

# Mobile Life Centre

The *Mobile Life Centre* at Stockholm University in Kista will be a world-renowned focal point for research in mobile services and ubiquitous computing, joining forces with local research organization such as SICS and KTH. The topic of the Centre includes research on consumer-oriented mobile and ubiquitous services spanning all areas from entertainment and socialization to work and society. It will have major partners from the IT and telecom industry, including *Ericsson Research*, *TeliaSonera*, *Sony Ericsson* and *Microsoft Research Ltd*, as well as a number of small and medium-sized enterprises. Partnerships in the public sector, including *City of Stockholm Municipality*, *Kista Science City* and the *Swedish Defence Research Agency (FOI)* will secure societal relevance, and collaboration with *Stockholm Innovation and Growth* ensures that results are integrated in the innovation system. In the Centre, this academic, industrial and public partnership will be able to jointly work on strategically important projects that can provide a sustainable growth for Sweden.

The telecom and IT industry is now facing the challenge of a *second* IT-revolution, where the spread of mobile and ubiquitous services will have an even more profound effect on commercial and social life than the recent Internet revolution. Users will expect services that are unique and fully adapted for the mobile setting, which means that the roles of the operators will change, new business models will be required, and new methods for developing and marketing services have to be found. Most of all, we need technology and services that put people at core. The industry must prepare to design services for a sustainable web of work, leisure and ubiquitous technology we can call the *mobile life*.

The Centre will adopt a fundamentally user-oriented perspective on services for the future mobile life. It will provide a neutral arena where researchers and industrial partners together develop:

- New *interaction models and platforms* that provide a unified interface across different applications and terminals
- Efficient and user-oriented *methods* for developing mobile services
- A deepened *understanding* of the unique properties of the future mobile life
- A *future mobile service eco-system* where we explore alternative universes for infrastructure, business models and the industry's new roles

An important activity of the centre will be to develop new mobile and ubiquitous services. During the centre's lifespan the application domains and research questions will be continually negotiated and extended to meet partners' demands. We have identified four initial domains where mobile services can have significant impact on peoples' lives, and where there is also a clear commercial potential. They include:

- *Humans in motion* – services adapted for the truly mobile settings; on the road, commuting on public transport, leisure travel and tourism, etc.
- *Mobile media* – services for creating and sharing photographs, music, and other forms of personal media
- *Pervasive gaming* – new and exciting gaming experiences that profit from the blend of real and virtual game elements
- *Social mobile services* – services that take advantage of, and contribute to, social and emotional interactions

The Mobile Life Centre will be a vital strategic component in ensuring that the IT and telecom industry successfully meets the challenges of the next ten years and beyond, both in the Kista region, in Sweden as a whole, in the European Union, and throughout the world.



# 1 Vision

## 1.1 The Centre's vision in a 7-10 year perspective

We are facing a *second* IT-revolution, caused by the spread of mobile and ubiquitous services, in combination with a broad consumer-oriented market pull. The first IT-revolution, the introduction and deployment of Internet and the World Wide Web during the 1990's, had a major impact on all parts of our society. This technology has now become intertwined with almost all societal, industrial and private activities.

Today everyday devices like phones, digital cameras and MP3-players already contain more processing power than a supercomputer did a few years ago. Soon, computer chips, sensors and displays will be so small and inexpensive that they can be integrated into virtually any product. The interconnectedness and ubiquity of this technology moves us towards the visions of *ubiquitous computing* and *mobile services*, where computation and digital communication will be available in many new situations and become a natural part of everyday life. As information and communication technology moves from the desktop and out into the world, users will expect services that are unique and fully adapted for the mobile setting. This means that the roles of the operators will change, new business models will be required, and new methods for developing and marketing services will have to be found. Most of all, we need technology and services that will put people at core, and where mobile services find a natural place in an intricate web of work, family life, social activities, leisure and culture – the future *mobile life*.

As mobile, ubiquitous technology now becomes widespread, the design and evaluation of mobile services – i.e. information technology that can be accessed and used in virtually any setting – represents a vital area for every aspect of the IT- and telecom industry. This development has a particular relevance for Sweden. The penetration of mobile technology is already unusually high, and Sweden is economically dependent on this industry. Furthermore, due to our position as early adopters of mobile technology, many European companies consider Sweden both as an important customer for existing mobile services and a test market for innovative products before they are launched globally.

It is now of strategic importance for industry to engage in *service development* in order to secure a sustainable economic growth. First, services will be important for generating revenue by itself. Sweden has a possibility to considerably strengthen the business opportunities in this area. Second, the introduction of new services will drive the technical development. The telecom industry, which is currently mostly oriented towards infrastructure, must understand these drivers in order to meet the demands of future consumers. Thus, in our vision the telecom industry will grow in the service sector and provide technologies based on strong commitment to consumers needs. We envision an abundant use of mobile services in peoples' everyday lives. In the future, industry must be able to support rich and dynamic generation of services, and even include the users themselves as service providers.

The *Mobile Life* competence Centre will be located in Kista, where it will become a national and international focal point for the best and most innovative research in user-driven mobile services and ubiquitous computing applications. It will have as its basis Stockholm University in Kista. The Centre will directly extend the very successful *Mobile Life research program*, 2006-2007, which was a collaboration between SICS, Interactive Institute and Viktoria Institute. Stockholm University here has an opportunity to strengthen its research, where the creation of technology in dialogue with societal values and social science research promises to become one of its new profile areas. The Centre will join forces with national and international industry partners to take research and development in mobile services to the next level, thereby vitalizing the area and creating many commercial and academic opportunities. In par-

ticular, it will provide the basis for establishing a new industry offering mobile and ubiquitous services based on Sweden's current strengths in this area.

To do this, it is necessary to conduct basic research as well as practical service development. In its research, the Centre will address fundamental questions regarding mobile services, such as studying the requirements that are unique for mobile situations, and exploring the new interaction possibilities, infrastructures and business models of mobile technology. The Centre will also develop and evaluate novel new services in emerging domains, such as media, games and travels which may be taken up by Centre partners or commercialized in spin-off companies.

## **1.2 A generator of sustainable growth**

According to several recent reports, the *mobile services* area is the sector of the Swedish IT- and telecom industry that is most likely to create sustainable growth for the coming decades. A 2004 report by the committee *Teknisk Framsyn* (Technical Foresight) found that mobile service systems belong to strategically relevant clusters in both interactive technologies and usable IT. Such Swedish clusters are promising areas since they are internationally competitive in terms of innovation and scientific knowledge as well as with the industrial sector.

Furthermore, in 2003 the consultancy firm *Northstream* presented an investigation called "Wireless Sweden", commissioned by the government agency Invest in Sweden. This report came to a similar conclusion regarding our national potential. Sweden has a successful industry that focuses on the infrastructure side of ICT, which at the time consisted of 429 Wireless ICT companies with over 50 000 employees. The report claims more specifically that the growth potential is on the service side of the telecom industry, where already 138 companies were doing application development, and 177 companies provided professional services. To stay competitive in the telecom sector it will be necessary to concentrate even more on consumer-oriented services, as this is where business will grow, in particular with the introduction of the "true" mobile Internet. The Northstream report concludes that there is a "large growth potential for mobile applications and content providers".

Northstream's primary suggestion is therefore to establish an R&D Centre, which would "attract large and/or fast growing industry players to support the establishment of an R&D Centre for mobile service development." They argue that "this establishment should either be based on a partnership with existing R&D efforts of a University or institute, or through acquisition of a smaller wireless ICT company, for the purpose of further development."

Our proposed Centre in Kista would meet exactly these demands. Both the reports refer to the fact that Kista already is a cluster in the telecom sector, although it is currently mostly focused on technical infrastructure. By locating a user-oriented competence Centre here we would take advantage of the technical competence in the region to secure the continued growth of the IT- and telecom industry.

The Centre would add to the competitive strength of the region and the nation by providing resources to critical local research institutions. The Centre will have a broad impact on research and education in the region through these important organisations as well as through e.g. the public activities of Kista Science City. Drawing together all these partners will also increase the possibilities to secure more EU funding to Sweden, and thus strengthening mobile technology research and industry even further.

The topic of the Centre includes research on consumer-oriented mobile services spanning all areas from entertainment and socialization to work and society. Private consumer groups have not historically been considered strategic user groups in the Swedish innovation system, as it has relied on close collaboration between industry, research and a state that funds research and buys the products (often referred to as the triple helix). The strength of the Swedish inno-

vation system has depended on the public sectors ability to act as first buyer, creating a “safe” market for companies moving into new sectors. This innovation system will have to be complemented to ensure success in more consumer-oriented markets. The state as a first buyer is less relevant if the end products are consumer services. Furthermore, the possibility for the public sector to provide such support has decreased due to deregulations of a number of strong public actors in our field. As an example, the former state authority for telephone services is now an independent company competing on a private market.

### 1.3 Strategy for realizing the Centre’s vision

The Mobile Life Centre should have a major and long-time impact on *research* in mobile services, the related *industry* and *society* as a whole. To ensure successful research results, it will from the start involve the best Swedish researchers in mobile services (including the *Mobile Life* strategic research program and the EU project *iPerg*) and the most advanced research departments in our most influential companies. It will be based at Stockholm University in Kista, where there already exist strong educational programs in many IT areas, which will secure the inflow of new masters’ and Ph.D. students. In Kista there is also KTH’s branch of the IT University, and the Swedish Institute of Computer Science (SICS) which is currently in the process of acquiring the other IT institutes in Sweden including Interactive Institute and Viktoria Institute. Several of the industry partners have advanced research and development departments in Kista. Building on these existing activities, the Centre will achieve a sustainable approach to research and development of mobile services. It is based on a strong theoretical foundation (*embodied interaction*), a well-defined methodology (*user-centred development*) and an important domain with large societal importance and commercial potential (*mobile life*).

The Centre will develop innovative ways for securing industry participation and relevance of the research. At the heart of this strategy lies the *mobile services eco-system*, including a novel testbed where researchers and industry can meet in a neutral arena to experiment with future mobile services, and develop new standards, infrastructures, business models and interaction paradigms. The eco-system is both an experimental environment for research and development for the Centre’s current partners, and a way of involving new companies before they become full-fledged members of the Centre. A successful test run of a service in the eco-system, where for instance the potential business models of a service is explored, can become both the motivation and the entry ticket for a smaller company to join the Centre. The smaller companies will act as “customers” for the Centre as well as for the partners that provide infrastructure and other services. From this can spring new collaboration between industry and researchers. The mobile services eco-system is described in more detail in section 3.6.

The centre will employ a number of collaboration forms with industry, where *internships* are a major part. Researchers from the Centre will spend time in partner companies to get to know each other and to learn the business way of thinking about the problems, and conversely, workers from the partners will spend time in the Centre to learn about practical and theoretical research matters. This will ensure tight exchanges of both ideas and people between the Centre and its partners. Another important component is the *roadmap* for projects, where research activities follow a clear path from inception to exploitation. More about these novel forms of collaboration can be found in section 5.

The Centre should have an impact on society and the innovation system as a whole. We have established a relationship to The City of Stockholm Municipality, initially to develop mobile services as part of the own administration. The City has several initiatives that will be beneficial for the Mobile Life project such as mCity and the IT-region projects. It will serve as an interface for getting access to larger test populations in such areas as elderly care, parking, education, citizen services etc.

The centre has secured integration with the local innovation system through including Stockholm Innovation and Growth (STING) and its member companies in combination with SU Holding, the university holding company. To ensure that the Centre's result become know to a wider audience, including the general public, we will establish a strong media presence and present the work in various popular formats, such as brochures and web pages. We will work with local authorities, consumer advocacy groups, and other organizations to secure the societal relevance of the Centre's work, both on a local and national level. More details can be found in sections 5.2.

The total size of the centre in year 2007 (including VINNOVA-funding, industry funding, university funding and other projects that will belong to the centre) will be 12.6 MSEK plus 2.7 MSEK in kind contribution. This will then raise to 14.5 MSEK plus 3.6 MSEK in kind contribution in 2008. Thus, we expect to employ around 15 researchers in 2007 and about 20 researchers in 2008.

## 2 Related Research and state of the art

### 2.1 Related research by Mobile Life partners

The partners in the Mobile Life Centre proposal are already Sweden's leading constellation in this field of research. Three of the groups in this proposal – the *Mobility Studio* at the Interactive Institute, the *Future Applications Lab* at Viktoria Institute, and the *Interaction Lab* at SICS – previously collaborated in the *Mobile Life* research program. It was funded by the Foundation for Strategic Research with a total of 19 MSEK and ran for 3 years, between 2002 and 2005. During the project the three group leaders, Kristina Höök, Oskar Juhlin and Lars Erik Holmquist, have all become established researchers in their respective areas.

Some of the major achievements by the Mobile Life program in the last three years include:

- Two senior researchers, Kristina Höök and Lars Erik Holmquist, were awarded an *Individual Grant for the Advancement of Young Research Leaders* (INGVAR) by the Foundation for Strategic Research, the most competitive grant in Sweden, awarded to 18 young researchers chosen from over 400 applicants in all fields of science
- 29 articles published at international conferences and journals, and an additional 50 short papers, posters, demonstrations, and reports at smaller conferences.
- Research results were presented at practically all major international academic conferences in the fields of mobile and ubiquitous computing and human-computer interaction, including ACM CHI, ACM SIGGRAPH, ACM UIST, ACM GROUP, ACM DIS, ACM DUX, Mobile HCI, UbiComp, Interact, etc.
- 17 innovative prototype applications were implemented
- A platform for mobile graphics, *GrapiDraw*, became an industry standard and was commercialized in the spin-off company *Develant*
- There was extensive media coverage, with over 50 items including television and radio appearances, newspaper and magazine articles, etc.
- Several advancements were made in academic careers of the participants. Oskar Juhlin and Lars Erik Holmquist became Docents (Associate Professors) at the Göteborg IT University, Kristina Höök became Full Professor at Stockholm University, 4 students completed their Ph.D. thesis and one Ph.Lic thesis was presented as a direct result of the program
- New international collaborations were initiated with both industry and academia, including Sony CSL (Paris, France), Nottingham University (UK), Keio University (Japan), ETH Zurich (Germany), Glasgow University (UK), Royal College of Art (UK), Microsoft

Research Ltd Cambridge (UK), DFKI Saarbrücken (Germany), INESC (Portugal), Cornell (U.S.), Rensselaer Polytechnic Institute (RPI), (U.S.), Paris 8 (France), Washington University (U.S.), and many more

- The projects won many awards, including the audience award at the SITI conference three consecutive times (2002-2004), two best paper awards, the prize for Best Development Software by PocketPC Magazine for two consecutive years, and was nominated for awards at Mobilgalan and Tekniska Mässan

Taken together, these results have established the Mobile Life consortium as one of the world leading groupings in mobile services and ubiquitous computing research, with very few if any international rivals of similar size and activity. The intention with the Mobile Life Centre is to directly build on this momentum to ensure that Sweden continues to be a leader in this strategically important area.

To this successful consortium, Dr Annika Waern adds a strong industrial focus through her experience in industrial research both from SICS, as CTO of Gamefederation AB, and in particular as coordinator of the *IPerG* project, a 92 MSEK European Union effort developing Pervasive Games in collaboration with European industry and academia. At this time, the *IPerG* project has only run for one year, but has already produced eight game prototypes, four medium- to large-scale game events, six academic and two industrially oriented publications, as well as one spin-off company. It is clear that this project is advancing state of the art in mobile games in a way that will benefit both Swedish and European competitiveness in the area as well as provide a fruitful basis for extending the research in the Mobile Life Centre.

## 2.2 State of the art

The field of mobile services and ubiquitous computing is relative newly established, and has its roots in other fields such as human-computer interaction (HCI) and computer-supported cooperative work (CSCW). Mobile computing applications have only recently received any significant attention among HCI researchers; the first few publications on mobile services for end-users appeared as late as around 1995, and the first Mobile HCI conference was held in 1998. Topics of interest in mobile HCI include automatic generation of interfaces for multiple display sizes; novel input and output methods better adapted for mobile devices; and innovative social applications and services for ad-hoc networking. However, the activities in the area are still dispersed among many research communities and there is a significant overlap with other fields such as HCI and CSCW.

The concept of ubiquitous computing is more clearly delimited as a research field in its own right, and was introduced by Marc Weiser at Xerox PARC in the late 1980's. The field has several independent conferences, including *UbiComp*, first held in 1999 and *PERVASIVE*, first held in 2002. Moving the computer out of the office and into the "world" means that computing is dispersed in the physical world, and the research issues to a large extent revolve around how the context that surrounds a mobile user can be utilized. Positioning technology and other kinds of context awareness provides possibilities for new kinds of interaction. Important research issues include developing techniques for determining the user's location; sensor fusion and activity recognition; privacy issues; new methods for design and evaluation beyond the desktop; and novel interaction modalities such as haptics, gestures, and 3D sound.

Ubiquitous computing is an established field, with many groups that are active internationally, both in industry and academia. There are still not as many established groups that focus specifically on user-oriented research on mobile services, but the number is growing. In the following we present a number of constellations with similar research focus to that of the Mobile Life Centre.

The most prominent example in Europe is the *Equator* programme in the U.K. The program brings together eight different institutions and a variety of disciplines that address the technical, social and design issues in the development of new inter-relationships between the physical and digital. A number of well-known researchers are active in Equator, including Steve Benford and Tom Rodden (Nottingham), Matthew Chalmers and Barry Brown (Glasgow), Bill Gaver (London) and Hans-Werner Gellersen (Lancaster). The Mobile Life group already has extensive interaction with many EQUATOR researchers. A smaller group that conducts research in mobile HCI is the *Multimodal Interaction Group* at Glasgow University, led by Professor Stephen Brewster. Also in the U.K., the *Socio-Digital Systems group* at Microsoft Research Ltd in Cambridge is an interdisciplinary group bringing together psychology, sociology, computer science and hardware engineering to address the problem of designing technology to support people in everyday life.

In Japan, research on mobile services and ubiquitous computing has a very high priority, drawing on the country's early adoption of the mobile Internet and other technologies like ubiquitous tags. The national *u-Japan* policy is working towards realizing the "ubiquitous network society by 2010". Companies with research activities in mobile services and ubiquitous computing in Japan include leading consumer electronics manufacturers like Sony, Panasonic and Toshiba; service providers like KDDI, ATR and NTT DoCoMo; and others with a wide range of activities like Mitsubishi, Hitachi, Fujitsu and Fuji Xerox. Universities that have specific activities in the area include Keio University, Future University Hakodate, University of Tokyo, Ritsumeikan University, Waseda University and many others. Korea is also emerging in the area, with industrial research from Samsung and others recently gaining prominence.

In the U.S. research in this area is conducted at several universities and industrial labs. Intel Research is particularly strong in location-awareness and urban mobile services, where it has a strong collaboration with University of Washington and Berkeley University. Georgia Institute of Technology is a leader in university-based research on ubiquitous computing, in particular intelligent homes and support for the aging, whereas the Palo Alto Research Centre (PARC) and FXPal are examples of industrial research labs with a long history in mobile applications, context awareness and ubiquitous computing.

Other notable groupings include the HIT Lab at University of Washington and HIT Lab NZ in New Zealand, which have been instrumental in developing and deploying the Augmented Reality Toolkit; the Telecooperations Office (Teco) at University of Karlsruhe, where the popular ubicomp prototyping platforms Smart-Its and uParts originated; IBM TJ Watson Research Centre, which works in steerable projectors and multiple display surfaces; and many groups at the Media Laboratory at the Massachusetts Institute of Technology (MIT), including the Responsive Environments Group, the Tangible Media Group and the Ambient Intelligence group.

The topic is also addressed in many places in Scandinavia. In Finland, the industrial support from Nokia is particularly notable. Nokia Research is very active in both product development and research, and has presented several papers at recent CHI and UbiComp conferences. The Hypermedia Laboratory at University of Tampere is another example, performing design- and methods-oriented research in mobile games. Denmark has the Centre for Pervasive Computing in Aarhus, led by professor Morten Kyng, which is a major research effort in ubiquitous computing and mobile application, and associated with PALCOM, a major Integrated Project in the European Union's 6<sup>th</sup> Framework.

Finally, in Sweden, apart from the institutes that collaborate on this application (SICS, Interactive Institute and Viktoria Institute), we can mention the Departments of Informatics and Computer Science in Umeå, which includes the Interaction Theory Lab and the Umeå Centre for Interaction Technology, also associated with the Umeå Institute of Design. Malmö Uni-

iversity College has been engaged in several EU projects, including ATELIER and PALCOM, and KTH has also worked in the area, in particular through the Centre for IT Design (CID).

## **3 Research program for the first five years**

### **3.1 Motivation and research area**

By focusing on consumer-oriented mobile services spanning areas such as entertainment, socialization and work, the Mobile Life Center will add to and strengthen the Swedish innovation system. Emergent technology within the mobile technology sector has the potential to support everyday activities and thus we need to complement the foundation for user research otherwise mainly focused at work settings.

The innovation of meaningful services with commercial potential does not follow automatically from the development of new technologies, and the uptake of mobile services has been slow in Europe. Despite extensive development of new infrastructure, in particular the 3G and upcoming 4G networks, the main use of mobile terminals continues to be voice communication. In Japan, as well as other South East Asian countries like Korea, the situation is different. Mobile services are a natural part of everyday life and represent a large market. Many advanced services that are only in the prototype stage in the West have already been deployed. The risk is that when Europe finally catches up the initiative will still reside with Asian companies who will utilize their experience to continue to make profits in new markets.

There are some explanations to this situation. The European market is more fragmented with many small countries and languages. The widespread adoption of the stationary Internet happened much more quickly, which means that for instance web-based services are more successful in Europe. The early success of Japanese mobile services, in particular NTT DoCoMo's iMode, had much to do with a closed access and pricing structure that has not been successfully adapted to the European market.

There is now an opportunity for Europe to take the initiative, but not by simply copying the Japanese and Korean success formulas. Research and development of new mobile services must take a different approach, more suited for European conditions of everyday life. We need to develop research on private consumer applications to establish a sustainable foundation for the next generation of applications and services based on upcoming technologies. In particular, development must be based on studies and analysis of actual mobile life to achieve a better understanding of the specific opportunities of mobile services, and what makes such services successful. Mobile services are considerably more complex than stationary computing applications when it comes to context of use. This means traditional methods for evaluation might not be suitable. Instead, studies and evaluations must be done in real-world settings rather than in lab environments.

Future mobile and ubiquitous services will not be a unified set of systems that will replace Internet, PC-software, game consoles etc. A range of solutions will co-exist: internet services and mobile services, mobile services interacting with special-made ubiquitous solutions built into artefacts of various kinds, and so on. We have to ensure that the whole landscape is well integrated with our lives. The goal of the Mobile Life Center is to meet users' expectations on services that are unique and fully adapted for the mobile setting. To do this, we must design services for a sustainable web of work, leisure and ubiquitous technology, that we can call the *mobile life*. We must also identify the domains where mobile services can have significant impact on peoples' lives, and where there is also a clear commercial potential in Europe (and the rest of the world).

To do this, we must map out a design space that consists not just of individual prototypes, studies and evaluations, but cover the entire mobile services landscape. In the following, we will describe a research approach that will achieve this.

## 3.2 Research approach

The Centre will take a sustainable approach to research and development of mobile and ubiquitous services, by combining a strong theoretical foundation (*embodied interaction*, section 3.3), a well-defined methodology (*user-centred design*, section 3.4) and an important domain with large societal importance and commercial potential (*mobile life*, section 3.5). On top of this theoretical and methodological foundation two kinds of tangible results will be built:

- A *mobile service eco-system*, including a novel testbed where researchers and industry can meet in a neutral arena to experiment with future mobile services, and develop new standards, infrastructures, business models and interaction paradigms, section 3.6.
- A range of innovative *mobile and ubiquitous services* as well as their supporting technology and platforms, initially in four different domains:
  1. *Humans in motion* – services adapted for the truly mobile settings; on the road, commuting on public transport, leisure travel and tourism, etc., section 3.7.2
  2. *Mobile media* – mobile services for creating and sharing photographs, music, and other forms of personal media, section 3.7.2
  3. *Pervasive gaming* – new and exciting gaming experiences that profit from the blend of real and virtual game elements, section 3.7.3
  4. *Social mobile services* – services that take advantage of, and contribute to, social and emotional interactions, section 0

The research in the centre is conducted in two major loops, see Figure 1. In the inner loop we produce concrete mobile and ubiquitous services in what we name *domain projects*. They are built from a thorough understanding of the specific domain selected, studies of real-life situations, and existing or invented technology. Once designed and implemented they are evaluated experimentally under real or realistic conditions against the research questions outlined for the specific mobile service. The concrete mobile services developed in the inner loop are research result in themselves, but they also serve as explorations of the whole domain, mapping out the territory before reaching the commercial market.

From the individual mobile services development we also gain deeper insights into what sorts of designs that work, what methods render good services, and how people's behaviour interact with and change through the use of these services. We catch these higher-level insights in a set of *theme projects* in the outer research loop, see Figure 1. Theme projects include:

- *Theory projects* where we add to the growing theory formation in the field, in particular through generating mid-range theories about such design elements in the interface design that can be re-used for whole classes of systems.
- *Method projects* that provide feedback on and invent new user-centred design methods
- *Social science projects* that document and analyse people's behaviour as it unfolds in naturalistic settings
- *Mobile service eco-system projects* where we build the above-mentioned testbed, attempt to create and implement common interaction models for several mobile services, collect infrastructural demands, document end-user perspectives on new business models, and study the effects of integrating many mobile services into people's lives

Proposed theme and domain projects for the first two years are described in appendix 6.

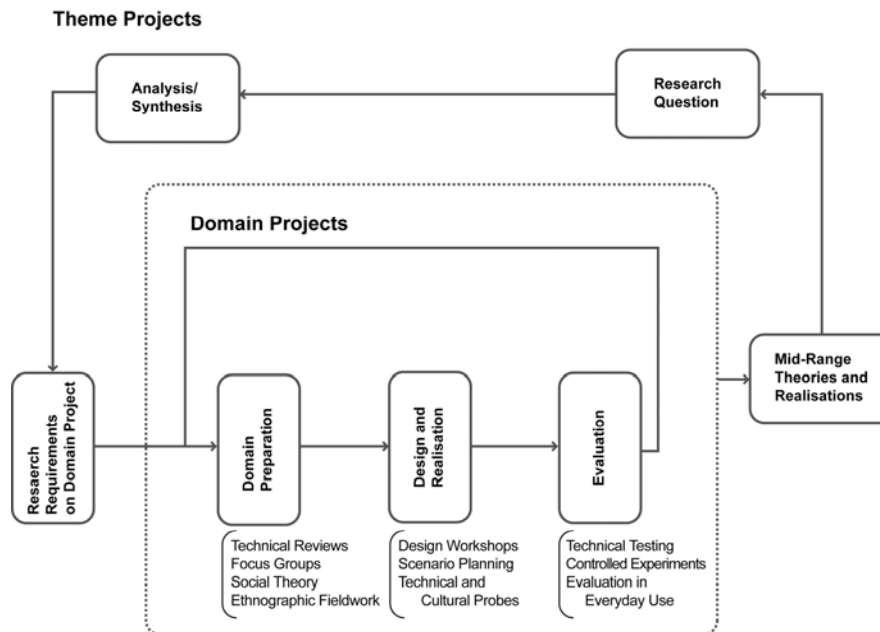


Figure 1 Research method

### 3.3 Theory: embodied computing

The Centre’s work will be guided by a set of theoretically oriented positions on the interactions between humans, technology and society.

Our starting point is the study and understanding of everyday practices – social practices as well as our interaction with the various tools we are surrounded by, and the way we make use of our body and cognition in our interaction with the world. Our theoretical foundation therefore has its roots in the ideas of *ubiquitous computing* and *embodied interaction*. In the late 1980’s Mark Weiser<sup>1</sup> introduced the notion of ubiquitous computing: computers that are seamlessly integrated with the task that they perform – much like writing, a mature and powerful technology that has become second nature to most people. The term embodied interaction was coined by Paul Dourish<sup>2</sup> and is used to describe a phenomenology-inspired basis for design that builds on tangible interaction and social computing to provide computing which “...moves beyond traditional confines of the desk and attempts to incorporate itself more richly into our daily experience of the physical and social world”. The idea comes out of our bodily and socially based knowledge of how to act in the world when there is no apparent “problem” to be solved. According to Dourish, humans focus the way in which we experience the world “as embodied actors interacting in the world, participating in it and acting through it, in the absorbed and unreflective manner of normal experience.”

Drawing on the theory of embodied interaction, we state that:

- Computing occurs in specific settings, which are organised and dependent on collaboration between many people and physical objects.
- *Embodied computing* exploits our familiarity and facility with that everyday world – whether it is a world of social interaction or physical artefacts.
- Embodied computing is integrated with physical artefacts as a way to augment everyday objects in the world and provide for interaction through such objects.
- It recognizes that computers are design objects with an aesthetic.

<sup>1</sup> Weiser, M., Some Computer Science Issues in Ubiquitous Computing. in *CACM* 36(7):74–83, 1993.

<sup>2</sup> Dourish, P., *Where the action is. The Foundations of embodied Interaction*, MIT Press, 2001.

By embodied computing we can also account for the ways in which bodily presence afford specific forms of interaction. This is a growing perspective in the field of tangible computing. We argue that:

- Embodied computing exploits our physical relationship to the world including our bodily presence in the interaction with computers

Our understanding of the ways in which social interaction occurs is informed by Lucy Suchman's studies of human-machine interaction<sup>3</sup>, and could be understood as *situated interaction*. In situated interaction, norms and social rules always have to be fitted to a contingent situation. In such situations, people continuously negotiate and make use of these negotiations to establish agreements and interact successfully even though the situation is both complex and their interpretation of it is uncertain. Thus, it is essential that:

- Computing should support social mechanisms for organisations and enhance situated social interaction.

It follows from our understanding of the context of human-computer interaction that the design of technology should recognise that the context in which it will be used will vary significantly. Thus, technologies should not be designed with the intention to support a very specific and fixed way of interacting in everyday life. Drawing on Dourish' design principles, technologies are more useful if users are in a situation to easily create meaning through their interaction with technology.

With the above discussion we have outlined a theoretical foundation for the Centre, where human-computer interaction is embodied and situated in everyday settings. The theories and assumptions presented above are highly abstracted descriptions of human computer interaction, and can only work to frame the research. In the centre, our goal is to generate *mid-range theories of interaction*. Such theories are on the one hand design elements that have been proven to work and that other designers can pick up and base their designs on; and on the other hand empirically tested theories of how people in specific settings interact with technology and each other.

Our perhaps most ambitious project along these lines is a project that takes a generalized view of mobile interaction, with the goal to find what could be called a new "desktop metaphor" for mobile devices. This project will explore mobile interaction from a theoretical and social perspective on interaction as outlined above, to find general properties that hold across many types of mobile services. It will generate design examples that can be critiqued and eventually tested in the Centre's mobile service eco-system. Complementing this, additional projects will explore other aspects of mobile interaction, such as how studies of mobile life can inform and influence the design of mobile interaction models.

### 3.4 Method: user centred design

The Centre's aim is to do justice to the full complexity of actual human lived experience, where people *actively* and *individually* construct meaningful experiences around technology. We will work from a fundamentally *user-centred perspective*. This will frame our design approach, where we seek to involve users in the design process in a variety of ways, ranging from studying extreme user groups, using ethnography as design inspiration, to participatory design and similar methods.

Each mobile service is developed through a method that can be roughly divided into three phases: preparation, generation, and evaluation (see Figure 1). In the preparation phase, we acquire knowledge about user activities and needs through methods such as ethnographic

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<sup>3</sup> Suchman, L. A. (1987). Plans and situated actions: The problem of human-machine communications. Cambridge, UK: Cambridge University Press.

fieldwork or focus groups. It is valuable to understand people's behaviour as purposeful actions and intentions in a natural context. This requires a familiarity with ordinary life, which surpasses a formal representation of behaviours and in many cases even the users' own representations of what they are doing and what they need. Mobile services can be used by anyone and anywhere, which means we will mainly study services that support aspects of human life not normally catered for in the mainstream design practice of human-computer interaction (HCI). Traditionally, HCI has focused on work-oriented tasks that are to be solved as efficiently as possible. We are instead inspired by areas such as entertainment computing, social interaction, personal media, and travelling. The project will therefore use unorthodox research methods, and a major issue for the project will be to continuously refine and evaluate its research and service development methodology.

An important component in this process is how the analysis of current practice, such as social and ethnographic studies can be used to form design hypothesis and inspire the service innovation process. There is a need for design methods that help structure a multitude of different sources of inspiration and fieldwork, and synthesize it into concrete requirements and concepts for mobile services. In previous work we have used a variety of such methods, such as *ethnography* as a basis for design, *Laban-notation* to analyse body behaviours, *paper prototyping* for quick sketching of mobile service interaction, *cultural probes* to understand emotional processes in people's everyday lives, *bodystorming* for situating ideas in the real world, and the *experience clip* method for user self-evaluation to evaluate mobile services in their realistic setting. We have also developed our own methods, such as e.g. *user-driven innovation*, that is studying extreme or specialised user groups and then innovating services for other user groups based on those experiences or the *sensual evaluation instrument* that makes use of tangible objects to allow end-users to express their emotional experiences of a system while interacting with it. In the Centre we will need both to extend existing methods and develop entirely novel methods that are particularly suited to the Centre's goals.

Once a service is designed, it will be evaluated along various dimensions. Concept demonstrators can be tested with users before the service exists through methods such as Wizard of Oz or paper-based methods. Once the system is implemented, laboratory studies can help inform design and technological solutions, while more realistic testing in existing communities can provide input on the up-take of technology as well as the high-level research questions. Some services will also be designed to test a particular design hypothesis rather than to be just good services; these might be better tested in lab studies rather than in real usage. An important part of the entire process is finding the criteria by which these mobile services should be evaluated. To understand e.g. what users react to emotionally in a position based game, requires methods that are vastly different from those used to evaluate whether one word processor is more efficient than another.

As discussed above, methods to support the design process of mobile services all the way from gathering information about the current practice, via brainstorming, early evaluation of ideas, to final evaluation of systems, need to be different from design methods for traditional office environments or stationary work practices. The research team has substantial practical experiences of designing and evaluating mobile services from a user-centred perspective. For example, we have addressed issue of how to meet the challenge of *baby interfaces* – small screen, small buttons; *context of use* – not in the office, noisy environments, out in the “wild”; and *realistic usage situations* – laboratory testing becomes meaningless, small bursts of usage throughout the day require new methods.

In order to transfer these methods from the research laboratories into industrial practice, additional requirements arise: methods need to be cost-efficient, ethically defensible, easy to pick up and make use of, etc. Researchers often work with ethnographic methods to elicit a better understanding of users, their practices, and how they interact with the world, each other, and

the tools that surround them. But a proper ethnographic study takes too long time to be a feasible industrial production method. Similarly, research prototypes are often based on unreliable and untested technology, with high cost and limited infrastructure support. Industry, on the other hand, needs to be able to turn a prototype into a product within the very short time it takes to go from concept to commercial launch. Therefore, an important challenge for the Centre will be to develop new methods and adapt existing ones so that they meet the needs both of the dedicated researchers in the Centre and its partners.

### **3.5 Use context: mobile life and its social properties**

A mobile service is often a portable window to some remote content, for instance e-mail or web pages. Other mobile applications are still based on data that is primarily stored and/or created on the mobile device, such as MP3 players and digital cameras. As networking becomes an integral part of mobile devices, we will see many more services that are based on always-on connectivity, where locally stored content and on-line activities mix.

This is just the start. The next step in this evolution is what we can call *truly mobile* services – services that exploit intrinsic properties of mobility, for instance access variability, ad-hoc meetings with other devices, context awareness, access to information dependent on geographical location, and positioning relative to other users or resources. An important part of the centre’s research will be aimed at exploring the new opportunities that arise from this.

Mobile services map to a complex and rich everyday mobile life, as it occurs “in the wild”. It is embedded in the web of buildings, roads, people, nature, which is intertwined with invisible wireless infrastructures and social practices. Mobile life occurs when people move between places where activities occur, such as the consultant who travels from one customer site to another or when student changes classrooms for each subject on the agenda. In addition, as travels and movement increases, mobile life tends to occur during journeys. These services thrive on these passing opportunities for interaction between users and the relationships between users and the changing environment they pass through.

On a general level, these everyday situations share some properties. First, when people move about they have to attend to several things at the same time. For example, when people engage in face-to-face interaction in public settings they are also engaged in looking at where they are walking or driving. They read books or journals, do window shopping, or arrange their clothes in conjunction with other activities such as talking on the mobile phone or interacting with a salesperson. On a very general level, the changing settings increase the need for mobile people to *divide their attention* between various activities.

Second, in mobile life, we constantly *shift social roles* as we move between one place and another. At breakfast in the home, we adopt family roles and responsibilities. At the office we adopt professional roles such as waiter, farmer, office worker or boss. At breaks, we may take on more relaxed and private social roles. Shopping makes us aware of our consumer rights and obligations. With friends we become entertainers, gossipers, and therapists. Travelling may turn us into tourists, sports into players and team-mates, and so on. With colleagues we enter roles such as junior or senior; trusted or distrusted and co-located or far off. Every role means shifting responsibilities and allegiances vis-à-vis other people, and thus fundamentally affects how people behave and set priorities. Movement between different places make the shifts between roles more complex.

Third, the way we use our lived *space* to organise life also becomes visible in a more detailed level. We put things on the shelf near the exit door to remember to take them to another place. We pile papers in specific orders and place them at specific places on the desk to coordinate our work. We post messages at a selected location and direction to add to its meaning. In mobile life, the places where people are engaged are wider, and the use of location is different.

Fourth, when people increase their travel and movements they are more likely to *meet* each other. Meetings in mobile life range from sustained encounters with familiar persons to abundant but brief interaction with non-acquaintances. We can expect such meetings to take place in a variety of environments such workplace corridors, public spaces, or on the road. Establishing and managing such meetings requires various negotiations – who is allowed into the meeting and why, what information am I willing to share and with whom, are outsiders allowed to interrupt the meeting, etc.

Fifth, the *temporal* structure of social life becomes more and more important since a mobile person has to divide their attention to several activities; they attend to several roles and often engage in brief meetings. Thus, a mobile person pays attention to the timing of the activities as they occur.

We aim to study mobile life as it unfolds in the real world and build service that harmonize with and build upon properties as those outlined above.

### **3.6 Systems: a mobile service eco-system**

The Center will do justice to the users' role as customers of mobile services. We will study, and also do experimental research, on the organisational and economical landscape in which the service is placed. In our vision, there will be an abundant market for mobile services of various kind to please different customers and different interests, which differ from the current situation where the value webs are dominated by large operators collaborating closely with equally large technology companies. From the user and consumer perspective, it is imperative that mobile services can be shared irrespective of mobile device, operator or country the users happen to be in. Furthermore, the industry must support rich and dynamic generation of services, even including the users themselves as service providers. We will specifically address the role of the future network operator and the necessary models to sustain and thrive on useful and meaningful services.

Our ambition is to approach the future mobile service market in the same innovative and experimental way as we approach the individual domains: by experiments with alternate market spaces for mobile services and ubiquitous technology. The key goal is to understand how a mobile service *eco-system* can be made to work. The term *eco-system* is used because it puts the service in both users' contexts and in business systems. This alternative mobile service *eco-system* will be explored through several activities – one will be a working environment in which both Centre partners and others (e.g. SMEs) can enter their mobile services to be tested with these alternative business- and operator models.

It is critical for the industry to adapt to the new situation, but there are strong vested interests in the current system. A Centre, as presented in the proposal, can make a difference. Our experimental approach will provide tangible examples which can engender further forms of collaborations and realisations of *eco systems* as compared to more analytical approaches. Furthermore, the Centre involve, from the starting point, critical partners from the mobile service value web. Generation of new experimental *eco systems* can therefore be seen as a first realistic step towards realisation of abundant market places. The Centre's research in this area will be specifically inclusive and open to new partners to reach the goals, and the strong focus on consumer and users interest, is a favourable environment to generate interesting concepts.

The proposed testbed for mobile service *eco system* will focus more on organisational and methodological issues than technology. Thus, we will not provide a testbed that solves the problem by suggesting a different technical platform. In appendix 6, a concrete project for the first two years is detailed.

Below, we list a number of issues which have to be addressed through our experimental approach to marketplace research:

**Alternative payment models.** For innovative services, the prevailing models for payment are often inappropriate. There are also direct usability problems with many models for payment. For example, it is very difficult for the user of a service to know its requirements on access quality, or to estimate the price that a certain quality level is worth. However, he or she is perfectly able to judge the quality of a service and negotiate an adequate price for it. An experimental market place should allow us to experiment with a large range of payment models, including such where users pay only for services and the access costs are paid by service providers. Other examples of novel models including payment in kind e.g. when users provide storage space or infrastructure for a service and get free access to the service in return.

**Novel service infrastructures.** The rapid development of service access technology and peer-to-peer technology has not been adequately reflected in device technology or market structure yet. This creates usability problems in particular with mobile phones, where service access requires complicated download and install procedures. To enable realistic experimentation with ubiquitous access to services through mobile technology, we need to make use of novel service infrastructure technology and experiment with many different models for payment on top of these.

**Rapid service creation.** Development and deployment of mobile services is very time consuming. In the future, this time has to be decreased. Ultimately, users should be able themselves to develop and deploy some sort of services. Rapid service creation is an essential part of the future eco-system. The experiences of using the design methods suggested, from pre-studies to evaluation, will be used as input to develop strategies for rapid service creation.

**Novel and ethically acceptable approaches to digital rights.** The rapid development of digital media has had a profound impact on the usage and distribution models for media resources such as film, music, and games. This has led to a legal and ethical conflict between the media industry (and its 'pay-per-use' model) and the 'file-sharing community' which advocates that media resources should be freely available. None of these extremes will in the long run provide for a sustainable service eco-system.

**Disconnecting services from technology.** The development of IP telephony is a very clear example of how services that previously were tied to particular technology infrastructures are becoming available in entirely new service and payment models that are not connected to a particular technology. Experiences show that people very quickly adapt to these when they provide an economically attractive alternative, even when the usability is questionable or the service quality inferior.

**Trust, credibility and security.** Unless users trust a particular service, the overall infrastructure or the payment model, they will not perform sensitive operations, such as buying and paying for goods. Some even advocate solutions where operators provide special networks to companies or groups of users where safety and service provisioning is ensured.

### **3.7 Domains in focus**

A major part of the Centre's research activities will consist of the innovation, design, development, deployment and evaluation of mobile services and ubiquitous computing applications. We have chosen four initial domains where we will carry out specific projects in the Centre's first two years (see Appendix 6). These domains were chosen because they are areas in which we already have strong competence in the Centre from previous projects. We also know they have significant commercial potential and societal relevance, and are valuable components of the future mobile life the Center will explore. As the Centre matures we will expand the research to encompass more domains in collaboration with our partners. This could encompass for instance public services, education, support for the mobile worker, and so on.

### 3.7.1 Humans in Motion

Travelling is key to mobile life. People commute to work and schools, and take longer journeys for vacations and holidays. Very different means are used to enable motions such as cars, boats, planes or trains. Common to most people is that we spend considerable time during travelling. Thus, in mobile life we cannot just consider when we are at work or at home. We have to take serious the life we live in between these ordinary sites. Mobile life spent during motion comes with a specific experience as people look out on the passing landscape. They look at the natural and cultural sceneries as well as other mobile people. It has been described as *sequential experience*, which resemble a dramatic play of space and motion. But people also spend time travelling with various activities such as reading literature and eating. Lately mobile technologies have become an alternative engagement in this situation. On the one hand people use applications which do not relate to the context such as electronic books, DVD players and mobile phones. They look at films and play mobile phone games on the commuter train. Or they talk to their relatives as the drive their car home from work. On the other hand there is a growing market for context dependent services such as navigation and security services where the application is dependent on knowing e.g. where you are.

Our goal in this project is to study and develop applications which all use the sequential experience as joint focal point. Thus, in this project we will study the next generation of applications for humans in motions, which can vary from games to mobile media, but combines the sequential experience of mobility with new technology. Examples from our previous work includes *Backseat gaming* and *Hocman*.

### 3.7.2 Mobile Media

Personal portable media has been with us at least since the Sony Walkman was introduced in 1979. But even before this, people would bring transistor radios and portable record players to enjoy music with friends – the difference with the Walkman was that the headphones made music listening a private experience. Similarly, people have informally shared photos for many decades, and the Polaroid camera has allowed instant sharing of newly taken photos since 1948. But the introduction of digital media like MP3 players and digital cameras coupled with wireless networking, increased computation power, and ever higher storage capacities promises to transform personal media drastically in the coming decade. In particular, we believe that the act of media creation and sharing will become even more fluid and instantaneous, and that emerging communication and computation has the potential to augment and even transform traditional media forms as different forms of media like music, voice, chat, e-mail, web, photo and video converge to a single device. Potential areas to explore include generalized forms for sharing and commenting media, for instance a “mobile media blog”, and innovative ways to use context for influencing the act of creating and distributing media. For the first phase, however, we plan to concentrate on two of the currently most popular forms of personal mobile media: photography and music.

Camera capabilities have become a de-facto standard in new mobile phones, which has led to new ways of using photos. Photo taking and sharing has become much more immediate, and studies show that digital photos are used not only to reflect on an event after it has happened, but also often has a role as an integral part of the event as it is happening. Yet the user experience of a digital camera (standalone or in a phone) is still more or less the same way as the analogue counterpart. We plan to find completely new ways of taking pictures and sharing them with others, which break with the outdated norms of classic photography. This includes developing camera technologies for new types of photography, including context-aware cameras that use GPS and other location sensing. It also means creating new services for sharing content in new ways and new situations. We have already explored this work with prototypes

such as the *Context Camera*, an application running on a standard camera phone that uses environmental factors like sound and movement to transform a picture as it is taken.

Music is another area that concerns many people. Interest in music spans practically all groups in society such as age, occupation, social standing and education. From a commercial perspective, mobile music is one of the strongest areas for mobile services. The mobile ringtones market is already valued at \$3 billion and according to some projections it will comprise 18% of all music sales in 2008. MP3-players are a big market segment for consumer electronics and many phones also come with the capability of playing back music files. We will develop services for mobile music consumption and mobile music creation. This can have the potential to unleash new forms creativity, to create new forms of music-based sharing and communication, and to create new markets and business models for artists and distributors. Examples from our previous work includes *Sonic City*, a wearable context-aware music generator, and *Push!Music*, a novel system for sharing music in mobile networks.

Projects in this domain will study existing practices, such as ringtone downloads and digital photo sharing. We will experiment with applying technologies such as ad-hoc networking, intelligent agents and context awareness to mobile media. We will explore business models that are viable both for media producers and consumers.

### **3.7.3 Pervasive gaming**

There is a specific attraction in games where the experience is directly connected to mobility, to the places we visit and the people we meet. This is the challenge of Pervasive Gaming, a novel game genre that has been made possible through the development of modern mobile and ubiquitous technology. In *Mobile Life*, our goal is to fully understand this experience, to work towards a design ideal for pervasive games through the experimental development and testing of multiple pervasive games.

It is possible to identify a set of salient features of pervasive games that make them very different from most other forms of gaming. The normative mode for gameplay is that it goes on within certain spaces and certain times, by certain players. Pervasive games challenge such boundary concepts of games.

First, a pervasive game will typically be played in spaces that are not commonly perceived as game spaces. These game spaces can be both physical and virtual. For example, a game using fake web sites (posing as real sites) as its main resource becomes pervasive as the player moves between real and fake sites, considering both part of the game play experience. Secondly, pervasive games can be played through objects and interactions that are not clearly distinguishable from non-game objects and interactions. For example, a pervasive game can use your ordinary equipment and interfaces, sending messages by SMS or fax or even the physical mailbox. A game can also be based on your ordinary day-to-day activities but reinterpret them as game activities. An example of the latter would be a game for physical exercise where you earn points from keeping your heart rate up (or down) for certain periods. Thirdly, pervasive games typically extend over time and require that you interleave and overlay gaming activities with non-gaming activities. Designing such a play mode becomes a challenge for more advanced games such as social role-playing games.

The perhaps most controversial aspect of pervasive games is that they obfuscate the boundary of who is a player and who is not. In the unexpected places and times where pervasive games are played, by-standing people make a difference regarding the gameplay. The issue of by-standers is more complex than just a question of spectatorship: by-standers must be designed into the game and given roles that are acceptable both to them and to players – whether this means that they must be avoided or ignored, or if they somehow can be temporally let into the game and given some influence over its development.

Projects in this domain will study how the different forms of ambiguity arise and interact, mapping out when they are desirable and when they should be avoided. The research will take several aspects into account including design opportunities, modes of interaction, business factors, and ethics. We will focus on specific subgenres of pervasive games where the pervasive aspects are particularly salient or pose specific challenges, and study in particular the bystander role. Our primary vehicle will be small-scale design experiments, enabling quick and focussed evaluation of a particular design option. Some of these will also be suitable for further study within the service ecology theme. To enable larger scale studies, we will collaborate with industry in the study of commercial installations (or near-commercial test runs) of pervasive games. As it is imperative that games are designed by experts, the research group will include game designers as researchers as well as collaborate broadly with experienced designers within industry.

### 3.7.4 Social mobile services

With the widespread networking of computers and other devices, the number of social applications immediately grew. Nowadays, most users deal with a range of applications to communicate such as email, instant messaging, IP-telephony combined with net-based computer games and mobile SMS, MMS. There is still plenty of room for more innovations in this area when we move into the mobile service arena. Our previous work range from position-based post-it-notes (such as *GeoNotes* and *MobiTip*), or informal and distributed voice message to convey traffic information (*Road talk*), to exchange of music based on social meetings (*Sound pryer*).

The goal of this project is to look for everyday experiences where the presence of others, their choices and their activities are crucial to the sense-making, and then generate social mobile services which enhance that interaction. This includes investigating various *forms of social interaction*, as well as different *interaction modalities*.

Social and collaborative interaction in vast areas provide for a specific form of interaction. For example, mobile services for audiences and organizers of field sports events, such as car rallying, downhill skiing, canoeing, horseracing, or running competitions is an interesting example in this area. Such events are interesting because people are eager to use new mobile technologies to interact, at the same time as they struggle with the highly mobile setting but enjoy its social character. New services can for example bridge between the local experience, where a group of people who visit a field event get to see a minimal but rich part of the event, and the global view of the event, which is occasionally provided to mass media spectators e.g. on TV. Our previous work in this area range from Ericsson's participation in the "Wireless Festival" as part of a Eureka funded project and the generation of the service *MySplittime*. But the approach could be broadened to include more abundant events organized by amateurs.

Current computer and mobile support for social interaction is constrained by the display and keyboard. Thus, social cues are mainly conveyed through text. Recent developments in the mobile interaction area show that there is plenty of room for innovation of new kinds of interaction modalities and especially in the area of affective interaction.

Social interaction in mobile situations bring with them specific emotional states. It follows that mobile services can benefit on it to support *affective interaction*. An emotion is a felt and experienced inner life, which through the cultural lens and in dialogue with others and our environment is modified and processed over and over. We are interested in investigating how to transform such sensations through digital interactions, with the best media and with the best interaction design paradigm and with the most suitable wearable sensor technology. We envision working with three kinds of mobile applications where emotional interaction is key.

First, situations where there is a need to *externalise* your emotional experiences in order to process and deal with them, or in a positive way, save important moments to remember the

good things in your life (see the *Affective diary* project in Appendix 6). There is a bodily side to this: the experienced, felt life, as it get stuck in our bodies, is what we are trying to deal with, modify, reflect upon, change, or remember in a positive sense. While the events we reflect upon are probably most of the time social events, the interaction with the diary itself may not be a social situation and only bodily in a very restricted sense. One of the reasons why we keep diaries is to shred, get rid of, after brooding, some of our emotional experiences. A digital artefact, as the one proposed in the affective diary project, can be a reflective device that aids this process. This design approach may also have important health applications, to relief stress and make people more aware of the relationship between emotional state and physical well-being.

Second, a set of affective mobile services are those where we seek *experiences* in order to initiate emotional processes – as for example with the pervasive gaming experiences, see above. People like to use games, see movies, hear music, etc. to change their emotional state – to become involved in an experience. Designing “for” experiences is tricky and needs careful design as experiences are constructed by people, in their minds, when interacting with the systems we build.

Third, when we are separated from close friends and beloved ones and we need to *communicate emotions* through some artefact. This kind of communication will be strongly dependent on the particular relationship in place between the people involved and by their subjective wishes and expectations. The aim is to allow for greater emotional expressivity.

## 4 Organisation and budget

### 4.1 Organization

The Centre will be located at Stockholm University, within the Social Sciences Faculty and physically located at the Kista campus. Main grant holder will be Stockholm University. All four groups will move to and be co-located in Kista.

**Centre Director.** The director is appointed by the board of directors. Initially, the director of the Centre will be Professor Kristina Höök at Stockholm University.

**Board of Directors.** The board of directors is appointed by Stockholm University and consists of nine persons including the chairman. The Centre director is adjourned to the board and participates in its meetings. The chairman and four of the other board members must come from industry. Furthermore, it is desirable that both SU and KTH as well as the institutes are represented in the board. The Board of Directors decide on the Centre’s research plan, yearly budget, collaboration agreements and potential industry members

**Industrial Reference Board.** All industry members are represented in the industrial reference board. Its primary role is to collaborate with the Centre researchers in the formation and renegotiation of the research programme. The industrial reference board is also involved in the recruitment of interns; planning of industrial dissemination and take-up activities. It is desirable that the industrial reference board consists of people from the industry that actively participate in the Centre’s project activities.

**Research Management Group.** The research management group consists of the senior researchers that act as group leaders within the Centre. It is responsible for the day-to-day operations of the Centre and for collaborating with the industrial reference board. The group is also responsible for the recruitment of Centre employees and supervision of Ph.D. students. To enable the latter, all members of the research management group are employed as adjourned professors at Stockholm University or Royal Institute of Technology.

**Industrial Member Partners.** The industrial members’ initial commitment covers the first two years of the Centre lifetime. Large companies can become members in the Centre under

the conditions that they commit to project participation during the first two years. It is expected that the major part of the commitment is in terms of money and own work within Centre projects, but it also include costs for internships (see below) and equipment or services donated to the Centre (see tables in section 4.2). Small and medium-sized companies (SMEs) are invited to participate in the Centre activities on a project-per-project basis, and will provide in-kind contribution consisting of their own resources.

## 4.2 Budget for the first two years

The cost budget is divided into costs incurred by the core partner, Stockholm University, and costs incurred by other partners. Industry partners are expected to bear their own costs and will not receive any funding from the Centre.

**Table 1 Cost budget for Centre activities, year one and two.**

<b>Expenses, in KSEK</b>	<b>2007</b>	<b>2008</b>
Director	1 000	1 200
Senior researchers	1 260	2 600
Ph.D. Students	1 200	2 500
Travel	400	660
Equipment	480	600
Material	200	200
Overhead (35%)	1 580	2 760
<i>Other partners</i>		
Industry in kind contribution	2 680	3 580
<b>Total</b>	<b>8 800</b>	<b>14 100</b>

The income budget is divided into contributions from the university and contributions from industry. Stockholm University will add new funding to the centre (1.5 MSEK per year), the rest is provided through the participation of Kristina Höök and her PhD-students (financed on faculty funding). The university will receive some reimbursement from SICS for its participation in the Centre. Industry contributions are partly in direct Centre financing and partly in kind.

**Table 2 Income budget for Centre activities, year one and two.**

<b>Contributions</b>	<b>2007</b>	<b>2008</b>
Stockholm University	2 500	4 500
Industrial collaboration	3 800	5 100
<i>Of which in kind</i>	<i>2 680</i>	<i>3 580</i>
Vinnova	2 500	4 500
<b>Total</b>	<b>8 800</b>	<b>14 100</b>

In kind contributions are expected to be partly through own work in the Centre and partly through supplying equipment and services towards the Centre. An estimated breakdown of the in kind contributions from industry partners is supplied in Table 3 and Table 4 representing year 1 and year 2 respectively.

**Table 3 Estimated industrial contribution year 1**

<b>Company/Contribution</b>	<b>Cash contribution</b>	<b>Internships</b>	<b>Own personnel</b>	<b>Services, infrastructure and technology</b>	<b>Courses, workshops</b>	<b>Total</b>
Ericsson Research AB	200	200	100	100		600
TeliaSonera AB	200	200	100	100		600
Microsoft Research Ltd	720		80			800
Sony Ericsson AB		200	200	200		600
STING					100	100
Kista Science City				400		400
City of Stockholm Municipality			500			500
FOI				200		200
<b>Total</b>	<b>1 120</b>	<b>600</b>	<b>980</b>	<b>1 000</b>	<b>100</b>	<b>3 800</b>

**Table 4 Estimated industrial contributions year 2**

<b>Company/Contribution</b>	<b>Cash contribution</b>	<b>Internships</b>	<b>Own personnel</b>	<b>Services, infrastructure and technology</b>	<b>Courses, workshops</b>	<b>Total</b>
Ericsson Research AB	400	200	400	200		1 200
TeliaSonera AB	400	200	400	200		1 200
Microsoft Research Ltd	720		80	100		900
Sony Ericsson AB		200	200	200		600
STING					100	100
Kista Science City				400		400
City of Stockholm Municipality				500		500
FOI				200		200
<b>Total</b>	<b>1 520</b>	<b>600</b>	<b>1 080</b>	<b>1 900</b>	<b>100</b>	<b>5 100</b>

The budget above includes only such cost and contributions that are directly associated with the Centre. At the time of the Centre formation, the involved partners will already be running a set of separate projects within the area of the Centre (see section 6 below). If we count those, the total size of the centre in year 2007 would be 12.6 MSEK plus 2.7 MSEK in kind contribution. This will then raise to 14.5 MSEK plus 3.6 MSEK in kind contribution in 2008.

### **4.3 Leadership and entrepreneurship**

The Centre will practice a leadership philosophy that stresses collaborative projects of the highest academic quality, while ensuring the production of demonstrable results, which are moved out to industry. Typically, we will first take on students in masters' projects, which are carried out in collaboration with industry, and based on the results of these projects select the best students to hire as researchers in the Centre. We will strive to let young researchers develop into independent researchers and eventually become competent research leaders in the own right. This is done by from the outset giving them a high degree of freedom to work within their assigned project and independently solve problems as they arise. Supervision of new masters' students is a good way to let young researchers develop their own leadership

abilities. Another is working directly with the Centre's partners, through internships and by working in collaborative projects based on industry needs. In time, researchers will be given their own project budget and the freedom to initiate their own research projects. They will also be expected to find independent funding through external sources, such as Vinnova and the European Union. Eventually the best researchers in the Centre will have created their own personal platform and can continue as full-fledged research leaders, either in the Centre (e.g. as founders of new research groups), at other academic institutions, or industry, often at the institute's partner companies where they will have built up strong contact networks.

We will also encourage researchers to become entrepreneurs. The working style for researchers in the Centre, where independent project work is coupled with a strong commitment to delivering tangible results, will be a perfect breeding ground for future entrepreneurs. The close exchange with industry through internships and collaborative projects will ensure that they have a strong insight into the current marketplace. If ideas with commercial potential appear in the Centre, the researchers will have the necessary experience to form a spin-off company or otherwise work to commercialize the results, e.g. in collaboration with Centre partners. We will also collaborate with established channels for developing entrepreneur skills, including the Venture Cup competition, entrepreneurship programs at various universities, and company associations such as STING.

## 4.4 Dissemination

An important part of the Centre's philosophy will be to have a high visibility for the Swedish industry and society as well as in the national and international research community. We will work consciously to establish and promote the identity of the Centre, treating it almost like a "brand". This "branding" and strong collective identity will be very beneficial both for the individual researchers, for the public perception of the Centre's work, and for companies who can benefit from the Centre's research. We will put a strong emphasis on using the web page as the Centre's "face" outwards, and it is important to provide easy availability of publications, videos, etc. When a company or other researchers see some work they are interested in, they can visit the Centre's web site and find other projects in similar areas. We will also work with traditional channels, such as TV, radio, newspapers and other media, to make sure that the Centre is visible and has a common identity. Academic channels such as conferences and journals as well as demonstrations for industry continue to be very important for dissemination. This work will be a direct continuation of how the activities of the Mobile Services and iPerg projects, both of which have established a high visibility in media and strong external identities.

Major forms of dissemination include:

**Presentations at academic conferences and publications in scientific journals** It is vital to have a lively interaction with the scientific community. Based on the production rate of the Mobile Life project, we can assume that during the first five years the Mobile Life Centre will produce around 45 full papers and an additional 75 short papers, posters and demos.

**Participation at industrial conferences and fairs** Work from the Centre will be presented at industrial fairs and conferences to increase the visibility of the commercial possibilities in this area. Venues such as the SITI Conference, Tekniska Mässan and Mobilgalan are all important for meeting the industry.

**Demonstration at Kista mobile showcase** The collaboration with Kista mobile showcase will provide excellent possibilities to continuously demonstrate the research to the general public. This will also ensure a direct interaction with the innovation system and local industry.

**Media** Popular media is an excellent way to communicate with both industry and the general public. Based on the experience from the Mobile Life programme we can expect to get in total

over 75 media impressions including television and radio appearances, newspaper, magazine articles, etc. in the first five years, which will make sure that the Centre and its results are well known from the start.

**Organization of conferences and workshops** The Centre will organise several international research conferences and workshops where participants from academia and industry can meet to discuss and disseminate research results.

**Website, brochures and other presentation materials** The Centre will provide a vivid web site, professionally designed brochures, and other materials where the research is presented in a popular format.

## 4.5 Gender aspects

In the following we will comment on two aspects of the gender dimension in the proposed competence Centre. First, gender could be measured in quantitative terms.<sup>4</sup> In appendix 3, we present the participating researchers. It is expected that approximately 50% of the personnel will be female, and the Centre will thus be gender equal in this dimension. It is also important to discuss the gender balance in management since these levels of hierarchy strongly influence decisions on research topics and career possibilities of participants in the Centre. In our proposal, the research management group will consist of two women and two men. Thus, management will not likely be gender neutral. Since these figures very well falls into the span of 60/40, we will not propose any specific programs to change the gender balance.

Secondly, the gender dimension is also of relevance for the topic of research, in this case development of mobile services. For example, the issue of a gender divide has been discussed by researchers within the Centre with reference to gaming and to personal integrity. Furthermore, gender is a relevant concern in this area where there is a clear male dominance among early adopters of mobile services and mobile technology. A design approach that unreflectively focuses on users with strong positive expectations on new applications runs the risk of becoming less valuable for other user groups. Here the user-centric approach is an important resource, which will provide us with methods to make all forms of mobile life inform the design of new services. For example, ethnographic studies of women-dominated areas in computer games could sensitise research to make their needs influence new and more interesting applications.

We will also apply other mechanisms to ensure that marginal voices inform design. In studies, experiments, demonstrations, and field trials, care will be taken to focus both on women and men. Some applications will be developed to target women or girls in particular, for example by using a female focus group in participatory design activities. Some mobile services developed within the project, in particular games, will be evaluated for gender bias by external experts or project researchers with expertise in the subject.

## 5 Partners and forms for collaboration

### 5.1 Partners

The Centre will be located at Stockholm University. The partners can be grouped into research organisations: SU, SICS and KTH, industrial partners, Sony Ericsson AB, Ericsson AB, Microsoft Research Ltd, TeliaSonera AB and a range of SMEs, organisations representing the

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<sup>4</sup> Genusperspektiv på innovationssystem, Daniel Hallencreutz, Per Lundequist & Katarina Beskrivning: Serienummer: VR 2003:12 Publikationer/VINNOVA Rapport/VR - 2003/

public sector, Stockholm City, Kista Science City AB and FOI, and finally, organisations that support the innovation system, STING AB.

## Research organisations

**Stockholm University.** Mobile Life will be organized as a unit under the Department of Computer and Systems Sciences (DSV) in Kista. If the centre proves successful, the university will examine the possibilities of transforming it into an independent unit under the Faculty of Social Sciences. The Centre will be physically located in the Kista campus. Through Stockholm University, the research in the Centre will be well connected with future undergraduate and graduate educations. Students employed the Centre will be enrolled in the masters and doctorate programs within the university, primarily in the Computer- and Systems department. Senior researchers will be actively involved in the formation of such programs, primarily in this department but also in other departments within Stockholm University and the Royal Institute of Technology (KTH).

**SICS AB.** Although three research institutes are involved in the project proposal (SICS, Interactive Institute, and the Viktoria Institute) only one will be part in the Centre once it is formed. The reason for this is the current reorganisation within the Swedish IT research institutes. On December 31st, the three institutes will be reorganised to form *SICS Group*, where SICS will own 100% of Interactive Institute and 91% of Viktoria Institute. The role of SICS in Mobile Life Centre will be that of a co-executor of research together with Stockholm University and some of the research will be contracted to SICS. SICS has its main office in Kista.

**KTH.** Royal Institute of Technology (KTH) has one of its Schools located in Kista, School of Information and Communication Technologies. Wireless@KTH is one of the important centres in the area that Mobile Life will work in close collaboration with. Some researchers, both senior staff and PhD-students, will be involved in the centre.

## Industry partners

The group of industry partners for the Centre is expected to grow during the Centre life time, reflecting that the industry for mobile services will grow and to some extent mature during this period. Here, we describe the set of partners that are involved from start.

**Ericsson AB.** Ericsson is a world-leading provider of telecommunications equipment and related services, to mobile and fixed network operators globally. Ericsson Research will provide the Centre with concrete technology as well as deep knowledge in the opportunities and limitations of future telecommunications systems and their interaction with other technology such as WLAN and peer-to-peer networking.

**TeliaSonera AB.** TeliaSonera is the leading telecommunications company in the Nordic and Baltic region. TeliaSonera bring to the Centre its vast experience of service provisioning, both from a cultural and business technology but also on multiple platforms including both fixed and mobile telephony, hot spot wireless communication, portals and communities.

**Sony Ericsson AB.** Sony Ericsson Mobile Communications is a global provider of mobile multimedia devices, including feature-rich phones and accessories, PC cards and M2M solutions. Sony Ericsson brings to the Centre both the technical, practical, and business requirements associated to the development of novel and innovative mobile devices.

**Microsoft Research Ltd.** Microsoft Research Ltd has identified three key domains in which support from Microsoft will enable university researchers to achieve the greatest progress: the emerging computing environment, transformation of science through computing, and advancing computer science curriculum. Through its focus on social and mobile services, the Mobile Life Centre targets the first of these areas. The researchers of the Centre have a well-established collaboration with Microsoft Research Ltd in Cambridge, furthering in particular the deep understanding of information technology use in everyday life activities.

**SME.** SME partners will participate in the Centre on a project-by-project basis. The Centre has direct contacts with a large set of small and medium-sized companies and will take some of them on board for specific project collaborations. Examples include:

**Hasselblad AB:** Åke Wassén, [Ake.Wassen@hasselblad.se](mailto:Ake.Wassen@hasselblad.se)

**Remit AB:** Johan Mårdfelt, +46 8 410 146 11, [johan.mardfelt@supporter.nu](mailto:johan.mardfelt@supporter.nu)

**Second Degree:** Håkan Ozan, [hakan.ozan@second-degree.com](mailto:hakan.ozan@second-degree.com)

**Redburst Technologies AB:** Lukasz Andersson, +46735006938, [lukasz.andersson@redburst.com](mailto:lukasz.andersson@redburst.com)

**Gamefederation:** Thomas Lindgren, [thomas.lindgren@gamefederation.com](mailto:thomas.lindgren@gamefederation.com)

**Moberty:** Richard Granberg, +46 (708) 30 65 50, [richard.granberg@moberty.com](mailto:richard.granberg@moberty.com)

**DigitalAction:** Anna Caracolias, +46(0)735 100 009, [anna.caracolias@digitalaction.se](mailto:anna.caracolias@digitalaction.se)

In addition, the collaboration with Kista Science City and their network of participating SME, the Centre will maintain constant communication with a very large set of companies in the mobile service sector and we expect new project to emerge from these contacts.

### **Public sector representatives**

**City of Stockholm Municipality.** Within Sweden as a whole, the Stockholm region and Kista play a crucial role in the establishment of a consumer-oriented service industry. This role has been recognised by the City of Stockholm that has chosen to establish and participate in several initiatives focussed on this sector, including the Mobile City Initiative (MCI), the Kista Mobile Showcase, and now to participate in the Mobile Life Centre. The City of Stockholm plays a natural central role in the Mobile Life Centre, through providing multiple channels for local collaboration, dissemination, and take-up with both small and large companies.

The city of Stockholm contributes to the centre by being prepared to be test-users representing the public sector. Furthermore the City strives at coordinating and cooperating regarding the various mobile initiatives in the city. The value of the City contribution are materialized in the form of in recourses and access to focus groups and can be valued at 500 KSEK yearly.

**Kista Science City AB.** Kista Science City brings to the competence Centre its project ‘Kista Mobile Showcase’ as well as several contact networks for small- and medium sized service development companies in the Stockholm area. The Kista Mobile Showcase is a physical test- and demonstration platform for the concrete presentation and dissemination of results, where the industry partners have provided both hardware and software for demonstration purposes. Kista Science City will set up a framework which enables its showcase partners and network members to participate in the Mobile Life Centre activities, further strengthening the dissemination and take-up potential for the Centre.

**FOI.** FOI is an assignment-based authority under the Ministry of Defence. The core activities are research, method and technology development, as well as studies for the use of defence and security. FOI provides its customers with leading expertise in a large number of fields such as security-policy studies and analyses in defence and security, assessment of different types of threats, systems for control and management of crises, protection against and management of hazardous substances, IT-security and the potential of new sensors. The Centre will collaborate with the department “Command and Control Systems” who will provide their technological expertise and collaborate on some of the HCI-related issues.

### **Innovation system partner**

**STING.** Stockholm Innovation & Growth (STING), founded 2001, is a support ‘system’ for technology startups. The ambition is to generate more technology startups through a well-designed extensive support system. STING provides support for entrepreneurs at a very early stage continuing throughout the growth process. The aim of STING is to commercialize ideas

from the IT-university, research institutes and spin-offs from company employees. STING offers support for entrepreneurs in four sequential programs named Startup, Business Lab, Business Accelerator and Go Global. STING also offers pre-seed capital via Sting Capital, a new venture capital company for technology startups.

### **Other research collaborations in Kista**

The most important reason for placing a research centre on mobile services in Kista that this area is the Swedish hotspot for telecommunications research and development. In addition to the partners that are directly involved in the centre, as outlined above, there are many other interesting research groups and institutes. The presence of additional groups at SICS, the Interactive Institute, KTH and SU all support the research environment by performing research that is complementary to the Mobile Life Centre, and there are will be many new opportunities for collaboration as the centre becomes established.

However, at the moment Kista is weak on research that applies a user-centred design perspective. It is dominated by technology and/or vision-driven research. One example is *Wireless@KTH*, which like Mobile Life has applied to become a VinnExcellence centre. Although the two centres conduct research in entirely different research disciplines and for this reason must be seen as separate, we plan to collaborate in research areas where there are strong synergy effects. *Wireless@KTH* aims to produce some infrastructure in which access possibilities can be modelled. The Mobile Life Centre will not do any research on technical infrastructure, but aims to explore users' reactions to and acceptance of variations in access, user experience, payment models, etc. Through combining the two centres' efforts, we can explore mobile service eco-systems from a realistic basis. This means that the Mobile Life Center and *Wireless@KTH* will be complementary, rather than competing, centres.

## **5.2 Contribution to the innovation system**

Kista is one of the world's major IT-clusters. Multinational companies, world leading R&D and students at the IT-university are located in the area. Kista provides excellent opportunities for contacts between industry, local authorities and research organisations through the so-called "Vision for the Future for Kista" initiated in year 2000 (Kista Science City, <http://www.kista.com/>). Stockholm Municipality, KTH, SICS, and some of the large companies in the area work together to realise this vision, resulting in a number of activities initiated and organised by Kista Science City AB – one of the partners in this proposal. They early on identified three kinds of technology that Kista is world-leading in: *Mobile Services*, *Wireless Services* and *Broadband Systems*.

One of Kista Science City's first activities was to establish Kista Innovation & Growth, now expanded into Stockholm Innovation & Growth (STING), in 2001, a support 'system' for technology startups. STING provides support for entrepreneurs at a very early stage continuing throughout the growth process. Through making STING a partner in the Centre, we will provide for moving some of the research ideas out into working business ideas, creating start-up companies. The holding-company formed by Stockholm University, SU Holding, will be an important partner in helping researchers determine what should be brought to STING and how to deal with IPR-issues.

Another activity started by Kista Science City AB is a showroom for mobile services where small companies and researchers can show their products to visitors that come to Kista. The showroom provides some infrastructure, a lot of mobile devices of various kinds, and personnel that can guide visitors on an exciting tour where mobile services pop up while walking through the Kista Galleria shopping mall. Some research prototypes are also shown in the showroom, including *MobiTip* that was developed by Kristina Höök's research team. A number of SMEs belong to this showroom (currently more than 30 partners) and this network of

companies will be crucial route for the Centre to identify industrial needs, find collaboration partners for different projects, and to disseminate results.

The research institute SICS is also involved in the Centre and researchers there will perform certain parts of the work. SICS has a long-standing tradition for how to work with industry to ensure that the results become useful to industry.

In summary, together with Kista Science City, STING, SU Holding, SICS and the industrial partners of the Mobile Life Centre we will build an *innovation system* that will be able catch all kinds of research results produced by the Centre. Each year all results will be listed and discussed among the partners to ensure that every result finds a route either to commercialisation or to the general public.

### 5.3 Forms for industrial collaboration

The Centre will bridge between basic academic research and applied development in industry. The Centre will be in the research frontier, but also related to the international industrial technological frontier. Therefore, it needs clear mechanisms, beyond their influence in the Industrial Reference Board and the Board of Directors, for how to work together with both the traditional industry but also together with, and sometimes even initiating, new industry for mobile and ubiquitous services.

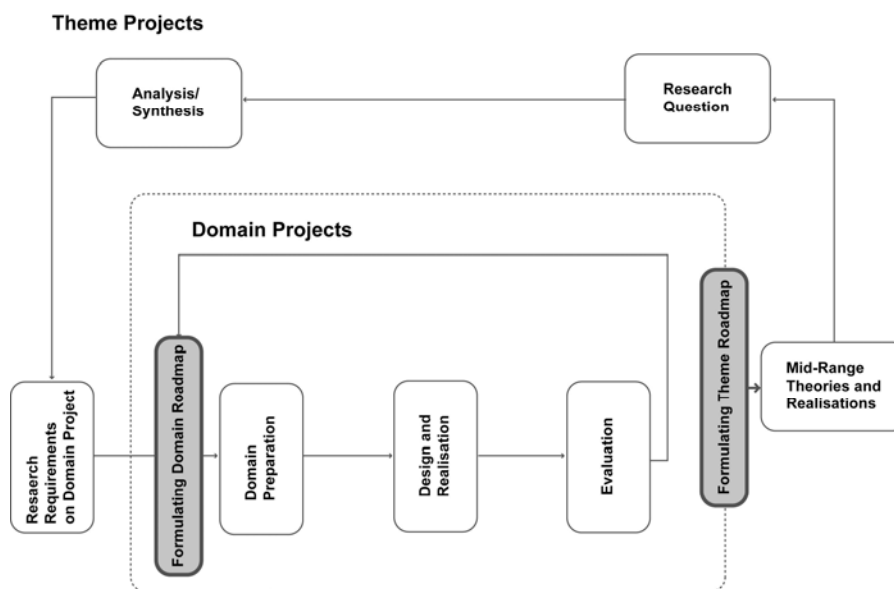


Figure 2 Roadmaps as part of the research process

**Collaborative research projects** Researchers and industrial partners will work together in collaborative research projects in various parts of the research process (see Figure 2). It will include collaborating in specific *domain* projects where industrial partners have a very specific interest and will contribute with competence and technologies. The researchers and the industrial will collaborate in generating new design concepts, implementing services, and conduct evaluations. Concrete collaboration also occurs in *theme* projects where all partners contribute with resources in kind e.g. to generate experimental mobile service eco systems. Here collaboration will ensure that the focus is correct and become realised leading to implementation and experimentation.

**Internships** To achieve a base level of the way partners ‘think’ within industry and academia, we will employ a system of *internships* for researchers in industry. All Ph.D. students employed within the Centre must do an internship (about 3 months) with one of the industrial members. When possible, the senior researchers within the Centre are also encouraged to do

internships. The internship will make the person understand the main problems that the company is attempting to solve both in the long and short perspective, the business model of the company, its products, priorities and company culture. Perhaps most importantly, the person will get to know people at the company. The positions will be selected to be relevant for their area of research but the work will typically not be research: interns will be placed in development, production or sales. Similarly, the Centre will offer ‘guest research’ positions for persons from industry. The Centre may also employ the more traditional model of industrial Ph.D. positions.

**Domain and theme road maps** The initiation of specific projects will follow a roadmap that all industrial partners have ratified. When an idea for collaboration presents itself, either by a researcher or an industrial partner, it is first explored by both parties without any contracts or official agreements for a time period of three to six months. Both parties work for “free” to explore the feasibility of the idea and discuss how collaboration should be set up. The only requirement is that a milestone is set up for when a decision is need to go forward or stop the project. At the time of that milestone, the collaboration will be regulated in a contract, specifying IPR, resources that will be spent from both parties, and project plan. The majority of such project collaborations will be based on more freely explored ‘wild’ research ideas that researchers in the Centre have been working on for some period of time. When such ideas and methods have been somewhat explored, understood, and are ripe for serious development, industry will be invited to help reshape them into viable product prototypes.

Collaborative research projects will be initiated following the same roadmap. These projects will typically concern a question originally formulated by industry, but where the Centre can provide further insights into state of the art in order to formulate a leading-edge research project targeting a core issue of the industrial partner. If an industrial partner at a milestone event decides to not get involved in a project that the researchers want to continue, it can take one of three paths. The project may be presented to the other industrial partners who can choose to join the project. A new industrial partner, not originally involved in the Centre, may be brought in. The researchers may decide to continue to work on the project without industrial involvement. This is to ensure that good research ideas are explored even in situations where there is not yet any targeted Swedish industry.

**Strategic road maps** Due to the ten year perspective of the Centre, it is important to ensure that the research activities are kept leading edge as well as industrially relevant over time. To ensure this, a strategic road map will be formulated in collaboration with industry. The individual research groups will be evaluated on a rotational basis as part of this process. This will be done after the first two years and then every third year.

**Free use of mobile service eco-system** In addition to being a research area of its own, we see the mobile services eco-system research as our main venue for the identification of service domains where the centre should increase its activities. We will invite our industrial partners to try out innovative services in any domains, enabling small-scale experiments also within domains which are currently not in focus for centre research. Based on such experiments, it will be possible to identify the viability and importance of a new domain, enabling an informed decision on whether it should be promoted to a focal domain for centre research.

We will also have open house events, joint workshops and an on-going seminar series.

## 6 Complementary research projects

The following are research projects with a direct relationship to the Mobile Life proposal.

### Funded by Microsoft Research:

#### Affective Diary (at SICS)

**Duration:** 2005-2006

**Budget:** 80 000 Euro

**Relation to the current proposal:** Strong connection. Deals with affective body memorabilia.

#### Backseat playground (at Interactive Institute)

**Duration:** 2005-2006

**Financing:** Microsoft Research Ltd

**Budget:** 80 000 Euro

**Relation to the current proposal:** Strong connection. Deals with mobile multimodal interaction as well as mobile games research

### Funded by the Foundation for Strategic Research (SSF):

#### INGVAR II, individual grant for the advancement of future research leaders (at Viktoria)

**Duration:** 2005-2008 (4 years)

**Budget:** 1.5 MSEK per year

**Relation to the current proposal:** Very strong connection. The theme of the INGVAR project is Ubiquitous Computing, which is a direct extension of mobile services.

#### INGVAR II (at SICS)

**Duration:** 2005-2009

**Budget:** 6 MSEK

**Relation to the current proposal:** Strong connection. Deals with affective interaction.

### Funded by the European Union:

#### HUMAINE (at DSV, KTH-part)

**Duration:** 2004-2007

**Budget:** 360 000 Euro

**Relation to the current proposal:** Strong connection. Deals with affective computing and affective interaction

#### ECAgents, Embodied Communicating Agents (at Viktoria Institute)

**Duration:** 2004-2007 (4 years)

**Budget:** ca. 1 MSEK per year

**Relation to the current proposal:** Strong connection. Develops intelligent systems for mobile services.

#### iPerG (at SICS)

**Duration:** 2004-2007

**Budget:** ~10 MEuro in total – about 2 MSEK to the interaction lab

**Relation to the current proposal:** Strong connection. Deals with pervasive games.

## 7 Stockholm University profile

Most of the research done in Kista at KTH, Wireless@KTH, SICS, Acreo, and other research institutions, is done from a technology and engineering perspective. Stockholm University's involvement in Kista is organised under the social science faculty, not by chance, but in recognition of the need for a social science perspective on the design- and engineering process and the resulting use of technology in the society. While the Mobile Life Centre will be an innovation-, design- and engineering-driven Centre, it will have a strong social science component. Sociologists and psychologists are part of the research team. Applied computer science, and in particular, human-machine interaction design is in its nature interdisciplinary and cannot be seen solely as an engineering or technology design problem, nor can we work in this area if we only do studies of people using technology: we need both. Thus, the only natural, interdisciplinary home, for a Centre that wants to create the next generation of designed interactive artefacts and systems must be in an environment with engineering, design and social sciences – which is what Stockholm University offers in Kista.

The Computer and System Sciences department (DSV), which belongs both to KTH and SU and is placed in Kista, has a long tradition of collaboration interdisciplinary with several other departments within the social sciences faculty. DSV was recently evaluated by the National Agency for Higher Education where it was clear that the department offers excellent undergraduate training. The department has been given the highest grade, and was judged to be the

only department to be a “first class undergraduate education department.” There is a good basis for recruitment of young researchers to the Mobile Life Centre.

The research at DSV has a long tradition of combining engineering, system development, with more critical analysis of technology and its use in society. For example, DSV’s research on information security issues takes both an engineering standpoint in producing good software solutions, but also a unique and in some ways more interesting grip on how security-awareness can be increased and catered for both by software developers and end-users. Similar duality in terms of critical and constructive design work has been done for CSCW and CSCL. In general, research at DSV will not only result in algorithms, technology and designs, but also in system engineering methods, processes for how to introduce novel technology into work and leisure contexts, and critical analyses of the consequences on individuals, organizations and society.

The newly created professor’s chair in Human-Machine Interaction given to Kristina Höök in 2003 is part of Stockholm University’s goal of strengthening the research in human-computer interaction. Through this Centre proposal, Stockholm University sees an opportunity to recruit several of the most prominent senior researchers in the area of creating technology in dialogue with societal values and social science research that together with Kristina Höök can form a centre with critical mass.

## 8 Expected results

We have shown how the Mobile Life Centre will concentrate the best of Swedish user-oriented research on mobile services and ubiquitous computing to one location, Kista. It is evident that *mobile services* represents the most strategically important research area for the IT and telecom industry, if it is to continue to be a generator of sustainable growth and be internationally competitive. But to be successful, it will not be enough to work in the short term and generate and test isolated services; there must be a strong theoretical and methodological foundation and a thorough understanding of the context of use. We also have to understand and test the future mobile services eco-system, where all kinds of services will co-exist, and it is important to work practically in specific, well-delimited domains such as mobile media or social communication. It is also vital to have a strong connection with the reality of the marketplace and be aware of the day-to-day concerns of the industry. The Centre will ensure this awareness through partnerships with major companies in the area, plus a host of SMEs. Collaborations with the public sector and representatives from the innovation system guarantees that the work in the centre addresses real-world concerns and is commercially viable. By locating this Centre in the Kista region, which has the highest concentration of high-tech industry and research in Sweden, we can make sure both that there are strong synergy effects with related efforts and that there is a direct connection to the latest developments in the area.

The major expected results from the Mobile Life Centre can be categorised as follows:

**Competence development** The centre will greatly strengthen the academic competence in the Kista area and Sweden as a whole. There will be many new Masters, Licentiates, Doctors, Associate Professors and Professors as a direct result of the Centre, all with cutting-edge competence in areas vital for Sweden’s competitiveness. Furthermore, through internships, collaborations, exchange programs and other activities, the Centre’s knowledge will be directly disseminated to its partners and to the innovation system as a whole.

**Practical design methods** A major goal of the Centre is to generate design knowledge that can be reused in many different projects. We will take into account issues like standardisations and market spread to make sure that methods created in the Centre are practically applicable outside the research environment. Design methods will be transferred directly to our

industrial partners, through Kista Science City and their network of companies in the area, and to the academic community.

**New mobile services** In each domain area we will generate, implement and test novel mobile services. In some cases, these services can be directly transferred to the industry as is, in others, they need to be developed further to become commercially viable. One way this can happen is through “shadow” projects that follow the research project closely and create commercial variants on the same theme. Such activities can be mediated by Stockholm Innovation and Growth to engage smaller companies in the research.

**New markets** The centre will explore emerging markets, such as pervasive games and affective services. Our experiments and exploration in new markets will allow companies to assess the need for supporting technology and platforms, and to make choices about whether or not to try and enter new areas of business. The centre can be seen as providing the first trials to mark out the territory, providing for a long-term payoff when completely new segments for mobile services are identified.

**Supporting technology and platforms** In order to realise the specific mobile services, the Centre will often need to build supporting technology and platforms. These research results will be in the shape of algorithms and software solutions that carry over between many different applications, devices and operating systems. Such technology can be transferred directly to our industrial partners, or form the basis of new spin-off companies.

**New business models, new operator roles, new infrastructure** The mobile services ecosystem will provide a testbed to explore new and emerging roles for the telecom operators and service providers, new business models for payment, and new ways of downloading, installing and using mobile services independently of device platforms and delivery systems. This experimental environment will provide an end-user perspective on what kind of demands we can expect on technology, business models and in the extension future technology and infrastructure.

**A sustainable society** Mobile life has many potentially negative effects on people such as loss of privacy, increased stress and a diminishing social life. Our services will be consciously designed to counter these negative effects. Studies of users’ mobile life are central to our research, and will reflect a holistic approach. The Centre’s research will support people in many aspects of their life. We hope to help people better combine work with leisure, to integrate social contacts with day-to-day chores, and to keep connected without being pressured. Our new services should support many forms of social interaction, which is essential for establishing a convivial and sustainable life. We will strive to preserve human values such as privacy or autonomy. Mobile services will be designed to promote health, physical movements, and environmentally friendly practices. The results on how to incorporate human values in the design of technology need to be communicated to partners, as well as directly to the public through media and public displays. A sustainable approach can not be created as an afterthought – it will need to be built into the technology we create, all the way from infrastructure to end-user applications.

Taken together, these results will represent a significant strengthening of Sweden’s research in the most important areas of future information technology. The Mobile Life Centre will be a vital strategic component in ensuring that the IT and telecom industry successfully meets the challenges of the next ten years and beyond, both in the Kista region, in Sweden as a whole, in the European Union, and throughout the world.