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Co-creation of Experiences on Mobile Information Devices

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Abstract

Over a 15-year period, mobile phones have evolved from providing one single feature - the mobile voice call - to multi-featured multi-media communication and entertainment devices. Customer value has been added through successive integration of features previously conveyed by dedicated devices, as clock, timer, camera, media player, radio, etc. This continued integration strategy now poses several challenges to the manufacturers: 1) the management and cost of large product portfolios, 2) the risk of customers being confused by complicated offerings, 3) limitations in signal processing capability, bandwidth and battery life-time and 4) a slow-down of innovation due to catch-up effects with single-feature devices available on the market. There is also severe price pressure in many segments due to new entrants, as well as threatening competition from substitute products like netbooks and single-featured devices, *e.g.*, navigators with added communication functions.

In this thesis, we investigate the possibility of strengthening the value proposition of mobile information devices (MIDs) by enabling co-creation of the user experience. This objective is addressed by transferring general theory of co-creation into the mobile arena and defining a cookbook process for systematic synthesis of co-creation applications and services for this market. The suggested process provides a roadmap that covers aspects of market positioning, technical implementation and assessment of the value released through the enabling of co-creation behaviour. The target audience is anyone concerned with innovation of experiences on MIDs, for instance, proposition planners, development managers and application developers.

The utility and limitations of existing theory and the suggested cookbook process are evaluated by developing a prototype application. It is found that there are numerous opportunities of enabling co-creation on existing MID platforms, using standard peripherals and it is suggested that such efforts shall be concentrated on value propositions that capitalize on key MID characteristics as mobility, immediacy and context awareness. The drivers of co-creation and the strategy for value extraction need to be clearly identified and revisited along the development process. Moreover, as the competitive environment is highly dynamic, reconfigurable software platforms for co-creation and modular development are key components.

Keywords: co-creation, experience, mobile, information device, contribution system, application, service

Acronyms

3GPP: third generation partnership project – standardization body activities, extending the GSM specifications towards a global 3rd generation mobile phone system.

aGPS: assisted GPS, where almanac and so called ephemeris information indicating astronomic position data of satellites are used in order to more rapidly establish a position where signal strength is low or where satellite signals are distorted, *e.g.*, urban and indoors environments.

API: application program interface.

CellID: information that enables identification of the basestation identification. Through web services, provided by *e.g.*, Google or OpenCellID a position estimate can be obtained.

DART: dialogue, access, risk-benefit trade-offs and transparency. Conceptual framework for co-creation infrastructure according to Prahalad and Ramaswamy (2008).

EDGE: enhanced data rate for GSM evolution – a type of radio transmission modulation, backwards compatible with GSM spectrum, giving a potential 3-fold increase of data rates.

Google Talk: a web-based application for VoIP and instant messaging using the XMPP protocol.

GPRS: general packet radio service with data rates between 56 and 114 kbit/s. GPRS with the EDGE modulation (EGPRS) supports 236.8 kbit/s when 4 timeslots are used.

GPS: global positioning system.

GSM: global system for mobile communications (orig. groupe spécial mobile), 2G standard.

IMS: IP multimedia subsystem – a means of providing unified services across heterogeneous access networks, aiming at simplifying multimedia delivery to mobile and stationary terminals.

ISP: Internet service provider – a company offering Internet access and various kinds of related services, as email and storage, over some kind of access network (DSL, fiber, wireless, etc).

HSPA: high speed packet access – a 3GPP standard based on WCDMA for mobile broadband.

HTTP: hypertext transfer protocol – a standard for exchange between a client and a webserver that can be implemented on top of any reliable transmission protocol (typically TCP/IP).

Jabber: a standard for chat services including, amongst other features, positioning and VoIP support, built on using the XMPP protocol. The jabber standard is open, which means anyone can run your own Jabber server and connect to users on other Jabber servers/services.

J2ME: java microedition –a specification of a subset of the Java platform (programming language), specially adapted to the limitations of MIDs, with respect to processing power and UI.

LTE: long term evolution – cellular standard for higher data rates and more efficient spectrum utilization, standardized by 3GPP and compatible with existing GSM and WCDMA spectra.

Mashup: web application that aggregates and combines data from one or several sources.

MID: mobile information device

NFC: near field communication - technology for short range communication, with applications to, *e.g.*, identification and payment in the range of 10cm between the devices.

OEM: original equipment manufacturer – a company producing and branding its own products.

ODM: original device manufacturer – company whose products are branded by another company.

OS: operating system.

OTA: over the air transmission of software and parameters.

RFID: radio frequency identification - method for automatic identification in short ranges.

SVG(T): scalable vector graphics format. SVGT represents the tiny version of the SVG standard that is used for clients with limited capability (*e.g.* for multimedia messaging services).

SDK: software development kit.

UI: user interface.

UX: user experience.

VoIP: voice over internet protocol.

WCDMA: wideband code division multiple access (3G).

Web 2.0: a paradigm geared towards enhanced creativity and collaboration on the WWW (Wikipedia:web2.0).

Webkit: open source web browser engine (Webkit.org).

WLAN: wireless local area network.

XML: extensible markup language is a general specification for creating markup languages where the users can define their own elements.

XMPP: extensible messaging and presence protocol which is an XML-like, near real-time protocol for instant messaging, presence information, VoIP, etc.

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1 Introduction

Over a 15-year period, mobile phones have evolved from providing one single feature - the mobile voice call - to multi-featured multi-media communication and entertainment devices. Customer value has been added through successive integration of features previously conveyed by dedicated devices, as clock, timer, camera, media player, radio, etc. This continued integration strategy now poses several challenges to the original equipment manufacturers (OEMs): 1) the management and cost of large product portfolios, 2) the risk of customers being confused by complicated offerings, 3) limitations in processing capability, bandwidth and battery life-time and 4) a slow-down of innovation due to catch-up effects with single-feature devices available on the market. For instance, the pixel resolution of cameras integrated in mobile phones now approaches that of the most advanced system cameras – something that reduces the marginal customer value per cost of sales. More severely, overshooting the market demand opens up for new disruptive technologies that may be game-changing for the mobile market as such (Christensen, 1997). Today, there is already severe price pressure in many segments due to new entrants, as well as threatening competition from substitute products like netbooks and single-featured devices, *e.g.*, navigators with added communication functions.

In this thesis, we investigate the possibility of strengthening the value proposition of mobile information devices (MIDs) by enabling co-creation of the user experience. This objective is addressed by transferring general theory of co-creation into the mobile arena and defining a cookbook process for systematic synthesis of co-creation applications and services for this market. The suggested process provides a roadmap that covers aspects of market positioning, technical implementation and assessment of the value released through the enabling of co-creation. In summary, the unique contributions of the study are the mapping of general co-creation theory on the reality of mobile communications and the application of this theory for the design and implementation of a prototype application.

In Section 1.1, we survey the general concept of co-creation and some of its current application areas. Sections 1.2, 1.3, and 1.4 provide an introduction to our specific area of study – mobile information devices, a definition of the research problem as well as the objective and methodology of the study. Sections 1.5 and 1.6 provide a foundation for the theoretical elaboration in Section 2, by explaining the conceptions of co-creation and user experience as defined and delimited in this study. In Section 2, a cookbook process for systematic synthesis and development of new applications is presented. The suggested process provides a roadmap that covers aspects of market positioning, technical implementation and assessment of the value released through the enabling of co-creation. Section 3 gives an example

of how the process outlined in Section 2 can be applied for the design of a new co-creation application. Section 3 also presents a prototype of this application, implementation in the Java Micro Edition (J2ME) language, which, today, is a widely available standardized application platform for MIDs.

1.1 Topic: co-creation of experiences

The concept of co-creation of experiences is subject to an increasing interest and an increasing number of web-based applications already implement this concept (Prahalad and Ramaswamy, 2003, 2004, Andersson et al, 2007 and Cook, 2008). This development is partly captured in the Web 2.0 paradigm[1], which describes changing trends in the use of technology and web design that aims to enhance aspects as creativity, information exchange, aggregation and collaboration on the World Wide Web (Wikipedia:web2.0). The increasing popularity of social networking sites and the widespread referral to personal blogs and reader contributions in online newspaper editions are examples that manifest these trends (see for example the novel approach to diffusion and debate of news by Newsmill.se). Other examples of this development, on a more aggregate level of contribution, are the so called mashup applications that combine data from several sources on the Internet, deliberately made available through open APIs or reluctantly shared in lack of the possibility to enforce legal rights.

Co-creation of experiences is a hot topic also in the tourist industry (Mossberg, 2007). For instance, the tourism industry combines their traditional offering - transportation, accommodation, dining and sightseeing – with creative activities as video production, art performances, music events and publishing. The connections between tourism and mobile information devices (MIDs) are already established, *e.g.*, through blogging and MMS functions, but obviously there is much more to explore. Mossberg suggests that the boom in the experience industry is due to that the markets are getting saturated in many areas and the consumption patterns of the customers are changing. We believe this may be valid also for the mobile market.

The co-creation theory contrasts the traditional model of value creation in terms of company or product-centric activities and can serve as a vehicle to identify strategic options in the face of device convergence and diminishing boundaries between products, *e.g.*, in the consumer electronics market. The framework of experience co-creation goes beyond the prevailing approach to value creation through simply providing an extended variety of products, *e.g.*, additional models of mobile phones with different feature constellations, as a means to increase the competitiveness in an increasingly converged environment.

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[1] The term Web 2.0 was first introduced at the O'Reilly Media Web conference in 2004. According to Tim O'Reilly, "Web 2.0 is the business revolution in the computer industry caused by the move to the Internet as platform, and an attempt to understand the rules for success on that new platform" (Wikipedia:web2.0).

In this context, convergence refers to the fact that the boundaries between mobile phones, media players, media recorders and navigation equipment are diminishing.

We argue that mobility, immediacy and context awareness, brought about by MIDs, add new distinct advantages that justify a discussion dedicated to the co-creation of experiences on this kind of platforms. Today's great interest in open source software development and open operating systems for mobile devices are two incarnations of this strategy. This attention, together with the fact that mobile social networking now gets going may signal the start of a new paradigm, "Mobile Web 2.0" (see for example DeJean, 2008).

1.2 Area of study: mobile information devices

As MIDs are getting more powerful with respect to processing, memory, UI and sensor capabilities, they appear to become a rather interesting platform for co-creation of applications and services. Moreover, MIDs have significant advantages of mobility, contextual awareness and immediacy (short response time), compared to regular laptops and stationary computers. Immediacy is useful in several aspects: 1) access of content stored in the MID and 2) acquisition and sharing of new content over the Internet. The development towards mobile broadband systems as high-speed packet access (HSPA) and long term evolution (LTE) together with flat-rate charging models imply that new creation and distribution models, with less buffering of information and content (such as books, music albums, maps) and more instantaneous sharing of multimedia and contextual information will emerge. Consequently, it will be easier for users to pick only the selected content needed in a particular situation and pay only for these items. The *Spotify* music service, which uses streaming technology to manage intellectual rights issues, is one recent example of a service that could become widespread on mobile platforms as a consequence of this development.

Today, the most obvious user contributions on the Internet are the sharing of various kinds of content as music, video, games or quizzes. However, it can be argued that a much larger set of applications build on user contribution principles. Moreover, as this development implies that the difference between a consumer / user and a producer becomes less distinct, it may be more adequate to speak about *prosumers*, rather than consumers or users. In this thesis, however, the terms consumer, user and prosumer are used interchangeably.

Regardless of the choice of terminology used to denote the receiver and originator of a particular kind of contribution, it may be argued that other contributions than those consisting of pure entertainment content, *e.g.*, music and video, may have more important influence on the creativity of the actors in a contribution system. For instance, music and video contributions are rarely ennobled through the interaction of different actors in a sequential manner. Instead they are, most often, terminated in the consumption experience of individual users. On the other hand, Wikipedia is an example of a contribution

framework that allows more elaborate interaction by its users and successive refinements of the contributions in several steps. Hence, we argue that different kinds of contributions lend themselves better or worse to creative interaction and processing. Consequently, it may be expected that contributions, as voluntarily shared information, knowledge and metadata are more important vehicles for value creation, in general, and that these will give a more important extension of the value proposition for mobile devices than the entertainment content now starting to become available through services as iTunes, PlayNow and Ovi.

An example of a user contribution taxonomy is provided in (Cook, 2008) and our study adds *active and passive sharing of personal context, status and behaviour* to that taxonomy. The extended taxonomy is illustrated in Figure 1. The contribution of knowledge, *e.g.*, Wikipedia-style expertise, was captured already in the original taxonomy, under the label of actively contributed content. Two examples of passive resource contributions – ad-hoc networking and collaborative communication schemes – are provided to illustrate the deployment potential of computation resources resident in MIDs.

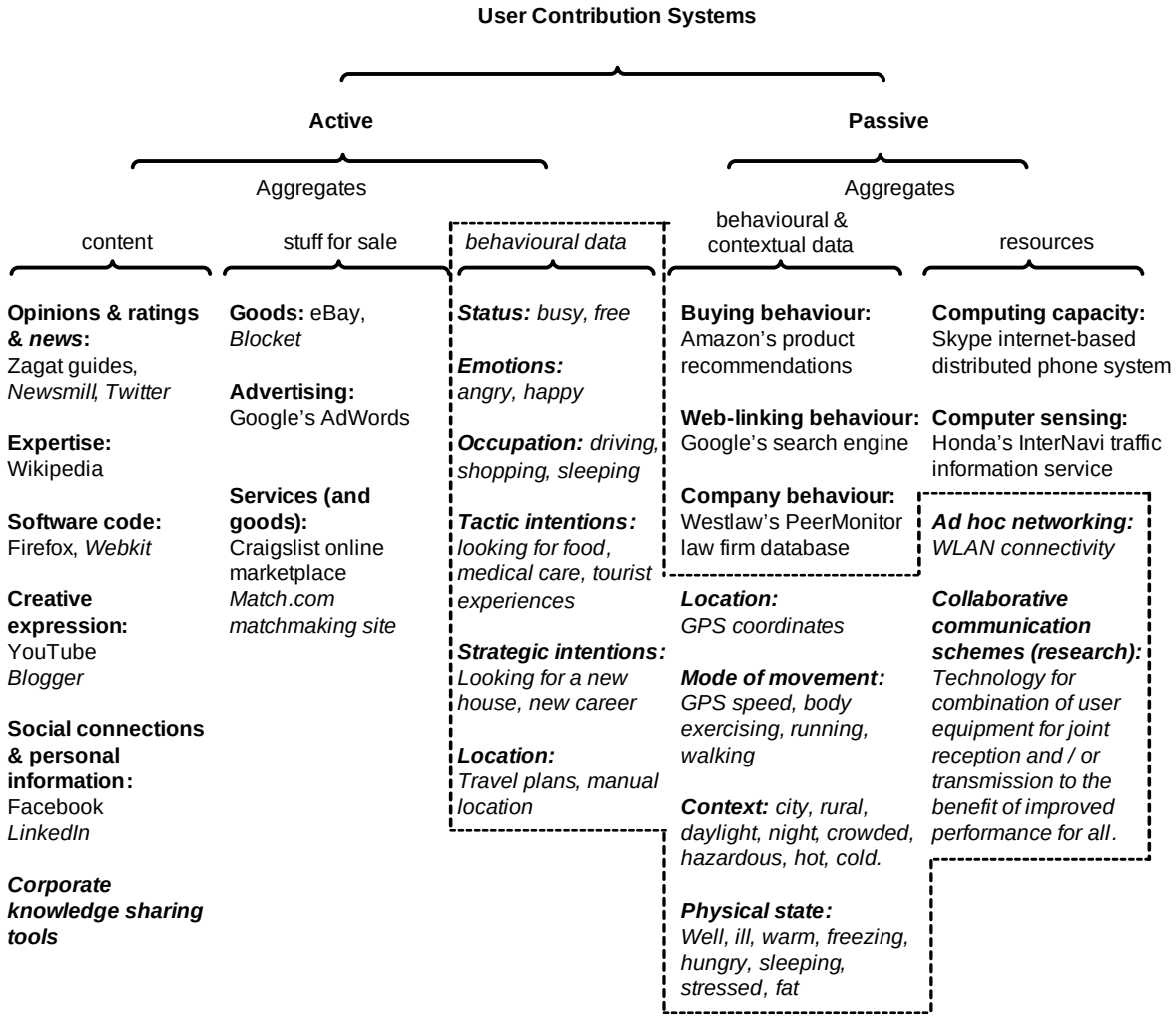


Figure 1 User contribution taxonomy developed from (Cook, 2008). The original taxonomy is extended with the focus areas of our study: active and passive sharing of behavioural and contextual data that provide information about individual utility functions. Extensions to Cook's original concept and some additional examples, more relevant to the mobile area, are given inside the dashed area and in italics.

Typical for contribution applications is that they fuel the *network effects* of an interconnected system, *i.e.*, the value of the contributor-and-user network increases with each additional participant and his ability to contribute. However, we argue that the network effects and the value potential depend on the possibility for the users to engage in creative interaction and processing of the actual contributions. Therefore, we believe that contributions in terms of voluntarily shared information, knowledge and metadata will better leverage the communication network facilities and build more value for interconnected mobile devices than entertainment content contributions. In either case, the presence of a well functioning distribution facility – a contribution store - is critical for the system to work.

The value is to a varying extent driven by a limited set of typical needs or utilities. For instance, these utilities can be related to education (Wikipedia), entertainment (YouTube), socializing (Facebook, StayFriends, Matchmaking), communication (Skype), business-life needs (LinkedIn), transaction needs (eBay). In the sequel, we will use the terminology *user experience utility* to denote the main needs addressed by an application and we will focus on the value added by providing this utility on a MID.

In conclusion, the mobile market is a mass market that consists of a large number of interconnected users and potential contributors. It seems likely that the technical enabling of co-creation behaviour in applications and services for MIDs has big potential to extend the current value proposition.

1.3 Problem definition

As discussed in Section 1.2, user contribution systems are increasingly making their way into corporate business models as well as our daily lives. Considering different user contribution systems and their potential importance for application and service innovation in the mobile sector, we have identified a gap in the general theory on co-creation available in the literature:

the lack of guidelines and best practices for development of co-creation applications on mobile information devices.

In contrast to the vast literature on design procedures and methodology for the development of electrical circuits and software components in such devices, there exists, to our knowledge, no standardized framework for the development of co-creation experiences through applications and services running on such equipment. This is particularly severe as the center of gravity of the value proposition of MIDs is now shifting away from telephony and simple data communication services to more composite applications and services.

The following literature observations bear further proof of the importance of understanding the mechanisms of co-creation and its implementation in the MID area.

- The importance of co-creation as a strategic option towards competitiveness is highlighted in (Prahalad and Ramaswamy, 2003, 2004, Andersson et al, 2007, Cook, 2008, Mossberg, 2007 and Prahalad and Krishnan, 2008). However, little attention is given to the tools needed to design a co-creation experience and the composition of the co-creation user interface.

- In general, innovation and value creation theory (quite naturally) relates to historical examples and "backwards assessment" of theory. Even though cookbook-style advice, rules-of-thumb and checklists are common in the management literature, few attempts to assess the theories' utility through practical synthesis or prototype development are presented. In order to differentiate from existing literature, an intermediate goal of this thesis is to put the theory on co-creation to test in a real situation.

The specific study of mobile information devices as application area for the co-creation theory can be motivated by the below set of market trends and observations.

1) Due to increasing product complexity and the pursuit of global R&D and marketing strategies, it is becoming more challenging to develop and maintain broad product portfolios. For example, Sony Ericsson's global phone portfolio

today contains some 93 models, where most models exist in 2 or 3 different variants (Sony Ericsson, 2009).

2) Device convergence and commoditization of hardware platforms force OEMs to climb up the value chain towards applications and services provisioning. However, this requires giant investments and the support from developer communities and users is vital in order to provide attractive content. A better understanding of the mechanisms stimulating the co-creation process is needed in order to motivate and retain the loyalty of these groups.

3) Technology is running ahead of services from a consumption perspective - complementary services and infrastructure for creation of content (both centralized and distributed, see for example Adner, 2006) are badly needed in the mobile communications industry, but has merely begun to catch up. The cellular infrastructure is, today, highly asymmetric since the data transmission rate of the down-link is typically much higher than for the up-link. Due to this, the focus for MIDs has been on consumption of content. However, as more uplink bandwidth will soon be introduced through HSPA and LTE, better infrastructure for consumer content creation based on MIDs will become available.

4) There is a slow-down of value addition through integration due to catch-up effects with single-feature devices on the market. For instance, the cameras in high-end mobile phones are getting close to the image quality offered by the more advanced system cameras on the market.

5) There is an increasing price pressure in many segments due to new entrants, as well as threatening competition from substitute products like netbooks and single-featured devices, *e.g.*, navigators with added communication functions (see for example Nüviphone).

Moreover, operators today find themselves in a need for more revenue. In fact, they are now competing with the mobile phone OEMs about the same cake, both in the application and service area (see for example iPhone's ground-breaking traffic-revenue sharing agreement with the operators). One direction of business expansion is the IMS platform, which is now becoming available. However, it needs to be filled with services in order for the business case to mature. As a consequence, the operators consider offering an interface towards third party developers (see for example ABI Research, 2008 and Ericsson AB, 2009). This will open up additional possibilities for co-creation of advanced user experiences.

Mobile phone OEMs struggle with the differentiation of their offered user experience through co-branding, fashion industrial design and more advanced user interface technologies. They also climb up the value chain and offer various services and applications (proprietary or third-party developed). In order to meet the cost pressure, suppliers are sought globally and development and production is re-located to low-cost countries. At the same time, there is a need for even more

specific tailoring of propositions to groups of customers with unique requirements.

Extrapolating this development, the value proposition will need to be tailored on an individual basis, for each specific user. Together with the need for cost efficiency, this calls for access to multiple resources globally. Prahalad and Krishnan (2008) describe this as the "N=1, R=G" situation, where N=1 corresponds to personalized co-created experiences and R=G represents the global access to resources and talent. Prahalad and Krishnan argue that this situation is now becoming reality and calls for new organization of companies and corporate processes.

A mobile phone manufacturer that responds to this development, simply through increasing the variety of its portfolio may end up creating too much confusion to the customer. Also, the management of an increasing product portfolio – in terms of R&D, marketing and maintenance – is clearly challenging, even when so called platform strategy is used for the development (see for example Cusumano, 2002).

In order to meet this challenge, Prahalad and Krishnan point to *co-creation of experiences* together with the customer. Instead of providing completely defined and finalized products and services, the company invites the individual customer to create parts of the experience himself. Prahalad and Krishnan stress the importance of business processes that supports this new of mindset. This thesis aims at providing guidance in this direction for the part of the business process that is concerned with hardware selection and software development for co-creation of mobile experiences.

1.4 Objective and methodology

In this thesis we analyze different possibilities of working with co-creation of experiences on MIDs in order to strengthen the value proposition of such devices in a structured way. The objective is to answer the questions: a) whether it is possible to add substantial value by enabling co-creation on MIDs and, given a positive answer, b) how to systematically develop applications and services that enable co-creation, taking the particular drivers of value into account (in response to the problem definition in Section 1.3). More specifically, taking existing and general theory on co-creation as a starting point, we study how applications and services, can be systematically synthesized and implemented on mobile phones and other MIDs. This objective can also be stated as *bridging the gap between theory and technical implementation* and *translating the management theory and language into technical artefacts as platforms with proper sensor hardware, adequate APIs and efficient application and service frameworks for co-creation.*

The observations made in this study are codified into a cookbook process, including a toolset for analysis of the value proposition of applications and services with special focus on the characteristics of MIDs as deployment platforms. In order to validate the utility of the proposed process, a prototype[2] application is defined and implemented in the J2ME language (see for example Li and Knudsen, 2005 and Skansholm, 1999).

In order to understand how the consumer participates in the co-creation process, we analyze the creation and exchange of different kinds of information flows that can origin from a consumer in possession of a MID. We study how to capitalize on key MID characteristics as mobility, contextual awareness and immediacy in different co-creation scenarios. We also seek to understand how to manage the particular limitations of MIDs with respect to UI, processing and communication bandwidth and, finally, how to monetize on the value created. The analysis is carried out in five steps

1) use existing theory as a starting point to create perspective and focus (Sections 1.1 to 1.4),

2) define our conception of co-creation and user experience (Section 1.5 and 1.6),

3) define a process for synthesizing new co-creation applications (Section 2),

4) define a new application and a make a prototype implementation (Section 3),

5) evaluate and conclude on the utility and limitations of the theory and the defined process (Section 4).

Our study has an explorative character, where empirical evidence is implicit in the mapping of general co-creation theory to the mobile arena, the recurring assessment of the utility of theoretical insights and the development of a prototype application. According to Merriam (1994) there exist three fundamental types of research problems: 1) conceptual problems, 2) problems related to choice of action and 3) consequence assessment problems. Conceptual problems originate from contradictory elements, for instance new theory that challenges prevalent theory and consequence assessment problems relate to the valuation of the consequences of making a particular decision and choosing a particular cause of action, according to certain criteria. The problem addressed in this study belongs to category 2 – problems related to choice of action. This kind of problems arises when there is a lack of guidelines for making some kind of choice. The problem

[2]Prototyping is known to be a powerful technique for early identification of issues in development of new systems. Inspired by the innovation mantra “observe, brainstorm, prototype”, promoted by Kelly (2001), we believe that the implications of the co-creation theory to experience development on mobile information devices can be better understood by doing a prototype. Thus, using software development kits available for free on the Internet, we implement a small trial application to support the conceptual work.

solving activity is typically concerned with finding the best method to reach a beneficial situation or avoid something inconvenient.

Our study can be viewed as a case study where the validity of existing theory is assessed in a particular application area and supplemented with new tools for analysis of this particular area. We adopt a hermeneutic perspective that allows for a more subjective and interpreting kind of study than the positivistic perspective frequently used in natural sciences (Merriam, 1994). This implies that the researcher allows himself to apply his own common sense and interpretation to the information collected during the study. It also means that the direction of the study is allowed to be more dynamic and somewhat similar to a non-deterministic process. One consequence of this hermeneutical, qualitative, perspective is that the requirements on the study with respect to reliability and repeatability are relaxed compared to the case for a positivistic, quantitative, study. In general hermeneutic research is more focused on the analysis of particular circumstances and attributes of an object or situation, subject to study, than the generalization of the result to other areas. Moreover, the hermeneutic observer focuses on providing guidelines for the particular audience targeted by the study. In our case, the situation of study is application and service development for MIDs and the target audience is anyone concerned with innovation of experiences on MIDs, for instance, proposition planners, development managers and application developers.

There exist different theoretical points of attack for a research problem. Three main approaches can be distinguished: 1) deduction, 2) induction and 3) abduction (Merriam, 1994). Briefly, a deductive approach implies an ambition to generate different kinds of hypotheses based on existing theory. These hypotheses are then evaluated by observation of an object. The hope is that an iterative series of such hypotheses generation shall lead to the creation of new theory. Induction means a more explorative search for knowledge and understanding of the reality and new observations may radically change the course of the investigation, *cf*. the hermeneutic perspective. In our particular study this has happened several times. For instance, at one point, the focus of the study was on self-enforcing business models and trade-offs between monetization and the building of installed base for mobile applications. In a later intermediate stage, the study concentrated on market analysis and positioning of general applications and services but turned back to the co-creation theme since there was a stronger theoretical foundation in this area.

The inductive researcher applies different analysis methods, as the definition of categories and search for patterns and similarities, in order to develop new theory and/or an extended understanding of a situation or object under study. Abduction is a combination of induction and deduction that uses existing theory to define a perspective and create focus for an empirical investigation. Abduction also allows for triangulation, *i.e.*, the combination of previous theory with new observations and interpretations of those, as well as comparisons and modifications of previous theory. Following this brief survey of research methodology, we conclude that the theoretical point of attack for our study is abduction.

1.5 Definitions

This section provides a set of definitions and attributes of experience co-creation. The objective is to support the early process of identifying a rough application or service, based on such a concept. The sequential identification of customer utility, platform device, metrics for customer utility, the context of the co-creation and the technical architecture is suggested as one way of structuring the initial brainstorming exercise for new co-creation applications.

1.5.1 Co-creation

Co-creation, as defined here, does not include traditional services available in a MID, *e.g.* SMS, MMS and voice. Instead, co-creation refers to the situation where the functionality or content of an application provided by a company (customer or other party) is extended or tailored by the consumer according to his individual preferences and fed back to the system in some way. These preferences may be common to a community of users and the contribution of one consumer may be shared with other users. Co-creation only takes place when creative contributions are made and when information with individual meaning is shared in a way that changes the state of the total system. Co-creation does not take place when simply mechanically executing an application or requesting a service, *e.g.*, a phone call, SMS, voice recognition, etc.

One can argue that co-creation takes place when users participate in regular beta-tests of new software (SW) and provide comments on the performance or contribute to the identification of functional issues (bugs). Also, a related sort of contribution takes place when users fill the empty shelves of the eBay Internet marketplace. However, as these practices are common and relatively well understood, they will receive no special treatment here. These kinds of user contributions and others are captured in the more wide-sense user *contribution system* taxonomy presented in (Cook, 2008).

In this study, we distinguish between six different types of co-creation that are listed below.

1) Develop applications or produce / provide content (image, video, audio) for a web application framework, as Facebook, MySpace, YouTube. This can be done on any kind of device with an Internet connection, either stationary or mobile.

2) Select what complementary application SW to buy and run on your MID. Download from an application store, *e.g.*, iTunes or PlayNow. The proximity of the application to the OS of the MID may be different, for instance extensive APIs of Mac OS X, Googles'

Android or Windows Mobile, or, alternatively, more contained sandbox execution environments as Sun's J2ME.

3) Write your own application SW, for any OS of the kind mentioned above, use it yourself and distribute to a wider community of users.

4) Asynchronously transfer information about your utility function to a service provider in order to expose yourself for various kinds of information and offerings.

5) Synchronously transfer information about your status and context, to complement your utility function. Note that this information can be directed in different ways, either to a dedicated service provider, or to another community, *e.g.*, by providing an interface from a mobile client application to a web application (see Wayfinder's Facebook connection). This interface can be more or less open (see for example the Jabber standard that enables open communication with any other server application through the XMPP protocol).

6) Generic transfer of knowledge, *e.g.*, training a mobile agent[3] in a particular skill, to carry out specific tasks, *e.g.*, pattern recognition or more general tasks as crawling the Internet for certain information or performing financial trading according to specific rules. Use the agent yourself and/or distribute it to a wider community.

We believe that the three latter types of co-creation behaviour have the highest value potential specific to MIDs and we will concentrate on category 4 and 5 in this thesis. This is due to that the distinct advantages of MIDs, when it comes to mobility, immediacy and context awareness, open up many new possibilities for collecting and exchanging information instantaneously. The combination of this synchronous information with an asynchronously provided, well defined, individual profile covering individual preferences, habits and objectives offer many new opportunities for value creation. Another rational for the focus on category 4 and 5 is their limited use of communication bandwidth, which is practical due to the limitations inherent in any radio communication system, at least as far as wide-area coverage and high-mobility are concerned.

The kind of information transferred during co-creation of type 4 and 5 can, at least partly, also be referred to as *metadata*. However, the information produced during these types of co-creation is more intentionally shared and better controlled than regular metadata. The aggregation and processing of metadata and other shared information show tremendous potential but also many issues related to

[3] A mobile agent can be described as a software agent with the features of mobility, autonomy, social ability, and learning (see for example Kanter, 2001, and references therein).

integrity and privacy (Perkins, 2008). For instance, the level of emotions in particular geographic areas, *e.g.*, after a political vote or a football match can be monitored through people's mobile phones and appropriate actions and commercial offerings can be tailored according to that (Chipchase, 2008).

Even though its application on MIDs may not be easily visible, we believe, as indicated by Stalnaker (2008) that co-creation of type-6 will be common in the new peer-to-peer economy and also particularly useful in mobile scenarios. This co-creation could, for example, take place when a mobile contributor engage in continuous enhancements of the skills carried by a mobile agent in some form, which are later conveyed to another mobile actor for use or further enhancement.

1.5.2 User experience platform (UXP)

This is the physical device that conveys the user experience. The UXP includes sensors, communication technologies, operating system (OS), APIs and UI facilities. The UXP is characterized by its technical specifications and a set of key performance indicators (KPIs) describing its performance, *e.g.*, memory, processing power, communication bandwidth, multimedia capabilities, etc.

1.5.3 User experience scope (UXS)

In order to describe the scope for different types of co-creation, we refine our taxonomy with the following categories

- **Sharing**: private / community / wide community / global sharing of the co-created content or functionality. The different kinds of sharing can either be contained to the own application or open towards other applications, *e.g.*, through an HTTP or XMPP-based API. A related aspect is the originator's degree of awareness of the information shared. For metadata, this awareness is not necessarily extensive.

- **Timing**: synchronous or asynchronous, *e.g.*, interaction at well-defined time and place, versus configuration of preferences and parameters that prepare for interaction at non-deterministic time and place. For example, uploading a picture to an Internet blog versus configuring a personal profile for later reception of location-based advertisement.

- **Contribution**: active or passive sharing of information.

- **Communication**: high / low communication bandwidth, *e.g.*, video exchange versus limited text-based information exchange.

- **Computation**: high / low computation. For example, customized pattern recognition services with heavy server support versus simple administration of limited data in the client.

These categories are useful during architecture and dimensioning of a co-creation system, in order to assess technical issues of scalability, capacity planning and information security. These issues are identified as particularly challenging as the time and place of value co-creation can be difficult to predict (Andersson et al, 2007). Moreover, the co-creation scope needs to be adapted to the targeted UXPs and should normally cover as wide a range of technical performances as possible.

1.5.4 User experience context (UXC)

The context describes the entities that participate in the co-creation, their mindset, emotions and the arena where it takes place. For example, a company may interact with a consumer entirely in a virtual environment (gaming) or two contributors may interact both in a virtual environment and through real life contacts, *e.g.*, in a sports benchmarking application. Mirroring of the real life in a virtual world can be a powerful way of creating a sense of presence between geographically distant parties. Rather than struggling to become part of fantasy worlds, Hemp (2008) argues that businesses should focus on creating and exploiting virtual worlds that reflect real life. Mobile information devices have a key strength in their ability to collect contextual information – something that could be exploited in the creation of virtual worlds or, directly, for aggregation of metadata.

1.5.5 User experience value metrics (UXM)

In order to assess the value of the co-created user experience and, ultimately, the ability to monetize it, some quantitative measures are needed. As discussed by Andersson et al (2007), there are many different perspectives on value but rather few straightforward definitions. This is the case for wireless services, in particular, since the technology is relatively young and since the terms and conditions of charging have not been so clear to the consumers. Moreover, measuring the success of a co-creation design in retrospect is tricky as it necessitates the observation of a large network with many points of interaction with partly intangible value creation.

Well aware that the value extracted by different stakeholders in a contribution system cannot be fully captured by simple heuristics and with no ambition for such a complete coverage, we propose to a set of value indicators for in Table 1. The objective is to provide the stakeholders of a contribution system; customers, service providers (operators), application providers and other contributors (other business) as illustrated in Figure 2, with simple metrics for estimation and understanding of the value potential of a particular co-creation scenario. For some of the value indicators in Table 1, a monetization strategy is proposed in the

rightmost column. It shall be noted that the suggested value indicators are not, in general, mutually exclusive. The intention is that they shall be helpful in the process of developing a co-creation application and applied to a level of detail that fits the degree of maturity of this development at a particular stage. For instance, the value indicator "number of ways for a user to save money" can be used at an early stage where detailed information as "average monetary saving per user per year" are too difficult to predict.

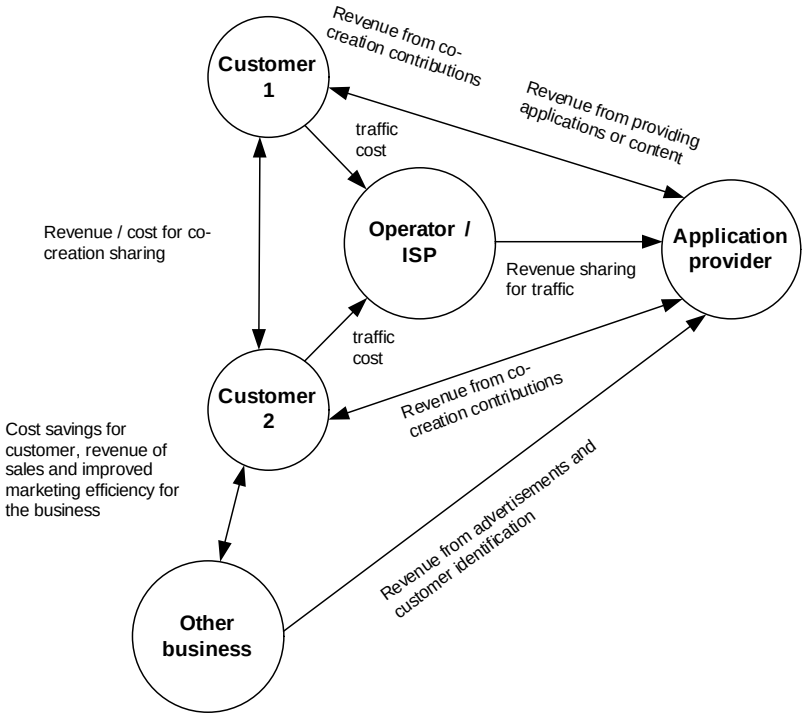


Figure 2 Example of value metrics and monetization-base for a co-creation scenario. An application provider may collect revenue from other businesses through customer referral and advertisements. As a result of the referral, there may be cost savings at hand for the customer. The application provider may finance his compensation to a contributor by sharing the operator's revenue for the traffic generated through the application.

Table 1 mainly indicates how the provider of a co-creation application or service can extract value. However, other stakeholders, as users and advertisers can also extract value from the system. For example, users can get compensation for sharing metadata. The reason why seemingly similar metrics as "number of content downloads / uploads" and "size of average download / upload" are considered as separate items are that they capture different aspects of the co-creation, *e.g.*, interaction frequency and content complexity.

Symbol	Value indicators	Possible monetization strategy
S	number of subscribers to a service	base for advertisements
L	number of content uploads / downloads	base for revenue sharing with operators
B	size of average content upload / download in kBytes	
T	pay threshold for access to the application	adaptive pricing for optimization of total revenue in a certain time
M	number of ways for user to save money	
C	average monetary saving per user per year	subscription
R	average monetary revenue per co-creator per year[4]	compensation for administration of payments to the service provider
V	added market value for hardware (HW) device (MID)	willingness of OEMs to sponsor application development
A	number of ways of monetary revenue of the application provider	
D	direct revenue for the application provider	
I	indirect revenue for the application provider	selling metadata and derivatives
K	kinds of metadata collectable	packaging and brokerage of metadata
T	average time saving per user per year	
N	number of raw metadata kinds collectable	
W	number of ways to contribute / co-create	
P	average payment for metadata per user per year	application provider rewards the users for willingness to share metadata

Table 1 Example of value indicators and some possible monetization strategies for those.

Frequent interaction may for example better capture the value of narrowband services and the potential for extending the value extraction during these events. An example of monetization-base for a co-creation application is provided in Figure 2.

[4] Note that value may be even better captured by the provider of a co-creation framework if the contributor revenue is small or non-existing, as long as there are still good incentives to contribute (see for exampleAndersson et al, 2007).

1.5.6 User experience utility (UXU)

The total utility of a user experience, to the individual user, can have different composition. Here, we propose a tool for analyzing the composition of a user experience and understand the differences between applications and services. In this tool, 16 super-utilities are identified, each of which may contain many sub-utilities (The number of utilities and the set of utilities can be chosen at the convenience of the analyst). The utilities are then mapped in a diagram depending on how much they leverage on 1) the mobility, *i.e.*, the utility of context flexibility and context-awareness (y-axis), and 2) the immediacy, *i.e.*, the short response times that are key characteristics of a MID that you carry in your pocket virtually everywhere.

The response times are short in two respects: 1) access of information and content stored in the MID and 2) acquisition and sharing of new information and content over the Internet. Clearly, the ability of a user to capture an opportunity depends on him being in the ”right place” at the ”right time”, getting the information about it and being able to respond with short notice. For social networking applications, immediacy is an important requisite for creating a sense of presence and belonging.

The mapping in Figure 3 is referred to as a *utility constellation* and it is helpful in order to inspire and structure initial application ideas as well as describing their respective value propositions. Moreover, it is a tool for comparing the proposition and positions of new applications to those of already existing ones. Some examples of how sub-utilities can be mapped on super-utilities are illustrated in Figure 4. Note that this figure just gives an example of different possible instances of the super-utilities with no ambition of being exhaustive. It should also be noted that the relative location of the utilities in the constellation is dependent on the detailed composition of each utility which can be different and, in its turn, depend on the particular application scenario and market subject to analysis. Also, it is envisioned that the footprint of a particular application, in this constellation, may change dynamically depending on time and context to fit the needs of the user.

The different utilities may be associated with different degrees of interaction and potential for co-creation. In Figure 3, those utilities with high potential for co-creation applications are marked with thick, solid, contours. The utilities located above the diagonal in Figure 3 capitalize the most on the mobility and immediacy properties characteristic to MIDs and, among those, the ones with high potential for co-creation are particularly interesting from a value perspective. For instance, safety applications can exploit flexibility and awareness of context for continuous monitoring and detection of hazardous environments. At the same time, immediacy is critical in order to take countermeasures and receive up-to-date information. Contributed informations about behaviour and context of a person in danger as well as other parties in the vicinity are useful to coordinate a potential rescue party.

As illustrated in Figure 4, a number of different sub-utilities related to safety can be imagined, *e.g.*, support with general advice or medical information during a crisis situation, surveillance and protection against hazardous environments. To the extent that safety applications are able to assess and mitigate risk, insurance companies could, at least in theory, tailor their offering and apply more flexible pricing policies.

Some additional details and explanation for a number of different utilities with high potential for co-creation are provided below.

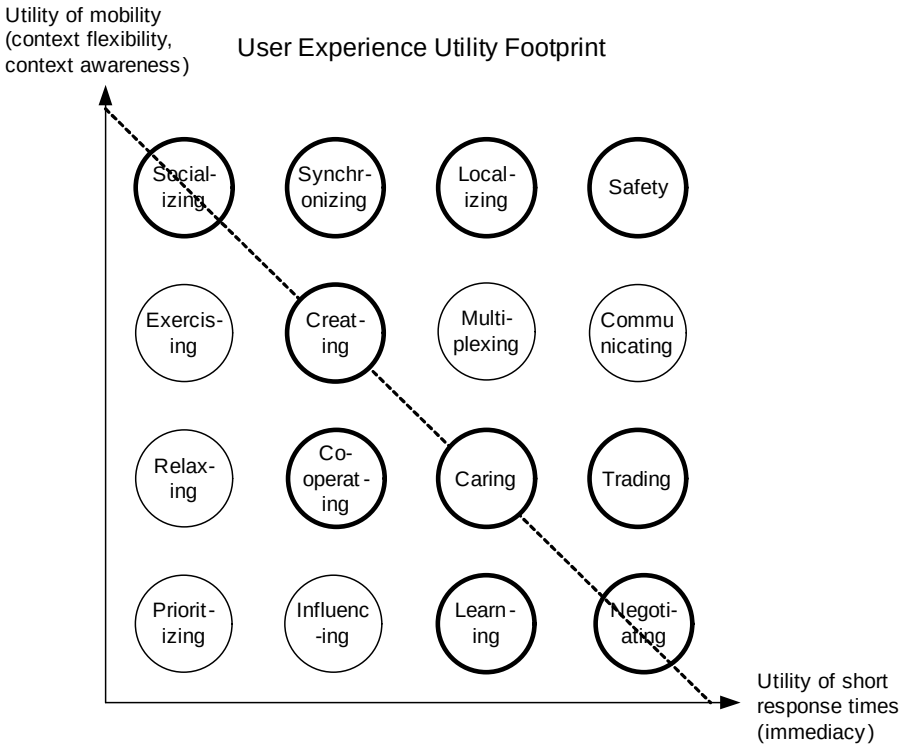


Figure 3 Graphical representation of user experience utility areas (utility constellation). Utilities with high potential for co-creation have thick, solid, contours. Utilities above the diagonal leverage the most on the attributes specific to MIDs.

Multiplexing – carrying out several actions simultaneously, *e.g.*, distribution of information while, simultaneously, doing spontaneous shopping or queuing for another service. Multiplexing typically has the value of time saving.

Relaxing – spending time on joyful activities and various kinds of entertainment.

Synchronization – automated alignment / agreement or joint planning, *e.g.*, Outlook-style on-line calendar (finds time where all meeting parties are available and proposes meeting slot) or simple organization of the individual's private life. There are also other kinds of synchronization in time and location, as more spontaneous coordination of meetings with friends, institutions and opportunities through location-based notification, etc.

Socializing is a widely defined utility that includes different elements as need for attention, visibility, love, confirmation and competition. Another utility that may be an important prerequisite for socializing is that of maintaining integrity.

Communicating – enhanced communication ways, *e.g.*, chat, sharing of status, emotion and intention to the humans and devices in the environment. Other examples of enhanced communication services are VoIP and sound communication through push-to-talk applications. Also here, maintaining integrity and the utility of not disclosing more information than desired are important. This can be obtained through various kinds of identity obfuscation filters.

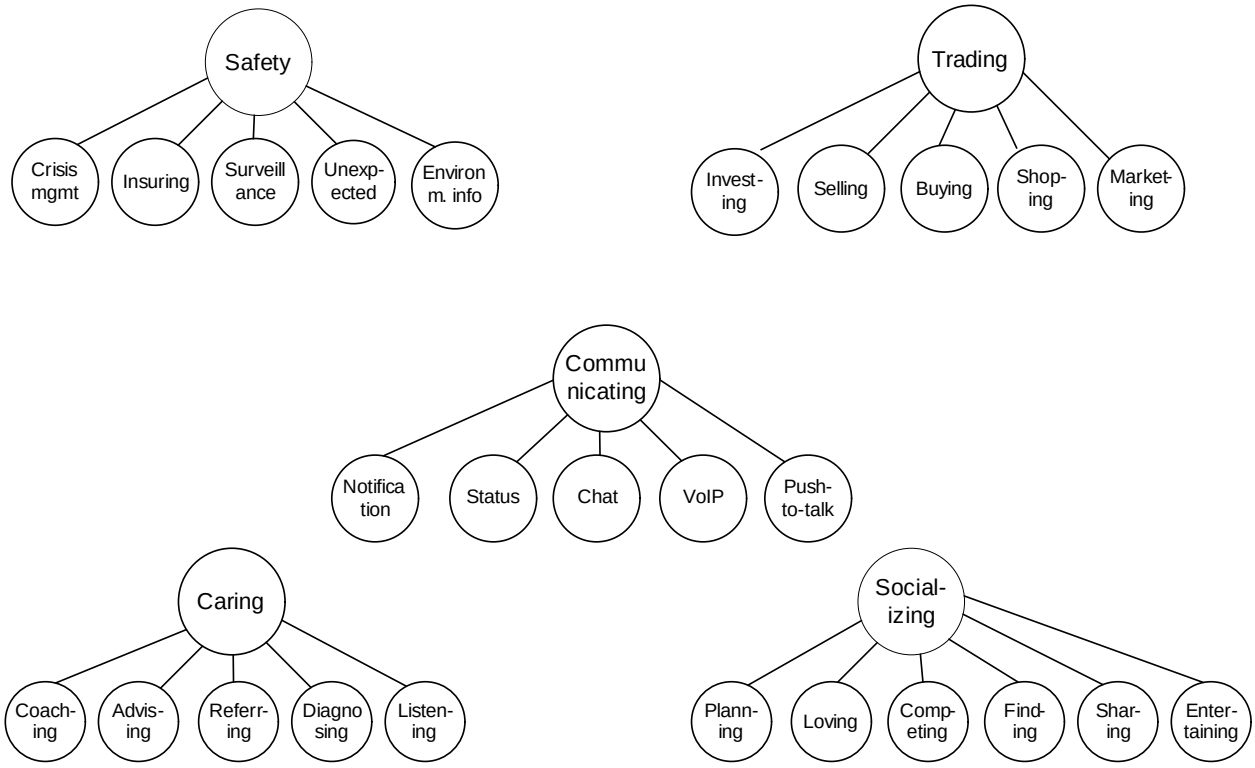


Figure 4 Example of partitioning in super and sub-utilities. The safety utility consists of several different sub-utilities, *e.g.*, features related to crisis management, insurance agreements, surveillance, risk management (unexpected events) and detection of environmental hazards. In the same way the trading, communicating, caring and socializing utilities each contain many different sub-utilities that can be emphasized differently to create a new co-creation value proposition.

Prioritizing – filtering activities, assigning attention by judging urgency and interest.

Trading – exchange of products and services as well as information for making educated decisions. Depending on the particular kind of goods and services traded, the real-time aspects are different, *e.g.*, in stock trading and bidding scenarios, information delays are more critical than during evaluation and purchases of commodity goods as consumer electronics.

Creating – exchange of content, *e.g.*, drawings, maps artwork – joint painting, joint music creation.

Negotiating – simplifying the reach of agreements in various situations. Understanding the willingness of customers to pay, clarifying risks and benefits and terms and conditions of a transaction.

Collaborating – splitting efforts and organizing joint activities, *e.g.*, the surveillance over common property. Brainstorming and bringing forward creative ideas in problem-solving situations are other examples of collaborative utilities.

1.6 Limitation of scope

This section describes our limitation of scope for the technical part of this study and the prototype implementation, with respect to the definitions in Section 1.5.

1.6.1 Technical platform

The user experience platform is limited to MIDs supporting standard cellular data and telephony (GSM/GPRS/EDGE/WCDMA) as well as local connectivity through Bluetooth and WLAN. Moreover, the platform device has support for the J2ME language with standard APIs for location and content. It is assumed that the platform is equipped with conventional UIs available in today's low and mid-end phones (2009). For instance, advanced touch-screen interaction is not considered. It is reasonable to impose this limitation in technical scope since a) the vast majority of subscribers does not have access to more sophisticated platforms, b) a large installed base is a key requisite to achieve strong network effects and 3) it is more challenging to define a co-creation concept the less the presence of technical enablers.

The context of the value co-creation discussed in this study is limited to 1) business-to-consumer and 2) consumer-to-consumer (prosumer-to-prosumer) use cases. Neither machine-to-machine communication, nor business-to-business communication is considered. The MIDs considered are not vehicle-based devices but portable handhelds with its associated limitations of UI, battery power, size and cost.

1.6.2 Client vs browser implementation

In this study, we focus on co-creation applications and services including a dedicated client application for the MID. An alternative that is well suited for many UX utility scenarios, is a (mobile) browser that support regular web service implementations, *e.g.*, MiniOpera. It is not always easy to understand when a

specific way of implementation is the best way of serving a utility constellation. The situations where we see major advantages of a dedicated client implementation are listed below.

a) Management of the UI of the MID

b) Management of the sensors of the MID

c) Exchange data with existing MID applications, *e.g.*, phone book

d) Manage the way of connecting the MID to the Internet or other MIDs (Bluetooth, WLAN, cellular)

e) Collect data about the user context, *e.g.*, environmental conditions.

f) Collect data about the status of the user, *e.g.*, moving, sleeping, exercising, mode of feelings, mindset, objective, etc.

g) Off-line access or buffering of data

h) Learn about patterns of user behaviour and individual preferences

i) Local co-creation together with other MID users. This can be different collaborative schemes based on, *e.g.*, sensor data collection (3D), editing of graphical file data, etc.

j) Collect statistics of MID use, *e.g.*, nr of phone calls made, who is called, schemes for staying in touch with people, when calls are made, where they are made, how many SMS, how much browsing during a day, etc.

1.6.3 Focus area of UX utility

Consider the categorization of UX utilities in Figure 3. Clearly, the most important attributes of MID applications are 1) the high mobility and 2) the short response time. As we are primarily concerned with the mechanisms of co-creation in this study, the degree of interaction of different UX utilities is another key parameter. Among the selected utilities in Figure 3, the utilities with the highest potential for interaction are marked with solid contours and those who are above the diagonal (leveraging on high mobility and short response times), are the focus utilities of our study.

2 Cookbook for experience co-creation

The change of value creation paradigm, from a company and product centric process towards an interactive design of personalized experience in collaboration with the customer has been studied by Prahalad and Ramaswamy (2003, 2004). This view of the firm-consumer interaction and the market, as a locus of value co-creation rather than a meeting point where the firm pushes finalized products on a passive consumer, is illustrated in Figure 5.

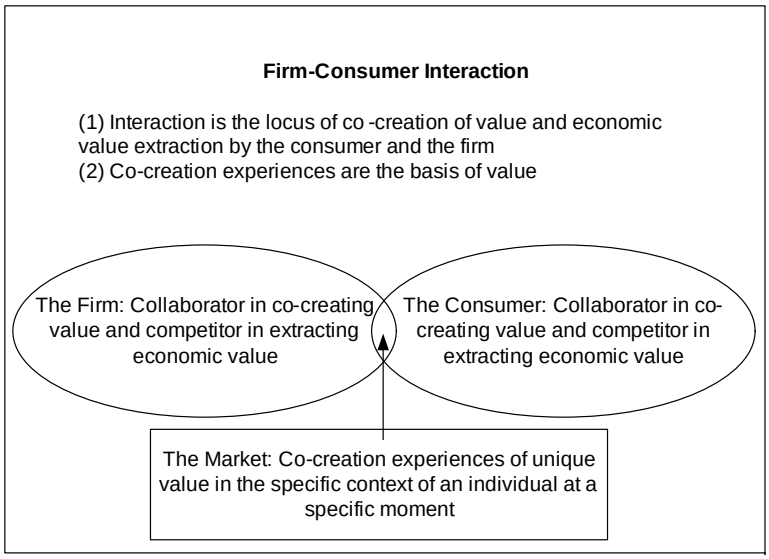


Figure 5 The market as a locus of value co-creation according to Prahalad and Ramaswamy (2003).

The special implications of this development for wireless offerings have been discussed in (Andersson et al, 2007), pp. 86 – 88 and references therein. However, a unified process for enabling co-creation in mobile services in a systematic and repeatable way is needed. In this section we transfer the general theory of co-creation, by Prahalad and Ramaswamy, into the mobile arena and define a cookbook process for systematic synthesis of co-creation applications and services for MIDs.. The suggested process provides a roadmap that covers aspects of initial definition, market positioning, information infrastructure design, technical implementation, monetization (business model), installed base and prototype development. We refer to this roadmap as *application synthesis process* and the objective is that each step of the application development shall reflect the focus on co-creation. An overview and some additional explanations are provided in Figure 6.

Section 2.1 summarizes the initial phase process step (application storming) where the definitions of co-creation from Section 1.5 are used to structure a first set of loose ideas of an application. In Section 2.2, the value proposition is refined

Co-creation Application Synthesis Process

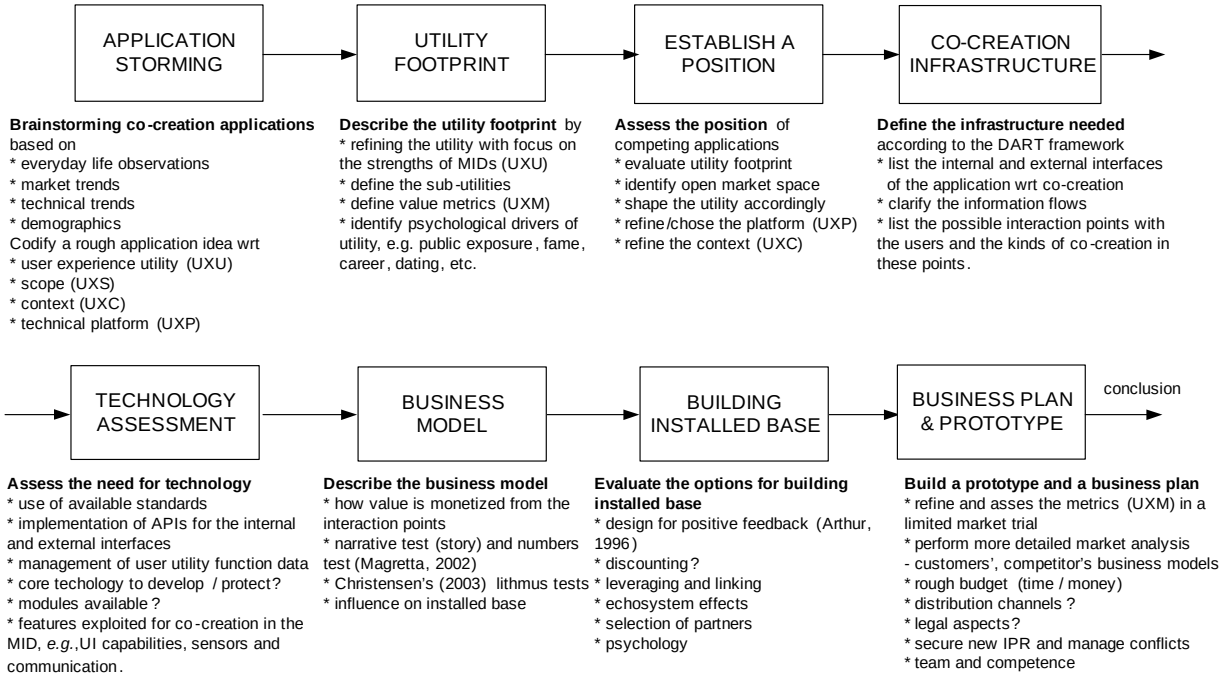
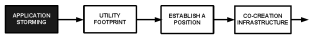


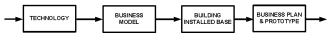
Figure 6 Description of the proposed application synthesis process.

by defining the utility footprint of the new application idea and analyzing those of other applications already on the market (positioning). The infrastructure needed to perform the interactive design of a personalized experience in collaboration with the customer according to Prahalad and Ramaswamy, and its implications for mobile systems are discussed in Section 2.3. This includes both the physical means and opportunities for collecting and transferring information from the mobile device as well as the logical interaction points between the application provider and the customer. The need to assess the system architecture in order to promote openness and modularity is discussed in Section 2.4. Sections 2.5 and 2.6 illustrate how a business model can be built around the information exchanges between different stakeholders, while at the same time the installed base of the application is nurtured and protected.

The build and evaluation of a prototype and the definition of a business plan are suggested as final steps in the application synthesis process. The design of a prototype application, based on co-creation, will be discussed in Section 3. However, given the business model considerations in Section 2.5, the definition of a business plan is a fairly straightforward procedure and will receive no special treatment in this thesis. Given the outcome of the prototype evaluation and the information brought forward in the business plan, a decision about the development of a commercial co-creation application can be made.



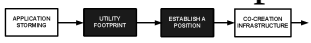
2.1 Application storming

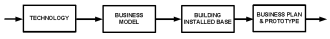


The definitions from Section 1.5 are used as stimuli for a first brainstorming session with the goal to come up with a set of possible application ideas. We refer to this exercise as *application storming*. The attributes of co-creation, defined in Section 1.5, are then used to carve out and codify a rough description of the kind of co-creation application we wish to design with respect to platform (UXP), context (UXC), value metrics (UXM), scope (UXS) and utility (UXU).

The application storming is the first step of a process for systematic and successive refinement of ideas for co-creation applications. A suggestion for overall work flow is illustrated in Figure 6. A starting point for the process can, for instance, be found in the observation of everyday life, market trends, technical trends, demographics / statistics, deregulation, intuitive feelings or ad-hoc ideas.

2.2 Establish a utility footprint and a market position





Having some initial understanding of the co-creation application we wish to design, the next step is to analyze the market environment and narrow down on the positioning of the co-creation offer in relation to other offerings. This analysis is carried out in an early phase, after the initial brainstorming, where a first formal description of the idea is established. The idea is not to kill creativity by first looking at everything that is already invented, while, at the same time, being able to shape a viable position in relation to existing applications at an early stage.

Positioning is one of the first steps in a series of activities that constitute a method to approach the customer utility functions. This follows the logic of Prahalad and Ramaswamy (2003), stating that *"co-creation is more than co-marketing or engaging consumers as co-sales agents. It is about developing methods to attain a visceral understanding of co-creation experiences so that companies can co-shape consumer expectations and experiences along with their customers"*.

Note that the development process has an iterative nature. Firstly, an application platform is provided by the originator. This offers certain possibilities for the consumer to contribute in extending the value of the application through co-creation. By observation of the consumer's contribution, his way of using the application and his general behaviour (metadata), the originator gain

understanding of the utility function of the consumer. Based on this understanding, the originator can take appropriate action to redefine or extend the initial platform (co-shaping).

For example, let's assume we consider implementing a position-based social networking application. We have an initial idea that the application shall help the members of a yachting community to keep track of each other during days at sea and eventually meet up in the same harbours with a minimum of co-ordination effort. Also, the application shall add a certain degree of safety as some of the community members are single-handed yachtsmen. Using the utility constellation in Figure 3, we can make a quick assessment of our intended offering in relation to existing applications, for example Facebook. As illustrated in Figure 7, the applications have different footprint, but some commonality since they share utility associated with relaxing (entertaining the fun the application), socializing and communication. We see that our position-based application has a unique opportunity for differentiation through co-creation related to safety, which is a utility that benefits heavily from the mobility and short response times featuring a MID. Our new application also features localizing, which is not yet included in the value proposition of Facebook.

The utility footprint of Facebook in Figure 7 also shows that key utilities of the application are creating and contribution (of content as games, quizes, tests, etc) and influencing (mobilizing opinion in different directions). In our view and as illustrated in Figure 7, these utilities capitalize less on mobility and immediacy than, for instance, socializing and localizing, and it may therefore be argued that there is no great value released by enabling Facebook on MIDs. Regardless if this argument is valid or not, it should by now be clear that the utility footprint can be used to analyze the value of an application in a mobile context.

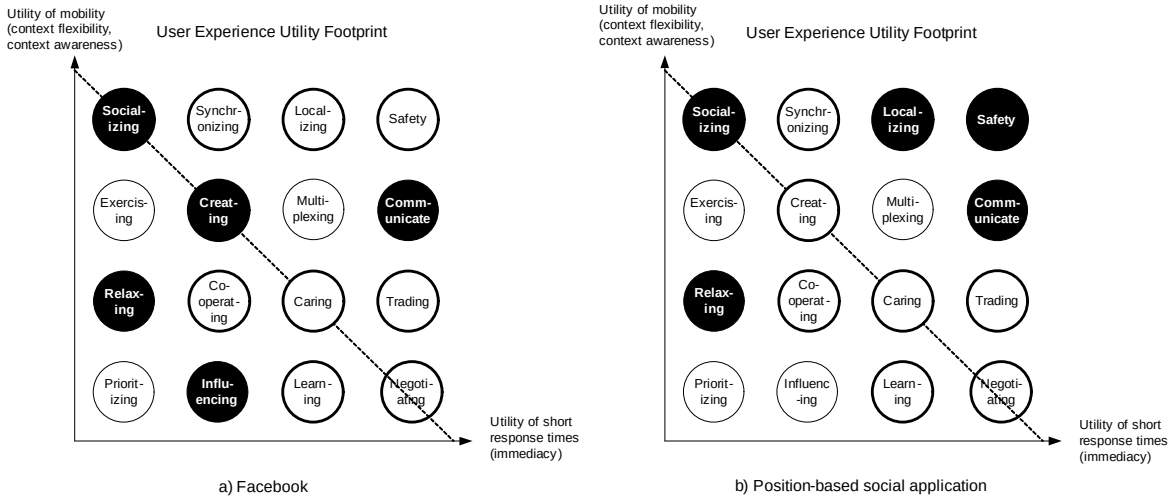
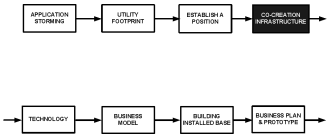


Figure 7 a) utility foot print of Facebook and b) utility foot print of a new position-based social application

A *substitute* user experience utility is characterized by a fully or nearly overlapping footprint. A *complement* experience is not overlapping at all. As the utility areas are quite broad and may contain many sub-utilities, even fully overlapping experiences can be very different in this example (see Figure 4).

2.3 Designing the infrastructure for co-creation



In the co-creation paradigm, as defined by Prahalad and Ramaswamy (2004), the market becomes a forum for interaction between active informed, empowered and connected customers. Consequently, the firm has to build infrastructures for *Dialogue, Access, understanding of Risk-benefits* (both helping its customer and itself to understand those) and *Transparency*. Prahalad and Ramaswamy denote this the DART framework. The fundamentals of this theory are explained below.

The reason why this theoretical framework is chosen is that there is - to our knowledge - little other theory in this area. Therefore we focus on the findings of Prahalad and Ramaswamy and analyze the implications and utility of their DART framework for design of the infrastructure needed to enable co-creation

2.3.1 Dialogue (D)

Dialogue is vital in order to understand the individual utility functions and the expectations of many different customers. Building an infrastructure for dialogue is about technical developments and investments as well as socializing managers. It should give customers the possibility to share their willingness to pay for different utilities, for instance, manifested in negotiation-tools as web auctions and other tools that simplify the process of coming to an agreement. Another example is the sharing of supplementary information through pictures and voice, *cf.* Skype access to the eBay marketplace. Dialog is also about the ability to asynchronously configure profiles and information about user behaviour, whereabouts, mindset and objectives.

2.3.2 Access (A) and transparency (T)

Access and transparency are about the balance act of disclosing and conveying information to the customers and, at the same time, collecting information from them. In order for joint problem solving to happen, the customer needs to be at an equal level with the firm and information asymmetry needs to be counteracted. It is more up to the customer to define the conditions on how he chose to interact with the firm than the other way around. It should be noted that firms have traditionally benefited from asymmetry, but this is no longer the case in the co-creation paradigm. Access and transparency is also about facilitating information exchange through open discussion forums. The openness of the system itself is another aspect that needs to be carefully managed by the use of open or proprietary interfaces and more or less standardized communication protocols.

The difference to the aspect of dialog lies mainly in the issue of the architecture, *i.e.*, the openness of interfaces and the modularity of the system as well as the barriers to starting the co-creation, *e.g.*, the availability of a development kit for a well established user environment.

2.3.3 Understanding of risk-benefits (R)

The understanding of risks and benefits is about clearly defining the risks and rules of the interaction, *e.g.*, how contracts become valid, how transaction of goods and services take place, possibilities for reversing agreements, terms of payments, complaining processes, etc. We interpret the responsibility of clarifying the risk-benefits as partly lying on the firm and partly the consumer, but also being an issue of governmental regulation through, *e.g.*, legal statuaries as trading laws and health regulations.

2.3.4 Mapping DART on MID applications

For MID application development, we see access and transparency mainly as a matter of defining the proper application program interfaces (APIs) of the operating system of the MID and the whole application system as such (for use of existing or forthcoming web applications). This implies that the co-creating consumer can get access to the various UI-devices, sensors and computation engines of the MID (as well as network facilities) in an easy way. It also implies that these APIs shall have a clear structure and be well documented. Dialogue is more related to the logistics of information, *e.g.*, how information about the consumer utility function is collected and analyzed, how the user can communicate his preferences, concerns and change requests and how information about his general status is conveyed.

Some risk-benefits of MID applications, which can be mentioned, are related to: the availability of wireless communication links; server connections; payment security and general integrity issues, *i.e.*, under which conditions status info, as position and mindset are disclosed.

Section 2.3.6 outlines the technical implications at an architectural level, with respect to the kind of information exchanged and ways for this information. In Section 2.3.7, technical details of how this information may enter the system through the MID, *e.g.*, UI features and sensors available are reviewed.

2.3.5 Understanding the interaction points

In the co-creation paradigm, value is created in all interaction points between the firm and the customer. Consequently, it is important to have a good overview of these interactions and a plan for how they can be extended. Note that there are different types of interaction, *e.g.*, Internet-based automated interaction (clicking

links, filling out forms, loading data), internet-based human interaction (email, chat), phone calls and meetings in real life, for example in a store. In order to obtain an appropriate infrastructure for dialogue (as discussed in Section 2.3.1), these types of interaction can be mixed.

Suppose, for example, that we would like to enable a mobile experience based on co-creation for people interested in sailing. In this scenario, potential interaction points are to be found

i. on the **registry** web page of the application, signing up for an account, disclosing personal data and downloading the application over the air (OTA).

ii. in the mobile client, when the user gets a **referral** to a specific web portal for navigation-related services, *e.g.*, weather related, navigational safety, etc.

iii. in a **buying** situation, in the mobile browser or in real life, when visiting web or real life facilities of stores for nautical equipment, selling various kinds of instruments, navigational SW, safety equipment and virtually anything that is needed at sea. Also when visiting web or real life facilities of companies providing equipment or services related to activities complementary to sailing, *e.g.* fishing, diving, etc.

iv. in the mobile client and on the web, in preparation or during a race or cruise sailing - enhancing / facilitating the **communication** between different members of the niche group, *e.g.*, between crew members on different boats.

v. when using the other **standard functions** of the client.

vi. during **tourism** activities, for instance in harbors and in terms of location-based notification of ongoing activities.

vii. when visiting the virtual (web) or real life facilities (offices, harbors) of existing **communities**, as yachting clubs, sail racing clubs, search, rescue associations and equipment-specific clubs.

viii. when visiting **government** web or real life facilities related to sailing and life at sea, *e.g.*, www.sjofartsverket.se, www.kustbevakningen.se, www.tullen.se

ix. when visiting web or real life facilities of organizations occupied with navigational **training**

x. when visiting web or real life facilities of **insurance** and **finance** companies

xi. when visiting virtual **planning** sites, *e.g.* web pages that provide tools for viewing pictures from different places, pre-booking harbors, restaurants, hotels, etc, during the cold winter months when people stay indoors and hutter, longing for the summer vacations.

xii. when accessing the **PC-view** of the application or its home page via Internet from a stationary home location.

2.3.6 Information flows and technical implications

The collection of customer data and the excavation of the individual customer utility functions, discussed in Section 2.2 are not restricted to customer injecting text-based data into the system. However, this is a straightforward way of acquiring the static foundation of the utility function, as such input may cover a huge amount of personal contact data, conditions of life, interests, objectives, future plans, etc. However, in order to capture the dynamic part of the utility function, alternative methods of information-sharing are needed. These include the

- disclosing of location information, coming either from aGPS or cellID. An alternative way of accessing location information is through ATM machine access, or general credit card use in stores.

- disclosing of state of connectivity, *e.g.*, wireless access technology, cellular as 2G, 3G, WLAN, Bluetooth, NFC, etc.

- sharing state of mind or current objectives/motivation, through the mobile device, *e.g.*, happy, sad, angry and objectives as shopping for clothes, cars, houses, socializing, flirting, etc.

- sharing of temporary interests and community participation (when engaging in community interaction, specific events (*e.g.* festivals, concerts) or transportation (flights, train, etc). This information can be made available through event organizers, transportation companies through open APIs and aggregated by so called mashup web applications (see for example Weinberger, 2007).

- disclosing of identities of entities as family friends, business partners or personal belongings as car, boat, house, etc.

Note that issues as personal integrity and access to personal information are important issues to address for some of the information sharing methods listed above.

The dynamic collection of indirect user data is paramount for the facilitation of the co-creation, since traditional forecasting methods do not apply in this paradigm. It is not possible to predict the experience of a particular consumer at a given time and location. Thus behavioural data is critical in order to facilitate the interaction and for the firm to orchester different events towards the interaction with that particular firm. General technical challenges foreseen in (Andersson et al, 2007), pp.12, as a consequence of the difficult forecast the time, place and nature of the co-creation experience, are capacity planning, scalability of resources and real-time reconfiguration of the infrastructure.

In the sequel, we will distinguish between four main ways for the user to participate in experience co-creation - directly or indirectly, synchronously or asynchronously. In Table 2, these modes of information sharing are listed.

	Active	**Passive**
Synchronous	Consumption, creation and sharing of content through active deployment of a handheld device, based on certain events, utility and needs in a particular moment. Example: the need of a map for one-time use in a particular situation of disorientation.	Granting regular access to up-dated information about the user context, *e.g.*, position, connection and other personal behaviour data as status (*e.g.*, emotions) or ways of using the application system. Example: disclosing position data to the application server, on a regular basis.
Asynchronous	Active injection of personal data and/or content into the application system in preparation for future opportunities. Example: preparation of an advertisement to sell your car if the right buyer would show up.	Granting access to information that is independent of certain events, *e.g.*, detection of equipment, configuration, contacts in the phone book, calendar or favorite place. Example: by using Gmail you passively agree to disclose your list of email contacts. Example: a positioning application can use the knowledge of your favorite hang-out place and alert your friends when you arrive there (see for example Nokia chat).

Table 2 Categorization of ways for a user to share information in a co-creation process

Exploiting the information shared by the users in the co-creation process requires the development of an automized engine that can collect and handle vast amounts of data. For instance, Google, is using some sophisticated procedures for this, *i.e.*, collecting various kinds of informations (metadata) from synchronous, active, interaction, by providing the search engine and at the same time feeding back advertisements based on the keywords of the consumer's query. A simple model of these information flows is provided in Figure 8. Other applications, as Google maps (see for example Lewis, 2007) and Google Talk are used to obtain synchronous, passive, information about your whereabouts and occupations. Also, the emails and contact list of the passive Gmail users are asynchronously mined for information. However, there is room for further innovation in this area. The overall goal is to map out and register the utility function of a customer and understand what action the firm needs to do for it to be met, through the co-

creation with the customer. One example of a technology that helps reaching this goal is the location capabilities that are now rapidly being integrated in many mobile devices. Figure 9 illustrates how co-creation through synchronous, passive, sharing of location and context information may be used to get a better understanding of the utility function of a customer and bring forward extended business opportunities.

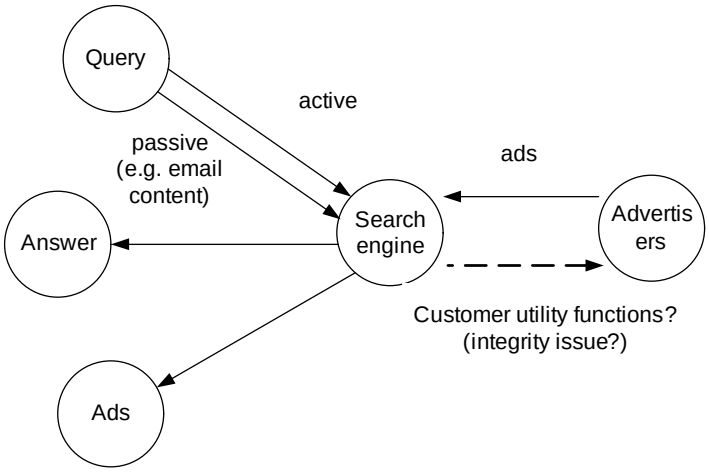


Figure 8 Example of information exchange in Google/Gmail setup.

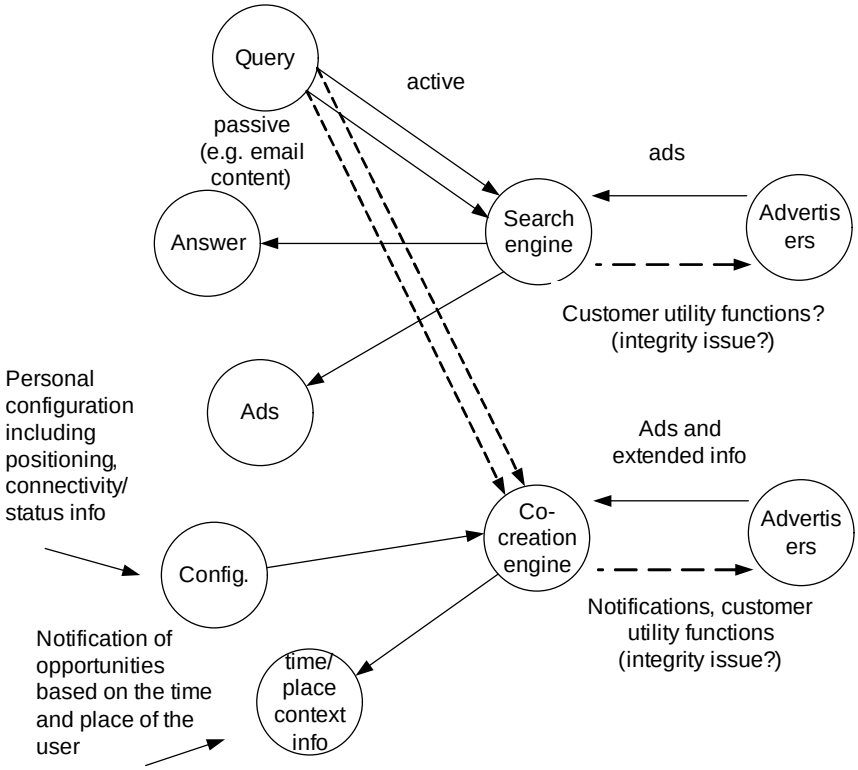


Figure 9 Example of co-creation enhancement to the Google/Gmail setup, based on synchronous / passive sharing of location data.

2.3.7 Information sources and capabilities of the MID as UXP

The list of information sharing methods, identified above, is one way to approach the enabling of co-creation and its prerequisites.

An alternative approach for identifying new possible ways of sharing information as input to the co-creation process is to make an inventory of the kind of sensors and input/output devices that are available in MIDs today and in the near future. A high-level listing (with no ambition to be complete in any respect) of such devices could, for example, contain

- **2G, 3G cellular modems** – enabler of wide-area mobile communication, potentially with broadband performance through the use of HSPA. Moreover, network information can be used to collect data about user location and behaviour (if authorized by customer)

- **Keyboard** – input of text info. Potentially enhanced with pitch information, sensing the pressure of the key touch.

- **AM/FM radio** – one-way audio communication to the customer. Also RDS data channel

- **FM transmitter** – transmission of audio content to a car radio or other more powerful audio equipment.

- **Joystick** – input of direction info, customizing and simplifying UIs.

- **Accelerometer / motion sensor** – input of motion information, *e.g.*, degree of physical activity of customer, jogging, walking, resting. Also advanced input methods, based on gestures and orientation of the mobile.

- **Touch screen** – simplifying GUIs, customer can customize its own UI as well as the same general input methods a PC mouse can support. See iPhone.

- **Bluetooth** – peer-to-peer communication with a variety of devices. Remote control applications and network sharing. Communication channel for event-driven information pushed to the mobile device or distributed from the mobile device to other users or user communities. Bluetooth can also enable wide area connectivity for an external device (*e.g.* PC), over the cellular network.

- **WLAN** – see Bluetooth. WLAN hotspots is becoming common. Sensing of environment, *e.g.*, if many other WLAN modems are present/active

or not may give an indication of the user is in an office, home, rural environment. Also, if the user is changing location or not.

- **aGPS** – sharing the current position or patterns of movement on a short-term or long-term perspective (assisted GPS to achieve better performance in urban and indoors envrinments).

- **Microphone** – can combined by a voice recognition system in the network, or used by a group of customers in a conference call (loudspeaker mode). See also the "Decibel" iPhone application which estimates the volume in a room based on the microphone of the device.

- **Loudspeaker** – can be combined with a voice-synthesis system. Also there are various ways of creatively using both loudspeakers and microphones in several units, when positioning information is available, *e.g.*, beam forming, special audio effects, etc.

- **Camera** (often two) – image / video content sharing. Pattern recognition and training of services (transfer of user skills).

- **LCD** (sometimes two) – image / vide content consumption. Customization of the UI together with the touch screen.

- **External memory slot** – asynchronous transfer / reception of massive amounts of data. "Podcasting".

- **SIM card** (potentially high-density cards for some markets, in the future) – see external memory. SIM card can provide authentication necessary to maintain security and integrity and a basis for charging / payment reception in different scenarios. SIM card can be coupled to various services, *e.g.*, banking.

- **TV-out** (RF modulated analog signal) – enabler of more sophisticated presentation of one-way image / audio media sent to the customer. Can create a more rich user experience

- **Projector** – see TV-out, but without external equipment (other than a fairly white area for the projection).

- **USB connection** – see external memory slot and Bluetooth.

- **NFC** – see external memory slot and Bluetooth with the restriction that very high proximity is needed for the data transfer. This increases the integrity of the communication.

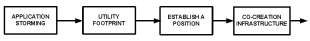
- **RFID** – identification of a unique individual, at a particular place.

- **DVB-H reception** - one-way video communication to the customer. Also one-way data communication channels included. Potentially, a DVB-H TX mode can be imagined, which would enable local area sharing of video content.

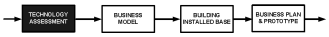
- Different kinds of advanced sensors, see the NTT Docomo blood or sweat sensor discussed in Dagens Nyheter (2008). Also, various kinds of wireless micro-sensors (*cf.* WiBree), integrated in, *e.g.*, home equipment, cups and clothing, could be used for co-creation. Today, these kinds of devices mainly appear in research, but they are likely to be an important part of the mobile device echo systems in the future.

These technical devices can be considered as enablers for co-creation, in isolation or, more important, in combination with each other and together with client SW and services available in the network, *e.g.*, over the Internet or systems like IP multimedia subsystem (IMS), more under the control of the operators.

Mobile devices are typically power constrained and therefore limited as co-creation enablers for some kinds of media transmission, *e.g.*, video. In general, it is important to keep in mind that certain platforms, as cars and boats, do not suffer from this limitation. However, as discussed in Section 1.6, we limit our discussion to isolated MIDs with a high degree of mobility. Often, nothing prevents the used of such units in different kinds of vehicles, though. Emerging technologies as fuel cells may well eliminate many of the limitations imposed by today's power constrained solutions.

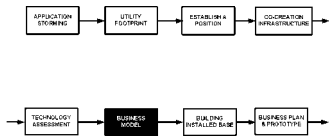


2.4 Technology assessment



In this phase, the system architecture is assessed. The utility of existing standards, as XML, XMPP, Jabber, SVGT is evaluated and a search for reusable blocks is carried out. Issues as openness and the implementation of APIs for the internal and external users are clarified and decisions are made on architectures for managing the bookkeeping associated with the excavation of the user utility function. Moreover, a modularization strategy for the SW development is needed in order to catch up and keep pace with the market (Baldwin, 1997). Another key issue is the delimitation of a core technology to develop and protect in order to have some entry barriers to the business (see for example Porter, 1998).

2.5 Deriving an interaction-based business model



The practical difficulty to specialize in niche markets and "dream up" viable business models targeting individual consumers has been discussed in (Andersson et al, 2007), pp. 87-88, and references therein. It is stated that the extension of consumers' ability to chose and interactively innovate is an important step in this direction. Interestingly, new technology may be one enabling part of the creation of a new user experience – however the scalability of the application framework and the potential for co-creation will more significantly affect the perceived value. For instance, the iPhone by Apple Inc., is one extreme example that contains no really new core technology[5] – yet providing a valued new user experience.

Taking the perspective that we shall monetize the value of co-creation, we consider the different types of co-creation and interaction enabled by the application (see Sections 1.5 and 2.3.5). We also consider the interaction points between the originating company and the consumer to see what value could possibly be extracted.

2.5.1 Inventory of co-creation value drivers in the interaction points

In Section 1.5, we identified six main types of co-creation and three of these types (synchronous and asynchronous transfer of information about users' utility function and generic knowledge transfer) were judged to have a higher value potential specific to MIDs. Prahalad and Ramaswamy (2004) stress the importance of value extraction from the points of interaction with the customer and a set of different interaction points for a thought nautical location application example was given in Section 2.3.5. As illustrated in Table 3, the co-creation opportunities in different interaction points can be visualized by a matrix.

The column headers represent different types of co-creation, according to the definitions in Section 1.5 and the rows illustrate different interaction points that can be detailed from the application example in Section 2.3.5. The entry "PC-view" represents the scenario where the application is accessed via a standard web browser interface, from a PC, with less advanced mobility properties but more sophisticated UI and computing capabilities. The letters in the elements of the matrix indicate the specific kind of value (according to Table 1) that a certain type of co-creation can drive in a particular interaction point. The intention is that Table 1 shall be used as a guideline to specific monetization strategy for the

[5] It can be argued that the multi-touch engine is new to mobile phones. However, similar features have been available in other application areas for quite some time.

various interaction points of the different co-creation scenarios and that the letters shall be used for quick lookup in Table 1.

Type of co-creation / Interaction point	4 [asynchr-onously transfer utility information]	5 [synchronously transfer utility information]	6 [generic knowledge transfer through training]
Registry	valueadd (V) saving (C) timesave (T)		
Referral	saving (C) timesave (T)	saving (C) timesave (T)	
Buying	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)
comm-unication	loading (L)	loading (L)	
standard functions	loading (L) saving (C) timesave (T) revenue (D)	loading (L) saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)
tourism, harbours, IRL events	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)	
community	valueadd (V)	valueadd (V)	
government			
Training	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)
insurance, finance	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)	
planning	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)
PC-view	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)	saving (C) timesave (T) revenue (D)

Table 3 Overview of co-creation opportunities and value extraction in different interaction points of a localization application. Virtually all interaction points feature indirect revenue from metadata collection (I) for the application provider and potential payment for metadata provisioning to the user (P).

From Table 3, we conclude that different intersection points can support several types of co-creation and that there are various possibilities of monetizing the resulting value. For example, the event when a user registers for an account and adds the application to his MID is driving value by 1) increasing the subscriber base (S), 2) adding traffic to the network (L), 3) adding direct revenue up to the pay threshold (D) and 4) adding perceived value to the MID by added features (V).

Note that value can be extracted, both by the provider and the users of an application or service. For instance, the application provider's revenues from selling metadata (I) and the user's compensation for actually sharing metadata (P) are applicable in most of the interaction points. Compensation for sharing metadata is not widespread today, but it will likely become common. The

compensation of users for sharing or consuming information increasingly becoming part of companies' business models. For instance, the Blyk.com (2009) service compensates the youth community with free mobile telephony in return for attending to advertisements.

In situations of buying, cost savings (M, C) through discount agreements or price comparisons may be at hand for the user, while the application provider may gain revenue from the identification or referral of the customer (D, I). The interaction when different users are using the system for communication, drives traffic in the network (L, B) and also valuable statistical data about user behaviour can be collected (I).

In situations where the user approaches a harbour and participates in tourist events, there are monetary savings through discounts at hand (M, C). Also compensation to the application provider for identification and referral of the user (I, D) can be imagined. Aspects of improved safety and the possibility to track the whereabouts of a boat, may motivate an insurance company to offer cost reductions to a user of the system (M, C).

It is concluded that interaction with respect to registry, buying, harbour and standard use of the client are interesting interaction points of value extraction to consider when designing the business model. During the implementation of the application interface in these interaction points, it is critical to have convenience and ease of access in mind, in order to make the interaction attractive for as large a population as possible, with a minimum requirement for special skills of this population (Christensen and Raynor, 2003). The "litmus test" provided by Christensen and Raynor provides additional insight in how to assess business potential of new products and services, in general.

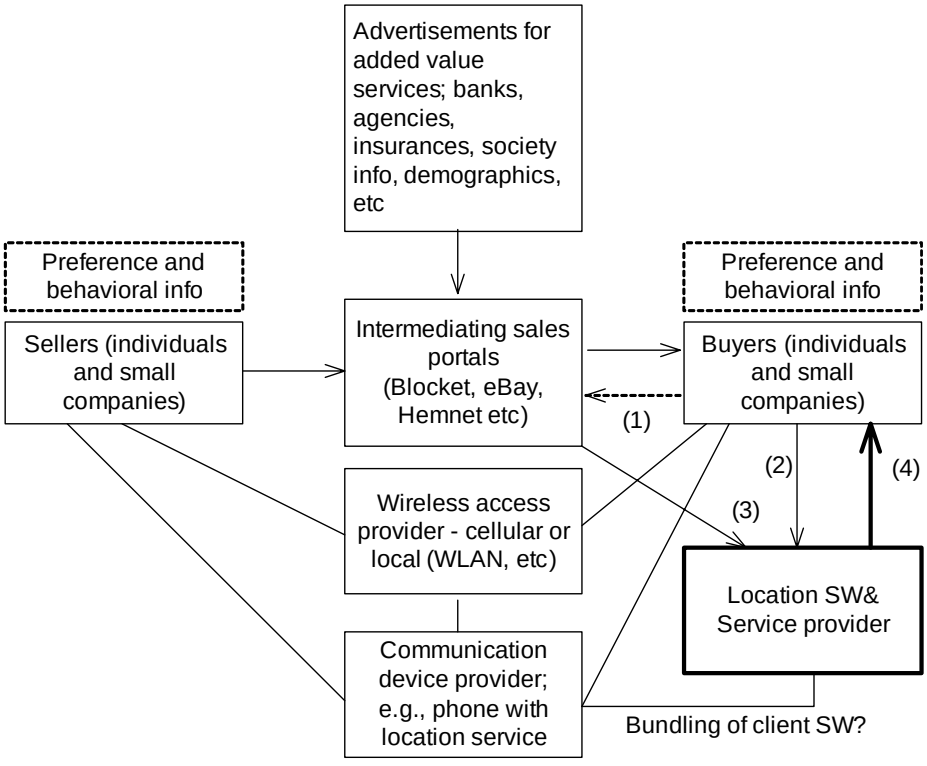


Figure 10 Example of a business model and interactions where information and value can be extracted

2.5.2 Example of business model

In this section, we give a simple example of a business model (see for example Magretta, 2002), with the objective to monetize the value of co-creation in a trading scenario, following the logic of Sections 2.3.5 and 2.4.1.

An example of how to extend a well known business model through a co-creation application is given in Figure 10. The arrows indicate flow direction of valuable data, *i.e.*, seller info about item for sale, buyer preferences, etc. Straight lines indicate an existing or potential commercial relation. The information flow between different entities is briefly explained in the below list.

1) Today, buyers have typically some limited possibility to store preference information about the items they seek to buy on a sales portal. On the buyer side, the behaviour of simply browsing the sales portal for information is much more common, thus the communication is highly asymmetric between buyers and seller. This deficiency in the information flow is indicated with a dotted arrow in Figure 10.

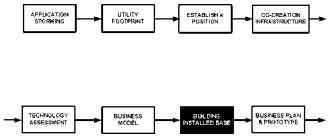
2) In order to address this asymmetry, information of buyer preferences, behaviours and location (conveyed through client application or regular web interface the on buyer communication device) could be provided to a provider of a location-based service.

3) The location service also receives information of seller outlet, incl. seller geographical info and contact details (conveyed by “location server” SW on the portal main server). Potentially also temporal information about seller availability is received.

4) The location service issues an alert to the buyer upon matching of preferences and spatio-temporal availability. Potentially this alert goes also to the seller, in order to take action proactively.

At least initially, it is essential that the business model supports the growth of the installed base of users for the application, by implementing some of the self-enforcing (positive feedback/network effects) mechanisms discussed in Section 2.6. Consequently, the communication in (2) is stimulated by free access to specific applications built on the ”location service” platform, as Hemnet (house location), Boatnet (boat location), etc. The main revenue stream comes from the payment of the sales portals for access to the location services. The rational for them is the increased exposure to the buyer side. Ultimately, a business model, similar to that of Japanese iMode can be established, where the ”location service” provider provides the platform, manages billing and funnels back a part of the revenues from customers to the respective developers.

2.6 Strategy for building installed base



According to W. B. Arthur (1996), the "active management of increasing returns" is a key strategic component in order to be successful in knowledge-based markets. This requires the understanding of the positive (and negative) feedback effects at play in the market. Some examples of how the feedback mechanisms can be managed are provided below.

- Heavy discounting to build up installed based (see for example Shilling, 1999)

- Exercising of the echo system interdependencies and striving for *cross-product positive feedbacks, i.e.,* recognizing the circumstance that many technological products exist in network of products that support and enhance them. This is a fundamental part of the business concept of a platform provider. For instance, a HW or SW platform provider could set up economical incentives for SW application developers to use the platform. Also, convenient development tools and building blocks could be provided. A recent example of lock-in strategy is that the iPhone SDK from Apple requires the proprietary OS X on the host computer used for development of applications.

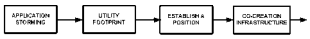
- Leveraging and linking – stepwise invading neighbouring markets by exploiting the installed base in the original market (also denoted node of the ecosystem). Tools as bundling of products and services and discounting upgrades have been successfully used by, *e.g.* Microsoft to transfer its installed base on DOS to Windows and further on. Having a well-established and configurable platform in one market facilitates this strategy, *cf.* Section 2.2, where we elaborate on the positioning of new co-creation applications with respect to existing markets.

- Careful selection of partners in the network and allowing partners to lock in their respective shares of the market in order to secure their commitment to the alliance. Typically, this implies that some profitable business opportunities must be given away to complementors.

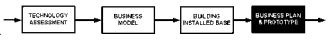
- Stimuli / rewards that are inserted for some or all individuals in the network, when a new member joins the network. For instance, such a reward may be the lock-up of an additional application, extended authority or credit made available to an individual or a group when a particular member count is exceeded.

- Psychological positioning that causes competitors to back off markets since they believe these are likely to be locked in by another company. Psychological positioning moves include, *e.g.*, announcements of attractive products that will never exist or are far from ready, and declarations of fake co-operations or alliances.

The development of a *platform* for co-creation, as a tool for rapid time to market and a remedy to the entry barriers towards an implementation, *e.g.*, in J2ME, is a natural step towards the building of an installed base (see for example the discussion in (Shilling, 1999). In this study, we limit ourselves to the development of an example application and imagine the platform to be derived from this application in a sequel step.



2.7 Prototype and a business plan



This step involves assessment and refinement of the value metrics (UXM) through a limited market trial. A more detailed market analysis is performed for understanding the competitive structure and competitor's business models. Also, issues as market window (time plan), budget, distribution channels, legal aspects and organization are considered.

Quality is an aspect that should be captured in the application synthesis process - perphaps in the business plan. However, due to time limitations, the quality of co-creation services is an area that has been completely left out of this study. There is little coverage of quality aspects in the literature and theory of co-creation that has been considered in this study. Commercial actors appear to have better possibilities to deliver quality applications through well defined processes and centralized control. However, as quality is about meeting the customer expectations, it may be that co-creation strategies are advantageous also from this perspective. The argument for this typically is that co-creators develop what they want, for use by themselves, instead of developing what corporate management wants, for someone else.

3 Assessing theory by prototyping

The objectives of this part of the study is to use the findings in Sections 1 and 2 to create a new application for a MID (also known as MIDlet), based on J2ME and evaluate the utility of existing theory and the proposed cookbook process.

This section describes how the cookbook process outlined in Section 2 can be applied to design a new co-creation application specifically geared towards the yachting world.

Yachting equipment is typically quite expensive and many different proprietary solutions exist in various areas, but the willingness to pay for quality equipment and safety devices is relatively high. The yachting community in Sweden is growing rapidly and also the general interest for sailing (see *e.g.* the TV sports reporting of Volvo ocean race and the attraction of the annual Swedish Match races at Marstrand). Also, the forties generation is now retiring and will have more time to spend on leisure activities as sailing.

3.1 Application storming

Currently, there exist several different SW applications for rendering of electronic sea charts with various navigation features (see for example Fugawi, Tiki Navigator and DLS 4.0 provided through the Swedish nautical administration, Sjöfartsverket). These tools specialize on sea chart rendering, navigation and planning on regular PCs. Some of them support download of sea charts and updates over the Internet at a fee while others bundle all sea charts of a particular coast with the application in a starting package.

The yachting world is generally perceived as conservative with slow technology adoption and this set of applications is no exception. Relying on map content that has been virtually the same over the last 50 years, with the basis provided by Sjöfartsverket, a substantial part of the design effort has gone into differentiation through rendering quality of the graphical content. The innovation / integration of complementary services appear to go slowly. For instance, the communication facilities of these tools, for maintaining contact with relatives at shore and other fellow sailors, seems very limited. However, interestingly, the Swedish yachting association (SXK) has a project where nautical corrections to the sea charts in DLS 4.0 and information about natural harbours are created and distributed as complementary content (Svenska Kryssarklubbens Västkustkrets, 2008).

Most of today's offshore navigation applications have a significant drawback in that they require the use of a laptop computer in a relatively harsh marine

environment. At the same time, much of the information provided is normally also available on traditional sea charts. Moreover, the high mobility and low latency of MID-based applications provide good advantages in the sense that you can instantaneously access the specific map content that you need and pay for selected pieces of information.

This could be the start of a completely new distribution and business model. Furthermore, any user of the system can contribute to the creation and maintenance (update) of content, in opposite to, *e.g.*, the DLS application. We also envision trading of new created content against existing content, *e.g.*, the contribution of one natural harbour description gives the right to draw an existing description. For the originator, *e.g.*, SXK the application may provide a better way of protecting the content, as it is terminated in the MID, when provided over the air, in contrast to the distribution of books and regular SW.

Consequently, it seems to be room for a low complexity navigation application that provides simple nautical information for tracking of position and assisting in fundamental situations, as finding friends in other boats, finding harbours and facilities in the archipelago.

3.1.1 Kind of co-creation targeted (see definition in Section 1.5)

We will create a new application in the J2ME language and distribute it to a community of users (type-3 co-creation). Access to the application (SW and user account) is received through an initial registry at an Internet web page, where personal information as contact details, kind of equipment, basic interests and objectives are registered. Also a payment channel, based on mobile phone subscription, is established at the registry (type-4 co-creation). Position and status information for the users is shared by the users of the application, synchronously (type-5 co-creation).

3.1.2 Kind of user experience platform targeted (see Section 1.5)

As the penetration of J2ME-enabled mobile phones is rather high - at least somebody in a typical sailing crew should have such a phone - we will target this kind of user experience platform.

Table 4 illustrates how the SailTracing application capitalizes on the HW features of the platform for the co-creation process. Clearly, rather little of the functionality that can be imagined in a high-end MID (feature phone) is exploited for creating the co-creation experience outlined here. We suggest to use similar kinds of checklists over input, output and sensor HW devices during the application synthesis process in order to fuel the creativity.

Feature	Used	Utility
2G, 3G, HSPA cellular modem	x	Sharing of position and status data. Download of graphical content.
Keyboard	x	
AM/FM radio		
FM transmitter		
Joystick	x	
Accelerometer / motion detector		
Touch screen		
Bluetooth		
WLAN		
aGPS	x	Acquisition of position data
Microphone		
Loudspeaker		
Camera		
LCD	x	
External memory slot	x?	Might be needed for map content
SIM card	x	Possible payment vehicle
TV-out		
Projector		
USB connection (OTG)		
RFID		
NFC		
DVB-H		
Advanced sensors		
Torch / Flash		

Table 4 Checklist of HW features with possible utility in co-creation scenarios.

3.1.3 Technical architecture of the user experience

- The application will require low communication bandwidth and be able to run on relatively simple GPRS enabled devices.

- As positioning equipment is commonly available in boats, there is no strict need for a MID with integrated GPS solution. However, it will simplify the operation of the application. Moreover, due to the sea being a hazardous environment for electronics, the use of high-end MIDs should not be a prerequisite.

- Information from the users will be collected both synchronously (real time) and asynchronously (when registering for access, *e.g.*, in a home environment)

- Low need for processing / computation of information.

- Possibility of defining a community and inviting users to join.

- Possibilities for sharing of textual and graphic content, in terms of simple map information and text messages, within the community.

3.1.4 Context of the user experience

- The application will be used to access and create information, while mobile, at sea or on land, or while stationary, at home.

- The application shall be easily available, for a quick glance on your mobile phone, while navigating your boat.

- The age/actuality of position data shall be clearly indicated and the contact with the network regularly monitored.

- Users interact with the originating company as well as with other users of the same community in creating and sharing information and content.

3.1.5 Utility of the user experience

Considering Figure 11, the main utility areas of the application are

- socializing and localization – it is easier to localize friends at sea, in the vicinity, as it works out even without planning or synchronizing through phone contacts or SMS,

- safety – your friends at sea and your relatives at home can see where you are (this requires high quality and good status indications in the communication and positioning functions),

- creating – local knowledge, as harbour information, may be shared through simple graphical objects,

- relaxing – it is a fun to see where your friends are located. Information is provided in a simple way, while you are focusing on other aspects of your favourite occupation – sailing.

In conclusion, the utility footprint mainly consists of socializing, creating and safety items.

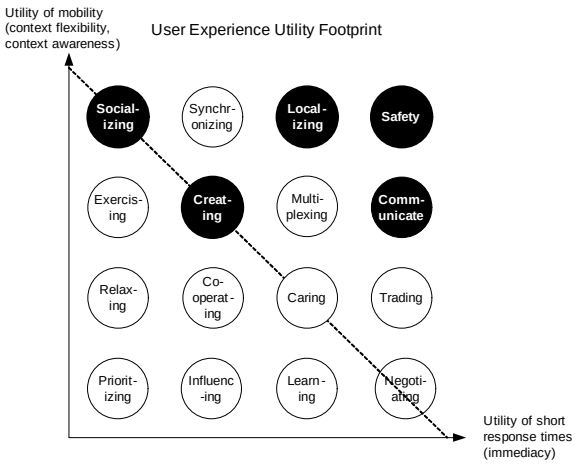


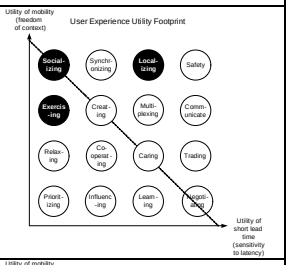
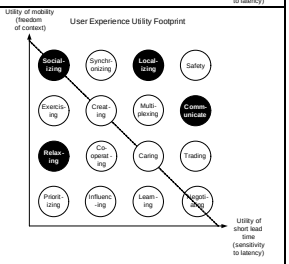
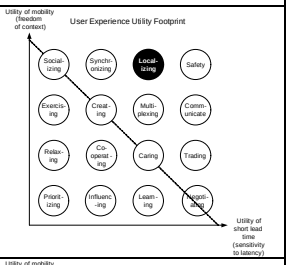
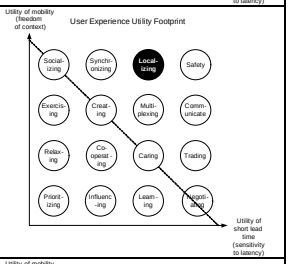
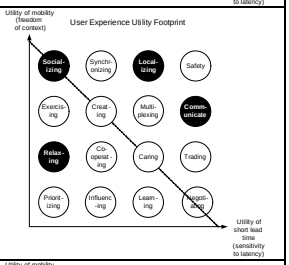
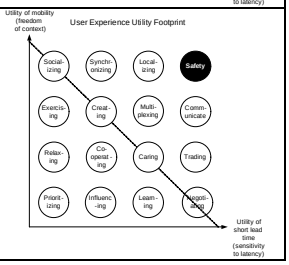
Figure 11 Illustration of the utility footprint of the SailTracing application outlined in Section 3.2.

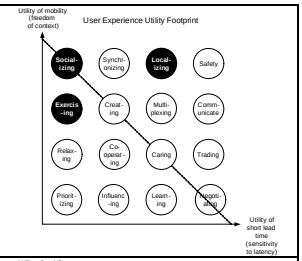
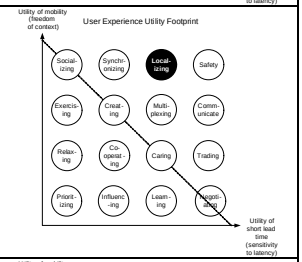
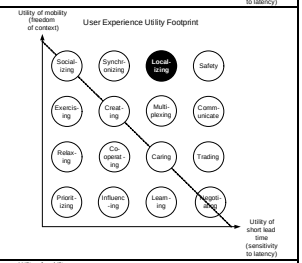
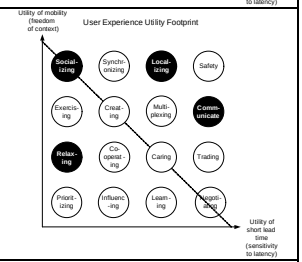
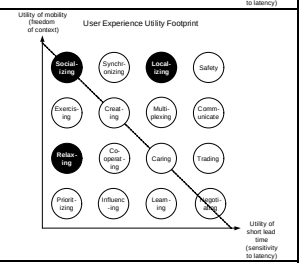
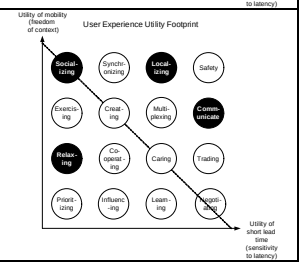
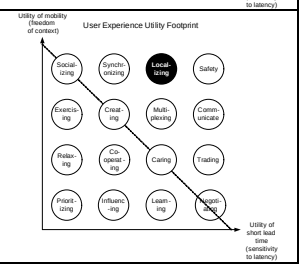
3.2 Market position

This section aims at providing and example instance of the third step - establish a position - of the application definition process outlined in Section 2, *cf.* Figure 6. There are a number of MID-based positioning applications already on the market (see for example Mobil, 2008). Some of them are described in Table 5, and their respective utility footprints are identified in the rightmost column. It is concluded that co-creation of type-5 (synchronous sharing of position and status data) is available in several applications. The Jabber standard is an interesting way of providing this information as it enables the exchange of data with many other applications via the open XMPP protocol (see for example the Nokia Chat application).

The iPhone application NearBy has taken the mobile co-creation most far by enabling users to share their geographical discoveries and experiences with other users, which is an example of co-creation type-1. It could have had a flavour of the knowledge transfer feature of type-6 if there were more structured descriptions about things worth seeing and general travel recommendations, but this seems no to be the case.

Our application has uniqueness in that it targets a marine community, runs on J2ME and enables the sharing of simple map content, defined by the users. Other applications, as, *e.g.*, Nokia Chat and SmartComm GPS have more sophisticated communication features (chat, voice packets) and map rendering features, respectively. However, Nokia chat only runs on Nokia devices and SmartComm GPS is a UIQ, smartphone, application. A general observation is that few applications manage to exploit social networking for achieving benefits of safety. Our J2ME application is expected to achieve some of these synergies and be available for a more broad selection of MIDs thanks to that J2ME is typically supported on a larger base of platforms, including Symbian/UIQ, Symbian/S60 and Windows Mobile phones (iPhone does not support J2ME though).

Application	Co-creation support	Utility footprint
Sportstracker (www.sportstracker.nokia.com) where you can log your jogging paths and share with your friends via a web service. You can, for example, also count the number of steps and maintain a training diary. The application uses the UIQ application framework for MIDs using the Symbian OS.	2, 4, 5	
Nokia Chat (www.nokia.com/betalabs/chat) that combines a chat service with sharing of your GPS position to your friends. The position and status info is automatically updated when a user arrives at his hangout place preparing you for chance meetings. The application is possible to connect with other chat applications through the Jabber standard. It is possible to send voice / sound messages to other users. The application runs on a selection of Nokia phones (J2ME) and regular PCs, but is not supported on, for example, Sony Ericsson phones.	2, 4, 5	
The **Google Maps** application (www.google.com/gmm) shows the maps of Google together with satellite images and route descriptions, traffic information, etc.	2	
Smartcom GPS (www.wild-mobile.com) is a plotter application for scanned maps, e.g., sea charts, available for UIQ devices. It shows the kind navigation information, as course, bearing, speed, distance that is available in regular navigation devices for outdoor sports.	2	
Wayfinder Navigator (www.wayfinder.com) is a terrestrial navigation application with route directions and tags for sites of interest, e.g, golf courses. A Facebook application is available for sharing of position and status data with your friends. It is not clear if there is an API that enables anyone to create their own Facebook application that presents information from a Wayfinder MID client.	2, (1?, 4, 5 are available through an API towards Facebook)	
Anchor Alert (www.viking.tm) provides the drift-warning available in most marine GPS devices.	2	

Wayfinder Active (www.activeoutdoor.com) is a training application, similar to *e.g.* Sportstracker, for J2ME devices. Topographical maps from Lantmäteriverket are possible to download for an additional fee.	2, 4, 5	
Basenav (www.basenav.com) is a plotter application for different kinds of maps (and sea charts), enabling trace indication of your paths, and regular outdoor GPS functions. The application is written in J2ME	2	
Tomtom (www.tomtom.com) is a terrestrial navigation application for Windows Mobile and Nokia's S60 application framework, reflecting the standard features for in-car use.	2	
GPSToday (www.geoterrestrial.com) shows your position on the "today"-window on Windows Mobile. The application supports amongst other features, geo-tagging of pictures and presence indication for people in your address book.	2, 4, 5	
Nearby (http://platial.com/Iphone) is a web-based Google maps-based application that connects you to a database of information about the discoveries of other users. Seems rather unstructured with a lot of ad-hoc references of different users. The application is available for iPhone (and PC).	1, 2, 4, 5	
Twinkle (tapulous.com/twinkle) is a chat application with sharing of positioning and status information to your friends. The application is available for iPhone.	2, 4, 5	
GPSCompass (www.amalgamatedcoders.com) provides map and regular GPS information with different exclusive skins for presentation. The application is available for iPhone.	2, 4, 5	

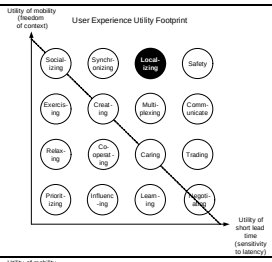
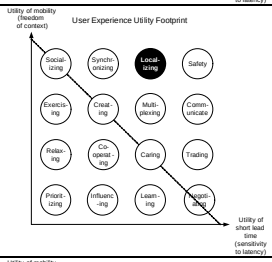
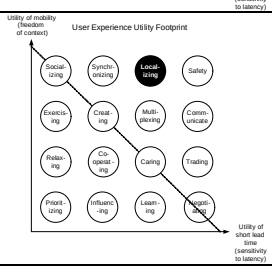
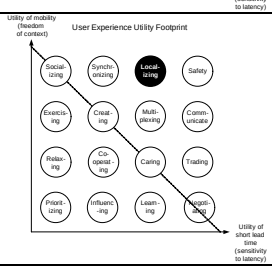
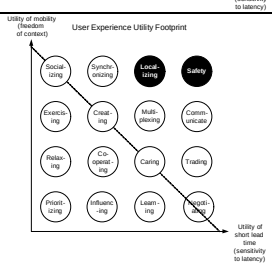
Fugawi (www.fugawi.com) is a GPS navigation and mapping software for use at land or sea. The application runs on regular PCs or PDAs or proprietary navigation equipment. Fugawi has various applications for Windows, Windows Mobile and Palm OS. PC-based applications for B2B map creation are available.	1, 2	
Det levande sjökortet (DLS) is an application for PCs featuring sea charts from the Swedish nautical administration. Correction and specific information about, *e.g.*, harbours are provided from third parties (Swedish yacht associated SXK). The application has no specific support for sharing of user/community produced content, but the SXK map data can be downloaded from their site, www.vastkustkretsen.se/Teknik/DLS.	1	
MapTech (www.maptech.com), navigation application for PCs supporting various national on land and sea charts, features similar to Fugawi.	1	
Tiki Navigator (www.tiki-navigator.com) is a nautical navigation application for PC, similar to Fugawi, DLS and Maptech.	1	
Garmin Nuviphone (www.garmin.com) is an announced phone product with specific focus on navigation and features as touch screen and mobile browsing. It is built on a proprietary OS from Garmin. Features announced (see for example http://www.letsgomobile.org/en/2898/garmin-mobile-phone/) include standard navigation features of Garmin devices as, online information about traffic, weather, fuel prices, hotel discount; Google local search and geotagging of pictures; etc. The phone is announced for Q3, 2008, but has not shown up yet.	?	

Table 5 Overview of market offerings and utility footprint with respect to GPS-based location applications for navigation.

3.3 Infrastructure for co-creation

The system architecture for the application is illustrated in Figure 12. The co-creation with respect to exchange of position and status information as well as the content consumption takes place via the client. The content creation is mainly contributed through a web interface, by using a built-in graphical interface or uploading SVGT graphical objects created with an editor of choice.

Today, only a first mySQL database for user data is set up and running (web hotel). The exchange of data between the web and client applications takes place via this database. Wireless access trials for the client have been limited to cellular (socket) connection. Dotted lines illustrate non-existing features to be evaluated and possibly implemented in the future.

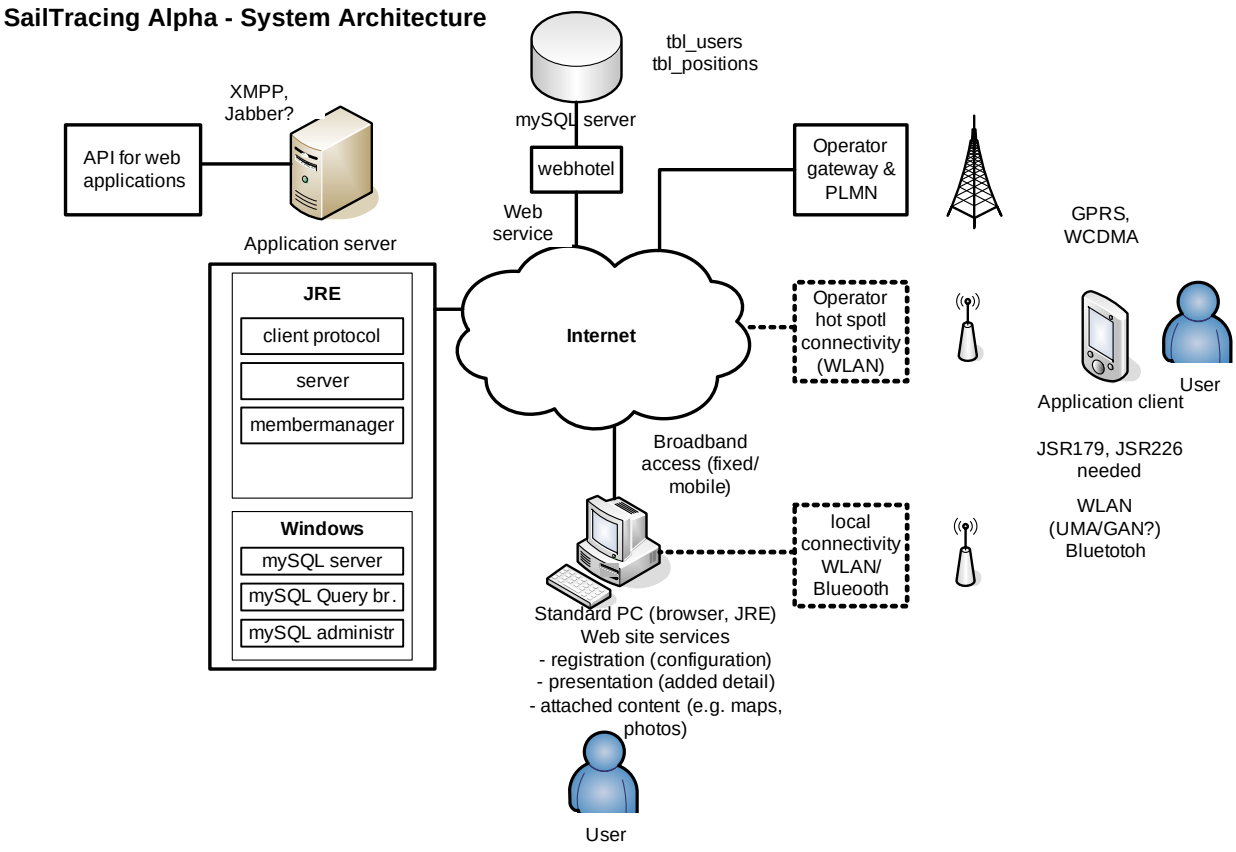


Figure 12 System architecture of the SailTracing application.

3.3.1 Dialog

The dialog with the consumer is enabled by

- a web forum on the administration web page for the application, where feedback and comments on the application can be exchanged
- the application is beta-tested in a limited community before release.
- teaming up with nautical communities, possibly offering slight customization in compensation for discussions about customer utility. We assume that the main population of interest is located along the Swedish west coast and we seek to use advantages of local knowledge.
- the willingness to pay for content can be explored by defining a marketplace for nautical map content and services. Also a credit / reward system for content or service contributions can be imagined. Due to time limitation, these options are considered for future extensions and they need to be studied further.

3.3.2 Access and Transparency

These aspects are addressed by giving the user clear information about the features of the application in a reference manual, *cf.* Appendix A. The user has freedom to use any graphical editor for the creation of map content, under the constraints of format (SVG Tiny) and certain interface specifications. These specifications concern display parameters, size and geographical co-ordinates to enable integration with the application. The co-creation is limited to type-1 (content creation), 4 (asynchronous profile information) and 5 (synchronous, position and status information), where the application is considered as a framework for content creation.

We use the MySQL database community server to keep track of all user data and graphical content available. The users can access and modify their static (profile, objective) data and dynamic (location, status) data through a web interface.

3.3.3 Risk-benefit understanding

The accuracy of the map content and the positioning needs to be well defined (disclaimers for inaccuracies and consequences of relying on position data from the application). Also, known errors (bugs) and limitations in the released SW needs to be clearly communicated on the application home page. The availability

of server connections and limitations in reliability of the system shall be clearly stated (network coverage is limited at sea, etc). Also, disclosure of the own position and status shall be possible to shut off and the conditions of integrity clarified. For instance, the identity and passwords of a user are protected by cryptography when he is logging on to the system. The property rights of the content created by the users need to be clearly defined. The conditions of participation is communicated in an agreement for that needs to be signed in order to register for an account and obtain the client SW. Also, a clear description of the payment system used for different content transactions is an important aspect.

3.4 Building installed base

The strategy to build installed base is to piggy-back on the web pages of some existing nautical communities, offering the positioning service as a free enhancement of their web experience. The application shall contain a referral system, where it is possible to register for the application from the mobile client and be up and running in less than 1 minute. Initially, beta tests of the application are carried out within a small community.

3.5 Business model – analyzing the interaction points

This section follows the outline in Section 2.5.1 and Table 6 reviews the possibilities to monetize on the interaction points of the system. Based on these findings, a possible business model is created. The analysis builds on the generic set of revenue streams illustrated in Figure 2 and further developed in Table 3.

Interaction point	**Can we charge for this?**	**How can we charge? / Why not?**
In the mobile client application, when the user access a specific advertisement, leading to a web portal for navigation-related services, *e.g.*, weather related, navigational safety, etc.	yes	Similar to Google's sponsored links, advertisers pay when users click its link.
Location-based notifications about special offerings, restaurant discounts, events, from companies, communicated via the client or SMS to the device of the client.	yes	Companies can be charged for the ability to push notifications to nearby customers, but the latter need to subscribe to this kind of offerings, in order not to be spammed (Funk, 2004), p.147.
When the user visits a bookstore searching for nautical literature.	perhaps	If the customer uses a discount coupon that has been conveyed via the client application, there is a possibility to charge for the management of the coupons. Alternatively, a credit system may be established, where

		contributing users can receive discounts on equipment and literature in payment of the content they have provided
Enhancing / facilitating the communication between different members of the niche group, *e.g.*, between crew members on boats	no	The growth of the installed base would suffer from this. The operator traffic rates are already incurred by the customer.
Providing existing communities, as yachting clubs, sail racing clubs, search and rescue (SRSS), *e.g.*, www.ssrs.org, with a location solution for their members, *e.g.*, via their web interface.	no, but can be traded for access to member info	Communities are often of a volontary character.
Providing companies in the nautical business with information about customer utility functions and behaviour.	perhaps	If integrity issues can be solved and information is presented on an aggregate level
Selling a customer communication service, linking from an API to the application used by the company web page.	perhaps	
Opening up the source code of the system (server and client) to other companies or the development community and charge for support	perhaps	If a core technology can be established. Modularity is already high and many different SW solutions exist on the market.
Packeting and distributing the content obtained from co-creating users	perhaps	Given that the quality is sufficiently high and of general interest outside a specific community (enabling economical savings), an application/content store, similar to iTunes could be imagined.
Developing and providing companies with tools / services for advanced processing of the users in various communities, *e.g.*, identification of segments of customers with high potential, based on their location, status, equipment, individual preferences and economic history in the system.	probably	As discussed in (Andersson et al, 2007), the targeting of advertising towards niche markets and individual users with high potential is a difficult task. Integrity issues need to be resolved.

Table 6 Overview of possibilities to monetize the information exchanges in various points of interaction between the users and originators of the system.

4 Conclusions

We have investigated the possibility of strengthening the value proposition of mobile information devices (MIDs) by enabling co-creation of the user experience. The meaning of co-creation theory has been explored for this specific area of application and a number of examples have been presented in order to clarify this meaning. In order to understand how the user of a MID can participate in a co-creation process, we have made an inventory of the sensor, user interface and communication capabilities of a subgroup of the MIDs - mobile phones - as well as the different kinds of information and interaction these devices are capable of providing at the moment of writing. In particular, the implementation of co-creation applications in the J2ME language that is commonly supported on this kind of MIDs has been studied through the development of a prototype application.

In this section, we conclude on the value potential of co-creation on MIDs and the utility of the general co-creation theory for this purpose and reflect on some limitations and opportunities that we have observed, both from a theoretical and technical perspective.

4.1 Value potential of co-creation on MIDs

It has been found that there are multiple possibilities to enforce the value proposition of mobile phones by co-creation and some applications on this theme already exist on the market.

Typical for contribution applications is that they fuel the *network effects* of an interconnected system, *i.e.*, the value of the contributor-and-user network increases with each additional participant and his ability to contribute. However, we argue that the network effects and the value potential depend on the possibility for the users to engage in creative interaction and processing of the actual contributions. Therefore, we believe that contributions in terms of voluntarily shared information, knowledge and metadata will better leverage the communication network facilities and build more value for interconnected mobile devices than entertainment content contributions. In either case, the presence of a well functioning distribution facility – a contribution store - is critical for the system to work.

It is recommended that particular attention shall be made to the key characteristics of MIDs with respect to mobility, contextual awareness and immediacy. In order to successfully capitalize on these characteristics we have developed a conceptual framework for systematic design of co-creation

experiences on this kind of platform. This framework consists of a cookbook process with a chain of activities that should be part of the application development.

In order to quantify, assess and eventually monetize on the value introduced through co-creation, we propose a set of user experience value metrics that can be used in the development of new applications and services. Since the value for different stakeholders is difficult to estimate before the launch of a particular application, we suggest to use simple heuristic measures, as “number of different kinds of metadata available” and “number of ways for users to save time and money” during the development phase. Also, the information flows and interaction points between different stakeholders need to be carefully investigated at an early stage of the development. This is important, both to secure that value is extracted in the intended direction and that there will be sufficient capacity (bandwidth) and scalability of the total system, as the place and timing of the co-creation experiences are difficult to predict (Andersson et al, 2007).

In conclusion, the mobile market is a mass market that consists of a large number of interconnected users and potential contributors. It seems likely that the technical enabling of co-creation behaviour in applications and services for MIDs has big potential to extend the current value proposition.

4.2 Utility and limitations of theory

There exist many different kinds of co-creation situations that are quite different in nature. These range from the situation where ordinary customer comments on a product are fed back to the originating company to the case where a company only provides a thin platform and a user community does the rest of the development. Due to the challenge of establishing concrete design guidelines for such a wide range of definitions, we have chosen to address a subset of this range: synchronous and asynchronous transfer of information and knowledge (see the definition of co-creation in Section 1.3). This choice is due to that the distinct advantages of MIDs when it comes to mobility, immediacy and context awareness open up many new possibilities for collecting and exchanging information instantaneously.

The combination of synchronous information with an asynchronously provided, well defined, individual profile covering individual preferences, habits and objectives offer many new opportunities for value creation. We have found that existing theory of co-creation, for instance the DART framework outlined in (Prahalad and Ramaswamy, 2004), is possible to extend to the chosen subset of co-creation applications on MIDs and several insights on the design of the infrastructure for consumer interaction are obtained as a result. The incarnation of co-creation, subject to study in this thesis is the result of one possible approach to categorization and needs to be further explored and refined. The framework of user contribution systems introduced by Cook (2008) has been helpful for the understanding of the meaning of co-creation in a wide perspective.

During the development of an application, it is easy to get stuck in specific implementation issues and loose track of the drivers of co-creation that the application targets. In order to focus the development, the value potential of different implementation modules, in a co-creation perspective can be used as a means of prioritization. An inventory of the interconnection points where value shall be extracted, at the beginning of the design, saves time and improves the targeting of the application. Moreover, the aspects of monetization and installed base are tightly coupled and needs to be addressed in an iterative manner to optimize for growth and sustainable revenue. Finally, it is important to recognize that much of the activity in today's contribution systems take place without any monetary compensation.

During the prototype development phase, it has been tempting to implement proprietary solutions and take shortcuts in conflict with known best practices, such as modular development, reuse and well defined interfaces of constituent components as well as the final application. However, in order to fuel co-creation and linking of different utilities, it is important to have a clear strategy for how existing, standardized, modules shall be reused and how well defined APIs can be supported. The market moves very fast and many ideas are found to already be implemented by someone else. Thus, modular development is critical in order to obtain a short time to market (Baldwin, 1997). Also, modularity is necessary in order to be able to reshape the application's utility during the development period and change the type of co-creation in focus for the application. This calls for a rather flexible co-creation platform.

It may be argued that, ideally, the users targeted by an application should be part of the development from a very early stage (see the DART framework in Section 2.3). For those suppliers who plan to monetize on the distribution of SW and wants to build in strong control over the interfaces and customer utility data, this is a problem. The most powerful co-creation platforms may require profound open source community development. For instance, in Google's application framework Android (2009), there are various open source components already in the OS and middleware (Android, 2009), for instance the integrated browser is using the Webkit (2009) engine. Actually, Google's expectation is that substantial parts of the platform shall be developed through open source. Since the OS is open, the developer community has the same possibilities to control the application development, as Google themselves.

The quality of co-creation services is an area that has been completely left out of this study. There is little coverage of quality aspects in the literature and theory of co-creation that has been considered in this study. Commercial actors appear to have better possibilities to deliver quality applications through well defined processes and centralized control. However, as quality is about meeting the customer expectations, it may be that co-creation strategies are advantageous also from this perspective. The argument for this typically is that co-creators develop what they want, for use by themselves, instead of developing what corporate management wants, for someone else.

4.3 Technical considerations

In order to assess the cookbook development process suggested in this thesis and confront issues related to the technical implementation of co-creation applications, a prototype has been defined and implemented in the Java Microedition (J2ME) language.

The specific limitations of J2ME as a platform for application development are found to be significant. For instance the installation and configuration of the software development kit (SDK) ought to be easier, in order to get up to speed with the programming with less effort. The support for emulation and debugging of applications that include communication services and sensor interaction is not well developed and this is causing a need for on-device debugging, which is very tedious. Moreover, there is not full consistency between the J2ME platforms implemented on different MIDs (phones). It is our feeling that manufacturing company portals, supporting the J2ME developer community, are quite slow to respond to questions and trouble reports and that these services could be much improved.

The roll-out of APIs for access to sensors and peripherals, *e.g.*, GPS, as well as graphical media content management, *e.g.*, SVG, has merely started and relatively few MIDs that support these APIs are on the market.

The simultaneous acquisition and sharing of sensor data to the user and the network requires several parallel execution threads. This puts high requirements on the processing power of the MID. Battery lifetime is a clear limitation, *e.g.*, for GPS-based services. We have got the impression that GPS technology in mobile phones is not a fully mature technology as long acquisition times, before getting a position fix in urban environments, and rather high battery consumption have been observed in positioning mode. This implies that applications on these themes need to find ways of enhancing or replacing the current GPS positioning technology. For instance, strategies for improving the position accuracy (triangulation with other data) are needed at the server side, *e.g.*, using technologies as CellID. Also, in order to grow the installed base, it is important to support alternative ways of getting positioning data as many users may not have GPS-enabled MIDs, at least not today.

Obviously, the UI design and its appeal to the customer is a very important part of an application, but the design of an attractive UI is a challenge on the small display sizes supported in many MIDs. It may also be very time consuming. Initiatives to improve creativity and productivity in this respect are under way, *e.g.*, Sony Ericssson's Capuchin project that integrates solutions based on both Adobe Flash light and J2ME.

In conclusion, it is a challenge to overcome the entry barriers of the SW development, while, at the same time keeping track of the co-creation objectives with the application. It is our hope that the cookbook process outlined in this report will be helpful in this respect. In general, the accessible part of the mobile phone platform can be much improved with respect to co-creation support. For instance, APIs for more sophisticated sensors could be added and examples of co-

creation applications could be bundled with the SDKs. The development of a SW platform for co-creation, as a means of rapidly bringing new applications to the market, is another natural step to enhance the value proposition of MIDs.

4.4 Main contributions

The main contributions of this thesis are

- the application of general theory for co-creation on the area of mobile applications and services and the analysis of its specific implications and value potential for this area,

- the identification of behavioural data (active/passive and synchronous/asynchrounous) as key value drivers in a contribution system based on MIDs and the extension of Cook's (2008) contribution taxonomy,

- a set of guide lines for analysis and development of co-creation experiences for mobile devices , mainly

    - the utility constellation as a tool for analyzing the composition of a mobile user experience and positioning new applications and services by identifying the utility footprint of existing ones, and

    - the co-creation application synthesis process as a tool for systematic design of co-creation experiences on MIDs.

4.5 Future research

Possible directions for future research in the area of this study include an extended study of how mobility, context awareness, immediacy and other unique attributes of mobile information devices can be exploited for co-creation. Also the definition of a standardized application framework for co-creation on mobile devices, building on experiences and guidelines from the Web 2.0 paradigm and portable between different mobile operating systems, would be an interesting challenge.

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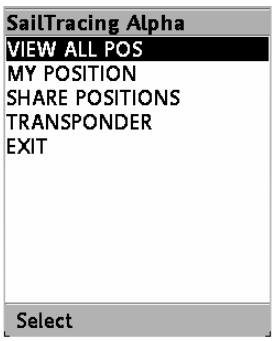
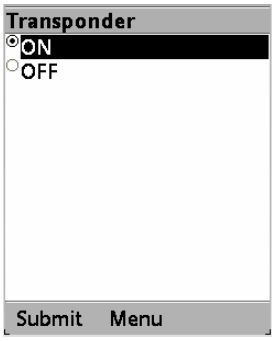
Appendix A – SailTracingAlpha v.0.2

System Requirements - Client

- Communication: GPRS/WCDMA/WLAN Internet access
- Java
  - JSR179, location API
  - JSR226, scalable 2D vector graphics API
  - JSR 172, JAXP XML Parser
  - MIDP2.0
  - CLDC1.1
- Size: 684kB

Feature Baseline (v.0.2)





Show welcome menu with the choices

- VIEW ALL POS shows large scale overview and all available positions
- MY POSITION enables input of own position into the own, local, client register (RMS).
- SHARE POSITIONS uploads position of client user to the application server and downloads the positions of other users in the same community.
- TRANSPONDER activates acquisition of position via GPS and transmission and sharing of it to other users in the community (currently, every 15 min)

Feature Baseline v.0.2 (cont.)

The VIEW ALL POS menu features

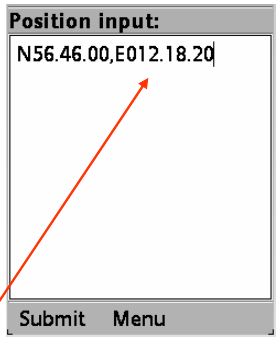
- Showing of pre-loaded SVG Tiny map of Kattegat and Skagerrak
- Selection of sub-area from fixed raster of 3x3 and zoom-in / zoom-out in 4 levels (using ”fire” and ”*” keys).
- Showing user positions and nicknames where such are available in the RMS memory of the client. The own position is marked by ”local” and set to a default position in the Gothenburg archipelago.

zoom in
zoom out

Feature Baseline v.0.2 (cont.)

The MY POSITION menu enables input of the users own position into the local, client register (RMS).

- Automatically: using an internal or external aGPS module. Note that aGPS is not a prerequisite for the program to work. However, currently only handsets enabling the location API, JSR 179, are supported.
- Manually: This is done manually as text input with standard nautical position format or by scrolling the cursor (”local”) to the desired position
- The position of the cursor is given in the display header
- The MY POSITION menu is available via the ”Menu” soft-button in the VIEW ALL POS mode, for each zoom level (1-4).
- Zoom out to the top-level can be done with the ”*” key.



Note: please make sure this format is followed (weak error mgmt)!

Appendix B – Development Tools

Software

- Sony Ericsson SDK 2.5.0 for the Java™ ME Platform, August 2007, http://developer.sonyericsson.com/site/global/docstools/java/p_java.jsp.
- The Sony Ericsson SDK for the Java(TM) ME Platform is a modified version of Sun Java Wireless Toolkit (WTK 2.5.0).
- Java SE Development Kit (JDK) 1.6, http://java.sun.com/j2se.
- Netbeans IDE 6.0.1, http://www.netbeans.org.
- TortoiseCVS 1.10.5, http://www.tortoisecvs.org/download.shtml
- Inkscape 0.46, SVG editor, www.inkscape.org.
- MySQL data base, community server, http://dev.mysql.com/downloads.
- DynDNS, dynamic DNS client, available at www.dyndns.com.

Hardware

- IBM Thinkpad T30, 2GHz Pentium M, 1GB RAM, 40GB harddrive. External Bluetooth EDR USB dongle and WLAN PCMCIA card.
- One.com, web hotel, http://one.com.