modelled is time-varying preferences e.g. my browsing behaviour is different at weekends (leisure time) and during the week (business time). Finally the user model needs to be easily expandable for new services. Therefore it is necessary to develop an effective and scalable framework which can be embedded within any system to provide personalisation of system response, and understand ability and modifiability for the user. In particular this will include personalised hierarchical classification, so that content and services are presented in a manner convenient for the user.

At first sight, it may seem strange that it turns out to be so hard to create successful applications for high bandwidth mobile devices. The issue has been addressed in many publicly and privately funded projects, but, until now, with very limited success. One of the reasons is that mobile applications – often heavily distributed – are hard to develop. Another reason is that the business models are unclear: the organisation paying for the development is often not the one receiving the revenues from the use of the mobile application. Furthermore, the added value for the users appears to have been very limited until now: the small screen and small keyboard do not provide an easy user interface for more complex applications. A final reason is the isolated deployment of the applications, which force the user to access several applications sequentially to complete more complex transactions from the mobile device.

Breakthroughs are needed in three different fields, in order to make services intelligent. Firstly, the intelligence itself has to be designed, in such a way that it is flexible and can be easily deployed both on the client side and in the back office. Secondly, these adaptive, intelligent services differ so much from more traditional applications, that new design methods are needed that take the distribution of applications and providers into account. Finally, the bundling from the perspective of the user needs to take place. Only when the applications are aware of user needs and the user context, will it be possible to create added value for a particular user by taking away interaction steps that are 'standard' for that user.

5 Developing a contribution

The approach consists of a way of thinking, a design process, design activities, modelling methods and tools presented in a framework. The way of thinking is used to provide guidelines that can be used as leading principles for the design activities. The design process is the design of the 'design process' which consists of process management and project management activities. The design activities are divided into the phases analysis, preparation, synthesis, implementation and test. Models are used during these design activities. Tools support the whole design approach. The light bulb is used to express an idea that might come from radical thinking and that starts the design process. This design approach will be further explained in the next sections.

An overview of the design approach for mobile service systems is shown in Figure 1.

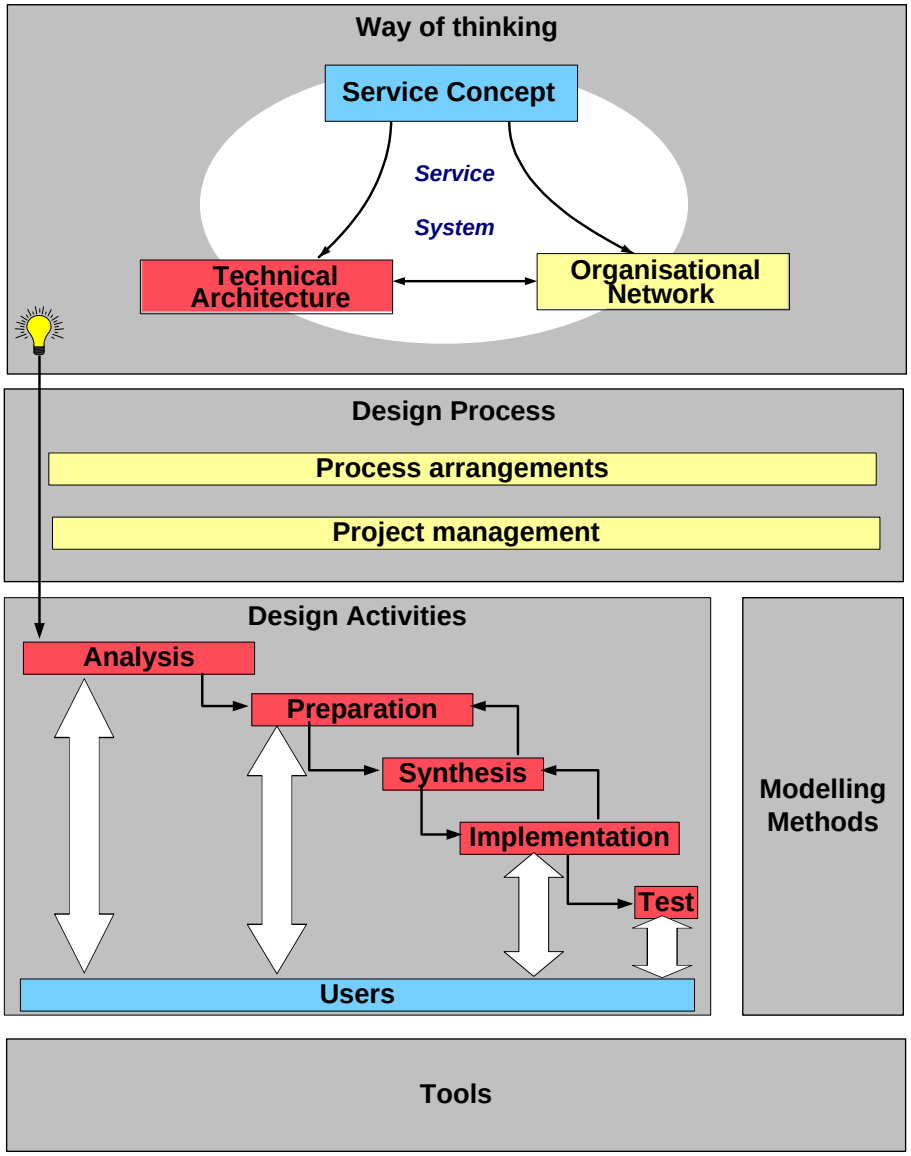

Figure 1 An overview of the design approach for mobile information service systems

5.1 The way of thinking

Mobile Information Services systems result from combining enabling technology, a service concept demanded by users and this service being supplied by organisational network. The guidelines in the way of thinking are the three trade-offs between the service system elements service concept, technological architecture and organisational network.

5.1.1 Trade-off between service concept – technological architecture

A lot of money has been invested in new technologies in which business developers believed. However, their expectations are often not realised. It is very difficult to know which service concepts users demand based on new technology. 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. The market failure of WAP services 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. We concluded that starting the design process with customers' wants and needs in mind

and focusing on delivering value to the target group is one of the requirements of our design approach.

Guidelines:

- the targeted user has to be part of the design approach in all phases of the design process; except in the synthesis phase.
- 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 user means that designers can have their ideas tested by users in several phases of the design process.

5.1.2 Trade-off between service concept - organisational network

The partners in the value network have to agree on the service concept, the differentiating value proposition offered to the customer. The service concept is determined by dominant actors' decisions along the dimensions of their business models (after Pedersen & 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. The gap between the customer's expectations and the service as delivered by the service provider has to be carefully managed (see e.g. (Zeithaml et al., 2006)).

Marketing is crucial for handling the perceived customer value. 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. This is different if an independent service provider has the relationship with the customer. A service provider might decide to hide the brand of the operator for the customers. Service providers or content providers 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.

5.1.3 Trade-off between technological architecture - organisational 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 come 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 ring tones, 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 development in the mobile field is quite dynamic. New wireless 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 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:

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

The need for the flexible creation of a value network puts a heavy 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 & 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 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:

- 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.

5.2 Design process, design activities and modelling methods

The guidelines outline the design process, design activities and modelling methods. These design activities are divided into phases, i.e. Analysis, Preparation, Synthesis, Implementation and Test. In each of these phases we have to deal with the trade-offs between the service system elements.

The design process is controlled by project and process management activities. These activities are all related to the actors and their interests and values. These are covered in design activities in the

service element ‘organisational network’. The design activities to build the ‘hard’ part of the service system are related to the technical architecture. All based on continuous input of the users. The deliverables of each design element in each phase are described in Table 1 below.

	Service Concept	**Technological Architecture**	**Organisational Network**
Analysis	Rough service description	Overview technical options	Letters of intention
Preparation	Detailed service description	Functional and technical design	Network creation
Synthesis	Communication formula	Prototype	Work procedures
Implementation	Launched for usage	Operational	Established relationships and processes
Test	Evaluation	Evaluation	Evaluation

Table 1 Deliverables per phase

In the PhD dissertation the whole design process (consisting of the way of working and the way of modelling) is visualised in diagrams for each phase. This is mentioned the ‘APSIT’ method and this method can be used as a kind of cookbook. Activities can be added in each of the phases depending on the project specific circumstances. It is important that the triad ‘organisational network, technical architecture and service concept’ is always taken into account. The deliverables mentioned in Table 1 are the result of each phase.

6 Instantiation

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 more quickly. 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 placed on 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.

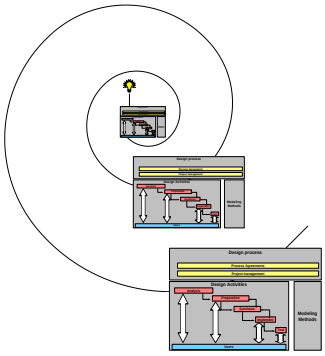

Figure 2 Design approach spiral

The whole design approach spiral is presented in Figure 2. 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.

The described design approach (in the PhD thesis) can be modified and extended in all directions: technical details, usability aspects, distribution, marketing, social interaction, etceteras, etceteras. Designing service systems is a multidisciplinary and complex process. The approach described can be used as kind of checklist.

7 Evaluation

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 instead 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.

8 Epilogue

This study has been executed during the period 1999-2004. It is amazing how fast mobile services are integrated in our daily life nowadays. At this time, 2016, the discussion is about the drawback of the easiness of using services; e.g. information about everybody can be found since location, personal preferences etcetera's are in the cloud. Easy for the user but what are the consequences? We still do not know.

9 References

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