Why Public Displays Invite Use in Some Places But Not in Others: A Comparative Study of UBIOnlu
Abstract

The purpose of this study is to investigate the mystery as to why public displays invite use in some places but not in others. This is a comparative study of UBI Oulu, where Open UBI Oulu project installed 11 UBI hotspots around Oulu city centre in 2009. In the most active time there were 18 UBI hotspots available. UBI hotspot is a large touch-sensitive screen and it is publicly located, and anyone can use it freely. UBI hotspots are located both indoors and outdoors, six of which were selected for this research. Swimming center Out of all the hotspots, the one located at Raksila swimming center gets approximately 55-85% of total clicks, depending on the weekday. This thesis tries to establish the reasons for that popularity.

Prior research was studied to obtain research data on contextual use of technology; privacy, propinquity and social designation. Furthermore, situated use of public displays was studied also to find out what the impact of weather, climate, time of day, and weekday, for example, have on hotspot usage.

Data for this study was collected in the autumn of 2015 and it consists of hotspot usage statistics in a period of one week. Six hotspots under study were analysed in detail from the social and architectural point of view.

On the basis of the results of this thesis, two conclusions can be made. When UBI hotspots or similar are planned to be installed, they should be located in places that already have a lot of visitors, who spend time there anyway. The content and the context should match, so that the displays will reach those audiences who are interested in the content. In the Oulu case, the displays were most appealing to children.

Keywords
ubiquitous computing, public display, UBI hotspot, UBI display

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Foreword

This thesis is written as a completion to the Master’s degree in Information Processing Science, at the Oulu University.

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Annekaisa Pahkala

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1. Introduction

Public displays and other urban technologies have been studied extensively in various parts of the world. A common limitation so far has been to focus on one interactive display point of view, or there has been no emphasis on the context of the displays.

In the past years, the City of Oulu has had a chance to be in the focal point of ubiquitous computing since the Open UBI Oulu project carried out a pilot test in 2009 in Oulu city centre. An essential part of the project was the network of UBI hotspots, which were installed around downtown Oulu. The UrBan Interactions (UBI) research program was coordinated by the University of Oulu.

A public display (Fig. 1) is a large interactive display and it is publicly located, so anyone can use it freely anytime. UBI Oulu is a network of UBI hotspots, and hotspots are located both indoors and outdoors.

Figure 1. UBI hotspot located at Raksila swimming center.

Jurmu et al., (2009) conducted an ethnographic study to get a grasp of what urban citizens need and what kind of services they would like to use before they started to create a conceptual design for the UBI displays. For the actual pilot test, 11 UBI hotspots were installed around downtown Oulu. The pilot test results contain quantitative data about UBI hotspots usage statistics and qualitative data from a special questionnaire for the pilot users. (Jurmu et al., 2009)

After the pilot test there have been several outreaches from the Open UBI Oulu project members to make the topic available also for the international community. The project members organize annual international UBI Summer Schools for young academics, the UBI Researcher in Residence Program invites other researchers to come to Oulu to do
research, and via the UBI Remote Deployment Program researchers can remotely deploy their applications in the UBI infrastructure, and there has also been two international UBI Challenges to accelerate concrete research cooperation. (http://www.ubioulu.fi/en/outreach)

During the UBI existence in Oulu, the hotspot at Raksila swimming center has had the most usage out of all the hotspots. Depending on weekday, Raksila swimming center gets approximately 55-85% of total clicks out of all the UBIs (Fig. 2) presented by UBI hotspots statistics, where yellow line represents the amount of “all hotspots total” and the topmost green line the “swimming center” clicks. Figure 3 displays the current state a bit clearer with statistics.

**Figure 2.** Summary of all hotspots total and every individual UBI Hotspot clicks between 24.-30.9.2015 (http://vm0031.virtues.fi/ubistats).

**Figure 3.** Summary of all hotspots total and every individual UBI Hotspot clicks between 24.-30.9.2015 (http://vm0031.virtues.fi/ubistats).

During the period between 24.-30.9.2015, total amount of all UBI hotspot clicks was 4943 and Raksila swimming center alone accounted for 3420 of them. Raksila swimming center’s share was 69% of total clicks. For more detailed information about UBI hotspots usage statistics, see http://vm0031.virtues.fi/ubistats/. Page was accessed on 1\textsuperscript{st} of April 2016.
UBI hotspot usage in Oulu in general already had a slowly declining trend in the timespan from June 2010 to May 2012 in the statistics according to Ylipulli, Suopajärvi, Ojala, Kostakos, & Kukka (2014). Alt, Schneegaß, Schmidt, Müller, & Memarovic (2012) have concluded two common problems for public displays. The reason behind their lack of attention is that a passer-by does not know or expect the public display to be an interactive one, and they think there is no interesting content available. Ojala, Kostakos, & Kukka (2011) describe the differences between the laboratory and a real-world setting. They say the location of a public display is crucial, since the Raksila swimming center, which is used by relaxed people in a leisurely mood, gets 47 times more clicks than a UBI hotspot placed in the lobby of a municipal service centre. Müller, Alt, Michelis, & Schmidt (2010) have also noticed that when passers-by are in a leisure-related mode, then the probability of interaction with public display may be higher than when they are shopping, for example.

This thesis aims to find out why public displays invite use in some places but not in others, to understand context-sensitive issues and to point out next steps so that ubiquitous computing could exist and even increase its influence in the future.

The following chapters present existing literature about the subject, after that the results are mirrored against a framework, the discussion chapter summarizes the results, and finally the thesis limitations are presented and future directions are stated.
2. Literature Review

The objective of this master’s thesis is to find out why public displays invite use in some places but not in others. This study introduces elements of social affordances with different characteristics found at several UBI hotspot locations, both in indoor and outdoor spaces.

During the existing years of public displays and the Open UBI Oulu project, a couple of synonyms have sprung to life. Public displays, UBI displays, UBI hotspots, and hotspots mean precisely the same thing - a public display unit with large touch-sensitive screen. These concepts are mixed in the literature and therefore also mixed in this thesis.

This thesis concentrates on context-sensitive issues since they are the only things changing in the different UBI hotspot placements. The technology behind the multi-purpose interactive displays are the same regardless the physical location. Each UBI hotspot consists of a 57-inch high-definition LCD panel with a capacitive touchscreen foil, 6 mm safety glass, two cameras, a near-field code and radio frequency ID (NFC/RFID) reader, a loudspeaker, Wi-Fi and Bluetooth access points, and high-speed Internet access (Ojala et al., 2012). The only difference is weather the hotspot is located indoors or outdoors. The indoor UBI hotspots are single-sided displays and they are available to people when the buildings are open. The outdoor UBI hotspots are double-sided and they are available to people 24/7. Heikkinen et al., (2010) describe the UBI hotspots as “not off-the-shelf” products but unique customized versions of a commercial Digital Information Display (DID).

The following section presents public displays, and then defines common theories for contextual use of technology in detail and the situated use of public displays.

2.1 Public displays

Public displays are used for several purposes. Alt et al., (2012) argue public displays do not have only one single goal they are trying to achieve; displays may try to strive attention, create an engaging experience, maximize usability, show warnings, and/or support fast evacuation of a building.

Public displays are commonly used for advertising, but public displays can also be used without a marketing agenda. Kostakos and Ojala (2013) describe the BBC’s Big Screens, installed in urban spots around the United Kingdom, which are mainly showing content from BBC TV. Additionally, different events have been organised near these displays, for example, several sporting happenings during the 2012 Olympics held in London. Other sports that interest audiences are also broadcasted live via the Big Screens.

Interaction with public displays does not necessarily start as late as when the display is touched, but interaction can begin actually begin much earlier. There are different phases of interaction and the model of audience funnel has got six phases; passing by, viewing and reacting, subtle interaction, direct interaction, multiple interaction, and follow-up action. In the beginning when interaction is in the first phase, attention is raised. When attention grows one goes to the next phase to viewing and reacting.
Attention changes to motivation when one starts subtle interaction. Motivation stays high if the rest of the phases are reached. (Memarovic et al., 2012; Müller et al., 2010.)

2.2 Common theories for contextual use of technology

This chapter describes the common theories for contextual use of technology found in UBI hotspots. Fayard and Weeks (2007) have studied how photocopiers and water-coolers enhance informal communication and interaction in enterprises. They introduced the notion of social affordances and they also identified the social and physical characteristics which produce the propinquity, privacy and social designation that are necessary for an environment to be able to afford informal interactions. Previously research on affordances has been typically focused on the affordances of the behaviour of an individual person. Uemukai, Hara, & Nishio (2004) mention how ubiquitous computers can, after identifying the user, offer them a variety of services, them, for example a map of the area around the them. The method for selecting appropriate data for the dedicated mobile user is based on personal information where the output data is selected based on the user’s requirements.

Langheinrich (2005) has studied how ubiquitous computing affects our notion of privacy, our right to be alone and whether we should we give up our isolation and anonymity in the name of new technology. The first option is to abandon privacy by using ubiquitous computing technology without any kind of barriers. The second option is to surround ourselves, have a full-scale anonymity by not using any ubiquitous computing. Langheinrich (2005) introduces a third option which contains methods to announce privacy policies in smart environments via privacy beacons and personal privacy assistants, to reason and act upon such policies by automatically configuring the available services with the help of privacy proxies, and to store the collected information and enforce their respective collection and usage policies through privacy-aware databases.

Boyle and Greenberg (2005) have studied video media spaces (VMS) and their privacy, and have found out their design prompts ethical questions, affords opportunities for abuse and creates severe concerns both from users and non-users. Privacy is a huge concept overall from which a big vocabulary of terms develops. Boyle and Greenberg (2005) build a broadly and deeply rooted vocabulary for privacy by synthesizing computer-supported cooperative work (CSCW) observations of privacy with video media spaces.

Kraut, Egido, & Galegher (1988) argue that the informal contact that results from frequent opportunities for communication often leads to collaboration, and that proximity increases the quality of communication. Kraut et al, (1988) also say communications technologies which do allow free-form interaction in real-time and time-shifted modes to substitute for physical proximity are likely to create good advantages.

According to Fayard and Weeks (2007), theories of privacy posit that people feel most comfortable interacting informally when they are able to control the boundaries of their conversation. Theories of propinquity state the opposite as they posit that informal interactions occur in premises that bring people physically closer to each other. Theories of privacy hypothesize that enclosed premises foster informal interaction. Forms of inaccessibility and privacy, like walls and partitions, are assumed to correlate with raised levels of informal interaction. Theories of propinquity hypothesize that centrally located, open premises foster informal interaction. Absence of different inaccessibility
items are forecasted to correlate with raised levels of informal interaction. (Fayard and Weeks 2007.)

The empirical evidence is conflicting since it supports both theories. Several studies have been conducted on these theories, one of the most famous being the Hawthorne experiments. Fayard and Weeks (2007) say the experimenters’ finding was that when workers were moved into small rooms where there was no supervisor present, the amount of informal interaction was increased and this supports the theories of privacy. A study by Oldham and Rotchford (1983) supports this by getting a result that open-office layout reduces the amount of informal interaction. There is also evidence that physical distance separating people at work is likely to exponentially decrease the amount of spontaneous and informal contact. Contradictorily, however, studies on the behavioural impact of open offices have produced results which indicate that open-office architecture is actually associated with more informal interaction. (Fayard and Weeks 2007.)

To understand previous findings, it needs to be acknowledged that the social construction of a setting is as crucial as the physical construction – especially when examining how social constructions shape behaviour. Both privacy and propinquity have social as well as physical meanings. The social purpose of a space has an effect on the privacy of the space. In other words, whether the space is a public or a private space and if some norms of interruption apply there. Propinquity, which is defined to have two people at the same place causing both an opportunity and a social obligation to interact. Thus it is partly a function of both physical closeness and social norms. Theories of propinquity have made an absolute assumption that when distance between two people decreases they feel increased obligation to interact with each other. Interaction obligation has only social origins and its attributes are socially defined. There are also ethnic, national and regional cultural differences when monitoring physical distance and interaction obligation. (Fayard and Weeks 2007.)

A certain amount of both privacy and propinquity are needed for informal interaction. Increase in privacy tends to decrease propinquity and vice versa. Privacy and propinquity do not cause informal interaction but they are more than just enablers – they encourage informal interaction and sometimes even obligate it. If a setting has got interaction obligation, people may choose to resist it, which is considered rude and the social situation is seen as awkward.

Geography, architecture, and the function of the space contribute to making the spaces feel like natural and comfortable spots for informal interaction. Comfort is partly a physical but also a social construct. A space can be comfortable to be in with others – it is large enough to fit in people without feeling cramped but it is at the same time surrounded to mark a distinction between the inside and outside. It then also protects against constant interruption. Comfortability of a space is also about being comfortable with being found in it. The social designation of activities is a set of imperfectly shared understandings about what is suitable and normal in a space. Multiple functions of a space afford informal interaction by giving people reasons to be in the space and stick around there. (Fayard and Weeks 2007.)

2.3 Public displays situated and temporal usage

Ojala et al., (2012) argue location is central to the way people use the UBI hotspots. They deployed identical UBI hotspots at multiple different locations, and the amount of usage varied greatly. Raksila swimming center clients tend to be more relaxed and
unhurried than people around other UBI hotspots. The majority of the Raksila swimming center user population are children and teens playing games (Ventä-Olkkonen, Lanamäki, Iivari, & Kuutti, 2016). Studies on social context also revealed that even though UBI hotspots mostly offer single-user services, people were using them in pairs or small groups, so social settings like the swimming center enhance interaction. (Ojala et al., 2012.)

According to Alt et al., (2011) the central design recommendation is to take the context of a potential public display into account, which means the public displays should be situated where the people are more likely to pass by. Memarovic, Langheinrich, Cheverst, Taylor, & Alt (2013) reported findings from the Wray Photo Display study, which was initially deployed in 2006 in a rural village of Wray in the North of England. The goal of the Wray Photo Display was to study if a public display system affects the community. According to Memarovic et al., (2013) the most desirable public display placements were the ones which have the most visitors, like village town hall and post office. Results show most of the users were seen waiting for the doctor’s appointment in the village town hall or waiting for their turn in the post office. A major observation was that interaction should be a kind of lightweight, meaning that people could just watch the content of public display without actual interaction. This requires automatic content change in the display in every twenty seconds or similar. And if people seem to have more time they could start interaction. In 2013 the system was still up and running and it had gone through several upgrades.

Some other social settings, like large crowds near the UBI hotspots, can restrict hotspot interaction. Reasons for this can be hotspot placement and the nature of nearby events. Researchers expected the amount of use to increase in the previously described situation, but instead they deduced that people arriving to a special event (mostly in pairs or small groups) were hasty to join the event and did not interact with the hotspot. Also, a big crowd waiting for the event to start caused the single persons not likely to start interacting with the hotspot. Researchers also found out that UBI hotspots are not practical in overcrowded events because people tend to block the display and thereby prevent others from using the hotspot. They make an implication according to their observations and state that people do not have extra time when they are attending a structured special event and are not therefore using UBI hotspots even when they are available during the event. (Ojala et al., 2012.)

The following paragraphs discuss context-sensitive issues which heavily affect public display usage in general. There are several cases which each have an impact alone, but also together.

2.3.1 Design challenges due to weather and climate

Ylipulli, Luusua, Kukka, & Ojala (2014) have done unique research how climate patterns, weather conditions and people’s adaptation to them affect the urban ICT everyday usage. According to Ylipulli et al., (2014) the concept of weather refers to a more local and short-term conditions, such as rain, while the concept of climate refers to long-term conditions. They name the new approach as climate sensitive urban computing and it concentrates on how people use ubiquitous computing outdoors at Oulu in Northern Finland. Oulu has got big seasonal variations in weather and there is also quite exceptionally rich computing infrastructure with public WiFi and a network of large interactive public displays at both indoor and outdoor locations. Ylipulli et al., (2014) made an empirical and qualitative study which was carried out in two parts, and especially the latter part, the notebook study, concentrated on the interactive public
outdoor displays usage. The notebook study was conducted in two parts, in winter and in autumn. Ylipulli et al., (2014) argue that weather and climate should unquestionably be considered as a design challenge, since computing is nowadays used everywhere, even outdoors, and in all seasons. They explain the term ‘context of use’ to include invisible cultural and social factors, but also external physical factors, like limitations and possibilities created by the climate, for example.

Ojala et al., (2012) have analyzed their logs of average daily temperatures and common weather conditions, for example, whether the weather is sunny or if it is snowing, and they argue the weather has an impact on the UBI hotspots usage amount, and even on indoor hotspots. They found out that the sunnier and warmer days do correlate with higher UBI hotspots usage amount based on screen touches, services launched, and user interaction times. Their results show about 10 percent of usage variation to changes only in the surrounding temperature. Other variables like time of day, day of the week or location were discarded from the results. Müller et al., (2010) argue public displays located outdoors may have physical constraints which are make using hotspots impossible. They listed direct sun shine on the display and cold temperatures.

A limitation of a capacitive UBI hotspot is the inability to sense non-conductive objects. In cold weather, gloves are needed but at the same time they insulate the skin’s capacitance. Ylipulii et al., (2014) reported that during the notebook study, most participants found cold weather problematic since they were forced to use the UBI hotspot with gloves on which had a negative effect on the responsiveness. Zarek, Wigdor, & Singh (2012) made an open-ended study for handheld capacitive touch device users. Zarek et al., (2012) tried to find out what people would do in the situation where the traditional touch device usage by hand would be impossible due to gloved, dirty or occupied hands. The study elicited 60% of respondents suggested to use their nose as an input device. They observed the nose is usually uncovered and available as an input method. As a downside they listed mobile user interfaces are not optimized for nose input and some respondents reported that touch screen would get dirty if nose was used. UBI hotspots would have a size advantage compared to mobile phones, but a further study is needed to discover whether UBI hotspots users would actually adopt the nose input method.

2.3.2 Architecture of privacy and propinquity

Setting has got its own physical and social characteristics which may or may not meet the environmental requirements for informal interaction. If requirements are met, affordance is signalled to perceiving actors. Key characteristics to evaluate a setting are its architecture, geography and function. Fayard and Weeks (2007) present their qualitative study results of informal interactions. They say a qualitative field study is an appropriate way to investigate the affordances of informal interactions for two reasons: affordances may be subtle and are thus not easily recognised by actors themselves, and to understand the effects of the communally physically and socially constructed environment (and to move beyond causality to affordance), a comprehensive and interpretive approach is needed. Fayard and Weeks (2007) listed elements which had positive or negative effects on propinquity, privacy and social designation: architectural elements such as doors and windows, geographical elements such as where the object on study was located and how it was situated, and functional elements concerning objects in the researched venue such as photocopier and bulletin boards. (Fayard and Weeks 2007.)
UBI hotspot usage questionnaire results show that public use of a hotspot is agonising for some users since passers-by may see too much of what the hotspot user is interested in, or there is the fear of failure when using the hotspot. These results are directly linked to privacy. Questionnaire participants suggested improvements, like the UBI hotspots should have visual protection on the sides. Another idea was to make the interactive section of the display smaller. Researchers argue different locations of UBI hotspots could decrease the agony of public hotspot usage. (Ylipulli et al., 2014.)

2.3.3 Time of day and weekday impact

Peltonen et al., (2008) have observations of the CityWall usage, which was installed by the researchers in Helsinki, Finland in summer 2007. CityWall was a public display which supported for example multiple hand tracking. The display was located at a central spot in downtown Helsinki, between the main bus and train stations which both are used on a daily basis by 400,000 passengers. In addition, the area has got a lot of pedestrians 24/7. CityWall provided, for example, real time content from Flickr with keyword “Helsinki” and then display users were able to move, scale and rotate pictures. Display usage was recorded in many ways; the system captured continuous interaction log of touches and a web camera recorded continuously during the observation cycle. The researchers chose eight days for more detailed analysis to find out differences in display use during time of day and weekday.

During the eight days of observation period, the CityWall was in use 8.8% of its uptime, total number of display users was 1199 and there were 516 separate interaction sessions. Figure 4 illustrates CityWall user amount at different hours. User amount per hour are summarised from the eight days of observation period and drawn as pillars. The X-axis shows the time of day and the y-axis shows the number of people present. The Y-axis figure also includes people who participated in viewing other people’s display usage but did not touch the display themselves. The researchers also reported CityWall usage having been a bit more active in the weekend compared to the weekdays. (Peltonen et al., 2008.)

![Figure 4. Number of people at CityWall at different hours. The values are sums from the eight days of use (Peltonen et al., 2008).](image)

Memarovic et al., (2015) deployed the Moment Machine in 2012. It was an urban screen application available for users over 12 weeks both in the United Kingdom (UK) and Switzerland (Memarovic, 2015). The Moment Machine was available at four locations in the UK, in Nottingham and London. The interface of the application showed a live video feed which allowed passers-by take pictures using a display-
attached camera. After a photo was taken, users had thirty seconds to choose if the snapshot was discarded or if it was displayed in all four locations. The researchers noticed there were periods with high and low interactivity which matched different times of day. Morning period from 6am to 12pm had low interactivity, afternoon from 12pm to 6pm had high interactivity, evening from 6pm to 12am had high interactivity and night from 12am to 6am had low interactivity. They wanted to balance engagement between periods and normalise the number of interactions and made some arithmetical operations. Results in Figure 5 display average normalised number of sessions for a period for a particular day of the week.

![Figure 5. Daily engagement with the Moment Machine application over a week in UK. The stacked graph shows weighted average of the normalised number of sessions for a day (Memarovic et al., 2015).](image)

Figure 5 shows the Moment Machine application usage, line named as “Photo sessions” in the figure, has ranged from Friday’s 2.18 sessions to 4.32 session on Saturdays. On average the Moment Machine was used more in the weekend (4.11 sessions) than in the week (3.28 sessions).

### 2.4 A summary

Public display usage is affected by both privacy and propinquity, which can be seen to have a close dependence relationship with each other. The social designation of the place where public display is located is important. The physical location of the public display, whether it is indoors or outdoors, plays a big role too, especially as north as this where winter conditions exist several months. Time of day and weekday too seem to have effect on the amount of usage.

Based on the literature referred to in this second chapter, I examine why the UBI hotspot usage in terms of total clicks has varied a lot at different locations. I examine the architectural attributes and social designations in chosen six example UBI hotspot locations and try to find explanations why usage amounts are so different. I also try to find out whether there is a connection between the time of day and weekday with usage amounts.
3. Research Method and Setting

This section introduces the research method used in this Master’s Thesis, and gives an overview of the UBI Oulu project and how its status has changed during this the course of this study.

3.1 Theoretical framework

This master’s thesis utilizes qualitative research methodology by trying to understand why people use UBI hotspots so differently at different hotspot locations. Social and architectural contexts are examined from privacy and propinquity point of view. This study also contains a quantitative research method since data received from the UBI hotspot usage statistics will be analysed from the time of day and weekday point of view.

The Results will be analysed by using abductive reasoning, which was created by an American philosopher, logician and the father of pragmatism, Charles S. Peirce. The idea in abductive reasoning is to find the simplest and most likely explanation to some phenomena by using novel thinking (Royce and Kernan, 1916). Locke, Golden-Biddle, & Feldman (2008) present Peirce’s view in their article which that abduction merely suggests that something may be. Peirce had presented a cycle between belief, doubt, and abduction. Locke et al., (2008) pointed out the living condition of doubt and its productive ability in the theorising process. They developed three strategic principles which help researchers further cultivate doubt’s possibilities. The principles are: turn toward/embrace not knowing, nurture hunches, and disrupt order.

The experience of turn toward/embrace not knowing is usually less familiar to people, since typically knowing and showing what we know is rewarded. It takes effort to unlearn how one usually responds to doubt. In order to be able to utilise this principle one can face different emotions like fear and anxiety during the process. With nurturing hunches, the hunches are seen as a sense of something we are ignoring in what we are able of articulating and verifying. The meaning and value of hunches are not distinctly severed. When researchers are feeling doubt, hunches help toward new knowledge. As an example of disrupt the order, researchers present C. Wright Mills’ proposition to deliberately mix up memos and files to a random order, since it can reveal strange but productive associations amongst the ideas embodied in them. (Locke et al, 2008.)

Alvesson and Kärreman (2007) have studied data in theory development through mystery creation and solving. They have created methodology, which also lies in abduction category, to find ways to encounter breakdowns and create mysteries (Fig. 6). Their objective has been to examine how data can be used to develop theory that is interesting rather than obvious, irrelevant, or absurd. Data, the empirical material, is tightly hooked up with theory. This fusion has profound impact on how the theory-data -relationship is perceived. Researchers highlight ways in which data can be utilised to facilitate and encourage critical reflection by how to advance our ability to challenge, revise, and demonstrate theory. Their goal has also been to suggest an approach where empirical material has been framed in alternative way – in the social sciences there are only interpretations.
Figure 6. Methodology to find ways to encounter breakdowns and create mysteries (Alvesson and Kärreman, 2007).

The next list of elements is not meant to be a manual or a model in how to carry out this kind of research. The list should be seen as a rough description or source of guidance and inspiration. The key stages in the mystery focused methodology are; 1. Familiarise with the setting under study, 2. Encounter breakdowns in understanding, 3. Move from breakdown to mystery, 4. Engage in more systematic work, 5. Solve or reformulate the mystery, and 6. Develop the (re)solution of the mystery. No theory is always right or always wrong but all are helpful in different occasions. (Alvesson and Kärreman, 2007.)

To find out the mystery in this thesis, why public displays invite use in some places but not in others, literature was reviewed, UBI hotspot location data was analysed, and statistics on UBI hotspots clicks were analysed.
Carlsen and Sandelands (2014) have conducted studies on wonder in organisational inquiry. They do not see wonder as a grand miracle coming to people but they see wonder as relational and something that people can actively seek out in everyday happenings. Wonder is a personal and social process. Wonder can be the most valuable, yet the least examined phenomenon in organisation studies. It is too important a phenomenon to be treated as belonging exclusively to the art or philosophy. Wonder is explored as an invitation to imagination in organisational inquiry. Researchers have focused on three questions; what is wonder, how does wonder enter inquiry, and how can we make inquiry more wonderful.

*Wonder is defined* as a combination of feeling startled by something unusual in usual, and being moved into incipient, self-transcending search which addresses mysteries of being. Researchers describe wonder as a play of four moments of activity where *wonder causes imagination in inquiry*; arousal, expansion, immersion, and explanation. Arousal is a distinguishing core, since it is a combination of awe and surprise in an occasion discriminate as strange and confusing. Expansion takes place if the reaction to an arousal seeds interest, and expansion many times occurs in tandem with the arousal moment. Immersion typically happens from moments of expansion and hence means to participate in the life world of object or a person which elicited intense interest. Explanation can be seen as ending the wonder, and it arrives in the feeling of coming to know, in the flash of an insight or forming of an explanation. Peirce’s intense feeling of beauty in abduction is an example of corresponding theoretical emphasis of an explanation. *Inquiry could possibly be made more wonderful* by wondering together since wonder is an engagement to distribute and it is magnified in the distribution, upholding mystery, which is the most primary of all since it cherishes the mystery of truth, and keeping wonder alive to come a full circle of process. (Carlsen and Sandelands, 2014.)

### 3.2 Data gathering

Six UBI hotspots were selected for the comparative study. The hotspots are Raksila swimming center, Urheilutalo, Rotuaari square, Rotuaari crossing, Rotuaari west, and Toripolliisi, see Figure 7. The picture collage (Fig. 8) gives an overview of the locations. Two of them are located indoors (Raksila swimming center and Urheilutalo) and four are outdoor hotspots. Section 4 will describe the setting of each six locations and the pictures provide genuine evidence of the surroundings. 32 pictures were taken, and they were intentionally taken on a time of day when there were hardly any people present to capture all elements which may have impact on the UBI hotspot usage amount. The Open UBI Oulu project provided UBI hotspot usage statistics in a form of a SQL dump, from all the hotspots at the period under study.

![Figure 7. A map of six UBI hotspots under study.](image-url)
3.3 Data analysis

In the first phase pictures of six UBI hotspot locations under study were analysed from the architectural point of view, to define whether the location causes more propinquity or privacy. The social designation of the UBI hotspot location was also analysed. Since there were several pictures from each location, a picture collage was created to give a better overview of the surroundings in its entirety. In the second phase I utilized the SQL dump by queries to get out detailed usage statistics from the selected six UBI hotspots. The “by hour” and “by day” information was then inserted into an excel sheet and figures were drawn. In the third phase I analysed how the surroundings may effect on outdoor hotspot usage; the weather and climate in different forms. Is the UBI hotspot user in danger to get wet during the usage or does the sun make reflections on the display and therefore can hinder the usage. The analysis ensued key elements which were then inserted with results into the table.

3.4 An overview of UBI Oulu

The status of the UBI Oulu project has changed during this study. The period under study in this thesis was between 24.-30.9.2015. Based on the original plan, the UBI
hotspots should have been available until March 2017, if not longer (Ojala et al., 2012). The situation in November 2016 was that some of the hotspots had already been unavailable for people for several months due to software and hardware problems, and a couple of hotspots have already been removed from their original locations. The removed hotspots include the ones located at Ouluhalli and the main lobby area of the University technology campus. I was reluctant to change the scope of the study, since the research question remained – why some public displays invite use in some places but not in others. The locations of the UBI hotspots studied in this thesis have been documented by photographing them before the hotspots were removed, usage statistics had been requested and provided by the Open UBI Oulu project team and the previously conducted interviews at the Raksila swimming center were available for analysis.

According to the UBI Oulu project team, in the most active time there were 18 UBI hotspots in use. Around the time when this study began, 10 hotspots were located in public indoor spaces and 6 of them were placed outdoors. Indoor hotspots are available for people to use when public buildings are open. Outdoor hotspots are available 24/7 for everyone.
4. Findings

During the UBI Oulu project, UBI hotspots have been installed around Oulu downtown, Oulu Airport, and a couple of campus areas. The hotspots have been both in indoor and outdoor settings. The set of UBI hotspots under study were located at Oulu downtown area, both in indoor and outdoor locations.

This section starts with a presentation of all UBI hotspot click counts at different hours and per weekday over the observation period. After that findings from each hotspot locations under study are presented in detail.

4.1 Comparative study based on location

During the seven days of observation period between 24.-30.9.2015, total number of display clicks was 4943. UBI hotspots under study had 4138 clicks on the same period. Figure 9 below illustrates the click count of all UBI hotspots at different hours. Click counts per hour are summarized from the seven days of observation period and drawn as pillars. The X-axis shows the time of day and the y-axis shows the number of clicks. The results show UBI hotspot usage took place on a relatively wide scale, from early in the morning to late at night. Usage was also concentrated on the weekend and on Monday (Fig. 10).

![Figure 9](image-url)
4.2 Raksila swimming center

This section presents the results of the UBI hotspot at Raksila swimming center; setting and propinquity, privacy, social designation, key elements, number of total clicks in the study period (Table 1), and a picture collage. Hotspot is a one-sided interactive public display. Raksila swimming center is open daily. In weekdays the opening hours run from 6.15/7.00 to 21.00/22.00 and on weekends from 8.00 to 15.15.

Setting and propinquity in Raksila swimming center

Raksila swimming center is a public venue which has got a steady flow of people during the opening hours. In the evenings and on weekends, the utilisation rate is even higher. The UBI display at Raksila swimming center is in an indoor setting and it can explain something for its part in the UBI usage statistics. At Raksila, the UBI display is available in a warm, dry and well lighted setting year round and there are also services available. The swimming center’s lobby area, where the UBI display is located (Fig. 11), has got a clear and roomy layout with big windows and it is easy to enter and exit. Also, the entrance is very wide and it has got automatic doors, making it easy to enter and exit. The UBI display has a central spot as it is set opposite the front door so it is seen when entering the lobby. When going either to the service desk, gym or locker rooms, people pass the UBI display. Next to the UBI display there is the stairway to the second floor where there is a cafe, conference rooms and the stands. There are also several benches in the lobby which are in heavy use when people are either waiting for their exercise class to start or waiting for a ride. Thus, even though Raksila swimming center’s lobby is relatively spacious, there are lots of elements available which increase propinquity and also informal interactions.
Privacy at Raksila swimming center

Since the previous chapter pointed out that propinquity is increased at the swimming center, it automatically tends to have an effect on the privacy by decreasing it, at least occasionally during the swimming center’s high usage hours. Privacy, which is also stated to be the ability to control boundaries of interaction has got two dimensions; spatial and temporal. Spatial dimension means people should have confidence in their conversation staying private when using an UBI display. Temporal dimension contains control over access to oneself – whether we are we able to choose when to interact with others and when not. Are we drifted into a situation when we are obligated to interact when we actually do not want to do it. For example, some games in the UBI display can be played by multiple players at the same time, so it is possible that you are getting co-players without asking. At the swimming center there are also one architectural aspect which has got a huge effect on privacy – the visibility. The large UBI display is visible to nearly every sport in the lobby, which reduces privacy even more. Even from pretty far off from the UBI display, others are able to see what the UBI display user is doing.
Social designation of Raksila swimming center

Swimming center is a place where users are supposed to be used to have people quite close around them. Besides people who come to the center alone, there are also quite many different groups which are interacting already during their exercise classes. There are for example the pensioner groups both at the gym and doing water gymnastics, several swimming groups divided by age in a couple of swimming sports clubs and boxing sports club groups. It is a natural phenomenon that the interaction continues after the class also in the lobby area, so social designation is increased.

Table 1. Key elements of Raksila swimming center’s UBI hotspot.

<table>
<thead>
<tr>
<th>UBI hotspot</th>
<th>Click amount</th>
<th>Share of Hotspots under study</th>
<th>Hotspot available 24/7</th>
<th>Hotspot causes propinquity</th>
<th>Social designation</th>
<th>Privacy element available</th>
<th>Weather may hamper usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raksila swimming center</td>
<td>3420</td>
<td>82.65%</td>
<td>No</td>
<td>Yes, greatly amount</td>
<td>Leisure. Time is also spent for waiting for ride and swimming classes to start</td>
<td>No</td>
<td>No, hotspot located indoors</td>
</tr>
</tbody>
</table>

The combined UBI hotspot click count was 4943 within the period, and Raksila swimming center accounted for 3420 of them (Fig. 12), so its share was huge; 69% from all UBI hotspot clicks and 82% of clicks out of all the UBI hotspots under study.

Figure 12. Number of total clicks of all UBI hotspots at Raksila swimming center at different hours. The values are sums from the seven days of use between 24.-30.9.2015. Total click count is 3420.

According to Uimahalliportaali and City of Oulu, Sports and recreation services, Raksila swimming center has reached in second place when all swimming centers in Finland were compared by usage rate during 2011-2015. In 2015 Raksila swimming center was third in this comparison, see Table 2. (http://uimahallit.vtt.fi/index2.asp)
### Table 2. Visitor count in 2015 – All swimming centers (http://uimahallit.vtt.fi/index2.asp).

<table>
<thead>
<tr>
<th>Center</th>
<th>Visitors (person)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HELSINKI MÄKELÄNRIITEN UINIKESKUS OY</td>
<td>782461</td>
</tr>
<tr>
<td>2. HELSINKI-VUOSAAREN URHEILUTALO OY</td>
<td>639668</td>
</tr>
<tr>
<td>3. OULUN UIMAHALLI (RAKSLA)</td>
<td>621834</td>
</tr>
<tr>
<td>4. HELSINKI-MALMIN UIMAHALLI</td>
<td>388829</td>
</tr>
<tr>
<td>5. ESPOONLAHDEN UIMAHALLI</td>
<td>380272</td>
</tr>
<tr>
<td>6. PORIN UIMAHALLI</td>
<td>332681</td>
</tr>
<tr>
<td>7. HELSINKI-ITÄKESKUKSEN UIMAHALLI</td>
<td>327824</td>
</tr>
<tr>
<td>8. VANTAA-MYYRMÄEN URHEILUTALO</td>
<td>318098</td>
</tr>
<tr>
<td>9. OULU-RAATIN UIMAHALLI</td>
<td>302090</td>
</tr>
<tr>
<td>10. LOHJAN UIMAHALLI-NEIDONKEIDAS</td>
<td>297375</td>
</tr>
</tbody>
</table>

During the years 2011-2015 Raksila swimming center has had quite clear increasing tendency in the visitor count as Table 3 below shows.

### Table 3. Raksila swimming center’s visitor count 2011-2015 (City of Oulu, Sports and recreation services).

<table>
<thead>
<tr>
<th>Year</th>
<th>Visitors (person)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>621834</td>
</tr>
<tr>
<td>2014</td>
<td>620261</td>
</tr>
<tr>
<td>2013</td>
<td>601897</td>
</tr>
<tr>
<td>2012</td>
<td>607212</td>
</tr>
<tr>
<td>2011</td>
<td>587826</td>
</tr>
</tbody>
</table>

### 4.3 Urheilutalo

This section presents results of Urheilutalo’s UBI hotspot; setting and propinquity, privacy, social designation, key elements, number of total clicks in the study period (Table 4), and a picture collage. Hotspot is a one-sided interactive public display. Urheilutalo is open daily. In weekdays opening hours run from 7.15 to 23.00 and in weekends from 8.30 to 22.00.

**Setting and propinquity at Urheilutalo**

Urheilutalo is a public venue which has got 3 gyms, one hall for different ball games (volleyball, floorball, basketball, futsal, boccia) and for aerobics and dancing, and one mirror hall also for aerobics and dancing. The UBI display at the Urheilutalo is in an indoor setting and it is available in a warm, dry and well lighted setting year round. Urheilutalo’s lobby area, where the UBI display is located, has got a roomy layout and it is easy to enter and exit. UBI display has a central spot as it is set opposite of the front door so it is seen when entering the lobby and when going to the second floor where the stand is (Fig. 13). When going from front door either to the service desk, gym or locker rooms people do not pass the UBI display. There are several benches in the lobby which
can be used when people are either waiting for their exercise class to start or waiting for a ride.

![Image of Urheilutalo UBI hotspot]

**Figure 13.** A picture collage of Urheilutalo UBI hotspot.

*Privacy at Urheilutalo*

There is no privacy in Urheilutalo’s lobby area, since visibility to the UBI display is free near from everywhere in the room. Benches in the lobby are located in a way that they all are very near to the hotspot. Also the service desk has got windows facing the hotspot.

*Social designation of Urheilutalo*

Urheilutalo is also a place where the hall users are supposed to be used to having other people quite close around them. Most of the visitors do group sports as different ball games use the venue the most. Users who come alone go to the gym. There is no daily open cafe at the Urheilutalo at the moment. During the different league ball games there are usually some refreshments available for the spectators.
Table 4. Key elements of Urheilutalo’s UBI hotspot.

<table>
<thead>
<tr>
<th>UBI hotspot</th>
<th>Click amount</th>
<th>Share of Hotspots under study</th>
<th>Hotspot available 24/7</th>
<th>Hotspot causes propinquity</th>
<th>Social designation</th>
<th>Privacy element available</th>
<th>Weather may hamper usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urheilutalo</td>
<td>45</td>
<td>1.09%</td>
<td>No</td>
<td>It can cause</td>
<td>Leisure. Time is also spent for waiting for ride and sport classes to start</td>
<td>No</td>
<td>No, hotspot located indoors</td>
</tr>
</tbody>
</table>

The combined UBI hotspot click count was 4943 during the period, of which Urheilutalo accounted for 45 (Fig. 14), so its share was really low; 0.9% from all UBI hotspot clicks and 1.1% of clicks out of all the UBI hotspots under study.

Figure 14. Number of total clicks of all UBI hotspots at Urheilutalo at different hours. The values are sums from the seven days of use between 24.-30.9.2015. Total click amount is 45.

During the years 2011-2015 Urheilutalo’s visitor count has first grown as Table 5 below shows but couple of last year’s show the tendency is going down.

Table 5. Urheilutalo’s visitor count 2011-2015. (City of Oulu, Sports and recreation services)

<table>
<thead>
<tr>
<th>Urheilutalo’s visitor count 2011-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>2014</td>
</tr>
<tr>
<td>2013</td>
</tr>
<tr>
<td>2012</td>
</tr>
<tr>
<td>2011</td>
</tr>
</tbody>
</table>
4.4 UBI Hotspots located in Rotuaari

This section presents the results of the three UBI hotspots at Rotuaari; setting and propinquity, privacy, social designation, key elements, number of total clicks in the study period, and a picture collage.

Setting and propinquity in Rotuaari

Rotuaari is a spacious pedestrian street in everyday life’s point of view. Whenever an event is organised there, it gets crowded pretty easily, and one is not necessarily able to navigate by one’s own interest. The UBI hotspots under study are located in essential spots, at the heart of the Rotuaari (rotuaari-square), nearby the main junction of the whole pedestrian area (rotuaari-crossing) and beside the main pedestrian route to the Oulu Market Square (rotuaari-west). Buildings are naturally channelling people to go by the UBI hotspots. Rotuaari-crossing-1 or rotuaari-crossing-2 has a shelter thanks to the wall and the roof of the nearby apartment building. Other Rotuaari UBI hotspots are located in an open area and there is no shelter or similar available. Rain, sunshine and wind have a major effect on hotspot usage.

Privacy at Rotuaari

Rotuaari-crossing-1 or rotuaari-crossing-2 has privacy due to the wall and the roof of the nearby apartment building. As for the other Rotuaari UBI hotspots, there are no privacy, since they are located in the crowded pedestrian street. Nearby buildings, cafes, restaurants and shops have got an unobstructed view to each hotspot.

Social designation of Rotuaari

There are a lot of shops, cafes and restaurants along Rotuaari. Many different kinds of events and markets such as Air Guitar World Championships, Tiernatori Christmas Market, Rotuaari Piknik, to name but a few, are organised yearly at Rotuaari. During the period under study there were no organised events. (http://www.rotuaari.info/index.php?id=480&date=20150901)

The Rotuaari square hotspot

Results of the Rotuaari square hotspot are presented in Table 6 and Figure 16. Rotuaari square hotspot is a double-sided interactive public display. Rotuaari-square-2 was out of order during the study period so it does not have any results. The UBI Oulu project team was not, without a doubt, able to identify the sides of the hotspot physically which affects my analysis, too. In this particular case, it does not have major impact, since the setting is almost the same in both sides of the hotspot. The only difference is the sunlight, one side gets more sunlight than the other, and it can disturb hotspot usage by making reflections, see Figure 15.
Figure 15. A picture collage of Rotuaari square UBI hotspot.

Table 6. Key elements of the Rotuaari-square-1 UBI hotspot.

<table>
<thead>
<tr>
<th>UBI hotspot</th>
<th>Click amount</th>
<th>Share of Hotspots under study</th>
<th>Hotspot available 24/7</th>
<th>Hotspot causes propinquity</th>
<th>Social designation</th>
<th>Privacy element available</th>
<th>Weather may hamper usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotuaari-square-1</td>
<td>57</td>
<td>1.38%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, transit traffic. Benches near hotspot</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
</tbody>
</table>

The combined UBI hotspot click count was 4943 in the period, of which Rotuaari-square-1 accounted for 57 clicks (Fig. 16), so its share was really low; 1.2% from all UBI hotspot clicks and 1.4% of clicks out of all the UBI hotspots under study.
Figure 16. Number of total clicks of all UBI hotspots at rotuaari-square-1 at different hours. The values are sums from the seven days of use between 24.-30.9.2015. Total click count is 57.

The Rotuaari crossing hotspot

Results of the Rotuaari crossing’s hotspot are presented in Table 7 and Figure 18. Rotuaari crossing’s hotspot is a double-sided interactive public display. Rotuaari-crossing-1 was out of order during the study period so it does not have any results. The UBI Oulu project team was not without a doubt able to identify the sides of the hotspot physically which has an effect on my analysis, too. In this particular case, it does have massive impact since the setting is totally different in each side of the hotspot. One side has got shelter from rain and sunlight and the other side does not (Fig. 17).
Figure 17. A picture collage of Rotuaari crossing UBI hotspot.

rotuaari-crossing-2:

Table 7. Key elements of Rotuaari-crossing-2 UBI hotspot.

<table>
<thead>
<tr>
<th>UBI hotspot</th>
<th>Click amount</th>
<th>Share of Hotspots under study</th>
<th>Hotspot available 24/7</th>
<th>Hotspot causes propinquity</th>
<th>Social designation</th>
<th>Privacy element available</th>
<th>Weather may hamper usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotuaari-</td>
<td>122</td>
<td>2.95%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Transit traffic,</td>
<td>Partly, wall and roof of</td>
<td>Partly, user is covered</td>
</tr>
<tr>
<td>crossing-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>no benches, etc.</td>
<td>a building are close</td>
<td>from the rain</td>
</tr>
</tbody>
</table>

The combined UBI hotspot click count was 4943 in the period, of which the Rotuaari-crossing-2 accounted for 122 clicks (Fig. 18), so its share was small; 2.5% from all UBI hotspot clicks and 3% of clicks out of all the UBI hotspots under study.
Figure 18. Number of total clicks of all UBI hotspots at rotuaari-crossing-2 at different hours. The values are sums from the seven days of use between 24.-30.9.2015. Total click count is 122.

The Rotuaari west hotspot

Results of the Rotuaari west’s hotspot are presented in Tables 8 and 9, and in Figures 20 and 21. Rotuaari west’s hotspot is a double-sided interactive public display (Fig. 19).
Figure 19. A picture collage of Rotuaari west UBI hotspot.

rotuaari-west-1:

Table 8. Key elements of Rotuaari-west-1 UBI hotspot.

<table>
<thead>
<tr>
<th>UBI hotspot</th>
<th>Click amount</th>
<th>Share of Hotspots under study</th>
<th>Hotspot available 24/7</th>
<th>Hotspot causes propinquity</th>
<th>Social designation</th>
<th>Privacy element available</th>
<th>Weather may hamper usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotuaari-west-1</td>
<td>31</td>
<td>0,75%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, transit traffic. A bench near hotspot</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
</tbody>
</table>

All UBI hotspots total click count was 4943 in the period and Rotuaari-west-1 had 31 clicks (Fig. 20), so its share was very low: 0,6% from all UBI hotspot clicks and 0,8% of clicks out of all the UBI hotspots under study.
Figure 20. Number of total clicks of all UBI hotspots at rotuaari-west-1 at different hours. The values are sums from the seven days of use between 24.-30.9.2015. Total click count is 31.

rotuaari-west-2:

Table 9. Key elements of Rotuaari-west-2 UBI hotspot.

<table>
<thead>
<tr>
<th>UBI hotspot</th>
<th>Click amount</th>
<th>Share of Hotspots under study</th>
<th>Hotspot available 24/7</th>
<th>Hotspot causes propinquity</th>
<th>Social designation</th>
<th>Privacy element available</th>
<th>Weather may hamper usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotuaari-west-2</td>
<td>225</td>
<td>5.44%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, transit traffic. A bench near hotspot</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
</tbody>
</table>

The combined UBI hotspot click count was 4943 in the period, of which Rotuaari-west-2 accounted for 225 clicks (Fig. 21), so its share was low; 4.6% from all UBI hotspot clicks and 5.4% of clicks out of all the UBI hotspots under study.
Figure 21. Number of total clicks of all UBI hotspots at rotuaari-west-2 at different hours. The values are sums from the seven days of use between 24.-30.9.2015. Total click count is 225.

4.5 Toripolliisi

This section presents the results of the UBI hotspot at Toripolliisi (Table 10, and Table 11); setting and propinquity, privacy, social designation, key elements, number of total clicks in the study period, and a picture collage. Hotspot is a double-sided interactive public display. Oulu Market Square, where Toripolliisi UBI hotspot is located, stands next to the Oulu city centre and it is a popular meeting point in the summer time (Fig. 22).

Setting and propinquity at Toripolliisi

The Market Square is a large and roomy area and there are no buildings or similar which could channel people precisely towards the UBI hotspot. A popular route to the city centre goes through near the UBI hotspot. At the Market Square there are benches available but around the UBI hotspot there are not any. Toripolliisi UBI hotspot is in an open area and there are no shelters or similar available. Rain, sunshine and wind have a major effect on hotspot usage.
Figure 22. A picture collage of Toripolliisi UBI hotspot.

Privacy at Toripolliisi

There is no privacy at Toripolliisi UBI hotspot, as it stands in the Market Square and near the Market Hall doors. Also a nearby building and a restaurant have an unobstructed view towards one side of the hotspot.

Social designation of Toripolliisi

There are a lot of market vendors selling berries, vegetables, clothes and jewellery, for example. People are also able to buy food dishes and take a break at cafes and restaurants or even take a sea cruise. Oulu Market Square is also a place for different kind of markets and events like Fall Market, Reindeer Carnival and many more. Market Hall, which lies just beside the UBI hotspot, is open from Monday to Saturday year around and it is a traditional and popular shopping place. In the winter there are also an ice skating rink available at the Market Square. Oulu City Library and Oulu City Theatre lie next to the Market Square and in that way also brings traffic nearby the hotspot. During the period under study there were no organised events at the Oulu Market Square. (http://www.rotuaari.info/index.php?id=480&date=20150901)
Toripoliisi-1:

**Table 10.** Key elements of Toripoliisi’s UBI hotspot.

<table>
<thead>
<tr>
<th>UBI hotspot</th>
<th>Click amount</th>
<th>Share of Hotspots under study</th>
<th>Hotspot available 24/7</th>
<th>Hotspot causes propinquity</th>
<th>Social designation</th>
<th>Privacy element available</th>
<th>Weather may hamper usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toripoliisi-1</td>
<td>83</td>
<td>2.01%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, marketplace in summer</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
</tbody>
</table>

The combined UBI hotspot click count was 4943 in the period, of which Toripoliisi-1 accounted for 83 clicks (Fig. 23), so its share was truly low; 1.7% from all UBI hotspot clicks and 2% of clicks out of all the UBI hotspots under study.

![Figure 23. Number of total clicks of all UBI hotspots at Toripoliisi-1 at different hours. The values are sums from the seven days of use between 24.-30.9.2015. Total click amount is 83.](image)

Toripoliisi-2:

**Table 11.** Key elements of Toripoliisi-2 UBI hotspot.

<table>
<thead>
<tr>
<th>UBI hotspot</th>
<th>Click amount</th>
<th>Share of Hotspots under study</th>
<th>Hotspot available 24/7</th>
<th>Hotspot causes propinquity</th>
<th>Social designation</th>
<th>Privacy element available</th>
<th>Weather may hamper usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toripoliisi-2</td>
<td>155</td>
<td>3.75%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, marketplace in summer</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
</tbody>
</table>

The combined UBI hotspot click count was 4943 in the period, of which Toripoliisi-2 accounted for 155 clicks (Fig. 24), so its share was low; 3.1% from all UBI hotspot clicks and 2% of clicks out of all the UBI hotspots under study.
clicks and 3.8% of clicks out of all the UBI hotspots under study.

![Figure 24. Number of total clicks of all UBI hotspots at Toripolliisi-2 at different hours. The values are sums from the seven days of use between 24.-30.9.2015. Total click amount is 155.](image)

### 4.6 Summary of findings

Key elements, which may have an effect on the amount of usage at UBI hotspots under study are gathered to Table 12. Two UBI hotspots are not listed since they were broken during the study period, one side of the double-sided hotspot was completely out of order, and there are no click counts available at all for that hotspot. The UBI Oulu project team was not, without a doubt, able to identify the sides of the hotspots physically. The UBI hotspots left out were rotuaari-square-2 and rotuaari-crossing-1. Rotuaari-square-2 hotspot information is not crucial since the setting is almost the same on both sides of the hotspot. With rotuaari-crossing-1 the lack of information has has a major impact since the settings of the sides are completely different; one side has got shelter from the rain and sunlight and the other side does not. This study examines the sheltered side of this hotspot to get some differing view to the results.

The seven-day study period totalled 4943 clicks on all UBI hotspots. Six UBI hotspots under study had 4138 clicks during the same time. The majority of the clicks took place at Raksila swimming center and its share was huge; over 69% from all UBI hotspot clicks and over 82% of clicks out of all the UBI hotspots under study, as Table 12 show. Urheilutalo is a similar kind of indoor sporting venue as Raksila swimming center, but its share is one of the smallest in the study; only around 1% of the clicks (compared to either all UBI hotspots or UBI hotspots under study). Urheilutalo’s visitor count is still notable (around 209000 – 239000 per year in 2011 - 2015) even though it is ~three times smaller than the visitor count at Raksila swimming center.
Table 12. Key elements of the UBI hotspots under study.

<table>
<thead>
<tr>
<th>UBI hotspot</th>
<th>Click amount</th>
<th>Share of Hotspots under study</th>
<th>Hotspot available 24/7</th>
<th>Hotspot causes propinquity</th>
<th>Social designation</th>
<th>Privacy element available</th>
<th>Weather may hamper usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raksila swimming center</td>
<td>3420</td>
<td>82,65%</td>
<td>No</td>
<td>Yes, greatly amount</td>
<td>Leisure. Time is also spent for waiting for ride and swimming classes to start</td>
<td>No</td>
<td>No, hotspot located indoors</td>
</tr>
<tr>
<td>Rotuaari-west-2</td>
<td>225</td>
<td>5,44%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, transit traffic. A bench near hotspot</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
<tr>
<td>Toripollisi-2</td>
<td>155</td>
<td>3,75%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, marketplace in summer</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
<tr>
<td>Rotuaari-crossing-2</td>
<td>122</td>
<td>2,95%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Transit traffic, no benches, etc.</td>
<td>Partly, wall and roof of a building are close</td>
<td>Partly, user is covered from the rain</td>
</tr>
<tr>
<td>Toripollisi-1</td>
<td>83</td>
<td>2,01%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, marketplace in summer</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
<tr>
<td>Rotuaari-square-1</td>
<td>57</td>
<td>1,38%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, transit traffic. Benches near hotspot</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
<tr>
<td>Urheilutalo</td>
<td>45</td>
<td>1,09%</td>
<td>No</td>
<td>It can cause</td>
<td>Leisure. Time is also spent for waiting for ride and sport classes to start</td>
<td>No</td>
<td>No, hotspot located indoors</td>
</tr>
<tr>
<td>Rotuaari-west-1</td>
<td>31</td>
<td>0,75%</td>
<td>Yes</td>
<td>It can cause</td>
<td>Leisure, transit traffic. A bench near hotspot</td>
<td>No</td>
<td>Yes, no shelter at all. Sun can cause reflections</td>
</tr>
</tbody>
</table>

Despite the fact that Rotuaari has got a lot of passers-by, this does not increase the amount of UBI hotspot usage. People do not have a reason to hang around a hotspot like they do at Raksila swimming center when they are waiting for their exercise class to start or they are waiting for their ride. A notable differential can be seen in one of Rotuaari’s double-sided hotspots, in rotuaari-west hotspots statistics. One side, rotuaari-west-2, has got 225 clicks and the other side of the same hotspot, rotuaari-west-1, has got only 31 clicks. Possible reason for this big dispersion could be sun causing reflections to other side of the hotspot, since the other side is always in shade. The other outdoor hotspot which has got statistics from both sides of the hotspot, Toripollisi, can also have same explanation why results differ from each other.
It is possible that every UBI hotspot has suffered from hardware and/or software problems during the study period between 24.-30.9.2015. Even though we are able to see clicks in the By hour statistics, we can still not be sure if the hotspot was available every minute of every hour in the study period. It is possible that users have faced problems several times when trying to use a UBI hotspot. During the observation sessions, which were carried out in the Project 2 -courses during spring 2015, the student group several times witnessed malfunction at the Raksila swimming center hotspot. When the swimming center staff were asked if they knew how long the hotspot had been out of order, the answer was always something like: “from yesterday”, “couple of days”, etc., so during the UBI Oulu project there has probably been serious problems with the hotspots availability since same people have been monitoring the situation at their workplaces. One can have occasionally seen some hotspot being out of order every now and then but that kind of observation is not so significant since it did not happen on a regular basis.
5. Discussion

Research question was, why public displays invite use in some places but not in others? UBI hotspot location has provably been the key issue for the success in usage amounts. The aim of this thesis has been to investigate the mystery of why the UBI hotspot at Raksila swimming center’s invites so much use compared to the other hotspots. Raksila’s share of the usage has been approximately 55-85% of total clicks out of all the hotspots depending on the weekday. The UBI hotspots are located both indoors and outdoors, and six of them were selected for this research.

Findings in this thesis are in line with Memarovic’s Moment Machine results (Memarovic et al., 2015). On average Moment Machine was used more on weekends (4.11 sessions) than in the weekdays (3.28 sessions). UBI hotspots (see Fig. 10) highest click counts occurred clearly on the timeline from Saturday to Monday.

Heikkinen et al., (2010) argue that laboratory and campus ubiquitous computing prototypes can be sufficient for research purposes, but the vision is not able to be fully realised without deployment and evaluation equipment in a real-world setting. This thesis presented the Open UBI Oulu project starting from the pilot test in 2009 when 11 UBI hotspots were installed around downtown Oulu. UBI hotspot usage trend was slowly declining already in 2010–2012, and the thesis analyses usage statistics from fall 2015 at six selected hotspot locations. The UBI hotspots under study are located both indoors and outdoors. The indoor hotspots were available during the building’s opening hours, whereas the outdoor hotspots were available 24/7. One of the hotspots under study, the Raksila swimming center UBI hotspot, had the largest amount of usage depending on the weekday with over 55-85% of total clicks from all UBIs (Fig. 2). During the observation period between 24.-30.9.2015, total amount of all UBI hotspot clicks was 4943 and Raksila swimming center’s individual count was 3420 of that, so Raksila swimming center’s share was 69% of total clicks. Figure 9 presents all UBI hotspots click counts at different hours and Figure 10 presents all UBI hotspots click counts per weekday.

The research question, why public displays invite use in some places but not in others, was tried to be answered by using abductive reasoning. Since the research question is interesting and the existing literature cannot explain it due to the absence of studies with the same emphasis, further theoretical and empirical study is needed. Earlier studies have been conducted only from one interactive point of view or there has not been emphasis on the context. Literature was reviewed, UBI hotspot location data was analysed, and statistics on UBI hotspots clicks were analysed.

If a machine is located in a place with a lot of visitors who spend time at the place (are not just passers-by), the machine has got a lot of potential users. Raksila swimming center has been among the top three swimming centers in Finland by usage. The swimming center’s visitor count has been high (around 607000-621000 per year in 2012–2015), which is ~three times more than at Urheilutalo. The hotspot at Urheilutalo hotspot was the other indoor hotspot in my study. Visitor count was the only big differentiating factor with Raksila swimming center and Urheilutalo. They both are public venues and exercise venues, but UBI hotspot usage amounts vary a lot. Urheilutalo’s UBI hotspot invited the second lowest usage number, around 1%, see
Table 12. The conclusion is, when a UBI hotspot was placed at Raksila swimming center, which has got a massive amount of visitors, also the UBI hotspot gets massive amount of usage (clicks). It can be said that the location of a UBI hotspot is crucial.

The content in the UBI hotspots has been mainly appealing to children and teenagers, who use hotspots mainly as a game platform (Ventä-Olkkonen et al., 2016). There were several games that could be played in a multi-player mode. Some games had high score boards which may also have been inspired frequent gaming. UBI hotspots “24/7 availability” did not seem to have a determinative effect on total usage since Raksila swimming center is open limitedly, on weekdays the opening hours run from 6.15/7.00 to 21.00/22.00 and on weekends from 8.00 to 15.15.

Raksila swimming center seems to have more propinquity than privacy elements from the UBI display user point of view. Also, social designation allows people to interact and use UBI display in group. The amount of both privacy and propinquity are needed for informal interaction. An increase in privacy tends to decrease propinquity and vice versa. UBI display tries to provide tips for the user on how to achieve a wanted outcome. Despite the increased investment in interaction design and persuasive systems design, we can still be wrong what the environment, and in this case, the UBI display is affording us.

The results of this thesis are in line with Fayard and Weeks (2007) who have established that photocopiers and water-coolers enhance informal communication and interaction in enterprises. They have recognised that informal interaction is beneficial for the enterprise and many researchers are working on to understand how to foster this informality. Informal interaction is also beneficial outside the work community, since it brings people closer and it can even reduce the fear of strangers. Since informal interaction cannot be planned or commanded by anyone, the probability of its occurrence may be influenced by indirect means, such as physical architecture (e.g. the openness of a space) and geography (e.g. the centrality of a space) and by social characteristics privacy, propinquity and social designation. Found evidence is that some settings foster informal interaction or even obligate it, while in some other settings informal interaction is unlikely to happen or is even impossible. According to Fayard and Weeks (2007), the theory of affordances offers a good starting point for the integrated framework, which explains how the physical and social characteristics of a certain setting can foster or prevent informal interaction. They build a theory of the social affordances on informal interaction by reviewing existing theories of privacy, propinquity and affordances, and analysing qualitative study results.

5.1 Limitations

This thesis covers UBI hotspot usage both in indoor and outdoor spaces, and from a several UBI hotspot point of view. What can be seen as a limitation is that the UBI Oulu project team was not, without a doubt, able to identify the sides of the hotspots physically. This had an effect on one hotspot analysis, the rotuaari-crossing hotspot. It is not possible to define without knowing the sides precisely, whether the shelter by chance increased the hotspot usage or not.

All UBI hotspots are installed in three different settings; in indoors, outdoors and campus areas. Each of these groups should be studied separately, starting from the actual setting and going through all the areas described in this thesis. Then the surrounding environment with different functions at close quarters should be studied carefully, especially in the outdoor group UBI hotspots, and conduct analysis on
whether some services (shops, cafeterias, bus stops, etc.) have an impact on the UBI hotspot usage. After setting groups are investigated then the results should be analysed and the individual UBI hotspots not following the general setting group results identified. Reasons for possible differences compared to the setting group results should then be investigated. The UBI hotspots in the outdoor setting should be studied by interviewing people, to find out how much the weather directly affects UBI hotspot utilisation rate, and how largely bad weather possibly decreases UBI hotspot usage.

5.2 Future directions

In the future, if new UBI hotspots or similar are going to be installed somewhere or some old ones are going to be relocated, based on this thesis results and UBI usage statistics in general, they should be located in places that already have some motivated people to visit them. Nowadays, UBI hotspot is not that novel piece of technology anymore which could alone attract people to visit them. There has to be some other driving force behind.

New ethnographic study should be executed to get an update on what urban citizens’ needs are today and what kind of services they would like to have in the future. New applications and services are definitely needed in order to generate a new wave of interest towards UBI hotspots. Moreover, it should be studied if similar ethnographic investigations have been carried out recently somewhere else and pick out the relevant issues for our culture and environment.

The future of public displays includes design challenges since even current technology causes interaction blindness and people do not realise they can interact with the large display they face. A goal should be to identify and develop standards, affordances, metaphors, and interaction patterns to help public displays to be more accessible and familiar (Ojala et al., 2012). Hosio, Kukka, Goncalves, Kostakos, and Ojala (2016) to address four main challenges; interaction blindness, motives for participation, input modalities, and the ability to find applications on public displays. They also emphasise how expectations of the rapidly developing smart phones can cause people to think public displays are obsolete pieces of work already at the beginning. The importance of public displays can be discussed, after all, they age fast they are costly to install and maintain.

New technologies should be studied to monitor if there could be some novel possibilities which could offer people something the common people does not even have a clue yet. In order to generate a real second wave of UBI displays in the consciousness of large audience, something revolutionary should be invented and also marketed in a way it would be noticed. If UBI displays wanted to make a real comeback they should be able to offer something for everyone. Current content tends to mainly tickle the children. One big group that could be tried to be lured to become UBI display users is the pensioners.

Children more readily find public displays as cool gadgets, but older people do not share the same point of view. Another future challenge is to create such technology for public displays that would not make people feel silly or afraid of failing when using it, or make them feel scared of losing their social role. (Müller et al., 2010; Brignull and Rogers 2003; Ylipulki et al., 2014.)

In the future it should be planned carefully how content of the public display meets the display installation location. There should be some variation in the content, which could
be specifically chosen for each public display location. Not necessarily do people want to perform the same interaction at every place, for example, locations like a sporting venue, shop, tax office, and library. The content of a public display should support the installation location.
References


Appendix A. Structure for the research plan

Background

The Open UBI Oulu project started in 2009 when 11 UBI hotspots were installed. Project was led by the UBI (UrBan Interactions) research program which is coordinated by the University of Oulu. City of Oulu is in the focal point of ubiquitous computing since UBI hotspots are publicly located for anyone, anytime and freely. Information Processing Science’s student programme Project 2 -course gathered data for the dissertation research done by Leena Ventä-Olkkonen: Use and Domestication of Urban Ubiquitous Technologies in Public Spaces–Case Public Displays (preliminary title).

Motivation

Raksila swimming center’s UBI hotspot has the most usage of all hotspots and it gets approximately 55-85% of total clicks from all UBI hotspots. UBI hotspots usage statistics are available at http://vm0031.virtues.fi/ubistats/. Purpose is to recognise the reasons why Raksila swimming center invites people so heavily might help to increase other hotspots usage amounts.

Research problem and research methods

Why public displays invite use in some places but not in others? Why Raksila swimming center invites UBI hotspot usage more in comparison to other locations?

Research method is qualitative comparative case study and data is collected by interviews and observations. Data analysis will be based on Fayard, A. L., & Weeks, J. (2007). Photocopiers and water-coolers: The affordances of informal interaction.

Theory

Theory will be based on technological determinism vs. voluntarism. Also Fayard, A. L., & Weeks, J. introduced propinquity, privacy, and social designation will be evaluated in the research settings.

Research process

Recognise elements at Raksila swimming center which invites UBI usage. Observe same elements & find possible new ones at 4 other UBI hotspots; Ouluhalli, University Technology Campus, Rotuaari, and Toripolliisi. Do data analysis for observations and interviews.

List of main prior literature in relation to the background theory


**Schedule**

Preliminary schedule for the master’s thesis is to carry out in during the 2016.
March–May: Planning, reading, literature review and observations.
June–July: Data analysis and thesis writing.
August–September: Finalizing, submitting thesis and preparing for presentation.
September: Presentation.
Appendix B. Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCW</td>
<td>Computer Supported Cooperative Work</td>
</tr>
<tr>
<td>DID</td>
<td>Digital Information Display</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
</tr>
<tr>
<td>LCD</td>
<td>Liquid Crystal Display</td>
</tr>
<tr>
<td>NFC</td>
<td>Near Field Code</td>
</tr>
<tr>
<td>RFID</td>
<td>Radio Frequency IDentification</td>
</tr>
<tr>
<td>UBI</td>
<td>UrBan Interactions</td>
</tr>
<tr>
<td>VMS</td>
<td>Video Media Space</td>
</tr>
</tbody>
</table>