A smart and ubiquitous urban future? Contrasting large-scale agendas and street-level dreams

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Abstract

This article examines the dreams and wishes of young-adult city residents regarding future ICT development, comparing its findings with two visions of ICT development offered by large-scale urban agendas, namely 'smart cities' and 'ubiquitous computing.' The article explores how the visions of ordinary city inhabitants contest or resonate with grand visions of urban future, and investigates alternative agendas that might be built upon those visions. The research site, the city of Oulu in northern Finland, offers a concrete example of a 'future city' in which many ideas relating to 'smart' and 'ubiquitous' urban space have been put into practice. The results indicate there is an urgent need to address questions pertaining to control, agency, and resistance in designing further technology for cities and to employ design practices that enable the creation and implementation of bottom-up visions.

Keywords: Ubiquitous computing, smart city, ethnography, urban technology, future visions.

Introduction

Everyday life in cities is currently undergoing interesting and profound change with the brisk development of computing technology. Information and communication technology (ICT) has become pervasive, no longer tied to desktops at work or home. Users of personal devices adopt and carry those devices everywhere, while digital public screens, billboards, projectors, and wireless networks are becoming more and more common in urban environments. All these technologies affect and to an extent construct and organise everyday life in cities (see e.g. Ridell & Zeller, 2013). ICT has – in other words – become part of the fabric of everyday city life. Such change does not happen purely 'naturally'. Many large-scale agendas such as the smart city movement, or research and design paradigms such as urban computing, aim consciously to furnish cities with high technology.

The research in this article was conducted in Finland, one of the most technologically developed countries in the world. Recent statistics stated that in 2013, eighty-five percent of Finnish citizens between the ages of sixteen and eighty-nine used the Internet (Official Statistics of Finland), while sixty-one percent of citizens between ages sixteen and sixty owned a smart phone (TNS Gallup). Information networks are almost pervasive in Finland, covering nearly every corner of the sparsely populated Nordic country. The author's research site is Oulu, a city of approximately 191,000 people just two hundred kilometres south of the Arctic Circle, and one of the northernmost relatively large cities in the world. Oulu is a particularly intriguing example of the interplay between cities and technology: it has for several decades built its public

image and economy around high technology. Moreover, 'Open UBI Oulu,' a recent joint initiative by local academia – the University of Oulu – and by municipal government – the City of Oulu – has aimed to transform Oulu's city centre into a so-called 'civic laboratory.' A range of computing infrastructures has been deployed to urban places to provide residents with new applications and services.

The related paradigms of 'ubiquitous computing' or 'ubicomp' and 'the smart city' currently steer the technological development of Oulu. Ubicomp's research agenda stands on the influential visions of Xerox PARC researcher Mark Weiser (1991; 1997). The study of ubicomp in urban spaces is referred to as 'urban computing,' an emerging interdisciplinary field that sees public spots such as streets and parks as potential computing sites, exploring the interaction between humans, computers and such environments (see e.g. Kindberg et al., 2007; Paulos & Jenkins, 2005). Both 'ubiquitous computing' and 'smart cities' aim to transform cities with technology; they propose a change to urban environments inhabited by vast, diverse groups of people. Both approaches have, however, been criticised for being overly technology-driven; critics have also accused the smart city idea of being too reductionist, and of promoting benefits mostly for entrepreneurs (see e.g. Hollands, 2008). Design processes have quite often neglected the diversity of city dwellers and their everyday life practices, perspectives, needs, and skills, although residents are crucial to cities becoming 'smarter' or more 'ubiquitous' (e.g. Dourish, 2007; Williams, et al. 2008).

This article aims principally to shed light on the perspectives of 'ordinary' city inhabitants by analysing ethnographic material concerning young adult citizens, aged from twenty to thirty years old and resident in the city of Oulu. I have scrutinised their ICT practices, attitudes, values and perspectives using a cultural-probe-inspired method (see Gaver et al., 1999; Mattelmäki, 2006) that combined participants' self-documentation with semi-structured thematic interviews. A *scrapbook* was used as a 'probe' sent to collect the thoughts of young adults about their everyday ICT practices, in spaces such as at home or in urban surroundings. Kitchin (2015) stated that one of the shortcomings of critical smart city research is a lack of empirical studies on specific smart city initiatives that address – for example – the socio-cultural implications of such agendas. I contend that an analysis of the Oulu case employing relevant ethnographic materials is timely and important.

In summary, this article moves between a discussion of international agendas concerning the future direction of cities and their Nordic real-world applications, and a discussion of the experiential level of young adults living in one particular 'technologised' city. The article's structure is as follows. I first introduce the above paradigms, the grand narratives influencing the development of ICT in the cities. I continue by exploring how those paradigms have been applied in the city of Oulu, and how young residents perceive the development in question. Finally, I explore the accounts of young residents in relation to the technology of the future. The latter section investigates what themes concerning the 'dream ICT of the future' are discoverable in the qualitative research material, and whether those themes contest or resonate with large-scale visions of ubiquitous computing and the smart city. My motivation for this analysis lies in the profound and much debated question, '*Who has the right to transform cities and whose voices are heard during processes aiming towards change?*' (e.g. Mitchell, 2003). I aim to conduct an analysis that contrasts top-down visions with bottom-up perspectives and visions, so as to provide alternative understandings of the nature of current urban technology – and to arrive at desirable future directions for that technology. I also discuss how different voices could be included in urban technology design processes more widely.

Large-scale visions behind technologised cities

Several overlapping paradigms currently steer the integration of ICT into cities. This section focuses on two influential agendas; *one*, the smart city paradigm, which can be described as a 'politico-economic' strategy; and *two*, ubiquitous computing, a paradigm of research and design. Both strategies first appeared in the 1990s. 'Ubiquitous computing' and 'the smart city' can refer to similar approaches to ICT integration, but 'smart city' is a more widespread, ambiguous term favoured in particular by politicians and other decision-makers. Ubiquitous computing is – in turn – used mostly within a context of academic research and design. Another difference between 'ubicomp' and 'smart city' is that 'smart city' operates mostly on a system level, focusing on large-scale strategies, whereas ubiquitous computing moves between scales, from a macro to a micro level. For example, ubiquitous computing concerns itself with the large amounts of data collected by sensor networks in urban environments – and with the experiential level of city residents. Ubicomp also proposes a powerful vision for *how* people should interact with computers.

In short, smart city is a *conceptual* model of a high-tech city that has gained popularity globally in recent decades and which heavily affects the development of numerous cities. 'Smart city' typically refers to an urban community that views computational infrastructure as an important city facet, increasing efficiency and competitiveness while providing added value to residents and visitors (Ishida, 2000). However, no single definition of a smart city exists; cities that have adopted the 'smart city' label have stressed different aspects of the urban use of ICT, from e-governance to environmental sustainability and IT industries. Söderström et al. (2015) present the following definition: "In quite general terms, smart cities involve the creation of new relations between technology and society. According to this vision, […] urban infrastructures and everyday life in cities are optimized through technologies provided by IT companies" (Söderström, 2015, p. 309). The idea of the smart city employs numerous infrastructures beginning with transport, but smart city proponents usually view ICT as lying at the core of its agenda (Caragliu et al., 2011; Hollands, 2008).

Smart city literature can be divided into two main parts; *one*, texts concerned with specific technologies that explore how cities might be turned smarter; and *two*, studies that take smart cities as objects of analysis, aiming to present a definition of the smart city (Söderström et al., 2015). More critical analyses have remained scarce until recently. Hollands' article (2008) presents an interesting early exception. His most important findings concern assumptions underlying the smart city concept. Deconstructing smart city rhetoric, Hollands notes that it often assumes the development of "a rather harmonious high-tech future" (Hollands, 2008, p. 314) that leans uncritically towards technological determinism and entrepreneurism. Within that future, Hollands argues, business interests are often privileged and social polarisation is considered an inevitable consequence. On the other hand, technological efficiency is seen as automatically producing wealth and well-being (cf. Suopajärvi et al., 2012). Hollands concludes that a "smart city" should be conceptualised as more progressive and inclusive:

> First and foremost, progressive smart cities must seriously start with people and the human capital side of the equation, rather than blindly believing that IT itself can automatically transform and improve cities. […] Second, the progressive smart city needs to create a real

> shift in the balance of power between the use of information technology by business, government, communities and ordinary people who live in cities (Amin et al., 2000), as well as seek to balance economic growth with sustainability.

Many recent publications on smart cities take these claims into account to some extent. For instance, in articles by Garagliu et al. (2011), Chourabi et al. (2012) and Vicini et al. (2012), social inclusion and social and environmental sustainability are mentioned alongside high-tech and business friendliness. Nevertheless, in practice it is often assumed that ICT is the driving force behind urban transformation and a necessary component in solving social and environmental problems (Hollands, 2015; Söderström et al., 2015). Concurring with other researchers who have recently approached this topic from a more critical stance, I find the exaggerated role of technologies in the smart city agenda unsettling. Smart city is reductionist in nature – I contend – in that it often undermines the diversity of cities, urban activities, and city inhabitants; and offers an overly simplistic picture of extremely complex urban processes. However, the smart city agenda has become so popular and widespread that it is often seen as a naturalised, normative vision of a future city (Vanolo, 2014). In other words, 'smart city' is a powerful *cultural narrative* (Söderström et al., 2015) that many seem to follow without question.

Another interesting technology-related utopia is specified by 'ubiquitous computing,' a branch of computer science that has had a wide impact on governmental agendas and the interests of technology researchers and developers across the globe (see e.g. Rogers, 2006). Mark Weiser (1952–1999), the founding father of ubicomp, was a computer scientist and director of the Computer Science Laboratory (CSL) at Xerox PARC[1]**.** In the 1990s, Weiser wrote two highly 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 John Seely Brown. Weiser's impact might be boiled down as follows. Weiser created the basic ideas behind ubiquitous computing and laid the foundations for a powerful research agenda, yielding huge quantities of academic writings, technological experiments, and technology-filled environments. One might propose that our present everyday life with smart phones and tablet computers mirrors Weiser's predictions to some extent. Instead of simply proposing a new research agenda, Weiser's first essay (1991) introduces a new paradigm (see Bardzell & Bardzell, 2014, p. 781). Weiser's vision reaches beyond engineering: one may interpret it as a philosophical project. In his article, he states directly that a traditional personal computer, a desktop or laptop, will be rejected as the main form of human-computer interaction. He imagines the next step as a reality in which technologies have disappeared and vanished into the background of daily life. At the same time, he continues, computers will be everywhere, unseen. Weiser's forecast begins with these famous words: "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (Weiser, 1991, p. 78).

Weiser depicts technological development that will enable the emergence of computational devices of different sizes, gadgets that vary from whiteboard-sized 'displays' to devices analogue to pads of

[1] PARC, formerly Xerox PARC, is a research and development company in Palo Alto, California, known for its contributions to information technology and hardware systems, see http://www.parc.com/about/

papers and sticky notes. He continues by stating that these smaller computational devices will be embedded into the everyday world and linked to each other via wireless networking technologies. The second of his famous essays (Weiser & Seely Brown, 1997) elaborates on somewhat similar thoughts but is concerned more closely with *how* people cope with the hundreds of computers always surrounding them. The second article introduces the concept of 'calm computing'; namely, that a massive quantity of computers in the future will mean that those computers can no longer be the centre of our attention. Instead, technology must stay calmly in the background and enter the centre of attention only when needed:

> The most potentially interesting, challenging, and profound change implied by the ubiquitous computing era is a focus on calm. […] But when computers are all around, so that we want to compute while doing something else and have more time to be more fully human, we must radically rethink the goals, context and technology of the computer and all the other technology crowding into our lives. Calmness is a fundamental challenge for all technological design of the next fifty years (Weiser & Seely Brown, 1997).

Again, the authors make brave technological predictions and ponder the profound socio-cultural implications of the changes envisaged. It is also interesting, I contend, that these changes are seen as happening inevitably. Therefore – state Weiser and Seely Brown – research and design should be oriented such that it can meet these inevitable transformations (Weiser, 1991; Weiser & Seely Brown, 1997; cf. Bardzell & Bardzell, 2014; Dourish & Bell, 2011, pp. 9–14). The above foundational articles are still cited repeatedly in studies published within the major forums of ubicomp; for example, at the Ubicomp Conference (Dourish & Bell, 2011, p. 20).

'Urban computing,' then, refers to a subfield of ubiquitous computing that aims to design ubiquitous computing infrastructures for city environments. In general, the goal of urban computing is to realise the visions of ubicomp in a certain place: pervasive computing systems are designed as an integrated facet of urban reality (Kindberg, 2007; Paulos & Jenkins, 2005). Studying and designing computing systems for urban environments requires a planner to draw heavily from both architecture and social sciences (e.g. Kukka et al**.,** 2014). Similar approaches with slightly different emphases are carried out under the name "urban informatics" (Foth, 2008) and "urban interaction design" (Brynskov et al., 2014). Ubiquitous computing was applied early to urban environments; one fascinating example of such an application is Singapore; the island state has built an impressive ICT infrastructure with innovative services such as fingerprint-only biometric banking (see e.g. Dourish & Bell, 2011, pp. 31–36).

I find ubiquitous computing and its subfields – such as urban computing – extremely intriguing, for several reasons. Firstly, Weiser's *manifesto*, a document resembling science-fiction writing, has given birth to a complete field of study and to far-reaching governmental technology agendas. Secondly, a twenty-year-old forecast still appears to offer the strongest argument for conducting research and design on the basis of rapidly progressing technology. It seems almost as if Weiser's original visions have transformed into a dogma that has seldom been questioned. Many scholars over the years have reviewed technological progress in the light of Weiser's writings (see e.g. Abowd & Mynatt, 2000),

but few have reassessed his central philosophical arguments (see e.g. Rogers, 2006). At this point I will note an interesting divide: it can be postulated that – as Bardzell and Bardzell suggest (2014) in their recent article – Weiser's agenda consists of two parts, a 'vision' component and a 'technical' component. Moreover, argue Bardzell and Bardzell, such agendas have been developed unevenly: the technical component, exemplified in devices and networks, has made enormous progress, while the 'vision agenda' has, arguably, remained unchanged for too long. According to the Bardzells, it is possible to develop a technological agenda within the boundaries of post-positivist science[2], in which ubicomp has firm roots. However, developing a philosophical vision agenda requires turning to other ways of knowing and producing knowledge; and computer scientists have found this project uncomfortable, if not impossible. In summary, Weiser clearly stepped outside the conventional boundaries and epistemologies of computer science when creating his vision, but only a handful of researchers followed him by developing the vision component further.

One of the few articles concerning the "vision agenda" of ubicomp was written by Rogers (2006), who reworks Weiser's vision in a more engaging direction. At first, Rogers concludes that some central problems of ubicomp, such as the development of computers that are context-aware on behalf of their users, have proved extremely difficult to solve. Rogers asks a profound question concerning the ubicomp vision as a whole; namely, "*Even if we could build the world imagined by Weiser, would we want to live in it?*" A profound problem, contends Rogers, is that Weiser's 'calm computing' seems to construct users as passive and disengaged. In the Weiserian vision, computers act on behalf of their users, providing invisible support and handling tasks automatically. Rogers ponders if such a reality is desirable for us as 'evolved humans' at all, and continues by proposing a new definition for ubicomp based on extending and even *transforming* people. Her account views humans as subjects that always already exceed a researcher's understanding, rather than simple "users" whose needs can be predicted (Rogers, 2006; see also Bardzell & Bardzell, 2014). Bell and Dourish (2007) offer another sharp, well-known critique of ubicomp, stating that ubicomp's principle arguments are harmful because they orient researchers towards a mystified 'proximal future' that is always close but never actually present. This has several drawbacks, one of which is that researchers who proceed according to ubicomp do not feel accountable for the present; this, in turn, creates ethical issues. Moreover, continue Bell and Dourish, an orientation towards the future prevents us from noticing pre-existing ubicomp communities – for example those in South Korea and Singapore – and conducting empirical research on those communities. Bell and Dourish argue that ubicomp's vision agenda should be deconstructed completely. Abowd (2012) recently claimed that 'ubicomp' is no longer necessary as a proposal because it is already manifested in contemporary technology use. Bardzell and Bardzell (2014) do not suggest that we *abandon* ubicomp altogether. Instead, echoing

[2] Post-positivism is a philosophy of science that acknowledges the critiques of positivism and reworks it. Post-positivists, for example, accept that the background, knowledge, and values of the researcher can influence observations and research. Nevertheless, in a manner similar to the actions of positivists, post-positivists try to achieve objectivity by attempting to recognise the possible effects of biases. However, post-positivism should not be confused with relativism as it generally it holds on to the idea of objective truth. Post-positivists believe that an empirical reality exists (like positivists do) but that the understanding of it is limited because of the biases of the researcher or other such limitations (e.g. Alvesson & Sköldberg, 2009, pp. 16–23; Kincaid, 1996).

Rogers, they propose that we should continue to develop and redefine ubicomp's philosophical side, its 'vision agenda.' In developing ubicomp's vision agenda, the Bardzells argue, researchers cannot rely solely on post-positivism; they must employ other ways of knowing. The Bardzell solution is to employ *science fiction theory* to create new, scientifically grounded speculations. These products of a "systematic and intellectually rigorous" cognitive speculation might provide design goals, perhaps even new visions, and "unthought possible trajectories for a dramatically better life" (Bardzell & Bardzell, 2014, p. 780). Also other scholars concerned with ubicomp have discussed the relationship between ubicomp and science fiction (Dourish & Bell, 2014). Galloway (2013) highlights the concept of 'design fiction' in tracing complex connections between the present and future. All the authors mentioned agree that such speculations must necessarily always be firmly grounded in the present.
One may conclude that creating a powerful vision of the future or speculating convincingly about it are by no means trivial acts. A projection of future urban ICT development can have very far-reaching social, cultural, material, economic and political consequences and implications. The next section aims to explore how the visions of urban ICT development offered by the 'smart city' and 'ubiquitous computing' have been applied in the city of Oulu, Finland. I hypothesise that that the realisation of these agendas can vary considerably depending on locale (see e.g. Kitchin, 2015). Moreover, the ideas offered by these agendas are interpreted and transformed according to local needs and conditions. The following sections present a speculative analysis that stands on ethnographic research materials, asking, 'What new visions can be built upon the dreams of young adult residents of this particular 'smart city'?'

A materialised vision: the technologised city of Oulu

The Finnish city of Oulu is a space in which the agendas of the 'smart city' and 'ubiquitous technology' have affected life on many levels. It is important firstly to note that, since the 1980s, Oulu has intentionally built a 'business land' image on high technology. In 1984 the city actually declared itself *Technology City Oulu*, a name that was – at the time – considered highly progressive. The aim was quite prosaic: to support and reinforce the business life, employment situation, and progress of the region. This strategy proved successful in attracting companies to the Oulu region and in boosting the city's economy and research and development activities. For a long time, Nokia was the most prominent example of such efforts. During the two decades following 1984, Oulu gained a national and international reputation as a leading European centre of electronic and ICT industry. Thousands of engineers graduated to the business sector from the University of Oulu and the Oulu University of Applied Sciences (see Äikäs, 2001; 2004). Different high-tech branding initiatives followed the 'Technology City Oulu' campaign, although those initiatives were not as intense as the initial programme (Pasquinelli & Teräs, 2013). The recent recession and problems faced by Nokia and other ICT companies have made a dent in this image. Nevertheless, recent marketing material on the city's official Internet pages presents Oulu as an intelligent, innovative high-tech centre (Oulu Brand Book, 2014). According to the booklet, the following is the Oulu brand in a nutshell:

> Oulu is the capital of Northern Scandinavia and blends a creative atmosphere with high technology, entrepreneurship and highly skilled people, the unique culture of a modern seaside town and a vibrant countryside. Oulu offers an impressive range of educational opportunities and the youngest population in Europe, as well as the ability to collaborate efficiently on building competence into international success stories. And all this in a prosperous city that's just the right size to provide a good, solid foundation for a happy life.

Intentional long-term image building and political strategy aimed at boosting the technology industry in Oulu was therefore launched long before the smart city concept gained global popularity. However, the label 'smart' or 'intelligent' is now often attached to Oulu as well[3]. The terms 'smart' and 'intelligent' are often used synonymously and slip easily into frames built during previous decades. At the time of writing, the Oulu smart city agenda is being promoted and used in varied ways by various stakeholders, research institutions, companies, and municipal officials (see Rantakokko, 2012 for a concise introduction). However, the Oulu smart city agenda centres explicitly on technology and not – for example – on environmental sustainability. Some recent exceptions exist, such as Hiukkavaara[4], the largest city district to be built in Oulu and northern Finland in the near future. The plans for Hiukkavaara combine smart city thinking, sustainability, and an awareness of the drastically changing northern seasons; the city district is advertised by the slogan "Arctic attitude, modern city life, and endless wilderness."

The research and design community of the Department of Computer Science and Engineering (CSE) at the University of Oulu, in turn, has promoted ubiquitous computing, over the last ten years. Projects have been realised in cooperation between high-tech companies and the City of Oulu; as these institutions are more familiar with the concept of 'smart city' it has often been employed together with 'ubiquitous' or 'urban' computing (see e.g. Kukka et al., 2013; Kostakos et al., 2013). Open Ubiquitous Oulu[5], also known as 'UBI Oulu,' has implemented a visible and internationally acknowledged technological infrastructure in the city centre and therefore made efforts to incorporate pervasive technologies into the everyday lives of city citizens. UBI Oulu is a joint initiative of the University of Oulu and the City of Oulu that aims to build a functional prototype of a future smart city. The overall objective of UBI Oulu has been to enhance everyday lives and interaction between the city and its residents. Research is conducted within the multidisciplinary 'UrBan Interactions (UBI) Research Program' coordinated by the CSE. Researchers from varied disciplines including computer science, economics, informatics, architecture, and cultural anthropology have participated in the activities of the UBI program, conducting long-term research or small-scale projects. The core of the UBI Program is ubiquitous computing infrastructure deployed in Oulu's city centre. That infrastructure includes – for example – a municipal, open-access WiFi network, a network of Bluetooth access points, and a large network of interactive public displays deployed in the city centre.

The UBI program has aimed to turn Oulu into an open 'civic laboratory,' enabling long-term, large-scale exploration of urban computing systems in a real environment. In general terms, 'civic laboratory' refers to

[3] See, for example, the Internet pages of the Oulu Smart City Seminar, 2015: http://www.smartseminar.fi/

[4] http://www.smart-ip.eu/2013/05/sustainable-arctic-winter-city-hiukkavaara-oulu-finland/

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

a study setting in which 'technology is adapted in novel ways to meet local needs'.[6] In Oulu the civic laboratory has endeavoured to cooperate with service providers, the City of Oulu, and city residents by offering stakeholders the opportunity to try the possibilities of the new technology in real-life settings. At the same time, the technology has been studied and evaluated academically. Nevertheless, operating in a complex terrain of urban public space has proved challenging. The original visions of stakeholders have not been completely fulfilled, as the author and co-authors argued in our 2012 article (Suopajärvi et al., 2012) tracing the goals and ideas behind the UBI Oulu initiative. Moreover, because participatory practices were not used, the role of city inhabitants has been somewhat limited in the design of the aforementioned technologies. 'Top-down' visions have dominated the outcome of the UBI initiative, and city inhabitants have acted mostly as testers of new technology, not co-creators. The dominance of a technology-centred perspective can be explained in part by Oulu's history as a high-tech city (ibid.).

UBI Oulu's two infrastructures, the panOULU WLAN and the network of public urban displays, are relevant to this article. The panOULU WLAN, which I will refer to as panOULU, is a municipal WiFi network founded in 2003. Use of the network does not require any registration, authentication, or payment, and provides wireless Internet access in the most central and busy places of Oulu, including municipal offices and facilities, the university campuses, and the airport. If the relative size of the Oulu community is taken into account, panOULU is the largest municipal WiFi network in the world, providing open, free, unrestricted Internet access (Ojala et al., 2011; Ojala et al., 2012a). The UBI displays – see Figure 1 – are large interactive public displays installed in central indoor and outdoor spaces around the city. The outdoor displays are all located quite close to each other in the centre of Oulu; six are positioned on a pedestrian walkway and one at the market place. Indoor displays, in turn, can be found in popular municipal buildings, including the University of Oulu, the University of Applied Sciences, the main library, and Oulu swimming hall. The outdoor displays and the first six indoor displays were all deployed in the summer of 2009, while an additional six indoor displays were installed three years later, in the summer of 2012. Each UBI public display unit has a passive broadcast mode that plays mainly advertisements, and an interactive mode consisting of a set of web pages offering services such as news and information about local restaurants, bus schedules, and games. The UBI displays currently constitute one of the world's largest networks of interactive public displays installed in a city centre for predominantly research purposes (Hosio et al., 2010; Ojala et al., 2010; Ojala et al., 2012b).

In relation to their research function, the panOULU and UBI display infrastructures enable the collection of large-scale, long-term use data which, in its most simple form, informs researchers of how much a certain display or WiFi has been used. The data collected also reveals use trends for different times of the day and seasons of the year (see Ylipulli et al., 2014a). Such data indicates that panOULU use has increased steadily and that the use of UBI displays has slowly diminished (Ylipulli et al., 2014b).

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

Figure 1. An outdoor UBI display in use

Source: UBI Program 2015.

Investigating the ICT experiences and perceptions of young adults

The vast amounts of quantitative data produced by Oulu's UBI infrastructures have their qualitative counterpart in several sets of research material scrutinising the experiential level of Oulu residents. The experiences, perceptions, attitudes, and values of the people living in this 'smart' and 'ubiquitous' city have been investigated by collecting qualitative research material within the UBI program and collaborative projects. Such studies have either mapped resident experiences of ICT in general or have focused on particular technologies. Studies have employed an ethnographic approach and also methods and perspectives derived from the design studies such as cultural probes (see e.g. Pihlajaniemi et al., 2012; Suopajärvi, 2015; Ylipulli et al., 2014a). This article focuses on research material collected by the author between 2011 and 2012 by combining ethnography with a cultural-probe-inspired approach (Gaver, 1999; Mattelmäki, 2006). The data set consists of 'ICT diaries' complemented by semi-structured, thematic group interviews with the aim of mapping the technologised reality of young adults living in the city of Oulu.

I decided to study young adults between the ages of twenty and thirty primarily because I wanted to scrutinise and challenge notions linked to this particular age group and technology. Young adults are often thought to be early adopters of technological innovations and are expected to have good skills in and knowledge of new technology use (Dourish et al., 2007; Williams et al., 2008). Nevertheless, as we have noted previously (Ylipulli & Suopajärvi, 2013), typical attributes such as 'technologically-savvy' often linked to young adults do not necessarily apply to the whole age group. One cannot view age as the only category defining people and their technological skills and attitudes. My research material therefore reflects the varying technological experiences and perceptions of young adults. I

recruited the participants mostly through the mailing lists of different academies in the city, but also used the so-called 'snowball' method, asking recruited participants to forward my invitation.

The ICT diary study detailed in this research stands on an ethnographic approach and includes a wide range of themes. My general aim in collecting the material was to gain a thorough yet broad outlook on the perceptions pertaining to ICT and the everyday life of young adults resident in the 'smart' city of Oulu. I conducted the study in late 2011 and early 2012 with forty-eight participants, including thirty-seven women and eleven men. Most participants had higher education or were studying either at the University of Oulu or at the Oulu University of Applied Sciences. The majority had lived in the city for several years; however, only sixteen were originally from Oulu. Most had moved to the city in their early twenties and late teens from eastern or northern parts of Finland, from nearby smaller towns, or from rural areas – a distribution that reflects the position of Oulu as the most popular student city in northern Finland (City of Oulu, 2012).

At first, the recruited study participants documented the use of their mobile phone and computer in a small scrapbook designed in the spirit of the 'cultural probe' methodology (see e.g. Gaver, 1999; see also Luusua et al., 2015). This intentionally colourful, playful 'ICT diary' included ten tasks whose open questions I designed to support out-of-the-box thinking and encourage the participants to observe, ponder, and reflect on their own ICT practices (Figure 2). After completing the diary, participants were invited to participate in group interviews in which they could elaborate on the themes of the diary and compare their views with the views of others. The research material of this article consists therefore of written 'ICT diaries' accompanied by drawings and clippings, and of hundreds of pages of transcribed interviews. I chose to employ a somewhat experimental method mainly because conducting participant observations of everyday ICT use would have been challenging, even intrusive. The technology in question, i.e. smartphones and computers, is used nowadays almost everywhere and in all types of situation (see e.g. Hemmings et al., 2002). Furthermore, ICT has become so mundane and usual that I wanted to use a method with the capacity to detach participants from everyday practices and encourage them to reflect critically on their own actions. In realising the study, I also noted that my choice of method allowed participants to rely on different modes of communication: they were able to express themselves by writing, talking, or in images. The resulting research material is particularly rich.

Figure 2. ICT Diary

Source: Anna Luusua, 2014.

Analysis of these materials stands on iterative readings, including the classifying, systemising, and structuring of the data into emerging themes. I organised these themes into matrices that enable the comparison of participant perspectives and the discovery of discourses, similarities, and differences (see e.g. Davies, 1999, Corbin & Strauss, 2008). My aim has been to understand these phenomena both as lived experiences and as a part of socio-cultural frames, an approach typical to cultural anthropology (see Suopajärvi, 2015). Participants expressed attitudes and implicit wishes towards technology throughout the research material, but the scrapbook also included responses to a direct question about "the dream ICT of the future." In this task, I asked participants to choose two images depicting their 'dream ICT' and add them to the diary. The task was on the last page of the booklet which was an intentional choice. Participatory Design (PD) researchers have noted the usefulness of letting participants first reflect upon their current practices and later build bridges between the present and future. Overly future-oriented tasks do not produce fruitful outcomes (Buskermolen & Ozcelik, 2012). Participant 'ICT dreams' were further elaborated on and discussed in the interviews. This task resembled 'imagework,' an experiential qualitative research methodology explored in particular by Edgar (2004). As the name implies, imagework refers to different image-based methods by which the researcher purposefully facilitates the imagination of the participants. Edgar argues that "experiential research methods, such as imagework, can elicit and evoke implicit knowledge and self-identities of respondents in a way that other research methods cannot" (ibid., p. 2). He continues by stating that the nature of the 'inner realities' of people is largely visual, and that the power of imagework lies also in this function within research; images resonate with the visual nature of human consciousness (ibid., p. 139). By asking study participants to use images instead of simply gathering verbal accounts, I wanted to tease out implicit associations and wishes. The analysis of these materials sheds light on perspectives of 'ordinary' city dwellers whose views are not always heard

when realising the grand urban visions. In the following sections I scrutinise young adults' perceptions of the 'smart' city of Oulu and their projections of the desired future.

The technologised city as a myth

This section charts overall young-adult study-participant perceptions of Oulu's 'smart city' or 'technology city' agenda. In the group interviews, we discussed the public urban computing infrastructures of Oulu, in particular the panOULU wireless LAN and UBI displays (see Ylipulli et al., 2014b). Following these conversations I asked the interviewees if they felt they were living in a 'technology city' or a 'high-tech city.'

A few young adults directly denied living in a high-tech or technology city: one participant told she was not interested in technology, and the other felt Oulu's techno-centric image had "dried up" (F21[7]). A few participants reacted positively and recalled noticing Oulu's high-tech reputation when living abroad. Participants studying or working in technology-related or communication-related fields had the most positive attitudes to and positive associations with the 'technology city of Oulu' as an idea. However, a clear majority of participants fell between these two extremes. Over half of the participants were hesitant, stating they did not know what to say. One commented, "I don't know if technology serves anybody else [here] but advertisers and technology designers" (F26). Another pondered, "It doesn't mean anything to an average person" (F21), and one stated, "I don't live in a technology city; it's like a myth that has always existed but I've never experienced being part of it" (F26). The rest agreed with the statement that Oulu is a 'high-tech city.' Nevertheless, in the same breath, many commented that the role of technology should be more visible or concrete, particularly in the city centre, if Oulu wishes to be perceived as a 'high-tech city'.

Overall, technology was mostly associated with local academies or companies. The vast majority of participants saw its role for ordinary city inhabitants as minor. For the participants, the panOULU WLAN appeared to be the most meaningful feature of the smart city, discussed almost always in a positive spirit. Nevertheless, quite many participants did not regard public open-access WLAN as "special," though acknowledging in interview when others remarked that such a technology is still a rarity, and not part of usual city infrastructures. Some saw also the UBI displays as "special," reinforcing Oulu's image, giving it "street credibility". However, as I noted earlier, adoption of the UBI displays has been slow and many participants were not familiar with the devices at all, although the displays are prominently visible and located in central spaces (Ylipulli et al., 2014b). The displays were considered too awkward to use in public and young adults preferred using a smartphone for information seeking. Even the most visible technology becomes invisible if it is not aligned with existing social norms and everyday life practices. (See ibid. for complete analysis on the appropriation process.)

In general, the analysis of the research material reveals a reality in which visions of a technology city were experienced as distant, even awkward by many participants. Some commented that they did not want to discuss the subject because they were "sick"or "tired" of it; they felt that high-tech

[7] Participants are referred to as follows: F=female, M=male, age.

discourse was always on display, but never actually affected their lives. Many participants had a negative attitude towards a 'high-tech' city agenda, citing the notoriously malfunctioning digital schedule screens at Oulu bus stops as an example of poor technology use.

Overall, the discussions lead me to conclude that bold visions, initiatives, and projects in technology have largely remained within the walls of research institutions and companies. Only infrastructures belonging to the UBI program – specifically panOULU and occasionally the UBI displays – were experienced as having a direct impact on the everyday lives of Oulu city inhabitants. These findings are actually not very surprising considering Oulu's branding history: in the 1980s and 1990s, decision-makers considered it important that Oulu seem to outsiders an inviting centre of technology. City marketing was mainly targeted at stakeholders operating in southern Finland or abroad. This image was important primarily in business life, not everyday life. For ordinary city residents, Oulu's "technology image" remained a distant phenomenon (Äikäs, 2001; 2004). However, 'smart city thinking' has clearly become fused with older technology city strategies during this millennium; current trends underline the significance of city residents; and specifically, their participation in technology design processes, inclusion, and other social issues (e.g. Hollands, 2008). For example, in his introduction to smart city of Oulu, Rantakokko (2012, p. 251) states that

> From the user community's point of view – both citizens and businesses – the city appears as a smart space providing a rich interaction between the physical, virtual and social spaces. This means that citizens can enjoy about innovative service solutions, such as innovative schools, and also contribute to the development of new services.

I propose that, for many of the young adult participants in this study, the above vision had not yet been turned into reality. Although most of them felt that technology visions of Oulu were not really linked to their everyday lives, the value of ICT development and research was viewed as supporting the economy of the region. At the same time, young adults wished that other features of the city and its surroundings would be highlighted in branding processes and political strategies. They acknowledged that such visions of the future can have very concrete implication, constructing reality and affecting concrete decisions concerning – for example – education and urban development. The participants in this study mentioned local culture, the history of Oulu, surrounding nature, and the city's large parks as features deserving of much more attention. Some suggested that these aspects be merged with the high-tech brand and know-how. Interestingly, references to nature and 'naturalness' also formed a noticeable theme when participants discussed their dream technologies of the future.

Dreams and visions of the young adults

I have constructed three main themes from the ICT diary study concerning the dreams and wishes of the young adult participants; namely, *one*, qualities of the future technology; *two*, mode of interaction; and *three*, attitudes towards future technological development. Discussions of technology and the future were not linked explicitly to the Oulu city environment, but participants' perspectives could offer fruitful insights

into urban technology design and research. Constructed themes can be understood as "weak signals" (Ansoff, 1982), a type of warning still too incomplete to enable an accurate estimation of the impact of underlying causes, but which has the potential to develop into strong signals that might require ICT designers to respond. However, the most important aim of this analysis is to outline whether or not views of ordinary city inhabitants provide alternatives to large-scale urban narratives, and to highlight the diversity of relevant perspectives. In other words, I have been seeking more versatile and nuanced projections of the future.

Qualities of dream technology

I will first explore the features that young adult participants in this study envisaged for 'dream' technology, in accounts that reveal a lot about their personal values. Perhaps unsurprisingly, one of the most visible themes was linked to the *functionality* of technology. Study participants hoped that future technology would be smooth, practical, reliable, flawless, and easy-to-use. Speed and efficiency were mentioned repeatedly and some argued that future technology should remain unnoticeable. The dreams painted a picture in which technology was a personal, rather mundane tool. These perceptions can be seen as being in line with many thoughts of Mark Weiser who also envisioned smooth and flawless future technology, intertwined with the fabric of everyday life. Technology as innovation or spectacle surfaced only in a few interviews. Participant visions of dream technologies could, for the most part, be described as "practical". Ecological concerns such as reusability and recycling were another recurring theme. A large number of the young adults were, for example, concerned about how old computers were shipped to developing countries where toxic waste is not properly processed; they discussed biodegradable materials and "organic" computers that would not put pressure on nature and ecosystems. In a similar fashion, many stated that ICT devices should be much more durable and designed in a way that makes fixing them easier. In a sense, "ecological technology" was a pervasive theme in the material. Its occurrence was not linked to gender, overall attitudes, or other factors. For example, one participant spoke strongly on behalf of ecological values, then added, "However, I'm not any vegan hippie" (M29). I contend that he wanted to separate himself from more radical activists and emphasise that an "average guy"can also support ecological values. Moreover, repeatedly surfacing accounts linked to ethical aspects presented the "global scale" of the young adults' wishes. Many participants stated that ICT manufacturing should comply with the rules of fair trade. They worried about abusive working conditions and human rights violations in countries where minerals for basic components are mined and devices assembled. In addition to such global worries, many participants expressed wishes regarding Finland and their immediate surroundings, linking those wishes to the *democracy* and *equality* of technology. Participants stressed that everyone should have the possibility to access the Internet, while some also hoped that smart phones might be cheaper so that everyone could afford them.

The group of study participants consisted mainly of people with higher education, a factor that may have affected the results. However, environmental consciousness also reflects "accepted discourses of consuming" in Finland (see e.g. Tuuva-Hongisto & Timonen, 2011; Wilska & Pedrozo, 2007). Emphasis on ecological and ethical values as pertaining to future technology was remarkably strong, indicating that participants felt that ICT designers and manufacturers have not yet responded efficiently to those

challenges. Furthermore, it is interesting that stressing the importance of ecological and ethical issues in this context is in line with many "greener visions" of a smart city (e.g. Hollands, 2008) that argue for social inclusiveness and for sustainability (e.g. Newman et al., 2009). These types of urban vision clearly resonate with the perspectives of the majority of study participants.

Mode of interaction

When first examining the research material, comments regarding the 'naturalness' of technology seemed peculiar to the author. This theme was, however, consistent throughout participant discussions about dream technologies and was mentioned by a considerable number of the young adults taking part. I contend that one may understand such accounts as referring to a desired *mode* of interaction and, in some cases, to a desired *role* of technology in everyday life. In their diaries, participants expressed 'dream ICT' visions relating to this theme through imagery of nature (see Figures 3 and 4), including pictures of trees, birds, or beautiful landscapes. One participant attached an image of a drinking glass to her page, writing that she wished technology was as "mundane" as a glass of Finnish clear water. In interviews, many participants described wanting to be "in harmony with technology'; they used expressions such as "calmer use," "balance," "less stressful use," or "technology should be just a tool, a natural tool." They proposed that technology not be the centre of "everything," but should settle into the background of everyday life. Some commented that technology might be located more or less everywhere, but should sink better into its surroundings and become more mundane. They hoped ICT would not create a hasty feeling in its users; rather, a feeling of calm in supporting social interaction and connecting, not isolating people.

Figure 3. (Left) The elephant represents the life of the participant while the small "cleaner bird" illustrates ICT; it is helpful but unobtrusive. The lower image illustrates the participant's wish that media and ICT-filled environments would be less commercial. Figure 4. (Right) The participant used imagery of nature; the text says "natural, calm." Biking is harnessed in order to produce electricity for ICT.

Source: Johanna Ylipulli, 2015.

Interestingly, this group of 'dream technologies' seems somewhat compatible with Mark Weiser's (1991; 1997) original vision of "ubiquitous computing'. Weiser describes a post-desktop world where computers have vanished into the background of daily life, in which technology is a calm, invisible helper, always present without disturbing. However, while aspects of naturalness, calmness, and unobtrusiveness resonate with Weiser's visions, participants in this study accompanied their wishes by stating that they wanted to be *in control* or *in charge of* technology. Some also stressed the importance of critical reflection, an inherent part of the ICT diary study, stating that people should realise the role technology actually plays in their lives. Only this type of consciousness would, in turn, enable them to "fuse technology in their lives calmly" (F26). In summary, the very same participants that wished high-tech would be everywhere, invisibly and naturally, often hoped they would be able to use technology in a controlled manner.

Moreover, when asked about technology-related fears and concerns, technology dependency and becoming a "slave" of technology were mentioned several times. Many participants cited bleak science-fiction dystopias, such as that introduced in the film *WALL-E* (2008); some mentioned specific films by name. An animation film, *WALL-E* presents the scenario of a post-catastrophic world in which nature has been destroyed and people have abandoned the earth, becoming totally dependent on technology. Humans are portrayed in a highly dystopian manner as physically passive, obese, helpless creatures that move around with the help of hovering sofas, communicating principally with robots and through screens.

The young adult participants in question hardly meant that technology should perform tasks for them. Rather, their accounts resemble Rogers' (2006) suggestion of a redefinition of "ubiquitous computing," a call for designers to move "from a mindset that wants to make the environment smart and proactive to one that enables people, themselves, to be smarter and proactive in their everyday and working practices." I propose that many participants in this study dreamt not of context-aware technology, but of a world in which they might be aware of technology and use it efficiently for their own purposes. They sought to retain their agency and not transfer it to computers. This concern for the retention of user agency should be acknowledged and elaborated on within the research paradigm of urban computing, which inherently entails the aim of embedding invisible computers everywhere.

Attitudes

The dreams of the participants for ICT development connect inherently to the *attitudes* of those participants towards technology. In previous articles (Ylipulli & Suopajärvi, 2013; Ylipulli et al., 2014b) my co-authors and I argued that a relatively large number of the young adult participants found technology use distressing; they felt that ICT played too large a role in their lives. Many participants also confessed feeling somewhat ignorant of technology, and considered themselves left behind by its development. Negative feelings towards ICT development were quite common. In particular, participants who felt distressed by technology emphasised, in their visions of ICT development, that the role of technology might be altered to become more "calm." A few participants had already reduced the presence of technology in their everyday living environment, deciding to use the computer in one particular room of their home only. Two participants were so frustrated by frantic technology use they considered abandoning the use of mobile phones completely. They also hoped for technology-free zones in public environments.

In general, participants with positive attitudes towards technology stressed its functionality and saw it as an "enabler." One participant had – for example – added to his diary entry an image of the Disney cartoon character "Mad Madam Mim" and explained that future technology should be "magical" and would "include everything" (M22). In the same vein, another participant included in his diary an image of a Superman, stating that "[ICT] should be fast, steely, not flimsy, and it should always work perfectly. It could be a small device in my pocket that would grow bigger by pushing a button; it would include everything" (F20). Between "technology critics" and "advocates" existed a large group of participants who had an only slightly critical, positive, or neutral attitude towards ICT and its future development. Some of these participants saw technological development as an inevitable force that *must* be accepted; the accounts of this group were in line with technological determinism (e.g. Escobar, 1994).

In all, one of the most striking findings of this study is the broad variety of attitudes found within a relatively homogenous group of study participants. Smart city or urban computing discourses rarely discuss or recognise that some city residents do not necessarily *want* more technology in their environment. Negative attitudes are often perceived as belonging to an insignificant minority and disregarded. Nevertheless, researchers have recently noted the growing trend of "ICT resistance" (e.g. Foot, 2014; Rainie et al., 2013). For example, Morrison and Gomez (2014) scrutinise reactions against constant connectivity, calling the phenomenon "pushback" and claiming that pushback is motivated by a

need "to regain control, establish boundaries, resist information overload, and establish greater personal life balance" (ibid., p. 1). It seems therefore that accelerating technological development divides people into advocates and opponents of ICT. I propose that an urgent need exists to address the meaning of this divide for technology-centred urban visions.

Conclusions: Reforming techno-urban visions

The aim of this article has been to critically examine how large-scale urban agendas – namely the "smart city" and "ubiquitous computing" agendas – have been appropriated in the city of Oulu in Northern Finland; and how young city inhabitants see the influence of these grand visions. I also aimed to investigate whether the "ICT dreams" of young adults contested or resonated with such large-scale visions of a technologised urban future, asking, "What alternative futures, what "bottom-up" urban visions, might we build upon those dreams?'

In summary, my analysis indicates that large-scale urban agendas are not always turned easily into reality. Such agendas can develop in locally unique ways, depending on – for example – a city's history. Various historically formed socio-cultural and material conditions make Oulu and Finland unique; therefore, these results cannot be directly applied to cities in other countries. Additionally, it should be noted that these grand urban agendas are not univocal; they consist of different strands; and some of their features are in line with and some contradict the thoughts of the young adult participants of this study. Moreover, I wish to highlight that the perceptions presented here belong to one relatively homogenous group of city dwellers. Residents belonging to a different age group may have different opinions.

Overall, my analysis shows that to a large extent, techno-urban narratives and the "street-level" visions of young adults are not aligned. Here and there these forces do resonate, and new urban utopias might be built upon the resulting points of agreement. For example, the thoughts of the young adult participants were in line with more recent "smart city" visions which highlight the significance of environmental sustainability, "green thinking," and social inclusiveness alongside technological advances (e.g. Vanolo, 2013, p. 1). Current smart city or ubicomp technologies installed in the city centre of Oulu did not properly respond to the needs of young adults, and local technological agendas were experienced as distant.

Furthermore, the vast diversity of young adults' voices was identified as an important finding in this study. *Negative attitudes* towards technology were quite common – a phenomenon which, in general, is not addressed in technology-centred urban visions offered by smart city thinking and ubiquitous computing paradigm. "The actual high-tech future" may not be as harmonious as these grand visions assume. This finding urges technology designers and urban planners to be cautious when designing further technology for already information-rich urban spaces. (cf. Kitchin, 2015). Quite many of these study participants expressed that ICT in its current form causes anxiety and stress; thus, adding high technology to an urban environment inconsiderately can actually make those spaces seem repulsive for these people. 'Technologised' urban environment can appear as *a dystopia* for surprisingly many residents – also for those who are usually considered as 'early adopters' of innovations. Thus, my empirical findings resonate with the notion of Rogers (2006) who asked whether we would, after all,

want to live in the 'ubicomp' world imagined by Weiser. These results do not necessarily imply that we would need to abandon the idea of a 'technologised' city altogether, but they offer a strong argument against deterministic, "one-size-fits-all" techno-urban agendas (cf. Kitchin, 2015).

In addition to resistance, questions pertaining to *control* and *agency* are extremely relevant in designing further technology for cities. Weiser's vision has been advanced, for example, by developing tracking and context-aware technologies that are used for monitoring people and environments. The underlying argument is that technologies should act on behalf of people and make decisions for them; this in turn, means that a part of our agency is transferred to computers. In the accounts of young adults living technologically saturated lives the significance of retaining agency over technology was underlined. Also the need to better understand the impacts and implications that technology has on people's daily lives surfaced repeatedly. Thus, perhaps the scenario offered by ubicomp should be reversed: '*How can we build a world where people could monitor technologies and be aware of them?'* For the sake of democracy, it would be important to imagine urban futures in which residents can be aware of technological infrastructures and understand their effects at least to some extent.

Another central point is the significance of 'calmness' in computer-mediated interaction, which clearly must be reconsidered. A considerably large part of the study participants wished technology to be more "natural" and "soothing". Nevertheless, the definition of "calm" computing offered by Weiser was not completely in line with young adults' accounts who hoped technology to be "calm" and "subtle" but at the same time, strictly under their control. My findings indicate calmness is still a relevant concept in technology design but it needs to be redefined, perhaps by fusing it with "engaging" computing suggested by Rogers (2006). She proposed that instead of reducing "the need for humans to think for themselves" (ibid.) ubicomp technologies should assist us to perform better, especially intellectually. These notions could offer new kinds of critical lenses through which urban technology could be understood and designed.

I find it important also to broaden the discussion and consider how the presented 'street-level' views – or visions of the residents of some other 'smart' city – could be taken into account in actual design processes. If we truly wish to address the problem of conflicting visions and make the 'technologisation' of cities more inclusive and democratic, I suggest that we embrace several disciplinary crossovers and use inclusive design practices. If our aim is – firstly – to *transform* everyday urban environments with technology, we must emphasise collaboration between cultural and social sciences and techno-science and the role of joint knowledge production (cf. Bardzell & Bardzell, 2014). These research and design processes are extremely multifaceted and one cannot grasp them from a single-disciplinary perspective. Moreover, the most profound ideas affecting urban technology design today – such as those ideas on ubiquitous computing presented by Weiser – are the results of disciplinary crossovers, and should be advanced through interdisciplinary practices. Disciplinary crossovers can result in more thoughtful design and development decisions. I contend, moreover, that such decisions should be informed by empirical knowledge that sheds light on local realities – such as analysed in this article.

My second point links closely to the first: I propose that, besides crossing borders of academic discipline, we should reconsider the boundaries between researchers and designers and between

designers and "users" (Sanders & Stappers, 2008). Participatory Design (PD), for example, has considered such crossovers extensively. In Participatory Design, different stakeholders actively involve themselves in the processes of design, with the aim of creating better, more usable artefacts. The goal of the process is not only the new product, service or application which is being designed. It is also of crucial importance that – through processes of mutual learning – participants gain insights into design processes, begin to understand the impacts of a technology, and realise they have a choice in what technology is developed (e.g. Bjerknes et al., 1987; Bjerknes & Bratteteig, 1995; Bødker 2003). The goal is to allow people to participate in the creation of their futures, to foster 'bottom-up' innovation, and to empower users of urban technology. Therefore, Participatory Design can respond to the need to regain control over technology-filled lives noted by participants in this study.

In conclusion, to build more inclusive and democratic cities there is a need to bring together a variety of voices and strive towards shared visions. This aim presumes holistic, interdisciplinary research-design work that integrates layperson and expert knowledge and extends towards both large-scale overviews and micro-level, empirical insights into everyday experiences. In the light of the theoretical perspectives and empirical findings presented in this article, I contend that the future direction of the technologisation of cities depends largely on our capability to cooperate, negotiate, and deconstruct epistemological boundaries dividing both experts of different fields and experts and laypersons. Utopias must be co-created in order to prevent them from turning into dystopias.

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References

Abowd, G.D. (2012). What next, ubicomp? Celebrating an intellectual disappearing act. *Proceedings of the 2012 ACM Conference on Ubiquitous Computing (Ubicomp)* (pp. 31–40). New York, NY: ACM Press.

Abowd, G.D. & Mynatt E.D. (2000). Charting past, present, and future research in ubiquitous computing. *ACM Transactions on Computer-Human Interaction (TOCHI),* 7(1), 29–58.

Äikäs, T. A. (2001). *Imagosta maisemaan: Esimerkkeinä Turun ja Oulun kaupunki-imagojen rakentaminen [From image to landscape: Turku and the City of Oulu as examples of image building]*. Oulu: Department of Geography, University of Oulu.

Äikäs, T. A. (2004). *Imagoa etsimässä: kaupunki- ja aluemarkkinoinnin haasteista mielikuvien mahdollisuuksiin [Searching for image: from the challenges of city and district marketing to the possibilities of the imagination]*. Helsinki: Suomen kuntaliitto.

Alvesson, M. & Sköldberg, K. (2009). *Reflexive methodology: New vistas for qualitative research* (2nd ed.). London: Sage.

Ansoff, I. (1982). Strategic response to turbulent environments. *Working Paper No. 82-35.* Brussels: European Institute for Advanced Studies in Management.

Bardzell, J. & Bardzell, S. (2014). A great and troubling beauty: Cognitive speculation and ubiquitous computing. *Personal and ubiquitous computing*, 18(4), 779–794.

Bell, G. & Dourish, P. (2007). Yesterday's tomorrows: Notes on ubiquitous computing's dominant vision. *Personal and Ubiquitous Computing*, 11(2), 133–143.

Bjerknes, G., Ehn, P. & Kyng, M. (Eds.). (1987). *Computers and democracy. A Scandinavian challenge.* Brookfield: Gower Press.

Bjerknes, G. & Bratteteig, T. (1995). User Participation and Democracy. A Discussion of Scandinavian Research on System Development. *Scandinavian Journal of Information Systems*, 7(1), 73–98.

Brynskov, M., Carvajal Bermúdez, J.C., Fernández, M., Korsgaard, H., Mulder, I.J., Piskorek, K., Rekow, L., De Waal, M. (2014). *Urban Interaction Design: Towards City Making*. Amsterdam: UrbanIXD Booksprint. Retrieved from http://repository.tudelft.nl/view/ir/uuid:9b936bee-c846-4283-9dc9-1804018c8efe/

Buskermolen, D. & Terken J. (2012). Co-constructing stories: A participatory design technique to elicit in-depth user feedback and suggestions about design concepts. In *Proceedings of Participatory Design Conference 12* (pp. 33–36). Roskilde: Roskilde University.

Bødker, S. (2003). A for Alternatives. *Scandinavian Journal of Information Systems*, 15(1), 87–89.

Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of urban technology,* 18(2), 65–82.

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., ... & Scholl, H. J. (2012). Understanding smart cities: An integrative framework. In *Proceedings of 45th Hawaii International Conference on System Science (HICSS)* (pp. 2289–2297). Albany, NY: Center for Technology in Governance.

Corbin, J. & Strauss, A. (2008). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (3rd ed.) Thousand Oaks, CA: Sage.

Davies, C.A. (1999). *Reflexive ethnography: A guide to researching selves and others*. London: Routledge.

Dourish, P., Anderson, K. & Nafus, D. (2007). *Cultural mobilities: Diversity and agency in urban computing*. In *Proceedings of DEGAS 2007* (pp. 100–113). Rio de Janeiro: CEUR-WS.

Dourish, P. & Bell, G. (2011). *Divining a digital future: Mess and mythology in ubiquitous computing*. Cambridge, MA: MIT Press.

Dourish, P. & Bell, G. (2014). Resistance is futile: reading science fiction alongside ubiquitous computing. *Personal and Ubiquitous Computing*, 18(4), 769–778.

Dourish, P., & Mainwaring, S. D. (2012). Ubicomp's colonial impulse. In *Proceedings of the 2012 ACM Conference on Ubiquitous Computing (Ubicomp)* (pp. 133–142). New York, NY: ACM Press.

Edgar, I. (2004). *A guide to imagework: Imagination-based research methods*. London: Routledge.

Escobar, A. (1994). Welcome to Cyberia: Notes on the anthropology of cyberculture. *Current Anthropology*, 35(3), 211–223.

Foot, K. (2014). The online emergence of pushback on social media in the United States: A historical discourse analysis. *International Journal of Communication*, 8, 1313–1342.

Foth, M. (Ed.) (2009). *Handbook of research on urban informatics: The practice and promise of the real-time city.* Hershey: Information Science Reference, IGI Global.

Galloway, A. (2013). Emergent media technologies, speculation, expectation and human / nonhuman relations. *Journal of Broadcasting and Electronic Media*, 57(1), 53–65.

Gaver, W., Dunne, T. & Pacenti, E. (1999). Cultural probes. *Interactions*, 6(1), 21–29.

Goffman, E. (1966). *Behavior in Public Places*. New York: The Free Press.

Hemmings, T., Clarke, K., Rouncefield, M., Crabtree, A. & Rodden, T. (2002). Probing the probes. In *Proceedings Participatory design conference (PDC)* (pp. 42–50). Malmö: Computer Professionals Social Responsibility.

Hollands, R. G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? *City*, 12(3), 303–320.

Hollands, R. G. (2015). Critical interventions into the corporate smart city. *Cambridge Journal of Regions, Economy and Society*, 8(1), 61–77.

Hosio, S. Jurmu, M., Kukka, H., Riekki, J. & Ojala, T. (2010). Supporting distributed private and public user interfaces in urban environments. In *Proceedings HotMobile 2010* (pp. 25–30). New York, NY: ACM Press.

Ishida, T. (2000). Understanding digital cities. In Ishida, T. & Isbister, T. (Eds.), *Digital cities: Technologies, experiences and future perspectives* (pp. 7–17). Wiesbaden: Springer.

Kincaid, H. (1996). *Philosophical foundations of the social sciences*. Cambridge: Cambridge University Press.

Kindberg, T., Chalmers, M., & Paulos, E. (2007). Guest editors' introduction: Urban computing. *IEEE Pervasive Computing*, 6(3), 18-20.

Kitchin, R. (2015). Making sense of smart cities: addressing present shortcomings. *Cambridge Journal of Regions, Economy and Society*, 8, 131–136.

Kostakos, V., Ojala, T. & Juntunen, T. (2013). Traffic in the smart city: Exploring city-wide sensing for traffic control center augmentation. *IEEE Internet Computing*, 17(6), 22–29.

Kukka, H., Ylipulli, J., Luusua, A., & Dey, A. K. (2014). Urban computing in theory and practice: towards a transdisciplinary approach. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction (NordiCHI)*. (pp. 658–667). New York, NY: ACM Press.

Luusua, A., Ylipulli, J., Jurmu, M., Pihlajaniemi, H., Markkanen, P., & Ojala, T. (2015). Evaluation probes. *In Proceedings of SIGCHI Conference on Human Factors in Computing Systems (CHI)* (pp. 85–94). New York, NY: ACM Press.

Mattelmäki, T. (2006). *Design probes* (Academic Dissertation). Helsinki: University of Art and Design.

Mitchell, D. (2003). *The right to the city: Social justice and the fight for public space*. New York: Guilford Press.

Morrison, S.L., & Gomez, R. (2014). Pushback: Expressions of resistance to the "evertime" of constant online connectivity. *First Monday*, 19(8). Retrieved from http://journals.uic.edu/ojs/index.php/fm/article/view/4902/4106

Newman, P., Beatley, T. & Boyer, H. (2009). *Resilient cities: Responding to peak oil and climate change*. Washington, DC: Island Press.

Official Statistics of Finland (OSF) (2013). Use of information and communications technology by individuals. Helsinki: Statistics Finland. Retrieved from http://www.tilastokeskus.fi/til/sutivi/index_en.html

Ojala, T., Kokkoniemi, J., Luukkonen, J., Hakanen, T., Salmi, O. & Pokkinen, P. (2012a). Reflecting QoS of low-cost multi-provider municipal WiFi on commercial 3.5G mobile data and ISM spectrum occupancy. In *Proceedings of the 10th ACM international symposium on Mobility management and wireless access* (pp. 37–44). New York, NY: ACM Press.

Ojala, T., Kostakos, V., Kukka, H., Heikkinen, T., Lindén, T., Jurmu, M., Hosio, S., Kruger, F. & Zanni, D. (2012b). Multipurpose interactive public displays in the wild: Three years later. *Computer*, 45(5), 42–49.

Ojala, T., Kukka, H., Lindén, T., Heikkinen, T., Jurmu, M., Hosio, S. & Kruger, F. (2010). UBI-hotspot 1.0: Large-scale long-term deployment of interactive public displays in a city center. In *Proceedings of ICIW 2010*, Barcelona, Spain (pp. 285–294). New York: IEEE.

Ojala, T., Orajärvi, J., Puhakka, K., Heikkinen, T. & Heikka, J. (2011). panOULU: Triple helix driven municipal wireless network providing open and free Internet access. In *Proceedings of Communities and Technologies 2011 (C&T)*, Brisbane, Australia (pp. 118–127). New York, NY: ACM Press.

Oudshoorn, N., Rommes, E., & Stienstra, M. (2004). Configuring the user as everybody: Gender and design cultures in information and communication technologies. *Science, Technology & Human Values*, 29(1), 30-63.

Oulu Brand Book (2014). The city of Oulu. Retrieved from http://www.ouka.fi/c/document_library/get_file?uuid=1ba92026-fcd2-4de7-8007-e5161c90a393&groupId=78560

Pasquinelli, C., & Teräs, J. (2013). Branding knowledge-intensive regions: A comparative study of Pisa and Oulu high-tech brands. *European Planning Studies*, 21(10), 1611-1629.

Pihlajaniemi, H., Luusua, A., Teirilä, M., Österlund, T. & Tanska, T. (2012). Experiencing Interactive and Participatory Urban Lighting Through LightStories. In *Proceedings of the 4th Media Architecture Biennale Conference: Participation* (pp. 65–74). New York, NY: ACM Press.

Paulos, E., & Jenkins, T. (2005). Urban probes: encountering our emerging urban atmospheres. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 341–350). New York, NY: ACM Press.

Rainie, L., Smith, A. and Duggan M. (2013). Coming and going on Facebook. *Pew Research Internet Project* (5 February). Retrieved from http://www.pewinternet.org/2013/02/05/coming-and-going-on-facebook/

Ridell, S. & Zeller, F. (2013). Mediated urbanism. Navigating an interdisciplinary terrain. *International Communication Gazette*, 75(5–6), 437–431.

Rogers, Y. (2006). Moving on from Weiser's vision of calm computing: Engaging ubicomp experiences. In *Proceedings of the 8th international conference on Ubiquitous Computing (Ubicomp)* (pp. 404–421). Heidelberg: Springer.

Sanders, E.B.N. & Stappers, P.J. (2008). Co-creation and the new landscapes of design. *Co-design*, 4(1), 5–18.

Suopajärvi, T. (2015). Past experiences, current practices and future design: Ethnographic study of aging adults' everyday ICT practices—And how it could benefit public ubiquitous computing design. *Technological Forecasting and Social Change*, 93, 112–123.

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.

Söderström O., Paasche T. & Klauser F. (2014). Smart cities as corporate storytelling. *City*, 18(3), 307–320.

TNS Gallup (2013). *Mobile Life 2013 Study*.

Tuuva-Hongisto, S. & Timonen , P. (2011). *Kuluttajien arvot ja unelmat ekologisten faktojen suodattajina [The values and dreams of consumers as filterers of ecological fact].* In: Donner-Amnell, J., Miina, S., Pykäläinen, J. & Tuuva-Hongisto, S. (Eds.), *Maailma haastaa. Metsä tulevaisuuden ratkaisuissa [A challenging world. Forest in the solutions of the future]* (pp. 188–200). Joensuu: University of Eastern Finland.

Vanolo, A. (2014). Smartmentality: The smart city as disciplinary strategy*. Urban Studies* 51, 883–898.

Vicini, S., Bellini, S. & Sanna, A. (2012). The city of the future living lab. *International Journal of Automation and Smart Technology*, 2(3), 201–208.

Weiser, M. (1991). The computer for the 21st century. *Scientific American*, 265(3), 94–104.

Weiser, M. & Seely Brown, J. (1997). The coming age of calm technology. In: Denning, P.J. & Metcalfe, R.M. (Eds.), *Beyond calculation: The next fifty years of computing* (pp. 75–85). New York: Springer.

Williams, A., Robles, E. & Dourish, P. (2008). Urbane-ing the city: Examining and refining the assumptions behind urban Informatics. In Foth M. (Ed.) *Handbook of research on urban informatics: The*

practice and promise of the real-time city (pp. 1–20). Hershey: Information Science Reference, IGI Global.

Wilska, T. A., & Pedrozo, S. (2007). New technology and young people's consumer identities. A comparative study between Finland and Brazil. *Young*, 15(4), 343–368.

Ylipulli J., Luusua A., Kukka H. & Ojala T. (2014a). Winter is coming: Introducing climate sensitive urban computing. *Proceeding of Designing Interactive Systems, DIS'14* (pp. 647–656). New York, NY: ACM Press.

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

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.