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Johanna Ylipulli

SMART FUTURES MEET NORTHERN REALITIES: ANTHROPOLOGICAL PERSPECTIVES ON THE DESIGN AND ADOPTION OF URBAN COMPUTING

UNIVERSITY OF OULU GRADUATE SCHOOL;
UNIVERSITY OF OULU,
FACULTY OF HUMANITIES,
CULTURAL ANTHROPOLOGY;
FACULTY OF INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING,
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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Abstract

This thesis explores the sociocultural processes shaping the design, adoption and use of new urban technology in the city of Oulu in northern Finland. The exploration is conducted at experiential level focusing on people's personal perspectives which allows uncovering underlying cultural meanings, social structures and historically formed practices and discourses. The unique case for the thesis is provided by the recent technological development in Oulu that has been shaped by agendas such as ubiquitous computing and smart cities.

The thesis first investigates in-depth the design process of the new urban technology, and also compares the visions of the designers and decision-makers with the practices and perspectives of the city inhabitants. Then, the adoption process of public urban technologies is studied in detail by constructing a conceptual appropriation model. Finally, the effects of the northern location of Oulu on the design and use of the urban technology are scrutinized. The research is based on empirical, qualitative research materials comparing the experiences of young adult and elderly city inhabitants; in addition, quantitative use data of urban technologies is utilized to provide an overview on the use trends.

The key findings indicate that the design and decisions concerning novel technologies and the outcome are shaped by complex sociomaterial practices based on experiences from previous similar projects, and on certain preconceptions about the city inhabitants and technology's role in the cityscape. Different people have differing power positions in relation to the development of the urban public places, and technology implementation can marginalize some segments of city inhabitants. Further, the adoption of novel urban technologies is found to depend heavily on the norms of public places and people's long-term experiences of technology use. Finally, climate, ICT use and sociocultural context are shown to be profoundly interconnected, and thus, urban computing design must reconsider the situatedness of technology. These findings call for further sociocultural studies on future smart cities.

Keywords: applied anthropology, northern location, smart technology, sociocultural factors, ubiquitous computing, urban anthropology, urban space

Ylipulli, Johanna, Älykkäät tulevaisuudet kohtaavat pohjoiset todellisuudet: Antropologisia näkökulmia kaupunkiteknologian suunnitteluun ja omaksumiseen.
Oulun yliopiston tutkijakoulu; Oulun yliopisto, Humanistinen tiedekunta, Kulttuuriantropologia; Tieto- ja sähkötekniikan tiedekunta, Tietotekniikan osasto
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Tiivistelmä

Väitöskirja tarkastelee sosiokulttuurisia tekijöitä, jotka ovat vaikuttaneet uuden kaupunkiteknologian suunnitteluun, omaksumiseen ja käyttöön Pohjois-Suomessa Oulussa. Tutkimus keskittyy ihmisten kokemukselliseen tasoon, jonka kautta on mahdollista hahmottaa kulttuurisia merkityksiä, sosiaalisia rakenteita sekä historiallisesti muotoutuneita käytäntöjä ja diskursseja. Tutkimuksen taustalla on Oulun viime vuosien teknologinen kehitys, joka osaltaan perustuu visioihin älykaupungista ja kaupunkitilaan sulautetusta jokapaikan tietotekniikasta.

Tutkimus tarkastelee aluksi uuden kaupunkiteknologian suunnitteluprosessia, ja peilaa lisäksi suunnittelijoiden ja päättäjien visioita kaupunkilaisten käytäntöihin ja näkökulmiin. Seuraavaksi julkisten kaupunkiteknologioiden käyttöönottoa jäljitetään rakentamalla malli, joka kuvaa omaksumisprosesseja. Lopuksi selvitetään Oulun pohjoisen sijainnin vaikutusta teknologian suunnitteluun ja käyttöön. Tutkimus perustuu empiirisiin, laadullisiin tutkimusaineistoihin, joiden avulla tutkitaan ja vertaillaan nuorten aikuisten ja ikääntyneiden kaupunkilaisten kokemuksia. Lisäksi käytetään määrällistä aineistoa kuvaamaan kaupunkiteknologioiden käytön kehityssuuntia.

Väitöskirjan mukaan kaupunkiteknologioita koskevat päätökset ja lopputulos ovat monimutkaisten sosiaalis-materiaalisten käytäntöjen muovaavia. Käytäntöjen taustalla ovat kokemukset samankaltaisista projekteista sekä ennakkokäsitykset kaupunkilaisista ja teknologian roolista kaupunkitilassa. Tutkimus valottaa ihmisten erilaisia valta-asemia kaupunkien kehityksessä ja tuo esiin, miten teknologia voi marginalisoida joitakin ihmisryhmiä. Tutkimus osoittaa, miten julkisten paikkojen normit ja pitkän ajan kuluessa muovautuneet teknologiakokemukset vaikuttavat uusien kaupunkiteknologioiden omaksumiseen. Lisäksi todetaan ilmaston, tieto- ja viestintätekniikan käytön ja sosiokulttuurisen kontekstin vahva yhteys, jonka vuoksi alan tutkimuksen tulisi arvioida uudelleen teknologian paikkasidonnaisuutta. Tulokset osoittavat, että sosiokulttuurista tutkimusta älykaupungeista tarvitaan lisää.

Asiasanat: kaupunkiantropologia, kaupunkitila, pohjoinen sijainti, sosiokulttuuriset tekijät, soveltava antropologia, sulautettu tietotekniikka, älytekniikka

To my grandmother Hilkka

For always being a source of positive thinking

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interaction from Dr. Hannu Kukka, Dr. Marko Jurmu and Prof. Vassilis Kostakos. Further, I would like to thank Dr. Aulikki Herneoja, Prof. Seija Ridell, Ms. Henrika Pihlajaniemi plus many others for fruitful and always fascinating interdisciplinary cooperation and conversations.

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This section of acknowledgements would not be complete without mentioning that at the same time when preparing this thesis, I was confronted with the loss of a loved one followed by some very difficult and sad times. I am still amazed and humbled for all the support I have received from my family and friends. I would like to express my deepest gratitude to the Northern Finnish rock climbing and freeskiing communities and especially to the members of Läskikymppi Freeride Team and Climbing Club Oulun Cave. Mountains may be ruthless but the shared passion for climbing and skiing creates amazing ties.

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Oulu, January 2015 Johanna Ylipulli

Original articles

This thesis is based on the following peer-reviewed publications, which are referred throughout the text by their Roman numerals:

I Suopajärvi T, Ylipulli J & Kinnunen T (2012) 'Realities Behind ICT Dreams'. Designing a Ubiquitous City in a Living Lab Environment. International Journal of Gender, Science and Technology 4(2): 231–252.

II Ylipulli J & Suopajärvi T (2013) Contesting ubicomp visions through ICT practices: Power negotiations in the meshwork of a technologised city. International Communication Gazette 75(5–6): 538–554.

III Ylipulli J, Suopajärvi T, Ojala T, Kostakos V & Kukka H (2014) Municipal WiFi and interactive displays: Appropriation of new technologies in public urban spaces. Technological Forecasting and Social Change 89: 145–160.

IV Ylipulli J, Luusua A, Kukka H & Ojala T (2014) Winter is Coming: Introducing Climate Sensitive Urban Computing. Proc ACM Conference on Designing interactive systems. New York, NY, USA, ACM Press: 647–656.

Content

1 Introduction

The objective of this thesis is to study the new urban technology in the city of Oulu, located in northern Finland, from a sociocultural perspective. Although mobile phones, tablets, laptops, displays, digital billboards and wireless networks[1] play important roles in this study, the main themes are *diversity, power* and *change*. Sociocultural perspective means that I look at cities as constellations of individual perspectives and memories, as well as collective history and dreams; they are made up by endless flows of people and goods, and by physical environment that is constantly under change and redefinition. I also understand cities as arenas for invisible power struggles and negotiations between several stakeholders. (e.g. Low 1999; Massey 1993.) Digital communication technologies are essential pieces of this puzzle as they have become part of the fabric of everyday urban life over recent decades. Personal devices carried by their users and public technologies are affecting and, to some extent, constructing and organizing people's experiences.

Various commercial and non-commercial stakeholders strive to benefit from new technologies and develop, design and study them. Implementing more and more technology in urban areas necessarily launches a set of diverse changes that have implications for the people inhabiting the cities. For example, new urban technology can favor some groups of people but make places to feel hostile for some others; it can enhance the feeling of security or give birth to new threats; create new ways to socialize or diminish the need to be in contact with others; or change aesthetics of the built environment. Furnishing cities with the latest technological innovations does not inherently make them any better places to live – or any worse, for that matter. It is up to us to actively decide where we want to go with possibilities brought up by our new digital technology.

Diversity and constant change are the essence of the cities. The focal point of this research has been to respect this diversity by developing our understanding of it in respect of technological experience; Secondly, the aim has been to illuminate the implications of technological change; Thirdly, I have attempted to outline how this understanding could be brought into the practice, which refers here to the design of urban technologies.

[1] In this study, I am referring to these technologies collectively with the concept *urban technology*. It is slightly misleading as all these technologies can exist also in non-urban environments, but in the context of this thesis, it makes communication easier.

This thesis comprises of an introduction and four original research articles. Technological development having taken place in the city of Oulu has provided the case for the thesis, and I approach my topic through empirical research material collected in Oulu between the years 2010–2013. The city has been furnished with rich digital infrastructure during the recent years, which makes it a unique and interesting research environment. Oulu is located approximately 200 km south to the Arctic Circle and has 193,798[2] inhabitants (December 31 2013); it is one of the northernmost cities having relatively large population in the world. The original articles open up a particular design process of urban technology from a sociocultural perspective; they shed light on the perspectives of the designers and decision-makers of the technological infrastructure (article I), explore city inhabitants' perceptions of the same technology, and scrutinize their ICT-related experiences in general (articles II, III and IV). Overall, the articles inspect the sociocultural conditions and meaning-making processes that frame urban technology design, adoption and use in northern environment. The lack of empirical, in-depth research has been recently recognized as one of the main shortcomings of sociocultural, critically oriented understandings of "smart cities" (Kitchin 2014). This is precisely the challenge I am addressing in my thesis.

In addition to the aims presented above, the meta-level aim, as underlined in this introduction, is to discuss what anthropology's role can be in the research and design of urban technology. My PhD project became an expedition into the world of multidisciplinary, interdisciplinary and transdisciplinary research in practice. To be able to understand the complex preconditions and forecast potential implications of urban technology, we need cooperation between disciplines and multi-perspective approach. The collaborative attitude spanning over disciplinary boundaries was the starting point for my PhD studies, and it forms a strand that develops and grows throughout the process; looking at the whole research process through this lens generates interesting and beneficial insights concerning epistemological, methodological and theoretical aspects. To some extent, they can be applicable also to other projects where sociocultural and technical perspectives meet.

[2] Official Statistics of Finland: Population Structure 2013. The population includes inhabitants of several smaller, nearby municipalities that have been merged to Oulu between the years 2009–2013.

1.1 Background and research environment

My research is connected closely to the *Open Ubiquitous Oulu*[3] (henceforth, UBI Oulu), a joint initiative of the University of Oulu and the City of Oulu which aims at building a functional prototype of the city of the future. Research activities are carried within the multidisciplinary *UrBan Interactions (UBI) Research Program* coordinated by the Department of Computer Science and Engineering at the University of Oulu. The UBI Program is an umbrella term for many research projects having differing aims. Researchers and students from different fields of study, such as computer science, economics, informatics, marketing, architecture and cultural anthropology have been conducting their studies and projects within the Program. The core of the UBI Program is constituted by the ubiquitous computing infrastructure deployed in the city center of Oulu.

According to statistics, Finland is among the most technologically developed countries[4], and the UBI Oulu initiative has turned Oulu an exceptionally well equipped city. The Program has deployed rich pervasive computing infrastructure, for instance, a municipal open access WiFi network, a network of Bluetooth access points and 18 large interactive public screens, at downtown Oulu. The foundations of the Program lay in the field of *ubiquitous computing*, *urban computing* and in the concept of a *smart city*; these terms are explained in the following section 1.2. The general objective of the UBI Oulu is to turn Oulu into an open "civic laboratory" for a long-term large-scale exploration of urban computing systems in real environment. In a civic laboratory, "technology is adapted in novel ways to meet local needs"[5]. In Oulu, this has happened in cooperation with service providers, the City, and city dwellers, by offering all stakeholders the opportunity to try out new technology's possibilities in real settings. At the same time, technology is studied and evaluated academically.

In practice, my research was conducted within two research projects funded by the Academy of Finland: UBI Anthropos (2010–2012) and UBI Metrics (2011–2014). UBI Anthropos was, for the most part, an anthropological project, its roots firmly rooted in qualitative research and social science theories.

[3] http://www.ubioulu.fi/en

[4] According to the most recent (2013) statistics, 85 % of citizens between ages 16–89 used the Internet (Official Statistics of Finland), and 61 % of citizens between ages 16–60 owned a smartphone (TNS Gallup). Also information networks are almost pervasive, as they cover nearly every corner of the country.

[5] http://www.iftf.org/our-work/global-landscape/human-settlement/the-future-of-cities-information-and-inclusion/

According to the public description, it was "focused on analyzing the background and the goals of ubiquitous computing technology deployed at downtown Oulu; and on citizens' practices in this smart space" (Public Description, Academy of Finland). These research aims steered my own PhD project's direction significantly, as I collected the majority of the research material and wrote three of the four original articles within the project – although the last one of these three was finished during the next project.

After UBI Anthropos, my work continued in the UBI Metrics research project which was a consortium promoting closer cooperation between different disciplines involved; architecture, cultural anthropology, computer science and economics. The central aim was to develop means to evaluate urban public technologies. The transition from a project with mainly anthropological aims to an interdisciplinary one was probably the best way to familiarize myself with the fields of HCI and ubiquitous computing; the transition towards completely new disciplines was less sharp.

The two UBI Oulu's infrastructures relevant for this study are briefly introduced below while further technical details are available in papers provided as references. The City of Oulu is the owner of the public sphere augmented with these technologies. The panOULU WLAN (henceforth, panOULU) is a municipal WiFi network founded already in 2003. In 2009, the network was expanded to include eight nearby townships. The use of panOULU does not require registration, authentication or payment; it provides wireless Internet access to the general public in the most central places of the city, municipal offices and facilities, at the university campuses and at the airport. If the relative size of the community is taken into account, panOULU is the largest municipal WiFi network in the world providing open, free and unrestricted Internet access. (Ojala *et al*. 2011; Ojala *et al*. 2012a; see also article III.)

The UBI-displays (**Figure 1**) are large interactive public displays deployed at central indoor and outdoor places around Oulu. All the outdoor displays are located at the center of the city; six of them can be found along the pedestrian street and in the market place. Indoor displays are located in popular municipal buildings such as the University, the University of Applied Sciences, airport, swimming hall and main library. The six outdoor displays and the first six indoor displays were deployed for summer 2009. Additional six indoor displays were deployed in summer 2012. The current 18 displays are the world's largest network of interactive public displays deployed at a city center for research purposes. Every display has a 57 or 65 inch high-definition LCD panel with a capacitive

touchscreen foil, two overhead cameras, a NFC/RFID reader, a loudspeaker, a control PC, WiFi and Bluetooth access points, and high-speed Internet access.

What comes to actual interaction, a display is in passive broadcast mode when nobody is close to it (**Figure 2**). In the passive broadcast mode, the screen is dedicated to the UBI-channel – a playlist of video, animation, and still photographs, showing advertisements. When somebody approaches the display, and overhead cameras detect his/her face, or if someone touches the screen, the display changes to an interactive mode. In this mode, the screen area is divided between the UBI-channel and the interactive UBI-portal, comprising a set of webpages. Some services involve a personal smartphone, for example, for content uploading or downloading, or coupling the personal phone's user interface with the display's public user interface. All the services can be used without any authentication or login mechanism, but a user can also create a personal account. A personal account enables personalizing the display and coupling the account with his/her Facebook account, which allows posting of game scores on the Facebook wall, for example. Three different versions of the UBI-portal have been launched: version 1 in 2009, version 2 in 2010, and version 3 in 2011. The current version 3 contains ~25 distinct interactive services in seven categories, including News, Services, City, Third Party, Fun & Games, Multimedia and Survey. These services are provided by researchers, the City of Oulu, private businesses, nongovernmental organizations and creative communities. Some services have been available only temporarily. (Hosio *et al.* 2010; Ojala *et al.* 2010; Ojala *et al.* 2012b; see also article III.)

Fig. 1. An outdoor display in use. (Reprinted with permission from the UBI Research Program).

Fig. 2. A display showing advertisements. The image illustrates also the ongoing struggles over city space: a bicycle is left in front of the screen although it is not allowed; and construction site has created a temporary wall next to the display. (Johanna Ylipulli 2015).

1.2 Locating the research: anthropology of urban technology

Although the approach of my research is mainly anthropological, its objectives cannot be understood without acknowledging the fact that it is located at the crossroads of several fields. In this subsection, I introduce the most relevant fields that have been guiding the phrasing of research questions and the whole course of the study.

To start with anthropology, we must first note that its field of study is nowadays vast and divided into numerous subfields. The most significant branches for this research are *applied anthropology* and *design anthropology*. Applied anthropology usually refers to studies where anthropological method or theory is used for solving practical problems; it can be described as "anthropology put to use" (van Willigen 1993, 7). My research can be interpreted as belonging to the field of applied anthropology; I have been studying ongoing processes of technology design and appropriation, which means that it has been possible to use the results while planning new iterations. On the other hand, the aims of this research and research questions are not restrained e.g. by stakeholders working with technology design; thus, the starting point of the knowledge production has been purely academic. Perhaps, the study is best defined by saying that it is located in between basic and applied research.

Design anthropology in turn, is anthropology put to use within design. It is a fast-developing, emerging interdisciplinary field, intending to combine elements from design and anthropology and focusing on relations between people and objects, as well as production and use. Otto and Smith (2013) write that design anthropology can be considered as a new field because of the many novel elements it introduces. Among these, are many interventionists forms of anthropological fieldwork and design that include using, e.g. mock-ups, props, games, performances; interdisciplinary collaboration to produce concepts and prototypes; and an "intentional focus on facilitating and contributing to change" (Otto and Smith 2013, 11.) Authors also claim that particular use of theory characterizes design anthropology as it is used to generate new concepts, frameworks and perspectives. My study is not actual design anthropology, but it shares many of these features: I borrowed methods from design; ubiquitous technology of Oulu worked as an interventionist prototype facilitating my studies; and in the last article of this thesis (IV) anthropological knowledge was enmeshed with architectural theories and perspectives to produce new design space for the benefit of a third field, urban computing (cf. Kukka *et al.* 2014b).

Other relevant fields for my research have their roots in technical sciences, especially in computer science. The first field that is necessary to introduce is *human-computer interaction* (henceforth, HCI). HCI refers to the study and design of interaction between people and computers, and it is nowadays divided into numerous research communities and fields of study; it can be seen as a general concept covering a vast array of approaches[6]. HCI is usually regarded to be located in the intersection of computer science, behavioral sciences, social sciences and design, just to name a few. Although HCI research is bringing together social and technical sciences, cultural approaches and perspectives have often worked as subservient for technological ambitions (e.g. Galloway 2013b, 53). When computing technology started to become mobile and smaller, and digital communication was not anymore tied to desktops, the field of study nowadays known as *ubiquitous computing* (henceforth, ubicomp) was detached from HCI. In general, it refers to the wide-scale proliferation of computing resources into our everyday locations and objects. Ubicomp can still be seen, at least partially, as belonging to the multidisciplinary field of HCI. The term "ubiquitous computing" was first introduced by influential PARC Xerox researcher Mark Weiser (1991), and it is often said to signify the third wave of computing. The first two waves of computing are mainframe computers and personal computers, and, according to the famous declaration of ubicomp, we are now moving towards the third wave, characterized by *invisible computing*. Within this era, desktop is not anymore the defining form of human-computer interaction; instead of it, technology is everywhere. However, it has receded into the background of daily life, and it is supposed to unobtrusively and "calmly" serve people.

Weiser emphasized the role of social sciences when studying and designing new ubiquitous technologies (1991; 1997). However, his writings have been interpreted in numerous ways, and sociocultural agenda has not always been at the center of the attention (e.g. Galloway 2004). By now, some scholars have claimed the focal points of his thoughts have been ignored or misunderstood by majority (e.g. Chalmers & Galani 2004; Bardzell & Bardzell 2014), or that we should move on and leave behind Weiser's utopia altogether (Abowd 2012). Nevertheless, the concept of ubiquitous computing is relevant and highly

[6] An indication of the broad range of topics and approaches in HCI is the *CHI Conference on Human Factors in Computing Systems*, flagship conference of the field. It presents every year research from the most technical hard-core studies to the psychological, sociological, ethnographic and artistic papers: http://chi2014.acm.org/

interesting for my study, as it can be seen as *powerful ideology* which is steering the research and development of new computing technologies to a certain direction (e.g. Galloway 2013a). I consider ubicomp in more detail in chapter 2.

Urban computing can be seen as a branch of ubiquitous computing, and it is a relatively new term (Kindberg 2007; Kostakos 2006). In urban computing, ubiquitous technology is deployed and studied in urban environments, including public indoor and outdoor places. Sometimes, the field of studies concentrating on computing and cities is referred to as *urban informatics* (e.g. Foth 2009). Despite having its foundations in computer science, urban computing is said to be an inherently interdisciplinary field, similarly as its big brother ubiquitous computing. The often articulated aim of urban computing is to change cities into better places by designing and integrating functional, useful and even delightful technologies into them. Many researchers agree that it is crucial to respect the diversity of the cities and their inhabitants when working towards this goal; thus, we need to study people inhabiting these cities and let them to participate in the process of change (Galloway 2004; Dourish *et al.* 2007; Williams 2009). In this phase, perspectives and approaches offered by social sciences and humanities become relevant. The role of architecture is, naturally, also pronounced when we are dealing with built environment (e.g. McCullough 2005). Experts from other disciplines such as psychology or interaction design can be as important.

Urban computing and *smart city* concept can be seen as related and overlapping: roughly defined, the former is a research agenda, the latter a political and economic strategy. In many cases, also the "smart city" visions are built on Weiser's ideas about ubiquitous computing (Dourish & Bell 2011, 31–36). However, the "smart city" is nowadays more ambiguous, despite – or perhaps due to – the concept's popularity in various contexts. It is widely used within academic and urban planning communities and also outside of them in a more popular context. Typically, it refers to an urban community where computational infrastructure is an important facet of the city; "smart city" has, e.g. high-speed networks and novel services that are intended to provide value to city inhabitants and visitors (Ishida 2000). Particularly ICT is seen as lying at the core of the idea (Hollands 2008). In the city of Oulu, the smart city agenda is promoted and utilized in differing ways by various stakeholders, companies and the City itself (see Rantakokko 2012 for a concise introduction). In academic research concerning the city, the term is often used together with ubiquitous or urban computing (e.g. Kukka *et al.* 2014a).

1.3 Objectives and scope

The overarching aim of my research has been to critically analyze sociocultural processes shaping the design and adoption of the new urban technology in the city of Oulu. The reasons that led to its implementation in the first place are as interesting as the meanings city dwellers have given to the technology; the technology has been created with certain goals, ideas and even dreams in mind, but does it fit into the everyday practices and flows of a northern city? In practice, I started by investigating in-depth the design process of new urban technology, and proceeded to compare the visions of its designers with the practices and perspectives of the city inhabitants. I continued by exploring in detail the adoption process of the proposed technology by paying attention to its public nature, and finally, focused on northern location of the research site by scrutinizing its effects on the use and design of urban technology. I have divided my aim into four research questions; each one of the original research articles answers to one question. The questions can be summarized as follows:

1. What were the aims behind the UBI Oulu initiative, and what kind of factors affected the outcome of the new urban technology?
2. How do the strategies of the designers of the new urban technology meet the needs, skills and perspectives of the city inhabitants?
3. How well the new urban technology has been adopted in northern urban surroundings and what kinds of factors affect the appropriation process?
4. How do northern conditions affect everyday practices related to the use of urban technology, and how these preconditions could be taken into account in design?

Following a typical approach for cultural anthropology, I have been studying my topic on micro-level and concentrated on mapping peoples' personal experiences and perspectives connected to my subject. Studying phenomena on experiential level enables to understand the underlying cultural meanings, social structures (e.g. Davies 1999) and practices framing both the design of urban technology and its adoption and use. Gunn *et al.* (xiv, 2013) describe this position excellently in the preface of the book *Design anthropology:*

> *[--] ...anthropologists make implicit understandings explicit. What the ethnographic method brings is contrast and relation, and it opens up the taken for granted by bringing into foreground what was in the background.*

In order to achieve this, individuals' perspectives are often captured through qualitative research methods, such as interviews, and analyzed and interpreted with a suitable theoretical framework. I am exploring my topic through empirical research material collected with conventional ethnographic methods, as well as methods derived from design studies. However, it is often useful to combine different kinds of research materials; in addition to using qualitative research material, I have also utilized some quantitative data in two of the original studies (III; IV). This enables offering a broader view of the phenomenon under inspection. Throughout the research, the focus is on city inhabitants: how they have been taken into consideration in the design process and how they themselves perceived the new urban technology.

The fact that I ended up studying new urban technology within a large computer science driven research program is linked to larger tendencies in the research of human-computer relations. Generally speaking, moving beyond desktop environments, workplaces and system development has created in HCI a shift in traditional research methods and also in interests, generating a turn to values and experiences. This shift has been called as "third paradigm of HCI" (Harrison *et al.* 2007) and it refers to various approaches that place the main emphasis on qualitative aspects of experience instead of concentrating on specific usability concerns or efficient information transfer. Exploring situated and holistic experiences requires utilizing approaches and theories derived from current threads of social sciences; for example, Williams & Irani (2010) propose looking at multi-sited ethnography and anthropological critiques about the boundaries of the self and others. Another relevant trend is connected to the first one and is tied to changing research environments. For a long time, human-computer relations where studied mainly in laboratories. Studies *in-situ* and even more importantly, studies *in-the-wild* (e.g. Rogers 2011) refer to rather new approaches in which new technology is tested and developed in real world situations, conditions and locations instead of laboratories. The "research in-the-wild" methodology has been celebrated as something that frees technology research and design from the unnatural constraints of laboratory environment. This can be the case: real-life places and people's practices offer challenges that cannot be simulated in laboratories. The environments and situations of technology use are becoming more and more complex. Interestingly, this kind of approach to technology research and design begins to resemble ethnographic and anthropological research; ethnographers and anthropologists have always conducted their studies in real world conditions, i.e. "in-the-wild". However, when comparing

ethnography to "research in-the-wild" approach, Crabtree *et al.* (2012, 1) write that

> *Unlike user-centered, and more specifically, ethnographic approaches which typically begin by observing existing practices and then suggesting general design implications or system requirements, in-the-wild approaches create and evaluate new technologies and experiences in situ.*

According to these authors, ethnography differs from "research in-the-wild" in the sense that the latter does not necessarily see current practices as its starting point but is more *experimental*. They also emphasize the intention to *create change* which is a typical orientation in HCI and ubiquitous computing. I argue, however, that there is no need to define ethnography as an approach that can be efficiently used *only* for studying the status quo (or past). For example, Blomberg & Karasti (2013, 88) claim that commitment to change has always been part of the ethnographic research; however, it often entails a strong tendency to start by describing the present. Some strands of ethnography are more committed to change than others; for example, *critical ethnography* takes social change as its focus (e.g. Madison 2012), and many branches of applied anthropology are always future-oriented, such as design anthropology, which aims to develop more precise tools and practices to engage and collaborate "in people's formation of their futures" (Otto and Smith 2013, 3). Further, many anthropologists are already "bending" ethnography and using experimental and creative methods (see e.g. Edgar 2004; Irving 2013). My research should be seen as following these branches of anthropology. For example, I have added creative, designerly elements into my methodological toolbox, and sketched ideas for new technological iterations, i.e. potential directions for the future (articles III and IV). Thus, ethnography nor the field of anthropology is by no means inherently non-interventionist, only observational and descriptive: rather, "research in-the-wild" actually resonates strongly with contemporary ethnographic trends.

Overall, although the methodological focus of the urban computing research is moving towards "research in-the-wild", most of the prototypes are still tested in laboratories or in exclusive, limited "real-life" surroundings, such as at university campuses. The "wild" studies are still mostly small-scale and temporary, due to many constraints posed by legislation, funding, the need to publish papers, etc. (e.g. Rogers 2011, 58). Therefore, UBI Oulu can definitely be considered as unique: it is the most versatile long-term test-bed in the world in which researchers have been in such a strong administrative and technical position.

(Ojala 2010.) The technology implemented in the city center of Oulu has enabled longitudinal providing of new kind of services to the city inhabitants in public places. The use of the services has been monitored yielding vast amounts of quantitative use data, and people's interaction, perceptions and attitudes towards new infrastructure and its offerings have been studied on behalf of the computer scientists by using surveys and some qualitative methods, such as short in-situ interviews (see Kukka *et al.* 2013). As a concrete realization and interpretation of ubiquitous urban vision, the UBI Oulu is highly interesting. The northern location of the city of Oulu and the relatively small size of the city increase the importance and uniqueness of the deployed computing infrastructure. Usually, similar technological deployments have been done in metropolises and in milder climatic conditions.

Due to the unique nature of UBI Oulu, I find extremely important that it has been profoundly scrutinized also from anthropological perspective. Firstly, the explicit and implicit agenda of urban computing is to build something new, to design future technology for people living in urban environments; this inevitable contains the aspect of change. As an anthropologist, I argue that it is crucial to acknowledge *what* we are changing, *why* and *what kind of consequences* our actions might have; in other words, the whole paradigm calls for a deep understanding of the sociocultural reality. Secondly, ethnographic approach and long-term "research in-the-wild" intervention make a great couple. A broader time frame offered by longitudinal experiment enables utilizing conventional ethnographic methods that require time. In addition, it also allows the technology to become part of the everyday life – whether ignored or not by its potential users – instead of just being a short-term interruption; this is intriguing from the perspective focused on peoples' experiences, perceptions and attitudes. Similarly, also the effects of different everyday rhythms become apparent. As a trained anthropologist, I have been able to apply the newest methodological and theoretical insights into the research and design of new urban technologies from a perspective that privileges situated experiences and highlights the role of context.

However, I want to emphasize that this dissertation is not purely anthropological; it has interdisciplinary elements and it is intended for readers coming from a variety of disciplines connected to the study of urban places and technology. I have utilized elements e.g. from design studies that might be new to anthropologist readers such as the *cultural probe* approach, introduced in section 4.3. On the other hand, some parts may feel unnecessary for anthropologists, but are nevertheless included to shed light on some fundamental premises behind my

work, such as *social constructivism* in chapter 3, and to make my research more approachable for representatives of other fields.

1.4 Original articles

I. Suopajärvi T, Ylipulli J & Kinnunen T (2012) 'Realities Behind ICT Dreams'. Designing a Ubiquitous City in a Living Lab Environment. International Journal of Gender, Science and Technology 4(2): 231-252.

II. Ylipulli J & Suopajärvi T (2013) Contesting ubicomp visions through ICT practices: Power negotiations in the meshwork of a technologised city. International Communication Gazette 75(5-6): 538-554.

III. Ylipulli J, Suopajärvi T, Ojala T, Kostakos V & Kukka H (2014) Municipal WiFi and interactive displays: Appropriation of new technologies in public urban spaces. Technological Forecasting and Social Change 89: 145–160.

IV. Ylipulli J, Luusua A, Kukka H & Ojala T (2014) Winter is Coming: Introducing Climate Sensitive Urban Computing. Proc ACM Conference on Designing interactive systems. New York, NY, USA, ACM Press: 647–656.

The original articles are presented here in chronological order. Articles I and II were written during the UBI Anthropos research project; article III was composed in between the UBI Anthropos and UBI Metrics projects; and article IV during the UBI Metrics project. I was the first author in three of these studies and second author in one article; my contribution is explained in detail in below. I especially concentrate on clarifying the roles we had in gathering the qualitative material and analyzing it, as ethnographic fieldwork is usually understood as lying at the heart of anthropology. However, my research was carried out in a research group and thus, some parts of the data were collected jointly with colleagues or completely by other researchers.

Article I is based on twelve semi-structured theme interviews, and I conducted eleven of them together with Dr. Tiina Suopajärvi who was working in the same project at the time. One interview was carried out by Dr. Suopajärvi alone. During the actual writing process of the article, the workload was distributed evenly between Dr. Suopajärvi and me. We both read all the transcribed interviews and realized preliminary analyses; second, we discussed about the findings. Final analysis and conclusions took shape when we elaborated the findings and perspectives within our anthropological research team.

Article II is based on aforementioned interviews and two other sets of research materials, collected independently by Dr. Suopajärvi and me. Dr. Suopajärvi conducted life-story interviews with elderly adults and I gathered my

materials with young adults by using cultural probe inspired approach combined with theme interviews. I was the responsible author of the article, but we both analyzed our materials independently and brought our results together under themes that we had formulated together. We co-authored the introduction and conclusions.

Article III was an interdisciplinary study which was jointly written by anthropologists and computer scientists. I had the main responsibility of writing this article; I built the theoretical section, analyzed the qualitative materials collected by myself and formulated the appropriation model of public urban technologies. I was also in charge of composing the discussion and results sections. In this article, we utilized, first of all, the two sets of qualitative research materials collected from elderly and young adults: for this study, they were analyzed from a different perspective. In addition, we used quantitative long-term use data of panOULU WLAN and UBI displays.

Article IV focuses on an idea that I came across early in my research, and I was the responsible author of the study. The paper is based on aforementioned research material that I collected from young adults; in addition, we used another set of material, gathered jointly with M.Sc., architect Anna Luusua from young adults by using cultural probes inspired notebooks. The final approach, which combines perspectives of anthropology, architecture and design thinking, was developed jointly by our interdisciplinary research team.

2 Interdisciplinary tensions in ubiquitous computing

Multidisciplinarity as well as *interdisciplinarity* have influenced my PhD project from the very beginning of the journey. In this chapter, my aim is, firstly, to introduce ubiquitous computing, which is said to be inherently interdisciplinary field. In practice, this "inherent" feature seems to cause serious tensions. Secondly, I am inspecting ethnography's and anthropology's role within ubicomp.

Scientific community seems to agree that multidisciplinary, interdisciplinary or *transdisciplinary* research are necessary in order to answer challenges posed by ever more complex societies (e.g. Brandt *et al.* 2013; Strathern 2007). In their funding calls, many important research funding institutions are nowadays emphasizing the role of crossing disciplinary boundaries (e.g. Academy of Finland[7]). This kind of research is often rationalized by claiming that it enables reshaping relations between research, economy and society; it is said to offer new ways to make science accountable to society and foster innovation (Barry *et al.* 2008; Strathern 2006). On the grounds of my own experiences, I heartily agree with this tendency; I do believe that cooperation between disciplines enables us to find solutions to complex problems and develop our understanding of the world.

Multidisciplinary, interdisciplinary and transdisciplinary research are sometimes used as synonyms although they mean slightly different things. Multidisciplinarity is the lightest form of collaboration – it usually means that researchers from several disciplines are working together to study the same problem or phenomenon but each researcher or team is drawing from its own disciplinary knowledge. Results are published in separate forums and "traditional" disciplinary borders are not crossed. Interdisciplinarity refers to more profound form of cooperation: experts from different disciplines are integrating methods and knowledge, and the aim is to create real synthesis by combining different approaches. Transdisciplinarity is the most challenging and the most in-depth version of these three. It usually means an approach where two or more disciplines are being merged to produce radically new insights or frameworks; in other words, it can result in unifying different disciplines. (Brandt *et al.* 2013; Pakkasvirta & Pirttijärvi 2003; Strathern 2007.) When referring to these terms, I follow definitions outlined above.

[7] http://www.aka.fi/en-GB/A/Academy-of-Finland/

I have conducted my research within projects that brought together researchers having extremely different scientific backgrounds; social scientists and engineers. This kind of cooperation can be called as "broad multidisciplinarity or interdisciplinarity". At first, the nature of collaboration resembled mostly multidisciplinary work, and later there was a tendency to move towards interdisciplinarity and combine methods and knowledge in joint publications. In my view, the strongest rationale for collaboration has been its assumed ability to create innovation and enhance societal accountability, but to some extent, the research has also been oriented towards *ontological change*, as defined by Barry *et al.* (2008): we have intended to transform the ways a technical object is usually understood and indicate how it is socially and culturally embedded. The challenges of (broad) interdisciplinarity are well-known (e.g. Blackwell *et al.* 2009; Pakkasvirta & Pirttijärvi 2003). MacMynowski (2007, 3) summarizes some of them in the following:

> *Repeatedly, issues raised include differences in the presentation of research, conflicting understandings of shared vocabulary, incompatible classifications of phenomena (i.e., "mixed taxonomies," Lele and Norgaard 2005), the status of interdisciplinary publications, and the challenges of peer review.*

The fundamental differences between disciplines manifest themselves on the more "superficial layers" of the research, such as the presentation of the research, mentioned in the quote above. The following example illustrates my point. When I was writing interdisciplinary papers for interdisciplinary forums, such as *Technological Forecasting and Social Change*, questions about the "correct" structure of the paper emerged. The writing style I was used to follow was considered as confusing and unclear by colleagues with background in computer science (cf. Strathern 2005, 126). It took me some time to understand how profound the differences between disciplines actually are, and how their roots can be explained. In studies leaning to interpretative stance, writing style can often be described as essay-like. The structure of articles and conference papers tends to be quite free-form. In HCI, ubicomp and in other sciences based mostly on postpositivist philosophy[8], papers and articles often use stricter format; the

[8] Postpositivism is a philosophy of science that acknowledges the critiques of positivism and reworks it. Postpositivists, for example, accept that background, knowledge and values of the researcher can influence on observations and research. Nevertheless, similarly to positivists, postpositivists are trying to achieve objectivity by attempting to recognize the possible effects of biases. However, postpositivism should not be mixed with relativism, and generally, it holds on to the idea of objective

content of each section is strictly defined. There are also substantial differences on level of argumentation; in postpositivist writing style, personal pronouns referring to author are often avoided, and arguments are presented in a very straightforward manner, without leaving space for shades or uncertainty. I found difficult, if not completely impossible, to try to squeeze my analyses into this kind of format – and soon understood it is not even sensible. In anthropology, a finding is rarely a single fact, but the whole story presented in the paper is the finding. An anthropological article, based on ethnographic practice, usually offers one possible, carefully explained view on the phenomenon under scrutiny. Current reflexive writing style emphasizes the role of the researcher and encourages making her/him visible in text.

In our research group, we usually found some kind of practical compromises when structuring the papers, and, for instance, we used sections' headlines creatively, drew figures, built visual models or used bullet points to clarify the communication. The results of this mediation can be seen in articles III and IV. However, these differences in argumentation and structure are not just cosmetic but they are linked to epistemological and methodological differences between disciplines. The authors of interdisciplinary papers must first acknowledge and understand the profound differences between different disciplines before it can be decided how to best present the study.

Conducting multi- or interdisciplinary research in a team where researchers come from very different fields means that each member of the group needs to have excellent expertise on the foundations of his/her own discipline, including epistemology and methodology. Anthropologist Marilyn Strathern notes that disciplines are often compared to cultures; this implies their ideas and concepts are "embedded in disciplinary traditions or contexts" and the role of these origins should not be neglected (Strathern 2007, 124). In addition, it is central that everybody is aware of the different kinds of foundations other fields have: knowledge about different *research paradigms* is crucial. In the introduction to ubiquitous computing below, I present some fundamental epistemological tensions that have grown out from the fact that ubicomp has its roots in both technical and social sciences. The goal of the second subsection is to explore how

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truth. Postpositivists believe that an empirical reality exists (like positivists do) but the understanding of it is limited because of the biases of the researcher or other such limitations. (e.g. Alvesson & Sköldberg 2009, 16–23; Kincaid 1996.)

ethnography has been understood and utilized in ubiquitous computing. This leads us to consider methodological challenges of interdisciplinary work. What kind of knowledge about human-computer interaction we can produce with anthropological means and in what terms – knowledge that has value of its own and that can also benefit ubiquitous computing? I am concentrating on mapping epistemological and methodological fractures as I believe these points of discomfort can tell something substantial about the field of ubicomp. I have also learned from the history of anthropology that only by addressing the most fundamental problems, the field can evolve (about anthropology's self-criticism, see e.g. Davies 1999, 10–17). At the same time, this brief investigation helps the reader to locate my research.

2.1 Introducing ubiquitous computing

This thesis would hardly exist without ubiquitous computing, so I offer a brief historical and critical account of the subject from the perspective of an anthropologist. I am utilizing, especially the work of Jeffrey and Shaowen Bardzell, as they have produced epistemologically sensitive readings, which is not the most common perspective within the ubicomp literature.

As mentioned in the introduction, ubiquitous computing is a field of study born within computer science. The founding father, Mark Weiser, was a computer scientist and director of Computer Science Laboratory (CSL) at Xerox PARC. Weiser wrote two extremely influential essays, *The Computer for the 21st Century* (1991) and five years later an updated version of his visions, *The Coming Age of Calm Technology* (1997) with a colleague, John Seely Brown. These foundational papers have got enormous amounts of citations in the studies published, for example, at the flagship forum of the field, Ubicomp Conference (Dourish & Bell 2011, 20). Weiser created basic concepts and gave birth to a successful and powerful research agenda, yielding huge amounts of publications, more or less successful technology and technology-filled environments. It is a well-known fact that he got inspiration from anthropologist Lucy Suchman, who at the time led PARC Xerox's Work Practice and Technology Group. Weiser himself stated that the work done by Suchman and her team oriented his thinking; it led him away from concentrating on particular features of a computer towards asking how computers function as part of the daily life and interact with the rest of our physical environment. (Dourish & Bell 2011, 10–11.)

As Bardzell & Bardzell (2014, 781) note, Weiser's essay (1991) does not just propose a new research agenda but a paradigm. His vision is not only an engineering project but a philosophical one. He rejected a traditional personal computer, a desktop or laptop, as the main form of human-computer interaction, and imagined what would be the next step: a world where technologies would disappear and be everywhere at the same time; they would intertwine themselves into the fabric of everyday life. This is made possible by smaller and cheaper processors that would enable the emerging of computational devices of different sizes – from whiteboard sized "displays" to gadgets analogue to pads of papers and sticky notes. These smaller computational devices would be embedded in the everyday world and connected to each other via wireless networking technologies. Weiser forecasted this would give birth to a new mode of human experience, "embodied virtuality". The second essay (Weiser & Seely Brown 1997) elaborated somewhat same visions and was concerned the ways people cope with the hundreds of computers surrounding them all the time. Here, authors introduced the concept of "calm computing". Due to the massive amount of computers, they cannot be the center of our attention anymore; instead, technology should be in the background and enter to the center of our attention only when needed. Also in this essay, the authors made brave technological predictions – but not very specific propositions for concrete technological objects. However, they were pondering the profound sociocultural implications of these changes they see as *happening anyway*. Thus, they argue, research and design should be oriented in a way that it can meet these inevitable changes. (Weiser 1991; Weiser & Seely Brown 1997; cf. Bardzell & Bardzell 2014; Dourish & Bell 2011, 9–14.)

Out of these ideas has born a scientific tradition which manifests itself in concrete real-world technical installations such as UBI Oulu's infrastructure. Other fascinating example is Singapore, where Weiser's forecast launched already in 1992 an ambitious technological road map *Masterplan IT2000*, which has turned into reality by 2010; the island state has built impressive ICT infrastructure with innovative services such as fingerprint only biometric banking. (Dourish & Bell 2011, 31–36.) As an anthropologist, I find it peculiar that first of all, *a manifesto* has given birth to a complete field of study and for far reaching governmental technology agendas, and secondly, that 20 years old texts and forecasting still seems to offer the strongest argument for doing this kind of research – a research that is based on rapidly progressing technology. Of course, I am not alone with these thoughts, and during the years, many have assessed again

the central philosophical arguments of Weiser (e.g. Rogers 2006), and evaluated the technological progress in the light of his writings (e.g. Abowd & Mynatt 2000). It has also been stated that ubicomp's main arguments are actually harmful because they orient researchers towards mystified "proximal future" which is always around the corner but never actually reachable. According to Bell and Dourish (2007), this has several drawbacks, such as researchers do not feel accountable for the present which creates ethical problems; it also prevents us from seeing the already existing ubicomp communities, e.g. in South Korea and Singapore, and conducting empirical research on them. Abowd (2012) actually has recently claimed that we do not anymore need ubicomp because it is already here.

One of the most recent analyses of the meaning of Weiser's legacy is written by Jeffrey and Shaowen Bardzell (2014). In their article, they do not suggest we should abandon ubicomp altogether; rather, they present nuanced and epistemologically grounded analysis of current state of the field. First of all, they remind that the original vision of ubicomp can be interpreted as being inherently interdisciplinary; it contains elements that require attention from scholars coming from different fields. Moreover, Bardzell & Bardzell argue that his foundational texts do not follow the traditional patterns of reasoning and scientific writing typical for computer science in which the strongest underlying philosophical tendency is postpositivism. They propose the agenda of ubicomp is unevenly developed: the technical side has progressed enormously, but the philosophical agenda has remained the same (for too long). This has happened because it has been possible to develop the technological agenda within the boundaries of postpositivist science. However, developing philosophical agenda plausibly requires turning towards other ways of knowing and producing knowledge. Bardzells demonstrate this by giving an extensive and impressive example of how *science fiction theory* could be used to produce new, scientifically grounded speculations. These products of "systematic and intellectually rigorous" *cognitive speculation* could then offer design goals and "unthought possible trajectories for a dramatically better life" (Bardzell & Bardzell 2014, 780). Also Dourish & Bell (2014)[9] and Galloway (2013b) have been discussing about the relationship between science fiction and ubiquitous computing; the latter author also

[9] The article was presented in a seminar already in 2009 and has been available online; it was lately published in *Personal and Ubiquitous Computing*.

highlights the concept of "design fiction" when mapping complex connections between present and future within ubicomp.

The main point here is to underline the meaning of epistemological understanding. It seems that framing Weiser's thoughts with postpositivist thinking has created a situation where the technological agenda he painted has made steady progress, but the vision agenda is seriously outdated. Following Bardzells' remarks, it becomes evident that nobody has created a new vision, as bold as Weiser's, because from a postpositivist standpoint alone, it is simply not possible. It could be interpreted, then, that Weiser was so credible and strong a figure in computer science that he dared to step outside of its traditional boundaries.

The other topic I find important to address in more detail is connected to the previous one and is also bound to epistemology: it is the explicit aim to *change things*. This attitude is well visible in many branches of HCI – including ubiquitous computing – which are clearly aiming at designing "better futures". The following citation (Bardzell & Bardzell 2011, 676) highlights the "change agenda":

> *Yet one of the most valorized outcomes of scientific research in HCI is its implications for design. But design is an intervention, an intentional effort to create change. As design theorist Papanek defines it, design's job is "to transform man's environment and tools and, by extension, man himself".*

Authors conclude that "HCI has shown a strong interest in recent years to participate in large scale social change" (ibid.). Change is also a recurrent theme in discussion concerning "turn to the wild", a novel research approach in HCI in which technological prototypes are tested with real people in real environment (see section 1.3). In the Introduction to TOCHI's Special Issue of "The Turn to the Wild" (Crabtree *et al.* 2013, 1) authors write:

> *There has also been a shift in design thinking. Instead of developing solutions that fit in with existing practices, researchers are experimenting with new technological possibilities that can change and even disrupt behavior. Opportunities are created, interventions installed, and different ways of behaving are encouraged. A key concern is how people react, change, and integrate these into their everyday lives.*

Of course, nothing as such is wrong with change, but when a clearly stated attempt to change people's lives or environment is coupled with scientific

objectivity, there is a serious contradiction. Scientific objectivity's origins can be found in logical positivism and it is often part of postpositivism as well. It claims that values and scientist's person altogether should be cut off from the research. (Bardzell & Bardzell 2011.) However, if research attempts to produce social change, it must be committed to some values, and the agenda behind scientists' actions should be made visible.

In contemporary world of science, there are many fields that consider themselves as socially and politically engaged. Many of them argue that it is actually the only reasonable position. In their article, Bardzell & Bardzell (2011) introduce one possible option which intentionally makes the researcher accountable and which is one important building block in my scientific thinking as well: feminist philosophy of science. Feminist philosophers have argued on behalf of *situated knowledge*; knowledge is always produced by someone, in specific environment and under certain conditions; these include all the characteristics of a person, surrounding discourses, academic position, etc. (Alcoff & Potter 1992; Haraway 1991). In feminist epistemologies, human beings as knowing subjects are necessarily entangled in historically formed and culturally specific social relations, and thus, always bound to certain values. Good science intends to acknowledge and critically reflect these values rather than deny their existence. Also in ethnography, the positionality of the researcher, i.e. his/her position in relation to the research subject, intentions, methods and possible effects have been given significant attention during the recent decades (e.g. Davies 1999).

2.2 Ubiquitous computing and ethnography

The relationship between ethnography and HCI has a relatively long history. Ubiquitous computing has largely adopted the view that anthropology – or at least ethnography as an approach – can be useful. Also the father of ubicomp, Mark Weiser, especially underlined the role of social sciences in his foundational texts. A quick look at the origins of anthropological studies within HCI clarifies the relationship further.

As already mentioned, anthropologist Lucy Suchman worked in Xerox PARC in the 1980s, focusing on work practices and technology. Her seminal book, published in 1987, *Plans and Situated Actions: The Problem of Human-machine Communication,* was probably the single most influential factor in introducing ethnographic approach to HCI. Suchman's studies renewed common assumptions

behind the design of interactive systems. Her main argument was that *situatedness of human action* had not been taken properly into account in design. According to her book, human action is constantly constructed and reconstructed in dynamic relationship with the surrounding material and social worlds. Her empirical examples came from a field study where she explored how office workers tried to use a complex photocopier, provided with "expert help system"; her study revealed how people's actions did not follow designers' assumptions. She has significantly contributed, for example, to ethnographic analysis, ethnomethodology and participatory design, and her work has left a lasting imprint in the development of interactive computer systems. An updated edition of her book was published in 2007, *Human-Machine Reconfigurations: Plans and Situated Action*, whose new chapters centered on the recent developments in the field of computing and social studies of technology.

More recently, many scholars have been considering the synergies between ethnography and ubiquitous computing, and for example the book *Ubiquitous Computing Fundamentals* (Krumm 2010) dedicates a whole chapter for ethnography (Taylor 2010). This reflects ethnography's established role in ubicomp. However, the value of a method in HCI and in ubicomp has conventionally been based on its replicability – how well it can be transferred into another research setting – and by its predictability – how well does it provide a certain outcome. Williams and Irani (2010, 2732) compare this definition of a valuable method to a manufacturing process or an algorithm. When this kind of perception of a method is hovering in the background, it is no wonder that ethnography's utility in ubicomp has also been questioned: it has been seen too complicated and time consuming, and its capability for providing "implications for design", a concise set of practical design instructions, has been seen as weak (e.g. Taylor 2010). "Implications for design" as such is an interesting concept: it is sometimes seen as the ultimate goal for ubicomp, meaning that each study or paper should include a chapter dedicated for them (e.g. Dourish 2006).

Anderson (1997) was probably the first one to point out that ethnography in technology design should be understood as something that *can open up the possibilities for design*, rather than a source for concrete design instructions. Also Taylor (2010, 229) comments aptly that

> *So, rather than being seen as a means of narrowing in on a design, ethnography should be thought of as a way to discover the design spaces and how technological ideas might be subsequently investigated in more detail.*

Computer scientist Paul Dourish and anthropologist Genevieve Bell (2011) have recently elaborated these considerations, especially in their jointly written book *Divining a Digital Future: Mess and Mythology in Ubiquitous Computing*. They consider the whole concept of "implications for design" short-lived and superficial compared to the results that profoundly conducted ethnography can produce – ethnography where analysis and theories have not been marginalized. According to these authors, ethnography can actually produce implications for design *and* broader results. The latter refers to how it can help framing design challenges in a new way; it can broaden the scope of design and produce "profound guidance". We can ask, then, why ethnography is still often used only for getting implications for design, if the discussions about its role have been going on since the 1990s.

Dourish has discussed social sciences and HCI in many articles and papers, and highlighted the asymmetrical co-operation practices between ethnography and HCI (Dourish 2006). He claims that its roots can be, at least partially, found in the academic and funding structures that favor engineering sciences, making other disciplines seem as their subservient. This inequality creates a status hierarchy in which the demands of social sciences are not heard or taken seriously; the ones who got better resources are the ones making final decisions. (Dourish, 2006, 544.) In their article tracing the logics of interdisciplinarity, also Barry *et al.* (2008, 28–29) write about *subordination-service* mode of cooperation which has defined the role of social sciences in some cases.

The status hierarchy referred above is probably one reason behind the shallow perception of ethnography which has been criticized, more or less bluntly, by several authors (Dourish 2006; Dourish and Bell 2011; Taylor 2010; Williams & Irani 2010). When inspecting critically the role of ethnography in HCI and ubicomp, it becomes clear that picking up some parts of ethnography is a common course of action. This is done because some components of ethnographic practice are thought to be handy methods, tools, which are easy to transfer into the service of ubicomp. Of course, ethnography truly is one great way to dig into real environment. The problem here is that it is not just a tool; it is a whole toolbox, meaning that it should not be separated from larger methodological and theoretical considerations. Divorcing some methods, such as interviews, from ethnography, can lead to a shallow and one-dimensional understanding of the whole methodology and its possibilities. For example, conducting interviews without having any knowledge about interviewing as a scientific method is merely journalism.

Considering some parts of ethnography as a handy tool can also lead to an even worse situation where epistemological consistency is lost. A method, which is first separated from its original epistemological and methodological connections, is placed into a different body of scientific thinking and modified, sometimes violently, to make it fit into new frames. Boehner *et al.* (2007, 1078) comment this tendency in their article concerning an approach called cultural probes (introduced later in this thesis) but, as they argue, the same implies to ethnography as well:

> *Accordingly, while the uptake and interpretation of probes is our primary topic here, this exploration should be read in the context of broader concerns about disciplinarity and knowledge production in HCI. In particular, we will argue that patterns of probes adoption are driven by a common desire to turn reflective, interpretive research methodologies into formal, packaged, and ideally objective methods. We argue, too, that this drive substantially misconstrues the intention, merits, and nature of validity, not only of cultural probes, but of interpretive approaches to HCI research more generally, whether drawn from design, ethnography, or beyond.*

Ethnography is difficult to understand and complicated to apply, as Taylor (2010, 204) notes in *Ubiquitous Computing Fundamentals*. I argue this is a strong argument on behalf of interdisciplinary research teams. I truly believe we should have teams where specialists coming from different disciplines work together as equals, rather than having a group of specialists coming from one discipline working together and trying on experts' hats from different fields, perhaps just asking guidance from a neighboring department. The latter way of conducting research can be less time-consuming and appear easier, but plainly, it can also lead to bad science. "Inherently interdisciplinary" hardly means that an individual researcher should master alone all the different disciplines comprising a complex field of research such as ubicomp.

3 Theoretical foundation

In general, *social constructionism* is still the most used philosophical orientation in social sciences (Alvesson & Sköldberg 2009, 16) and it offers a good starting point for comprehending the multitude of theoretical perspectives I have used in the original articles constituting this thesis. Ian Hacking stated already at the turn of the millennium in his famous book *The Social Construction of What?* (1999) that social constructionism is not a fancy term, perhaps, because it is considered a bit worn out and vague. Of course, social constructionism today is a multifaceted concept which has many kinds of interpretations. It can also feel as something self-evident for scholars having their background in social sciences, but not necessarily for researchers coming from other fields; and as mentioned earlier, this thesis is intended for wider audience. On the most general level, it refers to the study of how reality is socially constructed. In other words, reality is not seen as naturally given, directly observable and *discovered* by human mind; rather, it is understood as *created* by mind. According to Alvesson & Sköldberg, it is possible to discern four different types of social constructionism, with an increasing degree of radicality: social constructionism as 1) a critical perspective, 2) a sociological theory, 3) a theory of knowledge (epistemology) and 4) a theory of reality (ontology). (2009, 34–35.) Theoretical orientation of this thesis leans towards the milder variations and utilizes a broad view of social constructionism where it is understood as a sociological theory[10]. Alvesson & Sköldberg describe it as a view "arguing that society is in some sense produced and reproduced by shared meanings and conventions and thus socially constructed" (2009, 35). This perspective moves us away e.g. from *technological determinism* that sees technology as the driving force behind societal change; instead, it allows us to understand the relationship between technology, society and culture in a more nuanced way, as exemplified in the theories presented in this chapter. Certainly, the referred theories cannot be reduced presenting *only* social constructionism. However, it can be said that all of them implicitly or explicitly align themselves with social constructionism, negotiate with it or reach beyond it. Thus, it serves as an important reference point.

My intention in this chapter is to summarize and give some background information about the central theories utilized in this thesis. They have their roots in different fields of research, such as STS, media studies, cultural studies,

[10] I clarify briefly my ontological and epistemological premises in chapter 4.4.

sociology and anthropology, and many of them are debated, complex and massive systems whose interpretations have been discussed by innumerable scholars. I want to emphasize that the short introductions offered below cannot reveal all of their shades and nuances. Anyhow, this chapter has three goals: the intention is to 1) discuss the utilized theories more in-depth which was not possible in the original articles; 2) highlight features of the theories that are relevant for comprehending this thesis; and 3) explain how I have been applying these theories.

I also want to underline that my aim has not been to build a completely coherent theoretical argument. This is an inevitable consequence of, first of all, the interdisciplinary project work, that required answering certain design related-questions, tied to the aims of the projects, within limited schedules; and secondly, of the compilation format of this dissertation. In other words, this research consists of relatively independent articles whose final formulation was dependent on goals of the projects, scopes of the journals, and requirements of the editors and reviewers. Thus, actually a compilation dissertation belongs to a different literary genre than a monograph. Joining a set of different theories, the somewhat "eclectic" or "pragmatic" use of theories, could be justified by referring to designerly and interdisciplinary approach of my research; in design research, the use of theories is often a bit more open-ended. The metaphor of "bricolage", derived originally from Claude Lévi-Strauss (1972) and elaborated later in relation to design research, e.g. by Louridas (1999), offers one possible way to conceptualize this kind of theoretical practice. As Wängelin (2007, 3) writes

> *Bricolage is an attitude towards a problem; a mental trial and error where every separate phenomenon is placed in relation to the present structure. A bricoleur is a person who adapts tools and materials to the current challenge and meticulously uses everything – even what has not been designated for the specific task, such as leftovers and results from former constructions and deconstructions – to proceed with the work. The process has no fixed beginning and no defined end, but is in constant change. In bricolage different inputs are used – not always as intended – but always with the purpose of gaining more knowledge.*

However, I would stress that when applying the term "bricolage" to theories, we need to be cautious. Theories bear ontological and epistemological assumptions, views about the nature of reality and knowledge, and thus, I do not think they can be glued together arbitrarily. Although the articles comprising this thesis utilize

and apply different theoretical perspectives and concepts, I claim the way I have applied them does not posit them in serious contradiction with each other; rather, they offer slightly different views on the subject of study and provide us with richness of perspectives. All in all, in this dissertation, all of these theories are utilized in constructing sociocultural understandings of the smart city of Oulu.

3.1 Technology-designer relationship: Unveiling the "birth"

On the general level, science and technology studies (henceforth, STS) can be characterized as a research field exploring how science and technology are constructed. In other words, it is concerned with the social processes through which scientific and technical knowledge is created, evaluated, spread, and so on; on the other hand, it also studies the ways people use, shape, and contest scientific knowledge and technology.

Within STS, the attention has been turned, among other topics, to the construction of design processes of new technology. It is widely recognized that technology design does not exist in a vacuum; everything "new" is created and developed under certain conditions and numerous complex factors affect the outcome. In other words, the beginning moment of a new technology design process is not a *tabula rasa,* but rather, a mixture of various immaterial and material things, such as scientific traditions with their theories and methodologies, material conditions, political discourses, funding possibilities, and social relationships, just to name a few (e.g. Clarke & Star 2008, 116; Sismondo 2008, 13). These factors have been studied by using differing approaches, such as actor-network theory (e.g. Callon 1980; 1986; Latour & Woolgar 1979; Latour 1988; Law 1994) or social worlds framework (e.g. Clarke & Star 2008).

Bruno Latour has inarguably been one of the most influential scholars in the field of STS. His interpretation of actor-network theory (ANT), in which both human and non-human actors are considered important, has been successful. Latour's writings can hardly be summarized in a couple of sentences, but in the following, some of the most central themes are picked up and introduced – they also serve to shed some light on the theoretical choices of article I.

In general, ANT focuses on the socio-technical networks that scientists and engineers create when carrying out their work emphasizing that no one acts alone. Alvesson & Sköldberg describe Latour for being responsible for "a 'second wave' of social constructionism" where also "non-human actors such as technical artefacts and the like can play an active role in the construction" (Alvesson &

Sköldberg, 2009, 31). Following the example given by Alvesson & Sköldberg, a traffic light can be seen as an actor (or *actant*) because people (usually) obey instructions given by it. In turn, Cantoni *et al.* (2002, 875) describe ANT as follows:

> *The whole idea is to treat situations as essentially equal regardless of the means; the objective is still the same. Within ANT, human actors receive exactly the same status as technology; the distinction between human and nonhuman actors is systematically removed. ANT takes the fact that, in a number of situations, technical artefacts in practice play the same role as human actors very seriously: the glue which keeps a social order in place is a heterogeneous network of human and non-human actors.*

In his more recent writings, Latour (2005) underlines the role of single actors and events, arguing on behalf of micro sociological perspective; 'society' or other 'social' (macro) phenomena are created by micro level. He is also critical towards "too" high-level theorizations. According to him, a researcher should stick to the pure descriptions of how human and non-human actors create their networks, and any explanations should not be given. This point of view emphasizes the voice of the research subjects – an orientation typical for ethnography, and actually ethnography as a methodology is often paired with ANT when conducting research.

In this study one particular design process, the design of the UBI Oulu was approached by using a perspective typical for STS: the design process of a new technology was not seen as given but its construction was examined (article I). To be more specific about our theoretical commitments, we leaned towards *feminist technoscience studies* (FTS; see e.g. Wajcman 2009) that can be understood as a STS with a feminist twist. FTS is a field of research in which theories, concepts and perspectives developed within feminist critique are combined with the study of science technology. FTS usually takes carefully into account power relations and pays attention to gender issues; we found especially important to study these themes within UBI Oulu, as changes in the cityscape can potentially affect all the city dwellers' lives. In article I, we chose to build our theoretical framework by applying mainly the ideas of FTS scholars Lucy Suchman and Karen Barad (Barad, 1997, 2003, 2007; Suchman, 2002, 2007; see also Hekman, 2010; Sefyrin, 2010a&b). The previously introduced conceptualizations of Latour are one of their points of reference, as also Suchman and Barad are highlighting the importance of non-human actors. In other words, humans and artifacts are

considered as mutually constituted; however, in contrast to ANT's "generalized symmetry", Suchman claims that "mutualities are not necessarily symmetries" (2007, 268–269) and calls for a perspective that recognizes that humans and non-humans as actors are different; she sees persons as ones who, after all, configure the material-semiotic networks *and* are simultaneously incorporated into them. (Suchman 2007, 259–271.)

For us, the central concept was *sociomaterial practices.* We utilized the term to describe the complex continuances and circumstances framing – or rather *constructing* – the design process of a new technology. In our analysis, we took into account both human and non-human actors and emphasized their entanglements, instead of trying to itemize or describe all of the meaningful actors. Further, our conceptualizations were based on "dissymmetry" between humans and non-humans, as articulated by Suchman. Ongoing technology design processes offer an opportunity to explore "imaginative and practical activities through which sociomaterial relations are reproduced and transformed" (Suchman, *et al.* 2002, 164). Sociomaterial practices are hybrids of social and material arrangements, such as funding practices and scientific discourses, and they enable and also restrict the design process (cf. Sefyrin, 2010, 117).

One of the "imaginative practices" mentioned by Suchman *et al.* (2002 164) is the construction of *imagined user*. In article I, we analyzed what kind of implications the sociomaterial practices constituting the design process of new technology had for the imagined user. This is based on a view that technology design inherently includes the construction of user representations, and these preconceptions are embedded in the technology (Oudshoorn *et al.* 2004, 41). Thus, an imagined user is the representation of the user constructed implicitly and explicitly by the designers.

This aspect has been studied within STS by Steve Woolgar (1991), who introduced the concept of "configuring the user", and Madeleine Akrich (1992) and Bruno Latour (Akrich & Latour 1992), who both have been theorizing about the user-technology relationship by using the term "script". According to Woolgar, the design and production of machines includes a process of configuring the user, which limits the users' possibilities to "read" machines; designers always have a particular user in mind during the design process. (see also Oudshoorn & Pinch 2008, 548.) The concept of script, in turn, attempts to describe how designers picture future users' needs, skills and interests and inscribe these assumptions into technological objects. At first glance, these two views, configuring the user and scripts, may seem similar, but there is one major

difference between them: Woolgar's view has later been criticized because it seems to give too much power to designers and forget users' possibilities to shape technology, whereas Akrich and Latour especially highlight the active role of users. This is done by introducing the concepts of *subscription, de-inscription* and *antiprogram.* They refer to different reactions users' might have towards technology; do they accept the designers' "program", re-negotiate their relationship with the proposed technology or reject it altogether. Anyhow, Oudshoorn & Pinch (2008, 550-551) argue that theories about script usually put more emphasis on the world of designers than on the world of users; cultural and social processes shaping users' negotiations with new technology are not investigated in-depth.

3.2 Designer-user relationship: Who's got the power?

In general, historians and sociologists conducting science and technology studies have often been interested in "technology itself" – e.g. the research, production, design and marketing of technology. This attitude is visible in many of the approaches introduced in the previous chapter. On the other hand, in cultural and media studies, scholars have put more emphasis on the users and consumers of technology. Thus, cultural and social processes constructing technology-user relationship have been the primary focus of analyses. According to Oudshoorn and Pinch (2008, 552), the central thesis of aforementioned approaches is that "technologies must be culturally appropriated to become fully functional".

Media and cultural studies stress the consumers' freedom to create meanings and build their identity within the practice of consumption but also the role of the producers is taken into account. One of the most prominent scholars in the field, Stuart Hall (1973), has established *encoding/decoding* model of media consumption which highlights the interplay between these two domains: encoding refers here to a kind of boundary definition practiced by producers, e.g. how agendas, cultural categories and frameworks are inscribed in the media products; decoding, on the other hand, is done by consumers who make meanings from media's offerings. (Oudshoorn & Pinch 2008, 552.)

Michel de Certeau (1988) has radicalized encoding/decoding model by his classical conceptualization in which the power relations between producers and consumers can be interpreted as highly unequal and binary. According to de Certeau, we can make a distinction between *strategies* and *tactics*. Strategies usually refer to the actions realized by established institutions and structures of

power; for example, the visions of designers and decision-makers about the functions of the new technology can be seen as belonging to this category. As de Certeau (1988, 35–36) writes

> *I call a* strategy *the calculation (or manipulation) of power relationships that becomes possible as soon as a subject with will and power (a business, an army, a scientific institution) can be isolated.*

On the other hand, "ordinary people" have a broad array of tactics when, for example, using (or not using) the proposed technology; they interpret technology and create meanings for it, negotiate the rules and "bend" or reinvent altogether its purposes through their everyday life practices (cf. Caron & Caronia 2007, 217.) The key point in de Certeau's thinking is that "ordinary people do not just "decode" products provided to them but "encode" them again by giving them radically new meanings. Thus, everyday life turns into the site of resistance and appropriation (Pink 2012, 17).

The distinction between strategies and tactics has been utilized especially in "active audience theory" where it has provided a basis to models highlighting the active role of media consumers in meaning-making processes (e.g. Fiske 1989; Jenkins 1992). De Certeau's view of tactics implying that media products do not have determining influence on their consumers has created a body of work in which meanings of media texts are detached from sociocultural context, and authors produce skillfully subversive and even artistic interpretations of mainstream media products (magazines, films) – usually without referring to actual audiences or consuming practices. Resembling literary criticism, this branch of analysis is actually leaning towards arts instead of social sciences. (Smith & Riley 2001, 167–182.) The excessive and often hypothetical empowerment of users/consumers has also been largely criticized (Brunsdon 1989; Buckingham 1993; McGuigan 1992). Pierre Bourdieu's equally classic and influential writings are often presented as opposite to de Certeau's radical freedom and subversive nature of practices. Bourdieu (Bourdieu & Wacquant 1992) regards everyday practices and the act of meaning-making restricted by the established structures of society; thus, these practices are seen as normative. On the debated difference between de Certeau and Bourdieu, see e.g. Pink (2012, 16–19).

In addition to being highly influential in cultural and media studies, de Certeau's thoughts have been also extensively used in history, literature and religious studies. Within anthropology, his writings have not been referred widely,

as Napolitano and Pratten (2007, 1–2) point out. They contemplate the analytical usefulness of his concepts for anthropological discussions (2007, 11):

> *Tactics, de Certeau argues, are determined by the absence of power. They must play on and within a terrain imposed upon them and therefore manoeuvre 'within the enemy's field of vision' (de Certeau 1984). It is in tactics then that de Certeau offers hope of redemption from the overbearing panopticism of modern society. In describing the complexity, plurality, temporality and improvisation of their actions, de Certeau's framework is especially helpful in coming to terms with the practice of governance, since his analysis shows how the 'weak' make use of the 'strong' and create for themselves a sphere of autonomous action and self-determination.*

One apparent reason for the lack of anthropological references could be that strategies/tactics does not offer means to investigate sociocultural processes shaping people's actions. As already mentioned, it has been accused for understating the role of social and cultural. In his rigorous scrutiny, anthropologist Jon Mitchell (2007) points out two severe stumbling blocks that can diminish the usefulness of de Certeau's notions: his implicit assumption that tactics are inherently morally good (and strategies morally dubious) and that tactics are also a manifestation of "original will", universal human capacity; individuals mysteriously and naturally have the capacity for resistance. Mitchell argues that de Certeau's theory lacks notions about the sociocultural shaping of subjectivity and agency. Thus, my own interpretation is that his distinction between strategies and tactics should be used cautiously and perhaps seasoned strongly with "Geertzian" thinking that "enables us to understand the motivation for and meaning of agency in particular contexts" (Mitchell 2007, 103).[11]

[11] Mitchell seems to argue in his article that anthropologists should abandon de Certeau's twin concept of strategies/tactics altogether. However, I claim they can be used if their limitations are taken into account in the analysis. Mitchell concludes his article by saying that "In reproducing this moralising stance on resistance, whilst at the same time eschewing a systematic treatment of people's motivation to act – such as Bourdieu's development of habitus – de Certeau appears unable to offer us a useful theory for ethnographic analysis. Rather, he presents a theology of the human spirit as redemptive counter-point to the moral bankruptcy of modernity – a fourth critique of the Enlightenment."

3.3 User-technology relationship: Cultural dynamics of "taming" the technology

Domestication is one of most important concepts in technology studies, developed by following the cultural and media studies' interest in the world of consumers. Roger Silverstone is the founding father of the approach which aims to describe how technology is integrated into everyday life and "tamed" and "cultivated". An unfamiliar and new object can be tamed, for example, by using it in a familiar place, such as in the living room, and decorating it with, for example, stickers to make its appearance more pleasing. In the domestication approach, cultural and social dynamics are taken into account and people are not seen as isolated individuals. (Oudshoorn & Pinch 2008, 553–554.) Thus, domestication is a process where new technologies are adopted and people negotiate both individually and with others how to tame the technology. What comes to power relations, the approach seems to have a rather neutral undertone. Domestication is neither socially nor technically deterministic. It can be described as a practical micro-level approach attempting to explore how people make sense of new technologies. (Ling 2004; Silverstone & Haddon 1996.) Technology's and society's relationship is seen as reciprocal: when technologies are domesticated and become part of daily life, they can mould the use environment and the user; but at the same time, people can shape technologies.

Studies on domestication have offered more nuanced understandings about processes that take place when people are confronted with new technology. Two classical accounts that specify these processes are presented below: The first of these was developed by Norwegian scholars in Trondheim, who linked the concept to the literature concerned with social shaping of technology; the second one is foundational framework developed by Silverstone *et al.* (1992).

According to Merete Lie and Knut Sørensen, domestication includes three kinds of overlapping processes: symbolic work, referring to the processes of meaning-making, where people create meanings for objects and accept or transform the meanings inscribed in the technology; practical work, the process where people incorporate technologies into their daily routines by developing patterns of usage; and cognitive work, the learning process (Lie & Sørensen, 1996). Silverstone offers another kind of grouping of different phases that constitute domestication in a household environment: *appropriation, objectification, incorporation* and *conversion.* Appropriation refers here to the moment when artefact or some immaterial commodity, such as media content, is

acquired, and brought from outside world into the realm of household. Objectification is expressed in use, and it reveals "the classificatory principles that inform a household's sense of itself and place in the world" (Silverstone *et al.* 1992, 22). These principles include the perceptions, e.g. of gender and age, as constructed in the household's own culture. Incorporation means the actual use of the technology and its integration into daily routines. Conversion, in turn, draws attention again on outside world and focuses on how technology shapes relationships between members of the household and people outside of it. (Silverstone *et al.* 1992, 20–26.)

It is important to note that although models presented above appear linear at first glance, domestication is never a straightforward or finite process; rather, it should be understood as a continuous negotiation which is closely connected to people's changing needs and conditions. The process of domestication is also tied and dependent upon people's previous experience of ICT or other similar technologies. Green and Haddon (2009) state that technologies can also be "de-domesticated" or "re-domesticated": this means that people can give up technologies that they do not need anymore, or return to some previously discarded technologies.

Especially in Scandinavia, the domestication approach has been built to understand the adoption of technology in households, as the name domestication also implies. Anthropologist Sirpa Tenhunen claims that the name refers to Western cultural categories and due to this, she utilizes in her own work (which is done in India) the term *appropriation* (2008). In article III, we found the term domestication problematic as well, but for slightly different reason: we were tracing the adoption processes of new technology happening in public urban places, and the sociocultural dynamics of these places differ drastically from the processes taking place at home environment. Thus, we decided to follow Tenhunen's example and use the term appropriation when referring to the whole process of domestication. Hence, the use of the concept in this study must not be mixed with Silverstone's classification of the four phases of domestication in which appropriation is a one sub-phase.

In his review article, Haddon (2011, 314–315) explores domestication approach and lists some of its shortcomings. He in fact claims that one of the problematic limitations of the approach has been its focus on the home and household. Some domestication studies outside the home have been done, in such environments as computer clubs and internet courses, but in general, other spaces have received less attention; our article addressed this gap by focusing on public

urban places. Due to the special nature of these places, we did not find the specifications offered by traditional domestication theory useful. Instead, we looked at discussions concerning social interactions happening in public places, implications of urbanization and other similar, relevant topics. From these theorizations, we derived three perspectives that we took into account in our analysis concerning appropriation of new technologies in public urban places. These should not be directly compared with the phases of domestication provided by Silverstone *et al.* (1992) that aim at specifying the process; rather, they worked as analytical lenses when looking at the research material and trying to understand people's experiences in our case study. Building a similar elaborated theory as that of Silverstone *et al.* was out of the scope of this thesis.

Firstly, when studying technology use in public urban places, the interplay between *actions considered either public or private* becomes central. These perceptions are highly dependent on the cultural and social contexts, and for example, people having different cultural backgrounds or belonging to different generations can understand them differently. Especially mobile phone use has been studied within this theme; for example, how public talking is understood and experienced (e.g. Humphreys 2005). The second aspect we paid attention to in our analysis was the *anonymity* of city inhabitants. It refers to a social norm, often discussed by theorists of modernization and urbanization (e.g. Goffman 1966; Karp *et al.* 1991; Simmel 1971), which means the minimization of open contact in public places. A certain amount of indifference ensures that people have a sense of personal space in urban environment filled with other people, information and action. In its part, the requirement of anonymity determines what people are ready to do in public places. The third essential viewpoint is *self-expression.* Despite the attitude of indifference, in public people are aware of others and want to give a certain kind of perception of themselves – often both consciously and subconsciously. In the terminology of Goffman, this phenomenon was called *impression management* (1959). Especially mobile devices have been studied from this perspective; they can act as objects of self-expression with complex symbolic meanings connected to, for example, fashion (e.g. Fortunati & Cianchi 2006). Impression management can have an effect on how people perceive the use of new public urban technologies.

3.4 Situating use and design: Putting technology in its place

The previous section already implies that in my studies *place* is one of the central concepts. Public urban places as a stage for technology use pose specific questions, and the geographical location of the city of Oulu in Northern Finland makes it a unique site for studying new technologies. *Space* and *place* and their relationship has been defined in numerous and sometimes conflicting ways, e.g. in anthropological, geographical and architectural studies. Generally, this study leans on a widely accepted definition in which place is understood as lived or meaningful space; geographer John Agnew clarifies the distinction by explaining that place is something specific and location (or space) is a more general concept (Agnew 2011).

In the following, I am looking at the concept of place more closely from the perspective of human experience by referring to authors that are relevant for this thesis. The first central viewpoint comes from anthropologist Tim Ingold who argues against static understandings of place. His concept of *meshwork* attempts to describe our relationship to our surroundings in a way that highlights movement (Ingold 2011). "Being in the world" is not formed by isolated dots, "places", but it is shaped by our movements and "trails" produced by these movements. Ingold describes how individuals' trails are entwined when they meet, and how these meetings form "knots", intensities of things (see Pink *et al.* 2013). Knots are like places connected to each other. (Ingold 2011, 141–154, 160; see also Ingold 2000.) Thus, we need to consider the larger *patterns* and *histories* of everyday life instead of scrutinizing just practices happening in one (physical) point at a one certain moment. If this perspective is applied to the study of technology design, the whole design process and the city inhabitants' lives in a technologized city can be understood as a meshwork. Technology design should not be seen as an isolated event but connected and continuous process; it is connected also to the use and users of technology, and we can assume they are strongly participating in the meaning-making processes of the whole flexible and constantly moving system.

The concept of meshwork is not part of science and technology studies' typical toolbox; thus, it has not usually been applied to the study of technology design or adoption processes. Anyhow, it offers a holistic and slightly unusual view about our existence, and it can be utilized to shed light on how complex processes comprising of multiple actors are constructed, as aimed at in article II. It must also be noted that Ingold sees the distinction between meshwork and

network as critical: "It is a field not of connectable points but of interwoven lines, not a network but a meshwork" (Ingold, 2008, 1805). Further, in his book *Being Alive* (2011), Ingold comments on Latour's actor-network theory (ANT), referred to in section 3.1, by contrasting it with an approach called SPIDER[12] which is, of course, a metaphor for his own position (2011, 64–65; 89– 94). Ingold does not accept ANT's central notion which gives equal agency to humans and non-humans. He introduces his views in the form of a vivid, fictional discussion between two arthropods, ANT and SPIDER, and in the end the SPIDER concludes (2011, 94; cf. Suchman 2007, 259-271):

> *Our concept of agency must make allowance for the real complexity of living organisms as opposed to inert matter. It is simply absurd to place a grain of sand and an aphid on the scales of a balance and to claim that they are equivalent. They may weigh the same amount, but in terms of complexity they are poles apart.*

Sarah Pink takes Ingold's theories as one of her points of departure when she writes about the interdependency of the concepts of *place* and *practices* in her book *Situating Everyday Life* (2012). In her accounts, place is seen as constantly changing "event" (cf. Massey 2005, 141) that does not simply offer a stage for everyday life practices but is at the same time a product of these practices. She emphasizes how practices – for example practices of technology use – are always part of wider environments and activities. (Pink 2012, 22–29.) The idea of *emplacement* is closely connected to these conceptualizations of experiential dimensions of place. The term is originally derived from David Howes (2005) and recently Pink (2009, 2011) has been elaborating it in relation to sensory ethnography and embodied performances. The concept of *embodiment* can be seen as preceding emplacement: In social sciences, theories of embodiment successfully deconstructed the divide between the mind and the body, and made researchers understand the human body as a meaningful site of knowing. These ideas have been utilized also in HCI, for example, by Paul Dourish, who has written about *embodied interaction* (2004). Nevertheless, emplacement attempts to add *environment* to this model comprising already of mind-body. In other words, the paradigm is emphasizing that knowledge is produced through the complex entanglement of mind-body-environment. Thus, with this model,

[12] "SPIDER" stands for Skilled Practice Involves Developmentally Embodied Responsiveness.

experiences of technology can be seen as profoundly embodied and situated, born out of moments where we sense our surroundings through our bodies that are necessarily always somewhere[13].

In article IV, our intention was to situate the urban use of ICT into its wider schemes by highlighting the role of Northern environment. In doing this, we depicted the Northern city of Oulu both as a concrete space with its harsh climate, and as a lived space, place, unfolding in the stories of our study participants. We found the concept of emplacement especially useful when conducting the analysis.

The conceptualizations of space and place lead us inevitably near the concept of *time*. For example, the concept of meshwork is dynamic and "needs" time in order to exist: movements constituting meshwork happen in time. (Ingold 2011, 141–149.) In my research, time is inherently present throughout the analysis as previous events, experiences, memories and life stories – i.e. the temporal nature of our whole existence – is taken into account in exploring the design process, power relations and appropriation related to the new urban technology. Temporal dimension became important along the concept of place also in article IV, in which we analysed city inhabitants' technological experiences in relation to Northern climate.

Time, space and their interconnectedness are some of the key themes in current social sciences where scholars are interested, among other hot research topics, how *rhythms* shape human experience. Rhythmanalysis, proposed by Henri Lefebvre (2004), is one of the most interesting attempts to merge the concepts of time, space and everyday life into one theoretical framework. In a collection of writings elaborating Lefebre's ideas, Tim Edensor (2010) breaks down the concept of rhythm by introducing subcategories of rhythms. *Rhythms of people* refer to comings and goings of people, for example, the daily flows of children going to school in the morning. The biological nature of our body means that we have certain *bodily rhythms*. They can be socially disciplined, out-of-sync or in-sync with our surroundings. *Rhythms of mobility* is a perspective based on a view that places are constituted by flows, including, e.g. patterns of commuting to work, traffic, travelling. Finally, *non-human rhythms* refer to certain natural

[13] This theoretical perspective actually resonates with the 3rd paradigm of HCI, briefly referred to in the introduction (Harrison *et al.* 2007): according to Williams and Irani (2010), it focuses on "situated perspectives" and "what it means for a system to be 'good' in a particular context" (ibid. 2726). Pink *et al.* (2013) have recently elaborated how theoretical and methodological framework offered by sensory ethnography can be aligned with the 3rd paradigm of HCI.

processes that are too often thought to be just a passive stage for human actions. Edensor (2010, 7) highlights the role of these rhythms in the following:

> *By acknowledging the usually cyclical rhythms of nature: processes of growth and decay, the surging of rivers, the changes in the weather and the activities of animals and birds which breed, nest and migrate, we can identify the ubiquitous presences of non-human entities and energies in and through place.*

In article IV, we considered the meaning of various non-human temporal rhythms for technology use. These rhythms were connected to the time of the year and the time of the day, and in our analysis we considered how people's experiences of information and communication technology reflect these variations. We focused especially on seasonal changes and studied how they shape people's ICT relations; on this basis, we proposed how these rhythms could be taken into account in the design of urban ICT. We leaned on Anne Galloway's writings (2004; see also 2010) about rhythms and flows of everyday life, as she has emphasized the importance of the subject in designing urban technologies. However, we analyzed one particular aspect of city life from the perspective of flows and rhythms, i.e. how seasonal variation and ICT use are interconnected. Galloway, in turn, sees the whole ubicomp as a series of flows, resembling many of the previous conceptualizations emphasizing the meaning of spatialization, temporalization and hybridization of human and non-human entities. The citation below (Galloway 2004, 400) reflects this perspective and also highlights the role of processes and events:

> *[--] any given ubiquitous technology may be understood to comprise its contexts of research, development, manufacture, sale, implementation, use and eventual disposal. Shifting socio-technical arrangements are negotiated in particular space-times, and it becomes impossible to reduce Ubicomp to discrete (stable) objects of computation. And so, in order to begin to understand ubiquitous technologies transductively, we must seek out their intimations – their shadows and resonances – and begin to ask about their flows.*

3.5 Summarizing theoretical perspectives

As I stated already in the beginning of the chapter, theories presented above do not constitute a completely coherent, seamless framework. Rather, every one of them provides a unique perspective and reveals one important facet of the topic of this thesis. Different theoretical perspectives were emphasized in different articles, due to the requirements of interdisciplinary, design-oriented project work affecting the aims of the articles, and due to differing publication forums shaping the final outcome. This approach inevitable differs from a theoretical approach of a monograph. However, I have demonstrated that the way I applied these theories in the original articles does not place them in profound contradiction with each other.

In article I, we were interested in the design process of UBI Oulu, and utilized mainly theories drawn from STS and FTS. Sometimes, we used a combination of two or more theoretical accounts in a study, as in article II: here our main aim was to describe the everyday ICT practices of our study participants and illuminate how they are part of ongoing power negotiations taking place between the designers of the smart city of Oulu and city inhabitants. Coupling de Certeau's conceptualizations with Ingold's meshwork theory made power negotiations visible on the level of everyday life stressing at the same time the meaning of sociocultural context and interrelationship between the design and use of new technology. In article III, domestication approach offered the overarching point of view, and it was elaborated by scrutinizing the factors that affect the adoption of new technologies in public urban space; this kind of surroundings have not usually been the center of attention in domestication studies. The last article further highlights the importance of space, place and materiality for technology related everyday practices and draws from the concepts of emplacement and rhythms of everyday life.

4 Methods and materials

When collecting the research material and analyzing it, I used both conventional ethnographic methods, such as *observation* and *interviews*, and methods derived from design studies, such as *cultural probes inspired diaries* and *notebooks*. In this chapter, I describe how I conducted my fieldwork and analysis. As cultural probes are not part of the typical ethnographic toolbox, the subsection dedicated to philosophy and methodology of probes is more detailed than the others.

Following my aims to tackle both the questions of technology design and use, the research material was collected by studying different stakeholders. The research material consists of, first of all, the interviews of the key designers and decisions-makers connected to the UBI Program; conducting these interviews was an attempt to understand the design process and ideas behind the new urban technologies deployed in Oulu. Secondly, the material reflects my aim to investigate the everyday life practices related to ICT, i.e. the "ICT reality" of city inhabitants; thus, the scope of the second set of material, ICT diary probe and interviews, is broad. It mapped young adults' everyday life with ICT in general, unfolding attitudes, perceptions, skills and dreams of the study participants. Thirdly, the remaining two sets of material, observations and notebooks, concentrate on examining young adults' perceptions of one particular technology, interactive public displays. Although UBI displays were discussed also in the diary probe and accompanying interviews, I found it important to gather also material focusing solely on these devices, as it was a new, interesting form of public urban technology without clear precedents in the media reality of Oulu's city inhabitants.

4.1 Choosing the participants for the study

The key designers and decision-makers were chosen for the study by asking from the different members of the UBI Oulu consortium who had been in charge of the various areas of responsibility. The process was quite straightforward, as the group of people in charge was not that vast. On the other hand, choosing participants for the studies that examined the city inhabitants' perspective was not that simple; I needed to delineate who I was going to focus on. My choice to concentrate on studying young adults' (aged between 20–30 years) experiences must be seen, first of all, against the background of the UBI Anthropos research project and its goals. Our aim was to map and compare the ICT realities of

different groups of people living in Oulu, and highlight the diverse skills, needs, practices and attitudes they presumably have towards new technologies. Of course, we were not able to study all the different groups of people inhabiting the city, so we chose two *age groups*: postdoctoral researcher of the project, Dr. Tiina Suopajärvi, concentrated on studying elderly adults (65–), and my task was to study young adults. Secondly, our goal was not to only examine potential differences between different age groups, but we also wanted to find out what kind of differences we could detect inside a certain age group.

In urban computing literature, young adults often appear as a popular "user group". They are commonly chosen as testers of new technology and they are the ones the new designs are targeted for. Choosing young adults for a test group is perhaps seen convenient: universities are full of potential, easy-to-reach participants for busy researchers. However, it seems they are often understood as a rather homogenous group, colored by preconceptions of the designers: they are seen as "the early adopters" (see e.g. Line *et al.* 2011) of new technological innovations, and "affluent, cosmopolitan and technologically savvy" (Williams 2010). Furnished with these (imagined) qualities, they get to represent the typical residents of the city and users of different technologies in design and research processes (Oudshoorn *et al.* 2004). Of course, this practice is exclusive at least in two ways: it considers the technological experiences of *just one age group* and, to make the definition of "typical user" even narrower, favors *certain kind* of young adults. The premise of our research project was that age cannot be seen as the only category defining people, and we aimed at breaking down essentialists notions attached to different age groups. All in all, although young adults may seem to be always on the stage in urban computing, I argue this group has rarely been critically examined and differences in the technological experiences of young adults have not been thoroughly considered.

The order of the following sections reflects the chronology of the fieldwork; materials are introduced from older to newer. All the qualitative data sets are presented in **Table 1**.

Table 1. Qualitative research materials utilized in this study.

Type of the material	Participants	Responsible researchers	Year of collection
Semi-structured thematic interviews	Designers and decision-makers of the UBI program (n=12)	T. Suopajärvi J. Ylipulli	2010
Observations in the city center	City inhabitants of different age (22 h)	T. Suopajärvi J. Ylipulli	2010–2011
Group discussions	Young adult city inhabitants (n=20)	J. Ylipulli	2011
ICT diaries and group interviews	Young adult city inhabitants (n=48)	J. Ylipulli	2011–2012
Notebooks on public displays	Young adult city inhabitants (n=41)	A. Luusua J. Ylipulli	2013

4.2 Conventional ethnographic methods

Interviewing as a method is usually understood as a cornerstone of anthropological fieldwork. An ethnographic interview does not necessarily focus just on "finding the truth" but goes beyond this aim. Interviewer and interviewee engage in a dialogue where experiences, meanings and memories are constructed together. (Madison 2012, 27–28.) The researcher usually aims at, of course, finding valid information and facts, but in addition, as D. Soyini Madison reminds us, interviews inherently reflect "individual subjectivity, memory, yearnings, polemics and hopes" that are profoundly entangled with "shared communal strivings, social history, and political possibility" (2012, 28). Thus, interviews can reveal something about both the individual and her/his community; they can also act as a window that shows how these two layers are intersecting.

Interviews can be grouped in many different ways. I personally find Madison's categorization useful. According to her, ethnographic interviews can be divided into three groups: 1) Oral history, which refers to remembering a certain social historical moment and telling it from the point of view of the individual who experienced the moment; 2) personal narrative, meaning an interview where individual's perspective or expression of an event or experience is captured; 3) topical interview, where the interviewee gives a point of view to a certain subject: an issue, program or process. These forms are often overlapping but usually an interview can be categorized as belonging mainly to one group. (Madison 2012, 28.)

On the other hand, interviews can be divided into individual and group interviews according to the amount of participants; further, group interviews and

group discussions must also be separated as the form of interaction is different. Group or focus group discussions tend to rely on the interaction that is born between the participants about predetermined theme; the role of the interviewer or moderator is to create auspicious atmosphere and enable the interaction but s/he does not actively participate in the discussions. (Ruusuvuori & Tiittula 2005, 12; Valtonen 2005, 223–225.)

There are several interviewing techniques, but probably one of the most commonly used approach in cultural anthropology is *semi-structured thematic interview* (Davies 1999, 94–95). It refers to an open interview where the researcher has a framework of themes to be examined but not a rigorous set of questions; it resembles an ordinary conversation rather than a survey. The structure of the interview is not predetermined and the openness of the format allows the discussion to wander from theme to theme in varying order as long as all the themes are taken into consideration. The format also allows new themes to arise and to be explored. This interviewing method can produce highly nuanced, rich and in-depth research material, and often interviewees find the method pleasant. The negative sides of this interviewing format are that in can be time-consuming and it is said to require a lot of expertise and social skills from the interviewer; s/he needs to be capable of making the situation as relaxed and conversation-like as possible, and on the other hand, s/he must not steer the discussion in ways that might produce bias. Current reflexive practice, however, does not necessitate fading out the individuality of the researcher. Rather, emphasis is put on establishing a rapport with the interviewee (e.g. Wulff 2014).

In reference to these categorizations, I have used in the different phases of my study both individual interviews, group interviews and group discussions. Interviews can be mostly described as topical interviews and personal narratives, and my interviewing technique has followed the form of a semi-structured theme interview.

Conventionally, in ethnographic fieldwork, interviewing has been accompanied with *participant observation,* another hallmark of anthropology. The classic type of participant observation means that a researcher spends a long period of time living among the studied people and participates in their daily activities; discusses with them, carries out the same tasks as them and later makes notes and reflects on things s/he has experienced. The goal is to gain a thorough understanding of cultural meanings and social structures of the group. More recently, participant observation has been used in more limited settings such as in schools or hospitals. (Davies 1999, 67–68.) This method, or according to Davies

(ibid.), *research strategy*, is in many cases coupled with interviews. The same actions or practices that are discussed in interviews are also observed; thus, a researcher gets to analyze the same phenomenon from two different perspectives, and, presumably, gains a deeper insight. However, current trends in ethnography tend to prefer a more integrated approach. For example, Skinner (2014, 35) writes that an interview should be understood "as *a part of* participant observation and not *apart from* participant observation". Walk-along interviews or other approaches that belong to "sensory methodology" represent this kind of growing tendency (Kusenbach 2003; Pink 2009).

In this thesis, observation had a relatively light role. Anyhow, I used it in the beginning of the process to familiarize myself with the new urban technology, with some of its designers and with city inhabitants using it. Although observation was used extensively and in a systematic way only in the beginning of the project, it can also be said that I have been a participant observer during the whole research process. I have been moving in the interdisciplinary terrain constantly, and, in addition, I have been living in the same technologized, northern urban environment that I have been studying. Of course, this is not just an advantage but calls for particularly reflexive attitude (see section 4.4.2.).

4.2.1 Observations concerning the public displays

In the beginning of the UBI Anthropos project, we had some limitations related to material collection: we could not carry out traditional observation on the design process of UBI Oulu as the most profound decisions and technological deployments had already been done. Nevertheless, we were able to observe how other central stakeholders, city inhabitants, reacted to the results of these decisions and deployments. Thus, we conducted observation in the city center of Oulu to better understand how city dwellers perceive the most novel and visible new ubiquitous technology, namely the interactive displays. This material was collected during the summers 2010 and 2011.

Participatory observation (12 h) was conducted in conjunction with guiding events, arranged once a week during summers 2009–2011 in the city center. During these sessions, a team of researchers, including myself, demonstrated in situ the use of the displays and their services to passers-by. At the same time, we observed how people reacted to the displays and discussed with them about the new technology. We wanted to understand users' interaction, perceptions and experiences connected to the displays. In addition, we inevitably witnessed how

researchers accompanying us during the guiding sessions, the computer scientists, interacted with the city inhabitants.

In addition, I conducted passive observations (10 h) with Dr. Suopajärvi in the city center; in practice, we were sitting in the benches or restaurants' outdoor terraces near the public displays, and made notes about interactions between displays and city inhabitants. We paid attention to the time and weather, approximate age and gender of the person(s) and whether people approached the displays in company or alone. We found especially important to observe how people approached the display and how they interacted with the device; and did they interact with others at the same time. We conducted most of the observations around the public display located at the marketplace. Also two other outdoor displays, located along the main pedestrian street, were observed. In addition, we also observed indoor displays in the library and in the swimming hall. The marketplace was found the most interesting location to conduct observations, as it is favored by both city inhabitants and tourists during the summer months. The place is located next to the sea and has lot of restaurants, cafés and booths selling goods, and people are usually just wandering around in the area. In total, we made notes on 54 interaction sessions.

The observations have been analyzed in a Journal article published in *Personal and Ubiquitous Computing* (Kukka *et al.* 2013). They have not been addressed in detail in any of the articles of this thesis. However, observing peoples' reactions and interactions connected to public displays in situ created an important foundation for further studies and helped to understand the use and appropriation of public urban ICT.

4.2.2 Interviews of the designers and decision-makers

During the summer and autumn of 2010, Dr. Tiina Suopajärvi and I conducted twelve thematic semi-structured interviews with the central designers and decision-makers of the UBI Program. The form of these interviews can be described as individual and topical; the purpose was to shed light on the background and the aims of the UBI Oulu and how they had been achieved. In other words, we were looking at the design process through the experiences of the central designers and decision-makers. We had just begun our work for the UBI Anthropos project and were, thus, part of the UBI Program, and all the potential interviewees answered positively to our interview request. We aimed at interviewing all the central stakeholders. Overall, we interviewed four

representatives of the University of Oulu; three employees of the public sector of the city of Oulu; two former employees of the city; one representative of the private sector closely linked to the city; one delegate of the industry and one of the financiers. The interviewees' age varied from 29 to 61, and ten of them had a technology-related higher educational background. Two of them were women. All of our interviewees had either been making the actual designing tasks and decisions concerning the applications and installations, or they had been involved in the larger design process. The latter ones had, for example, been participating actively in discussions and meetings, and in making construction plans and funding decisions. Genders were unevenly represented which can be seen reflecting the gendered national conventions of ICT research and business; in Finland, ICT is seen as a male-dominated sphere where culturally defined masculinity and technology are linked (see article I; cf. Vehviläinen, 1997, 2005).

All interviews were conducted in the workplaces of the interviewees, excluding one that was done in a local café. This might have emphasized the topical nature of the interviews and the feeling that interviewees were speaking from their professional position, and representing their employers. Perhaps, due to this "expert attitude", some of the participants seemed to be a bit wary if questions required them to make any kinds of judgements concerning the installed technology. On the other hand, some of them were very outspoken and expressed pronounced opinions.

The interviews had been divided into three large themes that each had several questions and sub-questions. The first theme was *Background and implementation of the ubiquitous Oulu,* and it focused on questions about the ideas, aims, decisions and launching of the Program. The second set of questions, *UBI displays*, was intended to map planning, services, users and usage of these devices. The questions of the last theme, *Effects of the ubiquitous technology in Oulu*, were tracing how the interviewees saw the city of Oulu, what constitutes a good city centre, and what kind of future they imagined the ubiquitous city of Oulu would have. (article I.)

4.3 Methods inspired by design studies

The broadest set of research material gathered for this thesis was collected during the years 2011–2012. I decided to approach my central topic, the urban inhabitants' everyday life practices and ICT, with a methodology that is not part of traditional ethnography. The chosen research approach was inspired by

cultural probes, a methodology born within design studies at the turn of the century (Gaver 1999). In general, cultural probes refer to varying methods that are based on study participants' *self-documentation* and employ playful, creative and participatory attitude; their aim is to uncover people's personal perspectives and experiences. Probes have been largely adopted and adapted by HCI research community and they continue to fascinate, e.g. interaction researchers (Boehner *et al.* 2007; Gaver 2013; Graham & Rouncefield 2008).

The term 'cultural probe' is used here as an umbrella term for many similar approaches. In different studies, probes have been named after their purpose or after the research site, and thus, different researchers introduce us, for example, "design probes" (Mattelmäki 2006), "technology probes" (Fitton *et al.* 2004) or "urban probes" (Paulos & Jenkins 2005). Usually, 'a probe' consists of different tasks that participants are asked to perform on their own. Tasks can be delivered, for example, in the form of a scrapbook or workbook that is intended to be filled; however, tasks can vary from photographing one's surroundings to recording dreams by writing them on a pillow (Wallace *et al.* 2013).

It is important to acknowledge that cultural probes methodology – or "probology" as Gaver *et al.* (2004) lucidly call it – was initially based on artist-designers' philosophical thinking. Probes were born out of the need to contact diverse and geographically dispersed groups of people during an EU-funded research project whose aim was to better integrate elderly in their local communities through creating novel interaction techniques. Elderly people from three European cities participated in the project. They were given a carefully designed probe packet personally by the designers: the set included postcards, maps, a disposable camera, photo album and media diary. The participants were supposed to complement the tasks and send them back to the designers; the general aim was to catch pieces of the experiences of the participants and use them as inspiration for design. Original probes were inspired by movements such as The Situationists who combined avant-gardist thinking with political theories. The group was active mainly during 1960s and 1970s in Paris. The aim of the collective was to critique advanced capitalism and make people to realize how they were alienated from their own lived experiences; according to the Situationists, these "stolen" experiences were sold back to them in the form of (media) spectacle.

It is essential to know these premises in order to understand the nature of the original probes. They were supposed to stimulate the imagination of *both* the elders and the designers and unravel conventional designer-user roles; their aim

was to provoke, inspire and enable reflexive design practice. Gaver *et al.* (1999, 27) also write that

> *The probes were not designed to be analyzed, nor did we summarize what they revealed about the sites [of research] as an explicit stage in the process. Rather, the design proposals we produced reflected what we learned from the materials.*

Thus, the analysis or interpretation of the material was not at the center of the process; rather, the original probes should be understood as a creative conversation between designers and groups of elderly people. After HCI research community started to appropriate probes and use them for less artistic and more scientific purposes, these premises have been largely modified. Gaver *et al.* (2004) have expressed their worries that original features – and also original strengths – can disappear when probes are adopted and used for other than purely inspirational purposes. They claim the essence of the methodology lies in qualities such as empathy, uncertainty and subversiveness. In the worst case, the foundations of whole methodology can be seriously misunderstood. Boehner *et al.* (2007) write how probe methodology is epistemologically based on hermeneutic tradition; the research material it produces requires *interpretation,* and, in turn, the information this interpretation produces is necessarily *partial and subjective*. However, sometimes probes have been used in studies leaning epistemologically on (post)positivist tradition. Trying to rigorously classify fragmented and fuzzy qualitative material in order to obtain a set of "design instructions" easily makes the whole methodology to appear useless. This epistemological controversy resembles the tensions between ethnography and HCI, discussed in Chapter 2.

4.3.1 Studying young adults with "ICT diary probe"

Also in my research, probes were used in an unorthodox way. Compared to the original approach, my central goal was different: I did not use probes to gain design inspiration but mainly information. For me, the most powerful feature of this methodology was the metaphor of a probe. It immediately creates an image of an artefact that is travelling somewhere a researcher cannot directly access – be it outer space or human body – and is sending back valuable information.

Thus, I used a probe to access the everyday life of the participants of my study. ICT can nowadays be part of even the most intimate moments of life, it is

used in bathroom and in bedroom, and it would have been impossible and even intrusive to approach peoples' ICT realities by using, for example, participatory observation. Probes have been found convenient in ethnographic studies exploring "sensitive settings" (see e.g. Hemmings *et al.* 2002), and I followed these accounts by employing *ICT diary probes* combined with interviews. As the name implies, this approach can be seen as situated in between cultural probes and *diary studies*, a well-known method in social sciences (e.g. Elliott 1997; see also Luusua *et al.* 2015). I attempted to preserve the playful, subversive and surprising attitude when designing the tasks and graphic appearance for my probe; I understand that these qualities are at the heart of the cultural probe methodology and separate them from more conventional surveys and diaries that also are based on self-documentation. I do not see any epistemological controversies between my philosophical grounds and original probe methodology, as my approach in general is based on interpretation and reflection.

Before I planned the actual probe, I conducted four group discussions with 20 young adults to gain preliminary insights on how this age group actually uses new technologies and what kind of attitudes they have. Group discussions were realized in local cafeterias and recorded; they were built around loose themes connected to everyday life and ICT. I let the discussion to flow quite freely and avoided interview-like formal situation. Participants were recruited by using a Facebook call and university mailing lists; some of them knew each other, e.g. from workplace, which made the situations more relaxed. This introductory inquiry into the ICT realities of young adults broke down some of my own preconceptions; for example, I was surprised that not all of my participants had smart phones but were using relative old, simple and cheap mobile phones, and how only a few of them had tried out or even knew what UBI displays were.

I conducted a light analysis of these discussions by mapping the central topics and trends, and used this information when designing an "ICT diary" (**Figure 3**). It was a small scrapbook, designed to be colorful and informal, that had several different tasks, including writing, drawing pictures and adding clippings. The idea of the tasks was to draw participants' attention to their own ICT use and make them to ponder everyday life with technologies from different angles. The tasks included the following themes:

1. What ICT devices they used and how they perceived their own devices,
2. How much time they spent daily by using ICT (this task required writing down all the phone calls, text messages, computer use etc. during two days),

3. How they used technology and experienced the use in different places, both in their home and in the city,
4. In what kind of places or situations, they considered ICT use inappropriate,
5. How they experienced the use of a public UBI display (this task required actually testing one of the displays),
6. How northern climate and ICT fit together,
7. How they would feel if ICT suddenly would not exist,
8. What kind of feelings technology use provoked,
9. What they would wish for the future ICT.

After participants had finished the diary, they sent it back to me and I invited them to take part in a semi-structured theme interviews realized in groups of three persons. Due to challenges in scheduling, some interviews included only two participants. The probes functioned as objects that inspired the discussions; the participants could reflect on the themes of the diaries and compare their views.

Fig. 3. ICT diary probe. (Anna Luusua 2015).

I tested the probe with five participants before recruiting more people; these university students representing the age group of young adults filled in the diary and participated in the interviews. According to the first participants' comments, the diary was working quite well, but they also proposed some improvements. I had thought some of the themes I was interested in, such as the "dream ICT of the

future", could just be discussed in the interviews, but participants said it would be better to contemplate all the topics already in the diary. They also told me that adding clippings to the diary was difficult, as most of them did not subscribe to any printed magazines or newspapers. Thus, I slightly refined the diary by polishing a couple of assignments, and by adding two tasks and a three-page set of printed images into the "probe packet".

Finally, I started recruiting participants to the study, mostly through mailing lists and digital notice boards of different academies in Oulu. I got plenty of answers mainly from university students although I also approached many vocational schools and institutions providing adult education. At this point, I did not meet the volunteers face-to-face, but I personally answered their emails and questions. The probe was sent by mail to 51 persons. 43 of them sent the probe back and participated in the interviews; however, I have also analyzed the probes and interviews of the five person test group as the changes made for the final version were only minor. Thus, the study involved 48 participants in total.

The majority of the participants were female (37). I put a lot of effort into involving more men in the study by re-sending the call and utilizing also so-called snowball technique in which already recruited participants passed the call forward, but genders are still unevenly represented. This might be due to calling the study "a diary study"; in western cultures, the concept of diary is often understood as something feminine (e.g. Hogan 1991). This hypothesis has been verified by our more recent studies: when we have been recruiting participants, e.g. through mailing lists, we have been consciously avoiding the word "diary" and called our studies as "tests", for instance, and both women and men have usually been equally interested. Nevertheless, I find the amount of men in the ICT diary study representative enough and sufficient for the purposes of the study. If the gender differences had been the focal point of the study, a few additional interviews might have been needed.

The educational level of the participants was relatively high, as most of them were studying either at the University of Oulu or at the University of Applied Sciences. Few of them had already graduated from either one. Some participants were working full-time; two were unemployed; one was on maternity leave and one a stay-at-home mother. Their educational backgrounds were highly different, ranging from communication to industrial engineering and midwifery. Only sixteen of them were originally from Oulu, while 25 had lived in the city for less than five years and four of them even less than a year. Oulu is the most popular

student city in northern Finland attracting young people, especially from northern Finland and nearby small townships.

4.3.2 Notebooks on public displays

The last set of the research materials comprises of the notebooks collected during two periods in 2013. The theme of the notebooks was more focused, and we did not carry out interviews related to the topic. M.Sc. Anna Luusua and I conducted the study together, and the aim was to explore in detail how young adult participants (aged 20–29) experienced the usage of one specific technology, namely the outdoor public displays. The emphasis was on the overall experience of using a situated outdoor technology in the center of the city.

We decided to use a simple but carefully designed notebook to trace young adults' thoughts and attitudes about the public displays. The collection of the material was carried out in two parts: the first set of the material was collected in February and March, and the second set in late September and early October. The winter time set included 20 participants, with 12 females and 8 males; and the second, autumn set, 21 participants, with 12 females and 9 males. Participants were recruited in the same fashion as in the diary probe study, and their backgrounds were almost identical to the diary study – they were from diverse fields of expertise, and almost all were studying in different academies. We asked these participants to use an outdoor display and then carefully wrote down their thoughts. The notebooks included ten open questions concerning three themes: *the overall experience, the position of the display in the surrounding city space and the appearance of the display*. As the subject of the study was very closely focused on the overall user experience of one specific technology, we did not deem interviews necessary; anyhow, we handed the notebooks personally to every participant, discussed with them and explained the meaning of the study and what we wished them to do.

The first group of participants filled in their notebooks in late February and early March 2013. During these two weeks, we had the typical winter conditions in Oulu, with temperatures ranging between –5,5 °C and –7 °C, and the precipitation in the form of snow was between 20 to 30 mm in February (Pirinen *et al.* 2012). The second group of young adults participated in the same study in late September and early October. Temperatures were ranging from +4 °C – 6 °C and precipitation was between 60–70 mm (ibid.). As the notebook study exploring the public displays was realized both in the autumn and in the winter,

we were able to explore how the changing setting influenced on technological experience.

4.4 Analysing the material

My philosophical bedrock is ontologically and epistemologically based on Charlotte Davies' (1999) interpretation of *critical realism*. Davies argues that actually much social research seems to be conducted from a position that resembles the perspective offered by critical realism, but it is just not acknowledged as such. Her interpretation of the philosophical perspective is based on the classical text of Roy Bhaskar (1989), which is situated between positivist and hermeneutic perspectives. It offers a view of society, "in which human agents are neither passive products of social structures nor entirely their creators but are placed in an iterative and naturally reflexive feedback relationship to them" (Davies 1999, 18–19). Thus, according to this view, society is not just a social construct, but it exists independently of our perceptions and conceptions of it; for example, its causal properties and its ability to use deterministic force on individuals are independent. However, it is dependent on human action for its reproduction.

Davies sees critical realism as especially suitable for ethnographic studies because it recognizes different ontological levels. Human actors as well as social structure are ontological levels, something that *exists*, and neither is completely determined by the other. They are interrelated so that they can affect each other. So, through ethnography, we can study the phenomenological reality about how actors understand and interpret their effect on social structure, but we need to understand that these interpretations are not "fully constitutive of social structure" (Davies 1999, 21). The level of social structures can be studied only through its effects on human actors, although it is "real". (see Davies 1999, 17–25.) In practice, this means understanding interviews, for example, in the following way:

> *[--] while interviews cannot be taken as a straightforward reflection of the level of the social, there is a connection, an interdependency between the two levels that allows interviewing to provide access to the social world beyond the individual (Davies 1999, 98).*

Epistemologically, I am also leaning towards feminist philosophy of science, and especially I have followed the perspective of situated knowledge. Donna Haraway (1991) has argued that the nature of knowledge is inherently partial. In

ethnographic work, this means that it is jointly produced by the interviewees (or participants) and interviewers in environment which is at the same time individual and socially shared. A researcher is not seen as an objective observer, because it is simply not a possible position for a subjective agent. Objectivity in feminist philosophy of science means acknowledging the partiality, imperfection and situatedness of the researcher's perspective. (Haraway 1991, 186–198; see also Landström 2007; Lohan 2000.)

4.4.1 Assessing the chosen methods

The temporal cycles of ethnography have traditionally been extensive; a researcher has spent years in the field and publications have been written afterwards. Clearly, this kind of approach has been questioned in the context of HCI where technology is developing and developed fast and the whole style of research favors quick innovation-implementation-evaluation cycles and rapid publication pace. However, when the emphasis of research is moved away from, e.g. limited work environments into large-scale and more complex sites – such as the technologized city – the temporality of the research needs to been seen in a different way. Conducting profound ethnographic fieldwork takes time, but when material has been collected and analyzed, it starts to pay off: the same set on research material is usually so vast and multi-faceted, that it can be analyzed from numerous perspectives in many different publications. Much more importantly, due to its broadness, ethnographic material can "deal with the unpredictable" (Strathern 2005, 129) and reveal issues that nobody would have thought in the beginning. It can provide extremely valuable sociocultural understandings that carry with them also the potential to steer technological developments into a more equal, sustainable and successful direction – if ethnography's message is heard and taken seriously.

However, bending and combining methodological approaches in creative ways – practicing cautious bricolage presented in section 3 – can provide a tool for conducting faster short-term studies that complement the large-scale ethnography and also more directly resonate with the designerly aims. In my research, this proved to be a workable strategy. However, I argue that there is a need to be particularly conscious of the philosophical roots of every approach to sustain epistemological consistency. As Danermark *et al.* (2002, 1–2) note:

> *Research involves a wide range of methodological tools, and we have to use many of these tools in a concrete research project. In other words, there is often a need to mix methods. However, we argue that this mix cannot be done without taking the ontological and epistemological dimensions into account. We call this perspective a 'critical methodological pluralism'.*

In my research, the notebook study belongs to the category of short-term studies; it was relatively efficient to carry out, and the material fitted nicely together with the larger sets of interviews and diaries, giving us new perspectives and possibilities. Pink and Morgan (2013) elaborate in their recent article the notions about *short-term ethnography*, and resign from the definitions that frame it as "quick and dirty" path to doing qualitative research. They argue it should be understood as a more deliberate and interventional approach than long-term ethnography but at the same time the engagement with theory should be retained. According to them, it is characterized by several forms of intensity that lead to deep ways of knowing; e.g. the use of the video leaves rich traces of the short encounters with the study participants. Our notebook study somewhat resembled this kind of approach; it was carefully planned, small intervention that left us with a rich set of hand-written notes, drawn images and photographs taken by the participants.

I would also like to highlight some special features of the diary probe study, as it is a somewhat novel way to collect material in an ethnographically oriented study. In my initial observations, it created room for several different kinds of ways to express one's thoughts: some participants clearly preferred writing; some were more visual and expressed themselves with vivid drawings and clippings; some made only short notes to the diary but verbalized their perspectives at length in the interview. However, the diary with its questions and tasks gave everybody similarly an opportunity to reflect his/her own practices and life with ICT over a longer period of time. Combining the probe with an interview was useful, especially regarding the study's ethnographic aims: the diary acted as a preliminary assignment that made the following interviews more profound and mature.

In the beginning of each interview, I asked the participants to assess the diary method. The majority of them had liked the overall experience and tasks, and they found the colorful and playful design of the probe appealing and motivating. However, some of them thought that openness of the questions had been difficult or confusing, and they wished they had been given more specific questions. On

the other hand, tasks and questions were purposefully meant to be as open as possible to give room for the participants' own perceptions; of course, this kind of freedom also requires that the participants are ready to use their creativity and invest their time in the study. Many of the young adults directly stated that discussing about ICT and everyday life felt much easier because of the diary. Moreover, several thought that participating in the study had changed their perspective, i.e. the study broke down the invisible routines and made them to realize what kind of role ICT actually plays in their own and also in other people's lives. Some even commented that they will never perceive ICT in the same way as before. Everyday life practices tend to become invisible but diary made them visible for the participants; here, we can conclude that the study clearly included the element of subversion, which was one of the foundational features of the original cultural probes.

The diary probe material was "layered" and thus, challenging to analyze. By layered, I mean that participants did not only observe their own actions but started also to observe others; in addition, they had to mediate between more private space offered by the diary and less private social space of the group interviews where they met other, unfamiliar participants. On the other hand, the intersections of these layers formed interesting points for analysis; for example, sometimes, a participant had emphasized some particular themes in her/his diary but did not brought these same things up in the interview at all. These topics can be interpreted as being especially sensitive/private/awkward (depending on the context; the social dynamics of each interview were different). Further, this kind of research setting required an especially sensitive attitude from the researcher. It meant, above all, that I needed to respect the boundaries young adults set for their participation; for example, I specifically told in the beginning of every interview that they did not need to discuss about all the things they had been pondering in their diaries. I also kept participants well-informed of the aims of the study and the ways the material will be used. Their anonymity has been protected in all phases of the study. These basic ethical principles apply to all the material gathered.

Furthermore, the notebook study proved that the flexibility of the probe methodology provides opportunities for adapting it for new purposes within design-oriented research. To this effect, we have recently developed the concept of *evaluation probes* within the notebook study; it was not used only for design inspiration or for collecting information, but also for conducting experiential evaluation of urban technologies in real-world settings. (Luusua *et al.* 2015.)

4.4.2 Being in the (interdisciplinary) field constantly

Doing "anthropology at home" (Jackson 1987) is not anymore an exception or new idea and my research falls into this category. However, in my case, the study did not comprise of visits to a separate "field" but being in the "field" was almost a perpetual state. I was studying the city center of my hometown and the interactions my fellow city inhabitants' had with urban technology. I was repeatedly visiting the city center myself, carrying out my own errands and using ICT there casually. Even my own office was located at the city center from autumn 2012 onwards. Thus, in addition to collecting research material systematically, I was participating in the life of the ubiquitous city continuously as an *insider*. I got extra information in informal ways by having spontaneous meetings with friends happening to use the UBI displays; or by observing other people's ICT use when I was just spending free time in the city center.

On the other hand, I cooperated closely with many of the people who have actually designed differing installations in the city center. This means that in addition to visiting the technologized city center repeatedly, I was visiting the technology researchers' and designers' territory constantly. It is noteworthy that within this domain I was clearly an *outsider*, especially in the beginning: I had completely different academic and professional background, and I was also among the few female researchers working at a male-dominated Department. This allowed me to see things from the outside and led me to challenge many aspects that are taken for granted in technology research and design.

I was roughly the same age with the young adults participating in my study which helped in relating to their experiences. I consider my own ICT use and knowledge to be on a rather average level for a person who does not have a background in technology related fields; this perception is based on my everyday experiences. My interest towards high technology is probably above average and I use several mobile devices in my home and outside of it, but due to my training as a social scientist – and not for example as a computer scientist – I am far from being an expert in technology. I assume this was also an advantage in group discussions and group interviews; different participants hopefully felt we can discuss as equals.

All the conditions presented above have inevitably affected my perceptions and I have paid special attention to my position as "an insider" and "outsider" in different contexts throughout the research. I have used the experience gathered during the years as a source of inspiration and in some occasions it has helped me

to interpret the actual research material. Sometimes, these observations, experiences and occurrences have supported my findings, and sometimes, they have made me to contest them. For example, once I met a friend with his baby daughter seeking shelter behind a UBI display and taking advantage of the heat the screen was emitting; this encounter partially inspired some of the design ideas presented in article IV. Furthermore, due to working regularly with the technology designers resulted that I became almost painfully aware of how differently experts coming from different fields conceptualize city, technology and its users.

However, systemically gathered and analyzed sets of research material form the backbone of this thesis. Nevertheless, being constantly in the field has resulted that my knowledge about the city, its inhabitants and about the urban technology and its designers has formed during a long period of time.

4.4.3 The process of analysis

The analysis of qualitative ethnographic material constitutes of repetitive readings, and it requires time, patience and also skills. This process entails thematising, categorizing, generalizing and explaining the material which is often voluminous. The interviews conducted with designers and decision-makers as well as the discussion and interviews related to the diary probe study were recorded and transcribed. This means that the data of this study consists of hundreds of pages of transcribed text plus the scrapbooks filled with essays, shorter notes, drawings, cartoons and clippings, notes from the participant observations and notebooks on public displays. The first step of analysis was to get to know the material, which simply meant going through it several times (Eskola & Suoranta 2005, 149–152).

The second characteristic of ethnographic material is its relative lack of organization, which means that analysis necessarily starts with organizing the data (e.g. Davies 1999, 195). Roughly, I followed the model presented by Davies (1999, 193–203). The interviews and diaries included already certain themes, and I used these as low-level theoretical concepts that enable classifying and thinking about the research material. Organization makes it possible to summarize data under categories, and I used tables to compress information in a more readable format. The analysis resembles grounded theory (Corbin & Strauss 2008) in a sense that in the beginning I did not have certain theories to work with; but under the loose themes I strived to follow the categorizations presented by interviewees and study participants, and derived concepts from the material. However, I do not

believe that looking at material without any theoretical presuppositions is possible, and in addition, the themes of the interviews and diaries already guided the analysis. Through the following readings, I moved towards higher level of abstractions and theoretical categories. For every article, the material was analysed from a different perspective and by using different theories that were chosen by their supposed ability to explain the data.

These brief chapters make the process sound like straightforward, and naturally, it must be systematic, but it is also an iterative process of interpretation that is moulded by the background of the researcher and the theories s/he uses. As Corbin & Strauss put it "in all qualitative research, there has to be some sort of balance between the art and science" (2008, 47; see also Skinner 2014, 10). A researcher needs to constantly mediate between research material and the theory; presenting solely descriptions, and on the other hand, getting lost in higher-level theories without any touch to the data need to be avoided alike. Analysis is also part of all the stages of ethnographic work; it does not begin when all the materials are collected, but at the same moment the research starts.

5 Results

The four original articles of this thesis form a continuum that stretches from the study of the design process of the new urban technology to the study of its use and appropriation. Article I focuses on exploring the design process and how it was shaped by different historically formed sociocultural factors; article II builds ethnographic accounts on people's everyday life practices related to technology and discusses the power negotiations between the designers and the city inhabitants; article III presents a conceptual model intending to explain technology appropriation process in public places; and finally, article IV traces the interconnections between the use of urban technology and northern conditions. The structure of this section is as follows: The results of each article are summarized in subsections 5.1, 5.2, 5.3 and 5.4. The order reflects also the chronological order of the research work and thus, illuminates the course of the project.

5.1 The design process of UBI Oulu

Article I was prepared during the UBI Anthropos project (2010–2012). We focused on studying the design process of the UBI Oulu and its technology by analyzing the thematic semi-structured interviews of central designers and decision-makers. **The general aim was to investigate the original goals, ideas and perceptions behind the UBI Program, and how the potential users of the new technology, the city inhabitants, have been taken into account during the design process.** These questions are explored in the article *'Realities Behind ICT Dreams'. Designing a Ubiquitous City in a Living Lab Environment.*

The design process was scrutinized through the analytical lens offered by the concept of *sociomaterial practices* (e.g. Suchman *et al.* 2002; Sefyrin 2010; Barad 1999). Sociomaterial practices are understood here as historically formed arrangements and conditions determining the realization of the design process. In addition, we paid attention to what kind of implications these sociomaterial practices have for the *imagined user* of the new urban technology.

5.1.1 Living lab as a starting point

Firstly, the analysis of the interviews pointed out that *living lab methodology* was thought to be an important starting point for UBI Oulu by all the interviewees,

except one, who had mainly participated in the hardware planning and design. Living lab usually refers to an approach where users are understood as co-designers and their participation in the design process is continuous; this is especially highlighted in the recent discussions about the methodology (Eriksson *et al.* 2005; Fölstad 2008; Schumacher & Feuerstein 2007). In the case of the UBI Oulu, city inhabitants' participation in the design process was, however, limited for several reasons.

City inhabitants' views and potential needs had been investigated before implementing the most novel and visible technology, UBI displays, by conducting observation, in-situ interviews and a "mock-up study" in the city center. Within these studies, passers-by had been informed about the possibilities of the future technology by using low-tech devices, and their views had been asked. These studies were conducted in the spirit of "rapid ethnography" (Millen 2000) and they lasted only for two days. University researchers had also been realizing some surveys at the moment we realized our interviews. In addition, they had arranged a storytelling competition to find out how people imagined the role of future technology in the city of Oulu, but unfortunately, it gathered only eight entries. The stories were successfully used as design inspiration; however, it is unlikely they reflect the diversity of city inhabitants' perspectives. (Kukka *et al.* 2014a.)

The largest set of user feedback consisted of quantitative use data collected automatically by the UBI displays. This data collection is still going on when writing this thesis. An atomic data unit is "click", corresponding to a person touching the interactive panel to press a button to launch a service in the UBI-portal, for example. The click data includes spatial and temporal distribution and information about the use volume of different applications. Without a doubt, this kind of quantitative data is valuable, especially when it is collected for a long time. However, it does not enable identifying current users or the co-creation of the services.

Thus, according to our analysis, the execution of the living lab approach in the UBI Oulu framed users as unidentified testers and not co-creators. City inhabitants were not involved *continuously* in the design process except through the automatically collected feedback data. Our interviewees had varied opinions on the succession of this existing form of the living lab. Some thought it worked well. Nevertheless, especially representatives of the city criticized the current situation and were not completely assured whether the new technology had really made the city center a more interesting and functional place for all inhabitants. One of these interviewees highlighted particularly the lack of user studies.

Following our analysis, the execution of the living lab had its roots in certain sociomaterial practices. They can be understood as larger sociocultural frames, constituted by material and immaterial conditions and arrangements that enable and, on the other hand, set limits for the design. From the designers' interviews, we reconstructed three sociomaterial practices that molded significantly the design process and shaped the living lab approach: 1) the funding resources framing the user involvement, 2) keeping up the high-tech image of the city, and 3) pursuit of scientific innovation.

5.1.2 The funding resources framing the user involvement

The interviewees explained that the failure to better involve users was, first and foremost, due to the lack of financial resources. At the beginning of the process, the UBI Program got EU-funding for the technological infrastructure but the content production was not funded. According to the interviewees, this led to a joint decision to start the Program with designing the technology and installing the hardware. Renegotiation of the goals was visible for instance in following interview quote:

> *You should go through the funding applications, what was applied for, and what was gained. […] How the goal setting has changed, how the resources have changed. And are the changed results of the project dependent on the project manager or not? The results that don't go together with the original wet dream, that we'll do it like that. (Ex-representative of the city.)*

At the time of the interviews, some steps towards a more participative approach had been taken; university researchers highlighted, for example, the *UBI Challenge*, a competition targeted at "anyone" to invent a new application for the displays. Nevertheless, the participants were supposed to produce the application by themselves, and consequently, only people with good knowledge on software design could participate. Some of the university researchers also depicted the results of the "rapid ethnography", realized in the city center before deploying the displays, as uninteresting and unsurprising. This did not encourage them to conduct more similar studies where lay people would have been involved.

We can interpret that in the beginning, the sociomaterial reality of the living lab of UBI Oulu was framed by performing a quick implementation of technological infrastructure and by excluding the city inhabitants from the innovation and design process. Thus, UBI Oulu can be best described as "a

technology driven test bed for new infrastructure and applications" (Thiesen Withereik *et al.* 2009; Fölstad 2008). Within this sociomaterial practice, the role of the city inhabitants was simply to act as unidentified testers of the already implemented technology.

5.1.3 Keeping up the high-tech image of the city

During the last three decades, high technology has been extremely important for the industry and business life of Oulu, and it has also significantly affected the city's image. Until the recent years, Nokia was high-tech Oulu's most notable symbol. The politically motivated strategy that emphasizes high technology was launched already at the beginning of the 1980s. (Äikäs 2001, 197–208.)

One of the strongest sociomaterial practice reconstructed from the interviews was the importance of *maintaining the high-tech image of Oulu*. The high-tech image and discourse had clearly gained a hegemonic status as it was discussed as an unquestionable fact. All the interviewees were concerned about the current "silence" in the high-tech field and worried that Oulu is about to "fall behind" in technological innovation. The rhetoric they used emphasized *high speed*, *movement forward* and *value of novelty*. The UBI Oulu presented something that ensures, at least, that movement continues:

> *It's like a wave, which just moves on, and it is doomed to happen. If we think about this kind of technology, it just moves on, and if we, here, just stand still, and then fall down, it still goes on, the progress. And from this point of view I'm hoping that the city of Oulu and the business life more widely and other actors would understand that now is the time to catch this, that not even in Helsinki do they have this kind of system. We should kind of hype this. (Representative of the University.)*

The rhetoric described above indicates that the discourse of high-tech Oulu was performed in relation to *technological determinism* (e.g. Escobar 1994; Cherlet 2011), a popular and widespread ideology which argues that technology and science are autonomous parts of society and that they function as triggers of social chance. In the light of technological determinism, and in a city where technology has been the driving force behind economic success, new technology can be seen as a value in itself. Furthermore, if technology is understood as a motor of change, it can be assumed that people will automatically adopt and appropriate it; social change follows technological change. This kind of logic can

make extensive, in-depth user studies appear useless before installing the actual devices, and it is perhaps one factor behind the joint decision to start creating *ubiquitous Oulu* by installing technological infrastructure.

Furthermore, Oulu's image as a high-tech city affected also the user representation: analysis of the interviews showed that in the beginning of the UBI Program, city inhabitants were expected to be comparatively competent users of new technology, and also interested in new gadgets. The sociomaterial reality of Oulu was reproduced as a place where technological innovation is appreciated in general and where city inhabitants are willing and able to act as testers of new technology. In practice, reception and adoption of the new technology had not been as straightforward as expected, and at least some interviewees were disappointed in the outcome.

5.1.4 Pursuit of scientific innovation

The representatives of the university had been making the final decisions concerning the applications of the UBI displays, as well as created many of them based on their own ideas. They expressed, anyhow, discontent towards "the test environment" and how it had been working in practice. These interviewees told that it did not allow them to properly test the new technology; city centre was considered too small, and the atmosphere was described as "restrained". The problem was addressed by planning to install lighter interactive displays at the university campus where the atmosphere was thought to be more permissive and experimental. "The atmosphere" refers probably also to the people who inhabit and use these places, i.e. the potential users.

In other words, carrying out research in the city centre of Oulu meant that the researchers could not design as *innovative* technology as they would have wanted to. However, they considered technological innovation essential if they wanted to succeed in their field of studies:

> *As a researcher I'd naturally like to have the kind of services that are technologically new and interesting, which would then enable [us] to make good publications. But generally, if you put technological novelties there, people either don't know how to use it, or they don't have suitable DTEs to use it, or they just aren't interested and so on. (Representative of the University.)*

Thus, our interviewees experienced that there is a serious contradiction between scientific innovativeness and real world; one representative of the university described that there is "a gap" between "the real world and the world of research". We argue that the contradiction was partly born because the designers of the UBI Oulu had, first of all, relied strongly on *I-methodology,* and secondly, because *innovation* is conceptualized in a certain way within the field of computer science.

I-methodology refers to a set of implicit user representation techniques. Since any in-depth studies investigating the users' everyday lives, technological skills, attitudes and practices had not been conducted, designers had probably been considering "themselves as representatives of the users" (Oudshoorn *et al.*, 2004, 41-44; Akrich 1995). This implies that they had relied strongly on their own interests and abilities when designing technology. Consequently, the imagined user was a reflection of a young male computer scientist.

In this regard, the representatives of the university and the representatives of the city formed clearly two groups with differing views. Many representatives of the university highlighted that the UBI Oulu was designed for "everybody" and did not question whether its services were suitable and easy enough for all the city inhabitants. They expected the potential users to share their own interest to new technology and abilities to use it. On the other hand, an interviewee who was not an expert on computer science thought that the interface of UBI displays was not easy enough for "everybody". Most representatives of the city also claimed that the displays contained too much entertainment and games.

Secondly, in the interviews, the discourse surrounding innovation framed it as something *radically novel*, something that creates a cut between past and present. Suchman (2002, 100) writes about this "mythologization" of the innovation:

> *[i]f current practices using existing technologies are assumed to be stagnant until the professional designer appears on the scene, the designer's ignorance becomes his or her credential.*

In other words, innovation can be conceptualized in many ways: it can be understood as something mind-blowingly new, or something that is constructed on the foundation formed by already existing practices. We argue that in the discipline of computer science, the discourse on innovation builds mostly on the former definition. This has colored the execution of UBI displays as well, steering the aims towards a direction where designers are creating innovations appreciated by other experts of computer science. Designing urban technology that builds on

existing everyday life practices was not seen attractive although it would presumably be much easier to understand and adopt also by the less technologically-savvy city dwellers.

5.1.5 Implications for the imagined users

Overall, our analysis of the interviews reconstructed the three sociomaterial practices described above; the living lab of UBI Oulu was realized within constraints and possibilities set forth by them. These arrangements, in turn, had several implications for the imagined user; how the user of these urban technologies was understood and configured by the designers and decision-makers.

The funding decisions and choices made later on resulted that the living lab of UBI Oulu did not intent to identify and serve different users but it is designed to offer "all services for everybody", as one of the interviewees stated. Similarly, many other interviewees argued that UBI Oulu was created for everybody. In practice, the concept of "everybody" remained vague. The main contact with users of the technology, i.e. the city inhabitants was made through statistical data collected automatically by the displays[14]. Anyhow, this kind of data tells nothing about who were using particular applications and what kind of solutions or interfaces would be most beneficial for different kinds of user groups.

When we asked from our interviewees who would be the most *probable user* of the services offered, he or she was described as a technologically competent child, teenager or young adult. These potential users were seen as probably open-minded enough and not afraid to use new technology in public places. In addition, some interviewees mentioned also elderly people as potential users, mainly because they were supposed to have time to experiment with the new technology. Children, teenagers, young adults, and elderly were discussed as homogenous groups of people; differences *within* these age groups and for example, the effect of gender, were not mentioned.

In addition to these *explicit* user definitions, the sociomaterial practices presented in previous chapters convey what kind of qualities an imagined ideal or potential user of UBI Oulu would *implicitly* have. Within these practices, she or he was an unidentified tester occupying the city center; a technologically

[14] Also panOULU WiFi enables collecting use data, as we later learnt.

enthusiastic inhabitant of the high-tech city; or a reflection of a young male computer scientist.

Overall, if all these findings are summarized, the imagined user can be described as someone equipped with enthusiasm towards new technology, good technological skills, plenty of time and enough courage to try out new devices and services in public. We argue that "everybody" does not fit into this definition. "The real" city inhabitants presumably possess a wide range of different needs, abilities and attitudes towards technology and technology use in public; thus, they are not necessarily the ideal users imagined in the minds of the designers.

5.2 Visions of the designers and urban ICT practices of the city inhabitants

To complement our understanding of the processes taking place within the UBI Oulu, we wanted to capture also city inhabitants' perspectives concerning the urban technology. Thus, we conducted life-story interviews with elderly adults, concentrating on their ICT histories[15], and carried out ICT diary study with young adults. With these multiple sets of materials, we were able to compare views of the technology designers with the views of city inhabitants belonging to different age groups. Both elderly and young adults were framed as potential users of the UBI Oulu technology in the interviews of designers and decision-makers which is a fruitful point of departure for analysis; our findings challenge the rather one-dimensional perceptions of these age groups and highlight the vast diversity of city inhabitants in general.

The overarching aim was to explore how conceptions and goals of designers and decision-makers meet the everyday life practices of elderly and young adult city inhabitants. The results of this analysis are presented in the article *Contesting ubicomp visions through ICT practices: Power negotiations in the meshwork of a technologised city.* In this article, the empirical findings tracing the everyday practices of our study participants were central.

However, the following theoretical concepts offered useful frames for the analysis: By using the classical conceptualization of Michel de Certeau (1988), we made a distinction between *strategies* and *tactics* in order to underline the reciprocity of power negotiations within UBI Oulu (on ICT-related power

[15] The material exploring views of elderly was collected by Dr. Tiina Suopajärvi. It includes the interviews of sixteen elderly adults living in Oulu (see article II).

negotiations see also Kinnunen *et al.* 2011). Further, we argued that the whole design process and city inhabitants' lives in a technologized city can be understood as a *meshwork,* a concept introduced by Tim Ingold (2011; see section 3.4). This latter aspect was taken into account by paying attention to 1) how past events and discourses formed "paths" for the designers of the UBI Oulu and shaped their visions and 2) how elderly and young adult citizens' life experiences and practices connected to other technologies and other places affected on how they experienced the new urban technology.

5.2.1 Strategies of the designers and decision-makers

Following our interpretation of the meshwork theory, many past, local events and processes can be understood as "paths" leading to the current strategies concerning new urban technology. One of the most influential "trail" is Oulu's previous success as a high-tech city. Many of the designers and decision-makers had participated in previous projects concerning high-tech development or research, and they shared a strong belief and urge to continue these successful stories. They wanted to ensure that technological development in Oulu continues, and pictured also inhabitants of the city as competent and willing technology users, as described in section 5.1 and its subsections.

In the designers' stories, the imagined use of the urban technology was framed by a certain kind of vision of the city of Oulu: it was seen as a place where people, especially the young and retired ones, are spending their extra time. They were imagined to have sudden information needs, such as a need to know where a certain shop is located. The designers and decision-makers manifested a strong agency within this place as they could change it, e.g. by creating new ways for city inhabitants to interact and find information.

On the other hand, tactics of the elderly and young adults living in the city revealed a diverse set of practices, abilities and attitudes that sometimes contradicted the strategies of the designers and decision-makers. These were analysed in detail in article II and grouped in themes linked to 1) urban mobility and technology, 2) perceptions about private and public use of technology and 3) perceptions of new urban technology (namely, the UBI displays).

Overall, elderly adults and young adults utilized ICT in differing ways; for example, only one of the elderly adults had an internet connection in her phone, whereas half of the young adults owned a smartphone and used it for accessing

the Internet. However, we found also significant differences inside these age groups.

5.2.2 Urban mobility and technology

The elderly city inhabitants' urban mobility was defined by their decreased ability to move and their physical fragility. Their ageing bodies made moving from place to place slower than before; due to differing physical problems, many of them felt that they cannot trust their own bodies anymore. Some also commented how urban places have begun to feel dangerous in the evening (cf. Freund 2006, 699). Due to these changes in their mobility, the mobile phone had become important as it offered a feeling of safety. Another shared feature in elderly interviewees' mobility was careful planning; they planned their visits to the city with the help of the Internet, checked opening hours and pictured their route in their minds beforehand.

Not surprisingly, in the young adults' interviews and ICT diaries difficulties in mobility were not an issue. All of them were quite fit and only harsh weather conditions in the wintertime caused some mobility problems. Anyhow, the mobile or smartphone was still carried everywhere mainly because "the perpetual contact" (Katz & Aakhus 2002) had become a social norm. Keeping the phone with oneself was considered *a duty*; many also described that without a phone they feel insecure, alone and are afraid that something horrible will happen. Likewise the elderly, also the young adults planned beforehand their visits to the city center. However, the individuals who owned smartphones used them for checking opening hours and other relevant information on the move; thus, it had clearly diminished their need for planning.

5.2.3 Private and public use of technology

Elderly adults did not especially prefer using ICT in public places: the mobile phone was the only technology they used in public, and its use was limited solely to calling. Sending text and multimedia messages, as well as using laptop was constrained to private places only.

Although elderly interviewees carried their mobile phones with them, some of them told they kept their phone always on a silent mode and it was carried around "just in case". In other words, they refused to talk on a mobile in public altogether except in a case of emergency. The rest of the interviewees described

that calls in public were kept short, and their purpose was usually to ask if family members needed anything, e.g. from supermarket or to find, e.g. a lost spouse. Those elderly interviewees who were especially reluctant to use mobile phones in public explained that in their former occupations as a teacher or nurse they were accustomed to protect privacy of others and thus, were accustomed to value it. Some also commented that especially when learning to use new mobile technology, answering the phone in public had been terrifying due to the fear of failure.

What comes to technology use overall, elderly interviewees drew a quite strict line between public and private places. The new urban technology does not necessarily appear attractive for people having this kind of perceptions about public use.

In turn, for the majority of the young adults, either a mobile phone or smartphone was an essential gadget in public places. The use varied significantly: from "heavy users" utilizing a large set of smartphone applications to individuals who were mainly just calling and text messaging. However, it was considered as an important part of the urban experience: one interviewee defined aptly that a mobile phone is "part of a navigating self-image" and "a cybernetic part of her" (F24[16]). The main function of the phone in urban places was "social navigation", i.e. finding friends and other important people, and staying in touch with other people not physically present (Kukka *et al.* 2014a).

Almost all young adult interviewees commented on the ongoing transition from mobile phones to smartphones. Many smartphone owners were fascinated by its capabilities; some people owning a "low-end" mobile phone were pondering whether they should buy a smartphone or not; however, a few expressed completely opposite opinions and stated that they will never buy a one. In general, negative feelings towards the pervasive role of ICT in everyday life were expressed by at least one quarter of the participants. For instance, computer use was blamed for consuming all of their time, and constantly being available was experienced as distressing. Also many of them felt, perhaps surprisingly, that they cannot keep up with the fast development of technologies. They complained that they were not using technologies effectively enough and described themselves with words such as "granny", referring to the discourse of the technologically incompetent elderly. Differences in regards to experienced ability

[16] Participants are referred to as follows: F=female, M=male, age. In the notebook data set I use W to denote winter time participants and A to denote autumn time participants: e.g. W-F29, A-M21

to use technology can be partially explained by different educational backgrounds: People working in or studying technology or communication related fields were generally more high-tech savvy and more familiar with new devices and applications.

In the young adults' stories, laptops and tablets were mostly connected to the home likewise in elderly adults' interviews; only a few particularly technologically-savvy participants took their laptops regularly to the city centre. Many young adults considered these devices either too clumsy or too fragile to be carried around and used outside. Nevertheless, a small part of the participants had interesting future visions about lightweight laptops that could be used in public places for creative or social purposes.

Overall, compared to the elderly interviewees' views, a strict divide between private and public spaces did not exist in the young adults' stories. Social digital space was experienced as an integral part of public urban places by most of the participants, and on the other hand, technology brought outside world into their homes and made "walls invisible", as one of the participants described (F24). However, some of them opposed this progress and relatively many expressed anxiety or negative feelings towards the pervasive role of ICT in their lives overall.

5.2.4 New urban technology

What comes to new technologies, we focused on discussing on the elderly adults' and the young adults' perceptions about interactive UBI-displays, since they are the most visible and extraordinary technology meant for public use in Oulu.

Only four of the elderly adults had used the displays so far. Some had not even noticed them and some had thought they are just digital billboards or mainly targeted for tourists. Interestingly, the publicity of the technology was not a big issue for the ones who had tried out the new technology; rather, the problem seemed to be that the displays offered nothing useful for the elderly city inhabitants. For example, a 69-year man commented that they offer services that "an old inhabitant of Oulu seldom needs". The elderly interviewees' opinions about the displays were divided: some stated that they are valuable symbols of the innovative high-tech Oulu, while others thought they are just "toys" for teenagers and thus, a waste of money.

The new urban technology potentially affects the social organization of public space; a space can become hostile or uncomfortable for elderly city dwellers if

public technology is targeted mainly for younger people. Although technology is physically accessible, it can be experienced as oppressive as it changes the meanings of space (Freund 2001, 697). Elderly interviewees underlined their need to stay mobile and use the services in the city centre; design of public urban technology should respect these needs.

The starting point for discussing about the UBI displays with young adults was a bit different: the ICT diary study included a task asking them to try out a display and write down their experiences. Thus, almost all the participants had tried out the displays at least once. The most striking feature in their experiences was the distress they felt when using a display in public. Information seeking was considered to be private business and also the fear of public embarrassment came up several times. The main issues appeared to be that the participants did not want others to see information they were looking at, and they were also afraid of a failure when testing a novel device. These perceptions and attitudes can be understood in the light of theories explaining the anonymity of people moving in urban places; many theorists, including, e.g. Goffman (1966), have discussed how anonymity is a necessary social norm in places filled with other people and events. Also the sheer novelty of the technology can hamper its usage: the big public interactive screen does not really have a predecessor in the lives of young adults. Mobile devices are personal and interactive, and on the other hand, huge screens are usually non-interactive. Both of these perspectives are further discussed in section 5.3, where we introduce a model of the appropriation process of public urban technologies.

However, the participants of the study gave also positive accounts concerning the displays. They were considered to be useful at least for tourists, and they were thought to reinforce the image of the high-tech city of Oulu. The diversity of the content was a positive surprise for many of them, but at the same time, some said that they can get the same information by using their smartphones. Using the display with someone else had clearly been diminishing the distress connected to public use; also some high-tech-savvy participants had just liked "playing" with a novel technology.

5.2.5 (Un)changing urban practices through power negotiations

In summary, the elderly and young adult city inhabitants' perspectives were sometimes in line with the designers' visions but we also found significant contradictions. The designers had assumed that the city space of Oulu would be

full of able and willing users who would gladly welcome new technological innovations. Especially both young and elderly citizens were depicted as the presumable users without questioning the differences inside these age groups.

Our analysis indicated that similarly to designers, also part of the study participants appreciated the novel urban technology since it reinforces the high-tech image of the city of Oulu. However, technology related attitudes, values and skills of the interviewed elderly and young adult city inhabitants varied substantially – between the age groups but also *inside* of them. Age as a singular category did not explain our study participants' ICT relations; a variety of factors starting from education and career were altering their perspectives. Remarkable, a notable part of individuals belonging to both age groups felt that as technology users they were incompetent or not using new ICT efficiently enough. In addition, some elderly and young adults were not interested at all in new devices such as smartphones. Also, the anxiety caused by the overwhelming role of ICT in everyday life was relatively common within the studied age groups. These attitudes and perceptions affect how these people interpret their surroundings and its affordances; they also shape individuals' technology related tactics.

According to the designers and decision-makers, it is on the users' responsibility to start adopting and appropriating the new urban technology. From their point of view, the new technology installed in Oulu is physically available for everyone and thus, offers means to construct new urban practices. However, our analysis showed that this agency is not necessarily accessible for all. New technology and its possibilities are perceived in various ways by different people. People's competence and willingness to utilize new services differ significantly due to their diverse backgrounds. To wrap up the analysis by returning briefly to the concept of meshwork (Ingold 2011), all the practices can be seen as a result of "the trails of experience". Experiences with previous technologies such as landline or mobile phones, changes in mobility and perceptions about norms in public places are some central factors composing elderly and young adults' relationship with the technologized city space.

What comes to constructing the technologized city, the designers and decision-makers can be seen as a powerful agents. However, both elderly and young adults have a broad variety of tactics when navigating in the technologized everyday environment, and with their everyday practices they can resist or strengthen the strategies embedded into it.

5.3 Appropriation process of the public urban technology

Article III focused on studying the appropriation process of the new urban technology. Many ideas expressed in article II and connected to city inhabitants' tactics were elaborated here to construct a detailed model describing the technology appropriation process. **Thus, the central aim was to explore how the public urban technologies, namely panOULU WLAN and UBI displays, are appropriated in the light of both qualitative and quantitative materials.** In addition, we intended to highlight how understanding better the appropriation process could benefit the design of public technologies by offering some concrete design propositions. These questions are discussed in the article *Municipal WiFi and interactive displays: Appropriation of new technologies in public urban spaces*.

The life story interviews of elderly adults and the material collected with young adults played a key role in article III. The quantitative, long-term use data provided an overview on the use trends of two technologies in question. Interestingly, the data indicated that the use of panOULU WiFi had been growing steadily, whereas the use of UBI displays had been slowly declining. Our qualitative research material was analyzed from the perspective of appropriation process in order to explain these differences. Furthermore, we developed a conceptual appropriation model intending to present the main factors affecting appropriation process in public space. The foundation of our model lies in the model originally introduced by Carroll *et al.* (2002). Its purpose was to present some of the factors attracting young people to mobile technologies and to construct a theory on the process by which they adopt and shape these technologies based on their needs. Similarly, our aim was to understand people's long-term use or non-use of technology by analyzing qualitative materials.

Carroll *et al.* introduced three sets of factors that affect the appropriation process and result in non-appropriation, disappropriation or appropriation of the studied technology. These levels are formed by 1) attractors/repellents, a set of factors functioning like a filter leading to the immediate rejection of the proposed technology or to the beginning of the appropriation process; 2) appropriation/disappropriation criteria, which means the stage were users try out, assess and negotiate with the technology; and 3) higher-order reinforcers that ultimately determine the outcome of the process.

Our appropriation model shown in **Figure 4** includes the same three-level structure. The main modification is to emphasize the role of sociocultural reality

which frames the whole appropriation process and has a profound influence on people's attitudes and values. Thus, in our model, the level three is called "higher order factors": these factors do not just function as reinforcers but can also hamper the adoption of new technology. The level one and two factors are actually understood and "read" through the level three; our model forms a circle where sociocultural context shapes the appropriation from the start and throughout the process.

In our model, the actual content of different appropriation levels is derived by analyzing the empirical research materials collected in Oulu. However, similarly to Carroll *et al.*, we found out that, for example, the familiarity/unfamiliarity of the technology is a significant factor. Some other factors are also equivalent in both models. When extracting the factors from our material, we paid special attention to the *public* and *urban* nature of the scrutinized technology. The fact that panOULU and UBI displays are used in *public urban places* is the main novelty we bring into the conceptualization of appropriation process. Due to this, we took into account three theoretical aspects in our analysis, derived from studies concerning city life and urbanization: the interplay between *actions considered either public or private*; the *anonymity* of city inhabitants and their *self-expression.* All of these concepts have been used to explain city inhabitants' experiences on urban technologies in question.

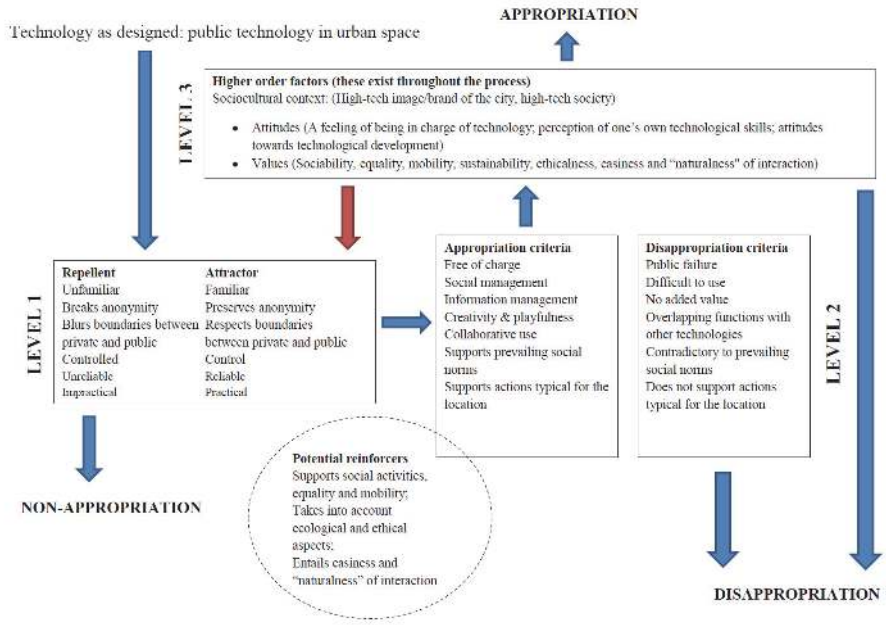

Fig. 4. Our appropriation model of public technology in urban space. (Reprinted with permission from Elsevier 2014, article III).

5.3.1 Brief overview on use trends

The differing usage trends of panOULU and the displays are presented in **Figure 5**. Over the chosen two-year period from June 2010 to May 2012, the use of panOULU had been increasing steadily, but the use of displays had been slowly declining. As presented in Figure 5, the online time had not been increasing as fast as the amount of unique devices. This is due to the growing proportion of mobile devices at the expense of laptops; this indicates how the device base in Oulu is evolving in the course of time. Also our young adult study participants brought up the transition from mobile phones to smartphones (see section 5.2.3). In addition, we inspected statistics showing the most popular applications of the UBI displays during the same period and find out that all the five games offered at that time were among the twelve most popular services. These services and their percentage values are shown in **Table 2**.

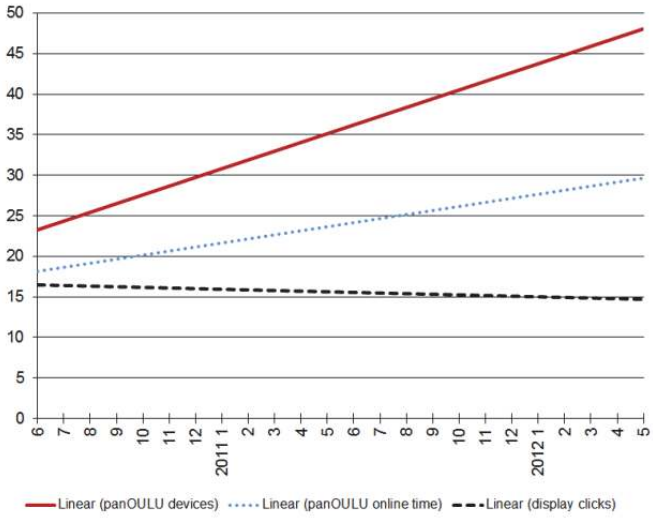

Fig. 5. Linear trends illustrating the evolution of the usage of panOULU and displays. The units of the vertical axis are: number of unique WiFi devices per AP, 1000 min of online time per AP, and 100 clicks per display screen. (Reprinted with permission from Elsevier 2014, article III).

Table 2. The ranking of the 12 most popular services in the UBI-displays. (Reprinted with permission from Elsevier 2014, article III).

Rank	Service	Description	Share *(%)*
1	Hangman	Game	17,4
2	Oulu Today	Current news headlines& Weather	14,2
3	UBI Mosquitos	Game	9,5
4	UBI Postcard	Photo greeting	6,6
5	City of Oulu	E-government information	4,1
6	Ubitris	Game	3,9
7	Blood Service	Information on blood donation	3,8
8	BelleMemory	Game	3,3
9	UBI Photos	Photo Archive	3,0
10	BlueInfo	Mobile information pick-up	3,0
11	Battleship	Game	2,8
12	Kaenkky	Fastfood restaurant directory	2,6

5.3.2 Appropriation process of UBI Displays

The long term use trends indicate that the appropriation process of UBI displays has mainly led to either non-appropriation or disappropriation. We were able to pick up several factors affecting the outcome of the appropriation process from our qualitative materials; these are presented in **Figure 4**.

Firstly, several factors can prevent people from using the displays altogether leading to non-appropriation. We noticed that *unfamiliarity* of technology was a strong repellent: both elderly adults and young adults had been having difficulties in understanding that the display technology is interactive, or intended to also other people than tourists. They were comparing interactive displays either to digital billboards or smartphones and it seemed that interactive digital large screens, located in public places, did not really fit into any previous categorizations they had. The appropriation process is a continuum based on people's previous experiences on similar technologies; if technology does not have a clear predecessor, it can be perceived as difficult to understand which, ultimately, can lead to its rejection (Green & Haddon 2009).

The whole event of using a public display can be interpreted as a *public performance* and thus, several social norms define the experience. Especially young adults gave colourful accounts on how distressing they found browsing the large display because it revealed the content to its surroundings:

> *[The use of the display] was quite oppressive because the screen is huge and everybody sees what the user is doing. I haven't been able to adopt the displays as part of my life and as a part of moving around in the city. -- It is a fun idea, it brings something special to Oulu that one can be proud of, but in practice only a few people use them. (F21)*

This can be understood in the light of theories discussing the *distinction between private and public* and *anonymity;* using the display was blurring the borders between private and public and worked against the social pattern of anonymity, which made its users to feel awkward. Similarly, content that users could not control during the interactive session, such as automatically appearing advertisements, were experienced highly obtrusive. Ads skewed their *impression management* by showing content that users did not want to become associated to, such as teenager movies' ads. The occasions where screen had not been working properly and, for example, did not respond to touch, were perceived also very unpleasant and led some of the young adults to state they will never try the device

again. The failure was made public, and according to participants, this felt extremely embarrassing. Thus, also the *unreliability* of the technology can be seen as a strong repellent.

Positive comments on the displays were connected to their versatile content, although some of the participants mentioned they can access the similar kind of content with their smartphones. Overall, *collaborative use, social aspects, playfulness* and *creativity* were emphasized by those young adults who had liked using the displays and/or had been using them several times. For example, in her ubicomp forecast also Rogers (2006) has been arguing on behalf of a new, more engaging and playful direction for designing ubiquitous computing systems. These features can be seen as belonging to the appropriation criteria, especially as quantitative data affirms that games are among the most popular services (**Table 2**). However, due to generational differences, games are probably serving mainly the younger city inhabitants who are already familiar with digital games.

Only four of the elderly adults had used the displays so far. Probably one significant reason was the aforementioned unfamiliarity of the technology. However, the ones that had been using the display highlighted that the services they offer were not useful for them. Thus, the sheer *impracticality* of the technology made it appear not worth of using for aging city inhabitants.

5.3.3 Appropriation process of panOULU

PanOULU WiFi proved to offer an interesting point of comparison for UBI displays. Many young and elderly adults were aware of it and had integrated it to their daily lives but utilized it in differing ways. Also their expectations and attitudes towards panOULU were relatively different.

In general, WiFi is easy to understand as the same technology is used at schools, homes and workplaces. Technology itself is invisible and its use does not require being in a certain location; people need to rely on their own personal (mobile) devices when using panOULU. Together, all these factors decrease the concerns connected to the public performance: content explored is not exposed to others, failure is not made public and people can freely choose where to browse their devices. In other words, use of panOULU is more flexible and private than the use of UBI displays. It is also possible to use it at homes in some areas of the city centre.

For most young adult participants, ICT was an essential part of the urban space since they used their mobile devices there in versatile ways. Continuous

contact enabled by technology was already a social norm (Katz & Aakhus 2002) although part of them opposed this development.

> *[ICT] belongs to the city. The WiFi connection of the city of Oulu enables mobile connection wherever you are. Nowadays it is important to be available also in social media. Mobility also enables working and having fun while on the move. (M21)*

In the young adults' lives, city was a *hybrid space* comprising of overlapping physical and virtual layers (de Souza e Silva 2006). For the ones using smartphones or laptops in the city, panOULU was a useful technology providing free and effortless access to the Internet when needed; comments concerning panOULU were generally positive. However, participants of the study had quite strict social rules concerning the use of ICT in different places and in different occasions. They were able to make long lists about places where surfing in the Internet, loud talking on a phone or talking altogether, for example, were not appropriate, and these lists were relatively consistent among the participants. Albeit experiencing the city as hybrid space, they emphasized that modes of mediated communication have to be *subtle* in public or in the presence of others.

On the other hand, for the elderly adults, city space did not seem to be very hybrid. They expressed strict boundaries between private and public behaviour; many of them did not use mobile phones in public at all due to perceptions that talking loud on a phone violates privacy. Overall, their life spheres were strictly divided into public and private areas and ICT was belonging mostly to the latter one, i.e. home. However, many of them lived in the city centre and used panOULU with their computers at home. They were enthusiastic about using free open access WiFi but did not understand why it did not function as "promised": Many of them reminisced how the local newspaper had (misleadingly) announced in 2005 that the network would be available for everyone all over the city. Thus, they had strong opinions about panOULU which they saw as malfunctioning and unreliable. For these interviewees, the value of the free WiFi was mostly *economic*. They did not use smartphones or laptops in public, and thus, the possibility to use panOULU in public was insignificant for them. We must remember that the city is also many people's home, and the ways people use technology at home is connected to the ways they are using or not using it in public.

5.3.4 Attitudes and values

The third level factors in our model are called as "higher order factors". This level refers to the sociocultural context and comprises in our case mainly of people's attitudes and values, affecting fundamentally level 1 and 2 factors. If these factors are recognized, they can be taken into account in the design process. When tracing attitudes and values towards technology, we have to note that they are historically formed and can differ from generation to generation; and, as we noticed, they are usually not consistent even among the same age group. Anyhow, our material enables drawing general conclusions that might assist the future designs.

What comes to attitudes, many young adults and especially elderly men though that high-tech image is an important part of the city of Oulu because technology has been important for local business life and economy. The UBI Oulu initiative and displays as a highly visible technology were seen as reinforcing this image. Although especially young adults had found using the displays distressing, most of them still argued that the proposed technology could bring some added value to the urban space. Despite their negative experiences, they saw it as a developable idea (see quote in subsection 5.3.2).

When discussing future ICT in general, both generations expressed anxiety as well as enthusiasm. Attitudes varied substantially inside both age groups. Other rather surprising finding, connected to the previous one, was to notice how knowledge about new technologies varied significantly among both age groups. The occupational and/or educational background was the most obvious factor explaining these surprisingly deep differences: in general, the ones who had (had) close contact to high technology due to their studies or career, were more technologically-savvy and had more positive attitudes towards future development. Anyhow, our analysis shows that technological attitudes, abilities and skills of any age group cannot be taken for granted.

Values were explored by looking at, for example, at the fears and dreams of the participants of the study. Elderly adults' central concern was the ability to live in their own homes as long as possible, which calls for staying mobile. They were also worried about the fast development of technologies and hoped that someone introduces new technology to them. In their accounts, young adults emphasized first of all, the functionality of technology: the use of future devices should be smooth, fast and effortless. Secondly, they highlighted the democracy of technology wishing, for example, that even the most remote villages in the

countryside would have a fast Internet connection. Third, ecological and ethical values were mentioned often and young adults discussed, for example, fair trade and the reusability of high-tech. Also, interestingly, the "naturalness" of technology was a recurrent theme. These wishes were often accompanied by explaining how technology should have a less visible role in everyday life; it should assist people without interfering or interrupting their doings. One participant mentioned how ICT of her dreams would be like a "glass of water" (as perceived by Finnish people): as self-evident, invisible and clear.

5.3.5 Towards future design of urban technology

Our study indicated that appropriation of a new technology in public urban surroundings is a complex process that cannot be fully understood without long-term and in-depth interdisciplinary research. However, by examining both quantitative and qualitative material, it is possible to unwind the process and identify some of the main factors either supporting or hampering the adoption of new technologies. Our study revealed how important it is to consider social dynamics when designing technology for public places; technology use in private settings differs remarkably from public use. We have to note that the factors presented in our model are derived from the material collected in the city of Oulu; they cannot be considered universal. People having a different kind of cultural background and living in different cities do not necessarily perceive, e.g. a public failure, in a same way than Finnish people do (Laine 2006).

Considering the case of UBI Oulu, the important finding was that in general, the higher level factors, or attitudes and values, are not intrinsically against new urban technology: in fact, proposed technology entails many features valued by study participants, such as democracy. Urban public technologies are, in theory, very democratic as they are accessible for all. One young participant actually referred to this by mentioning that UBI displays as visible devices could be used for "public informing which belongs to democracy". Also attitudes were in general positive towards installations reinforcing the high-tech image of Oulu.

However, certain "problems" at levels 1 and 2 can oppose technology appropriation by making technology useless or intimidating for some of the city inhabitants. Fortunately, many factors listed on our model at levels 1 and 2 could be taken into account in the design process and changed; we discussed these implications for design in article III. To take two examples, urban public displays were mixed with digital billboards, and on the other hand, interacting with them

was experienced as distressing due to their great visual capacity which exposed content to the passers-by. The first problem could perhaps be solved with less business-like and more playful aesthetics (e.g. Tractinsky & Eytam 2012). Secondly, a different kind of placement could diminish the distress of public use; at the moment, outdoor displays are mainly in the middle of the streets in very visible locations but they could also be, for example, integrated into the existing infrastructures (e.g. Peltonen *et al.* 2008). Also some of the study participants suggested that displays could be located nearer to the walls of the buildings.

To broaden the perspective, we reflected our findings to some recent ubicomp forecasts. Bell and Dourish (2007) have stated that instead of emphasizing homogeneity and the seamless interoperability of technology and pursuing towards these unrealistic goals, ubicomp researchers should admit that future technology is already here, in the form of messy, versatile and heterogeneous technologies and manifold technology-related practices. According to them, "future" technology is also very unevenly distributed. On the other hand, Williams *et al.* (2009) have argued that when designing urban technology, it should be acknowledged that urban environments are not just fixed setting but changing places whose meanings are dependent on the context, time of the day and time of the year, as well as on the people inhabiting these places and moving through them. Also interconnectedness of different places such as city and home should be noticed when making sense of urban reality. These forecasts emphasize diversity on many different levels: on the level of technology, practices and cities; also everyday rhythms connected to time of the day and people's movements between places are included.

In our empirical analysis, many of these aspects became clearly visible: technological realities of people were highly versatile. Some of the participants of our study already lived a technology-filled life resembling the visions of ubicomp; on the other hand, some were less technologically-savvy and found promises of technology rather scary and repellent. In our material, urban environment is framed and moulded by meanings the different city inhabitants assign to it. Different people had different conceptualizations of the city of Oulu and different kind of perceptions of technology's role in urban life. Also the entanglements of the home and city environment were visible in our material; when looking at people's everyday practices, the pervasive role of technology is contesting strict separation between different locations. Understanding the everyday life calls for a holistic perspective.

The challenge of urban computing is to respect the varying and sometimes even contradictory practices of city inhabitants; it should be flexible enough to become part of the everyday life of different people, or designers should offer completely different solutions for different groups of people. However, successful designing for the messy and diverse city environments calls for profound empirical studies, which requires mapping urban reality from different angles and taking also experiential level into account. Further, the design approaches offered by participatory design (PD), e.g. its subfield co-design (Sanders & Stappers 2008), and design anthropology (Otto and Smith 2013) would be extremely useful when intending to change these challenging environments by new technology; they offer ways to include city inhabitants' perspectives in the design from the start, democratize the design and see lay people as co-innovators.

5.4 Proposing climate sensitive urban computing

The motivation of article IV **was to explore what kind of implications northern location can pose for the new urban technology.** Of course, northern, or to be more specific, *arctic location* can mean a number of things: it can refer to long distances, relatively small size of the cities, vast wilderness areas or to the harsh climate. In our paper, we concentrated on the last feature, as its effects on ICT use were so strikingly visible in our research material. The climate, weather and people's everyday ICT use in urban settings is explored in the article *Winter is Coming: Introducing Climate Sensitive Urban Computing.*

We used research material produced with one age group, the young adults. The ICT diary probe contained a specific question on northern conditions and ICT use, and the same theme was further discussed in group interviews. This material focused mainly on the use of personal mobile devices and home computers. To complement these accounts, we analyzed also the notebooks on public displays from the perspective on climate and weather; this way, we were able to grasp young adults' perceptions of another kind of technology, namely the outdoor UBI displays.

We used the term *climate* to refer to the long-term average atmospheric conditions, while the concept of *weather* refers to the more local and short term conditions, such as rain or heat. Our hypothesis was that since harsh climatic conditions and changes in weather inevitably affect people's life spheres and everyday practices in the north, they probably are also interconnected with ICT use. ICT has become a part of everyday life and it is used everywhere,

increasingly also outdoors. This aspect is especially relevant and timely from the perspective of urban public technologies because they are often designed for outdoor use. However, we did not just aim at studying and conceptualizing the interconnectedness of weather, climate and technology use, but, in addition, we attempted to map some central *design challenges* and potential *new design spaces* opened up by this perspective.

The theoretical considerations of cultural anthropology and architecture formed the foundations of the paper. Within these disciplines, climate and weather have been regarded significant drivers of human activity and design for centuries (e.g. Peterson & Broad, 2009; Rohinton, 2005). On the other hand, these same factors have not played an important role in HCI and urban computing research, as our literature review pointed out: sometimes, these factors are mentioned (see Zarek *et al.* 2012) but usually they do not play a central role in studies. This is probably due to several reasons: most of the HCI studies have thus far been conducted in laboratories, and overall, ICT has moved outdoors relatively recently. However, we found a research gap within anthropological and architectural studies as well: it seems that the effect of weather and climate has not been scrutinized *on the level of everyday ICT practices*.

In anthropology, ICT use in arctic or northern regions has been studied through several theoretical lenses; for example, it has been looked at from the perspective of cultural identity (e.g. (Christensen 2002), the digital divide (Subramony 2007), infrastructure (Beck *et al.* 2005), or technology adoption (Thulin & Vilhelmson 2007). Anyhow, none of these studies has especially concentrated on analyzing how physical conditions or seasonal variations typical to the north might affect everyday use of ICT.

What comes to architecture, scholars have paid attention to weather and climate for a long time, and actually the entire field of architecture can be understood as being a product of weather (Hill 2012). However, augmenting urban environments with digital technologies is such a novel phenomenon that issues related to technology, built environment, climate and weather did not surface in our literature review. Within architecture, however, the "perpetual summer 'state of mind'" (Pressman 1988) has been criticized, and the field offers design perspectives such as *climate sensitive design* (Rohinton 2005) that can be applied to urban technology.

To address this lack of micro-level studies on climate, weather and ICT use, we inspected our qualitative, empirical materials from a specific analytical perspective by using two concepts: *emplacement* and *rhythms of everyday life*. In

addition, we examined also the quantitative data sets concerning the use amounts of an outdoor UBI display in relation to weather and temperature, and found clear interdependency (see article IV).

5.4.1 Weather-related tactics of ICT use

The concept of emplacement helped us to take into consideration the *situated and embodied* nature of studied interactions. This part of the analysis dealt mainly with the effects of weather, and rhythms were mostly connected to the climatic variations.

The participants of the **ICT diary probe study** especially highlighted how difficult it is to use technology outdoors during the wintertime. Technology itself, mainly mobile phones (since nobody even tried to use laptops outside), reportedly froze and slowed down. The participants gave also rich accounts related to bodily experiences: using devices outside was experienced painful and irritating, especially because modern touch screens require taking gloves off. They discussed how during cold and dark time the mobile phone's role as a security device increases but, unfortunately, at the same time its reliability decreases. Some of the participants expressed strong emotions when talking about the incompatibility of winter and ICT. Roughly, the reactions of the participants reflected either submission or anger and frustration when talking about winter and ICT.

The young adults' experiences, shaped by the harsh northern conditions, affected also their perceptions of different phone brands: for example, they wondered why Finnish Nokia does not (anymore) make phones that fit better into Nordic conditions. Some still used their old phones when going, e.g. for a long hike. The fact that iPhone is apparently especially sensitive to cold (highlighted in the news at the time of the interviews) was found funny and ridiculous.

However, many participants had adopted practical ways to deal with the winter conditions: phones were for example kept close to the body, inside mittens or under the outerwear, in order to keep them dry, warm and functional. Keeping the phone close to the body was also in line with the need to hear or feel every call and message; some of the participants told they hate missed calls (see article II). Furthermore, one young woman told how she is in the habit of tapping sometimes her smartphone with her nose to protect her fingers from the coldness. The bright light of the touch screens was helping some participants to wake up in the dark winter mornings.

The notebook study revealed similar difficulties, although the used technology was almost the opposite of the lightweight portable devices: immobile, large screens. Using the touchscreen of the UBI displays was found unpleasant because of hands getting cold; this was a frequent theme in both autumn and winter data sets, although temperatures were much higher during the collection of the former one. One participant, however, had noticed that the screen emits heat and had been warming her hands on it. During unfavorable weather conditions, such as rain, participants had preferred displays that are sheltered from the weather: one is located in an arcade structure, for instance. Rain had also some unexpected implications: Several participants worried if the display is hygienically problematic, and these remarks were, interestingly, more common within the winter data set. This can be due to the fact that in milder temperatures rain cleanses the displays.

To summarize the findings, empirical research material revealed several *weather-related tactics of ICT use.* These include using body heat to keep devices functional, using heat emitted from the large situated device to keep fingers warm, and looking for sheltered places when using technology. Some people resorted to older, simpler and more reliable personal devices in cases where they did not want technology to fail. All in all, technology use was perceived through bodily sensations that were closely shaped by the location of use; these in turn, resulted in tactical adaptations and appropriations helping people to embed technologies in the everyday life.

5.4.2 Continuity-discontinuity patterns of ICT use

The radical seasonal changes in north seem to create a phenomenon which one of the participants aptly called "technological seasons". This concept nicely underlines how the ways ICT is used is linked with the natural rhythms – or non-human rhythms (Edensor 2010, 7) – of the year. This perception was extremely consistent **in the diary probe material;** a clear majority of the participants described how their use of technology changes over seasons. Participants told they spent more time at home and indoors during the dark and cold time of the year, and how this has an effect on the use of a personal computer: ICT and virtual networks became more important and meaningful during the winter. The participants commented, for example, that "During the winter I tend to curl up indoors where it's warm, and spend more time alone" (F26); "Going out takes a lot more effort, so I just kinda get stuck on my computer" (F21).

On the other hand, the diary study also clearly indicated that in the summer the meaning of PCs diminishes; the more pleasant the weather is, the more people move outside, and the mobile phone or the smartphone moves with them becoming the most important device. “Summer and the mobile phone go together hand-in-hand” (M29). “I use the mobile phone more during the summertime to keep in touch; the people of the city come alive during this time” (F26). The recurrent comment was that the northern summer is so short that it is extremely important to enjoy it as much as you can; this was done by being on the move and spending as much time outside as possible. The phone offers means to stay in touch and find friends at the same time. During the summer time, the meaning of ICT was experienced to decrease overall. Only a few participants told that they use other devices such as laptops also outside, for example to be able to study or work at beach or summer cottage.

When analysing **the notebooks on public displays**, we could trace similar patterns that are connected to seasonal variation. In addition to being linked to bodily comfort, these were also related to visual aspects. The appearance of the public displays was experienced differently within different seasons; the changes in lighting and the presence of snow transform the visual appearance of urban landscape producing aesthetic rhythms. The dark colour of the screen was experienced to be more visible during the winter, and a couple of participants described it as “protruding from the snow” (W-F29, W-M24; see **Figure 6**). In the autumn data set, more participants felt that the screens are meshing with their surroundings, and due to their shape and material, resembling the buildings or other urban furniture nearby. The seasonal variation, as well as variation related to the time of the day, affects also the lighting conditions having potential effects on the design. Thus, lighting conditions vary dynamically and matching the brightness of the display with them can be difficult. One participant described “In the dusk, the glow of the screen can lure people to take a closer look” (A-F26); in the daytime, however, the displays were “not bright enough” (A-F23) and the visibility and the glare were experienced as problems. One interesting aspect, related to aesthetics as well, was how some participants experienced sympathy for a situated device that seemed badly maintained and dirty, caught in a bad weather or being alone. One participant, for example, commented that the display “looks lonely when the marketplace is empty” (A-F26) The use of the marketplace is heavily connected with the seasons, as well as with daily rhythms. Overall, the city constitutes of numerous rhythms that are beyond the control of technology designers.

Fig. 6. UBI-display located at the marketplace in the winter. (Reprinted with permission from ACM Press 2014, article IV).

All in all, exploring technology in relation to the rhythms unfolded *continuity-discontinuity patterns of use.* Seasonal variation is intertwined with peoples' everyday life rhythms and practices, and technology use was deeply part of these practices; thus, also it followed these patterns. Seasonal variation changed young adults' behavior which, in turn, had an effect on *the role* of different devices. Despite emphasis was on different devices during different seasons, the main functions of the ICT did not vary that much: sociality and information seeking remained the most important functions. Mobile and personal devices enabled flexible shifts between indoor and outdoor use depending on the season, and the continuity of the use was never actually broken. From this perspective, the device itself is not at the center of attention but its meaning for everyday life, and how it fits into seasonally changing practices. Situated displays became problematic in this aspect because in their current form they did not support the continuity of use, as harsh conditions could prevent people from using them completely. Seasonal rhythms and resulting practices have not been taken into account in the design of the outdoor displays, which results in problems, e.g. with bodily

comfort and aesthetics; our network of outdoor displays seems to be designed with the "summer state of mind" (Pressman 1988).

5.4.3 Climate and weather as cultural variables

When conducting analysis on our empirical material by using the perspectives offered by emplacement and rhythms of everyday life, we found out that weather and climate actually have broad impacts on people's possibilities and willingness to use ICT. Climate and weather can be understood as *cultural variables*, because they affect peoples' meaning making processes and their whole way of life; and technology use must be seen as part of these.

We discovered some interesting **weather-related tactics of ICT use** that refer to various ways that young adults used to cope with inconveniences posed by weather. Nevertheless, our analysis pointed out that these tactics were not based on just functionality, but also people's values and, e.g. everyday objects' role in identity work must be taken into account. People for example chose to protect fragile devices against harsh weather conditions or own two different phones instead of simply acquiring one "weather proof" mobile device. Even more detailed ethnography could increase our understanding of these northern tactics. Situated technologies, such as the studied public displays, faced other kind of weather-related design challenges, as similar tactics could not be used; i.e. users were not able to adapt displays to prevailing conditions by their own actions. This might be an additional reason explaining the slow adoption process of the displays discussed in article III. Thus, the strategies of the designers are actually in more decisive role here: we argue that in-depth understanding of the emplaced experiences provides a starting point for design. After all, ignoring these problems can result a total disuse of technology.

Our investigations unfolded also important **continuity-discontinuity patterns of use.** The flexible changes between different use environments, technical devices and everyday practices constituted a cycle where the central meaning of ICT was actually the same all the time; only the means and places varied in respect to the seasons. However, the role of the UBI displays in this pattern was uncertain. We argue that a detailed understanding of the rhythms of the design context is crucial, including seasonal variations; mapping the impacts of various temporal rhythms of daily, weekly, and seasonal cycles could be extremely useful part of the design practice of situated technologies. These can be combined with other rhythms of everyday life, such as pedestrian flows and

varying use patterns in urban places, which change from season to season. Designing situated interactions could benefit from an in-depth understanding of people's sociality and information seeking practices at different times.

The aim of article IV was not to present any detailed implications for design, but to frame new design challenges. However, we outlined some possible design ideas to support our arguments. We concluded that **mobile technologies** are relatively flexible in regards to challenges posed by weather, and users had several tactics how to adapt their mobile devices into varying conditions. The designers should, then, think what, e.g. the closeness to the body, means for their designer strategies. For example, would it be possible to make the device or its shelter of materials which absorb body heat? Should it be made of slightly flexible materials – or at least have round edges – to align with users' body shape when placed in pockets? Of course, the radiation of mobile devices is one question that should be addressed as many users choose keep their phones close to their bodies. What comes to **situated technologies**, they could be designed to respond to the challenges posed by climate and weather, e.g. by making them to echo the changing visual aspects of their surroundings. This could be achieved on many levels – their overall appearance could change according to the changes in the environment, and different seasons could be harnessed for inspiration in content production. At the least, the brightness of the screen should adapt to the changes in lighting conditions. One key design strategy, derived directly from our analysis utilizing the perspective offered by emplacement, is that the potential users should be understood as *embodied beings* by offering them, for example, bodily comfort instead just "attracting their minds" with the content. In this fashion, designers could approach the design of situated technology from a completely different angle: not by offering a PC outdoors, but by taking *urban furniture design* as a point of departure. Urban furniture is meant to provide physical comfort and protection to enable people to spend time outdoors – and in this case, it would be digitally augmented. Of course, a more straightforward yet not so elegant solution would be to integrate a display into some already existing sheltered resting places.

Overall, we found clear resonance between weather, climate and technology use; and thus, we propose that *climate sensitive thinking should be an integral part of the design of urban ICT.* Local climate and weather conditions can be challenges but also a productive starting point for design. Technology is already outside; situated installations are being constructed, technology is integrated into the built environment and small computers are travelling in our bags and pockets

everywhere. Our findings indicate that *situatedness* and *materiality* of the urban technology, alongside with the social aspects of technology use, should be reconsidered.

6 Discussion: Expanding the horizons through interdisciplinary thinking

> *We believe that maintaining and updating Weiser's vision agenda entails a solid empirical understanding of the present (as advocated by Bell and Dourish) as well as an interested hope in working toward a future that is revolutionarily, not evolutionarily, better than the present, and a commitment to bringing about that hopeful future through action. (Bardzell & Bardzell 2014, 790.)*

In the first chapter, I outlined the main themes of this research as *diversity, power* and *change.* Diversity has been explored by concentrating on studying the design process of UBI Oulu and the diverse voices behind it; in addition, the technology-related, highly diverse everyday life practices of chosen groups of city inhabitants have been under the scrutiny. Diversity of cities was another point of departure; every city is unique due, e.g. to its history and location. Oulu's uniqueness was acknowledged by paying attention to historically formed local sociomaterial practices and to its northern location.

My main argument is that if we wish to change the urban landscape with technology, we need to ground changes in the current diversity. Sacrificing diversity in technology design means too often that interests of only one group are promoted – which, at worst, leads to sacrificing equality. Anyhow, the uneven power relations and tensions can seriously complicate the pursuit of urban technological dreams, no matter how egalitarian they had been: the tensions between different stakeholders making important decisions concerning the design; the tensions between the strategies of the designers and tactics of the city inhabitants; and the tensions between different disciplines and scientific traditions. This study has attempted to make all of these visible within one specific technological research and development program.

The UBI Program with its novel technology created a wonderful opportunity to explore how a new kind of technology was designed for and implemented in such a contested terrain as public urban places, and how it was received by the city inhabitants. The design and adoption processes of technology are two sides of the coin of innovation, as Silverstone & Haddon state (1996). Design is not in decisive role alone, but technology's faith is dependent on its adoption.

To summarize the key findings, the thesis showed that decisions concerning novel technologies and the outcome were shaped by complex sociomaterial

practices; in UBI Oulu, the main practices were the funding resources framing the user involvement, the need to keep up the high-tech image of the city, and pursuit of scientific innovation. These were built, e.g. on experiences about previous similar projects and discourses concerning scientific knowledge production. The design process is necessarily colored by certain preconceptions about the city, its inhabitants, and technology's role in the cityscape.

We examined also city dwellers' perspectives, and concluded that in Oulu the installed technology did not seem to meet the varying perspectives of the young adult and elderly city inhabitants. Importantly, age as a singular category did not explain our study participants' ICT relations; a variety of factors starting from education and career were altering their perspectives. Remarkable, a notable part of individuals belonging to both age groups felt that as technology users they were incompetent or not using new ICT efficiently enough. This finding is in clear contradiction with the fact that new urban technology had been designed with a particularly technologically-savvy imagined user in mind.

What comes to power positions, people are positioned differently in relation to new urban technologies and their design due to the different technological realities they inhabit. Some individuals and groups can be pushed further towards the margins if novel technology is taken as an imperative in the development of urban public places they live in or move around.

Further, we built a conceptual appropriation model explaining the factors that had been affecting the adoption processes of two specific urban technologies, panOULU WLAN and UBI-displays. Appropriation of new technology was depicted as a multifaceted process dependent on people's experiences of other similar technologies, and in the case of public urban technologies, of the norms of public behavior. In this regard, city inhabitants were in different positions as well; the designed technology resonated better with the practices and experiences of the young adults. From this analysis, we derived implications for design concerning urban technologies.

Finally, we investigated our young adult study participants' stories by paying attention to relationship between harsh northern climate and technology use, and found clear resonances. We proposed that climate sensitive thinking should be an integral part of the design of urban computing design. Local climate and weather conditions can be challenges but also a productive starting point for the design. Overall, the thesis highlights how technologies are always constructed by certain social, cultural and material processes; people's experiences of them are profoundly situated and entangled with heterogeneous everyday life practices.

6.1 Contributions for anthropology

This is the first anthropological PhD thesis carried out in Finland concentrating on studying large-scale urban technology installation from a perspective that spans from the design to the adoption and use of the technology. At the national level, the project has produced new knowledge that can significantly benefit the development of social studies of technology. I consider it extremely important that an internationally acknowledged and arguably unique civic laboratory, UBI Oulu, was studied also from the sociocultural perspective. This study has outlined directions for further sociocultural studies of urban technologies in Finland, which can be seen timely and important as smart city appears to be a vital vision that continues to steer politics and urban development in our country [17]. Anthropological knowledge does not need to stay within the limits of academia but it could be more often used for the benefit of technological development and business models related to information and telecommunications technology. In addition, this research has helped to build connections between different disciplines by investigating the epistemological and methodological tensions that can complicate cooperation. Also internationally, the empirical, socio-culturally and spatially oriented research on specific smart city initiatives has been scarce (Kitchin 2014). This dissertation addresses this gap and provides empirical data and situated knowledge on an actual, wide-scale urban project.

I claim that this study shows how anthropology can truly work on many levels in such a project (Dourish & Bell 2011). It can make invisible visible and "expose the mundane" (see e.g. Galloway 2004) by describing what kind of sociomaterial forces formulated the design process; it can provide detailed knowledge about the current technological practices of people, but it can also be tuned towards the future and towards the change. Thus, it can produce *both* implications for design, a set of design instructions that are applicable for certain situations (article III), and help to open up completely new, potential design spaces (article IV). In other words, anthropological knowledge can be oriented towards different time levels, and the profoundness of the knowledge can also have many levels.

What comes to methodology, I combined a traditional ethnographic approach with methods borrowed from design studies, which appeared to be a good

[17] See e.g. national Innovative Cities Program (INKA) which will continue until the year 2020. http://www.investtampere.fi/how/innovation-programmes/innovative-cities-inka/

strategy; this is also a theme that should be elaborated and discussed more in-depth in the future. The research material was plentiful, and some facets of it are still waiting for their analysis. On epistemological level, my central notion is linked to change: we need to engage ourselves with politics – be it politics of good urban life, wellbeing or something else. A citation from Galloway (2004, 402) is written ten years ago, but I claim the agenda still needs to be promoted:

> *To begin, we need to be clear on, and be able to justify, what it is about the mundane nature of everyday life that can be 'improved' through augmentation, amplification or attempts to merge the physical and the virtual – especially if the technologies themselves are expected to become ordinary and pervasive aspects of everyday life.*

Change cannot be promoted without any commitments; it postulates an engagement to values. In this research, my commitment to diversity and equality of urban life has hopefully been visible all the way. Nobody should drive change just because of change; we need to have commitments, and we need to make them visible. That is why pure postpositivist let alone positivist epistemologies solely, with their requirement of objectivity, are not offering ethically responsible ground for research that is so strongly engaged with social change (Bardzell & Bardzell 2011).

6.2 Limitations of this research and future directions

Firstly, I want to underline it would be extremely useful to use anthropology in all stages of such a research project; we joined the UBI Program a bit too late with our anthropological project UBI Anthropos. The most important decisions concerning the new urban technology had already been made, and the basic infrastructure had already been deployed. Thus, we were not able to study the everyday life, attitudes, skills and needs of the city dwellers beforehand with ethnographical means, which would have been beneficial for the success of the technology, as many previous projects have shown; it also would have provided us with even more interesting research material. In the future I would like to deepen my knowledge on design anthropology, as this PhD project has shed light on the multiple ways anthropological knowledge can resonate with design.

The second limitation I would like to point out concerns the initial scope of this research, largely determined by the UBI Anthropos project. However, I participated actively in defining the aims of the research project in question, and

thus, also goals of my own thesis. The scope that spanned from the design process of urban technology to its adoption and use was very ambitious – considering that two cultural anthropologists including myself worked in the project for less than three years. The design process could have been explored from other viewpoints as well: for example, the original written project plans could have been compared to the outcome; also the media discourse surrounding UBI Oulu could have been a truly interesting topic for analysis – but we simply did not have resources to conduct additional studies. The same applies to the perspectives of the city inhabitants: two groups of people, defined mainly by their age (and in the case of the young adults, partly by their educational background), are of course not representative if we think about the whole city and all its diverse inhabitants. Nevertheless, they serve as examples demonstrating how vast the spectrum of technological experiences can be. In the future, it would be interesting to study groups of people that are grouped according to some other factors, e.g. their activities and free-time interests, and not solely by age.

Thirdly, the richness of the research material concerning technologized everyday lives of the study participants and the urge to unveil their (often neglected) practices and experiences caused us sometimes to favor ethnography instead of deeper theoretical analysis. In other words, the scope of this dissertation is more practical than theoretical. Thus, I feel that many aspects of the research could be further elaborated in the future by engaging more profoundly with theories; one of the most urgent questions deals with the noted disparity of emplaced, socially and materially constructed experiences of city inhabitants and the smart city visions. This theme should be further discussed, and we must also ask what kind of participatory design or co-creation practices could enhance the situation. Conducting interdisciplinary research also means that the work could be connected with a vast array of theoretical discussions rising from several relevant fields and subfields – anthropology, STS, media studies, urban studies, HCI, ubiquitous computing – and I am well aware that in this dissertation I have been able to grasp only a few of them. Caught in the middle of such an abundance, a researcher is condemned to feel insufficient. At the same time, maintaining ontological, epistemological and methodological consistency becomes crucial and challenging, also due to the practical requirements to solve design-related problems and publish the results within limited time frames.

The last but not the least limitation and definitely also a relevant subject for the future studies, are the challenges of interdisciplinary cooperation. They completely surprised me. I spent an enormous amount of time and energy in

trying to understand, not only my own subject of study and anthropological perspective, but perspectives of my fellow researchers coming from other disciplines. The process has resulted that as a researcher, I have a hybrid identity. I may have missed some lessons about anthropology while learning about, let's say, HCI, but hopefully, I can transform my hybridity into a strength in the future. I have also been confronted with the fact that in such research projects, an anthropologist needs to negotiate and move between different *intellectual positions*: s/he must be part of the puzzle formed by design research and participate in resolving practical problems, but at the same time, the critical orientation typical for anthropology should not be forgotten. The anthropologist has the means to challenge broader taken-for-granted norms and structures – and within interdisciplinary research, this role of *a critic* should be transformed into a virtue, as Strathern (2006) suggests. Certainly, this kind of multi-layered, ambivalent – and sometimes uneasy – role is very challenging.

That said, I strongly argue on behalf of interdisciplinary research. This research process has allowed me to broaden my own perspective and made me to realize the narrowness of a single discipline's viewpoint. When we study, or intend to change, complex, broad phenomena such as a city, by utilizing, e.g. new technology, we need functional cooperation practices that allow us to go beyond the traditional disciplinary boundaries. The globalizing world has plenty of issues that can be tackled only by joint efforts, which means also shattering the old hierarchies on many different levels. The much needed collaboration also raises a host of broader questions and challenges that could not be thoroughly answered in this dissertation. However, I hope I have been able to demonstrate the complexity and importance of the following themes: Overall, how anthropological research should be conducted in such applied interdisciplinary projects? How such projects affect the realization of empirical research, e.g. how we can piece together the time scales and other requirements of ethnography and urban technology design? How such projects transform and challenge the ways the research is communicated? Overall, I wish this dissertation illuminates the vast amount of unanswered epistemological, methodological, theoretical and empirical questions related to applied, interdisciplinary studies of new technology and urban environments.

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I Suopajärvi T, Ylipulli J & Kinnunen T (2012) 'Realities Behind ICT Dreams'. Designing Ubiquitous City in a Living Lab Environment. International Journal of Gender, Science and Technology 4(2): 231–252.

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