Leena Ventä-Olkkonen

THE CHARACTERISTICS AND DEVELOPMENT OF URBAN COMPUTING PRACTICES

UTILIZING PRACTICE TOOLKIT APPROACH TO STUDY PUBLIC DISPLAY NETWORK

UNIVERSITY OF OULU GRADUATE SCHOOL, UNIVERSITY OF OULU, FACULTY OF INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING
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THE CHARACTERISTICS AND DEVELOPMENT OF URBAN COMPUTING PRACTICES
Utilizing practice toolkit approach to study public display network

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Abstract
This thesis concentrates on understanding people’s daily interactions with urban technologies and the role they play in everyday life by investigating use practices for the on urban, multipurpose, public display network in the city of Oulu in northern Finland. The goal is two-fold, namely, to investigate different aspects of emerging urban computing practices and understand the versatility of the contributing factors behind these practices.

The work is grounded in practice theory that understands practices as a result of an historical evolution influenced by several forces. On the one hand, the thesis concentrates on the local accomplishment of practices; on the other hand it, seeks to understand the broader connections between these practices as well as their history and evolution. The material comes from three main sources: Users of the public displays, their developers and additional stakeholders involved in the design process, and citizen comments on the display network project on social media. The research is based on empirical qualitative research material; quantitative use statistics are applied to support the findings.

The findings reveal that urban computing practices take on influences from several directions including designers and other stakeholders during the design phase, the users’ lives and existing practices, and ongoing societal and communal discourses. The thesis offers increased understanding of the designing and implementation of successful ubiquitous computing projects in a public setting.

Keywords: children and ICT practices, interactive public displays, practice theory, practice toolkit, smart technology, ubiquitous computing, urban computing
Ventä-Olkkonen, Leena, Kaupunkiteknologiakäytänteiden ominaispiirteet ja kehittyminen. Julkisten näyttöjen verkoston tutkiminen käytäntöorientoituneen lähestymistavan avulla
Oulun yliopiston tutkijakoulu; Oulun yliopisto, Tieto- ja sähköteknikan tiedekunta
Acta Univ. Oul. A 705, 2017
Oulun yliopisto, PL 8000, 90014 Oulun yliopisto

Tiivistelmä
Tämä väitöskirja keskittyy ymmärtämään ihmisten päivittäistä vuorovaikutusta kaupunkiteknologian kanssa tutkimalla käytäntöjä julkisten näyttöjen verkoston ympärillä. Tavoite on toisaalta tutkia kaupunkiteknologiakäytänteitä eri näkökulmista ja toisaalta ymmärtää monipuolisia osatekijöitä käytäntöjen takana.

Työ perustuu käytäntöteoriaan, joka ymmärtää käytäntöjä historiallisen kehityksen seurauksena sekä usean osatekijän tuloksena. Toisaalta tutkielma keskittyy paikallisesti käytäntöihin; toisaalta se yrittää ymmärtää laajempia yhteyksiä käytäntöjen välillä sekä niiden historiaa ja evoluutiota. Materiaali tulee kolmesta päälähteestä: 1) Julkisten näyttöjen verkoston kehittäjiltä ja muilta suunnitteluprosessin sidosryhmiltä, 2) näyttöjen käyttäjiltä sekä 3) kaupunkilaisilta, jotka kommentoivat näyttöverkkoprojektia sosiaalisessa mediassa. Tutkimus perustuu laadulliseen tutkimusaineistoon, jonka lisäksi määrällistä käyttötilastoaineistoa sovelletaan tutkimaan laadullisia havaintoja.

Havainnot paljastavat, että urbaanin teknologian käytänteisiin vaikuttavat monet tekijät mukaan lukien suunnittelijat ja muut suunnitteluluvene sidosryhmät, käytäntöjen elämä ja heidän olemassa olevat käytänteessä sekä ajankohtainen yhteiskunnallinen ja yhteisöllinen keskustelu. Tutkielma tarjoa uudenlaista ymmärtystä jokapaikan tietotekniikka -projektien suunnitteleusta ja toteutuksesta ympäröimässä.

Asiakirjat: jokapaikan tietotekniikka, kaupunkiteknologia, käytäntöteoria, käytäntöökalupakkki, lapset ja tietotekniikka, vuorovaikutteiset julkiset näytöt, älykäs teknologia
To Niilo and Lilli
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25.10.2017 Leena Ventä-Olkkonen
Original articles

This thesis is based on the following publications. They are referred to throughout the text by their Roman numerals:


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1 Introduction

Digitalization has changed our everyday lives and practices remarkably over the last few decades, and that same development still continues at an accelerated pace. Digitalization has brought new technologies, which are captivating continuously bigger shares of our lives and surroundings: Streets, squares, homes, schools, and spaces in between. The fastest changes have occurred during recent years with the proliferation of the smart phones. One example of these pervasive technologies and digitalization in urban scene are public displays. Public displays are replacing the more traditional advertisements and signs in today’s urban landscape. The number of these public displays, digital screens and signs have expanded over the last ten years, and today displays are installed everywhere from washrooms to bus stops and from hospitals to gas stations.

This ever increasing body of digital artifacts has the power to transform our everyday practices. New artifacts can produce new practices or change existing ones. It has been noticed that deploying any novel technology per se does not necessarily change human action, and the adoption of any new ubiquitous technology does not happen by itself (Ylipulli, Suopajärvi, Ojala, Kostakos, & Kukka, 2013). To be able to design systems that truly have a positive impact on our lives, we need to understand more precisely how technology fits into our everyday practices, the factors causing the emergence of these new technology-mediated practices, and how these practices develop, and affect our communities.

Along with technology becoming ubiquitous, the focus of human-computer interaction research (HCI) has started to move more and more from laboratories into the field or in-the-wild (Crabtree, Chamberlain, Grinter, Jones, Rodder, Rogers, 2013; Rogers, 2011: 60). The research is now running experiments and studying people with technology in their natural surroundings, such as in urban environment. The focus of these studies is on creating and evaluating new technology in situ without concentrating on specific needs, but rather aiming for how to augment people, places and settings (Rogers, 2011: 60). Also, the public display research stream has established its position today through experiments in-the-wild. However, these experiments have concentrated primarily on the short moments of human-computer interaction (Kuutti & Bannon, 2014). The study of the dynamics of public display practices is still largely missing, since studying practices requires long-term deployments and time-consuming study methods (Wulf, Rohde, Pipek, & Stevens, 2011). Also, the theories for conducting ubiquitous computing research are few. It is essential, therefore, to develop theories that are suitable for studying people and
technology in-the-wild and in the urban context. (Kostakos, O'Neill, & Penn, 2006; Rogers, 2011: 60).

This thesis settled on Open Ubiquitous (UBI) Oulu, a joint initiative between the university and the city of Oulu. The goal of the initiative was to build a functional prototype of a future city. Almost a decade ago (in 2009), a real life in-the-wild, ubiquitous computing test bed was built in Oulu. Research activities were carried out then by a multidisciplinary research program called UrBan Interactions (UBI). The most visible part of the UBI-program was a network of 18 public displays around the city.

The mainstream of human computer interaction research has concentrated traditionally on the individual and the human-machine relationship. These studies have tended to focus on momentary interaction situations that are not specifically connected to a particular time and space. (Kuutti & Bannon, 2014). However, it has been acknowledged that relying too much on individuals as the unit of analysis does not always produce the best outcomes in either design or intervention (Pierce, Strengers, Sengers, & Bødker, 2013). In addition, concentrating on technology use on a specific time and place, on the other hand, does not provide the complete picture of the technology. Thus, it becomes useful to look beyond the local accomplishments of the involved actors. Implications derived from other levels and timeframes are essential. (Williams & Pollock, 2009).

Focusing on the interaction between human and machine also leaves out several other significant factors, such as politics, history, culture, etc. (Kuutti & Bannon, 2014). While this kind of ‘interactional’ research has its role in information and communication technology (ICT) development, these studies do not really demonstrate how technologies are adopted and integrated into everyday life. Practice-based research takes practices as the unit of analysis and studies these practices instead of people, artifacts, or interactions. This type of research also takes into account social, cultural, and material contexts (Pierce et al., 2013). Thus, it has become crucial to turn the focus to existing urban computing technology-mediated real life practices.

1.1 Background and research environment

During a sunny spring day in 2009 a truck with an eagerly expected load drove to a windy square next to a policeman statue in a medium-sized town in northern Finland. A set of researchers and workmen appeared, opened the truck doors and started to bustle busily around a large grey box. The installation of the very first
interactive public display, the so-called UBI-hotspot (later the UBI-display), had begun in the market square of Oulu.

This was the beginning of the story that eventually led to writing this thesis. Actually, the story had started a couple of years before this sunny day, when proposing and designing the project had initiated. Deploying the display was the culmination point of multi-year preparation and effort to design the public display network. During the summer of 2009 eleven other displays followed and were deployed at various locations in the Oulu area. Half were placed outdoors, around the downtown area (market place, downtown pedestrian zone), and half found their way indoors at different open public locations (e.g., the swim center, library, schools).

![Fig. 1. UBI-display in use at the entrance hall of the swim center (Ventä-Olkkonen, Lanamäki & Iivari, 2017).](image)

The displays were large 57” screens with full, high-definition liquid crystal display (HD LCD) panels. Outdoor displays were double-sided. The displays were equipped with a touch screen foil, a control computer, local hard drive, two cameras, and near field communication (NCF), Radio-frequency identification (RFID) readers, and a loudspeaker. The displays were targeted for all those occupying the city. They consisted of various non-profit services, such as news, weather, bus timetables, local service information and entertainment, such as games and art
installations, but also commercial advertisements. The content changed over time. Some applications were removed, while other ones were launched.

Deploying these displays was part of a large research initiative between the university and the city of Oulu that aimed to research human-city interaction using large public displays. The project was aimed at enhancing citizens’ mundane lives, boosting municipality-citizen communication, and providing a test bed for ubiquitous computing research in the wild. The number of the displays increased to 18 at its highest. A list of existing displays as of 2015 is noted in Table 1.

### Table 1. Usage logs for the UBI-displays from 17 April to 16 October 2015. Total clicks in and clicks per day for each display.

<table>
<thead>
<tr>
<th>#</th>
<th>UBI-Display</th>
<th>Total Clicks</th>
<th>Avg/ day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Airport terminal</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Main Library</td>
<td>74</td>
<td>0.40</td>
</tr>
<tr>
<td>3</td>
<td>OAMK campus</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Ouluhalli Sports Center</td>
<td>4464</td>
<td>24.39</td>
</tr>
<tr>
<td>5a</td>
<td>Ritaharju school Northside</td>
<td>6023</td>
<td>32.91</td>
</tr>
<tr>
<td>5b</td>
<td>Ritaharju school Southside</td>
<td>6206</td>
<td>33.91</td>
</tr>
<tr>
<td>6a</td>
<td>Rotuaari crossing Eastside</td>
<td>2012</td>
<td>10.99</td>
</tr>
<tr>
<td>6b</td>
<td>Rotuaari crossing Westside</td>
<td>180</td>
<td>0.98</td>
</tr>
<tr>
<td>7</td>
<td>Rotuaari east Westside</td>
<td>116</td>
<td>0.63</td>
</tr>
<tr>
<td>8a</td>
<td>Rotuaari south Eastside</td>
<td>488</td>
<td>2.67</td>
</tr>
<tr>
<td>8b</td>
<td>Rotuaari south Westside</td>
<td>895</td>
<td>4.89</td>
</tr>
<tr>
<td>9a</td>
<td>Rotuaari square Northside</td>
<td>176</td>
<td>0.96</td>
</tr>
<tr>
<td>9b</td>
<td>Rotuaari square Southside</td>
<td>794</td>
<td>4.34</td>
</tr>
<tr>
<td>10a</td>
<td>Rotuaari west Eastside</td>
<td>3333</td>
<td>18.21</td>
</tr>
<tr>
<td>10b</td>
<td>Rotuaari west Westside</td>
<td>1175</td>
<td>6.42</td>
</tr>
<tr>
<td>11</td>
<td>Swim center</td>
<td>52862</td>
<td>288.86</td>
</tr>
<tr>
<td>12a</td>
<td>Toripolliisi Eastside</td>
<td>3372</td>
<td>18.43</td>
</tr>
<tr>
<td>12b</td>
<td>Toripolliisi Westside</td>
<td>2885</td>
<td>15.77</td>
</tr>
<tr>
<td>13</td>
<td>University humanistic campus</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>University technology campus</td>
<td>323</td>
<td>1.77</td>
</tr>
<tr>
<td>15</td>
<td>Urheilulaito Sport center</td>
<td>1175</td>
<td>6.42</td>
</tr>
</tbody>
</table>

Five years later, in 2014, when I started to work toward this thesis, the display network had become a self-evident part of the urban landscape in Oulu. However, the use statistics showed that use of these public displays was slowly declining (Ylipulli et al., 2013). The statistics also revealed that while some displays collected several hundred clicks per day, others remained almost or even totally unused or collected clicks only during special events or occasions (See Table 1).
This variation seemed to depend on the display location, but also the time of day, week and year. Also the use levels of different type of services changed, games being the most popular content type (See Table 2). According to the log data, the distinctly most used UBI-display was located in the entrance hall of the Oulu swim center in Raksila (See Table 1). The Swim center display was consistently used as much as the other displays taken all together. This research indicated the possibility of existing recurrent practices occurring at that specific display.

Table 2. Usage logs for the UBI-displays from 17 April to 16 October 2015. Most launched applications. Games are in boldface.

<table>
<thead>
<tr>
<th>Application</th>
<th>Launches</th>
<th>Avg/ day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start page</td>
<td>3964</td>
<td>117.09</td>
</tr>
<tr>
<td>Waste Tower Game</td>
<td>1740</td>
<td>52.73</td>
</tr>
<tr>
<td>Hangman Game</td>
<td>1177</td>
<td>35.67</td>
</tr>
<tr>
<td>Martians from Outer Space Game</td>
<td>958</td>
<td>29.03</td>
</tr>
<tr>
<td>Ubitris Game</td>
<td>637</td>
<td>19.30</td>
</tr>
<tr>
<td>Wordster Game</td>
<td>495</td>
<td>15.00</td>
</tr>
<tr>
<td>BelleMemory Game</td>
<td>416</td>
<td>12.61</td>
</tr>
<tr>
<td>UBI Mosquitos Game</td>
<td>374</td>
<td>11.33</td>
</tr>
<tr>
<td>City of Oulu</td>
<td>273</td>
<td>8.27</td>
</tr>
<tr>
<td>Hiukkavaara</td>
<td>267</td>
<td>8.09</td>
</tr>
<tr>
<td>Streetgallery</td>
<td>247</td>
<td>7.48</td>
</tr>
<tr>
<td>Whole city walks - around the world</td>
<td>244</td>
<td>7.39</td>
</tr>
<tr>
<td>Oulu university of applied sciences</td>
<td>238</td>
<td>7.21</td>
</tr>
</tbody>
</table>

Writing this thesis in 2017, it has been eight years since the launch of the display network. Displays are still part of the street scene in some places in Oulu, but the process of taking them down has started, as the funders’ obligation to keep them up and running has been fulfilled. Some displays have already been removed from their places, after several months being inoperably and out of order. Some displays are also still on their original spots working and running. The commercial advertising was stopped some ago due to the maintenance problems. We can now see that the displays were never fully adopted by the local citizens. At least, the emerged practices were not as originally envisioned by the designers. The user group as well as the usage modes turned out to be narrower than originally expected. Despite this issue, research-wise the experiment has been successful, producing thus far 10 doctoral theses, including the current one. These studies have concentrated on user experience of specific services, evaluation of user interfaces and service discovery, the contrast between self-proclaimed information needs and
actual information seeking, maintenance and the battle of urban space, appropriation of panOULU WLAN and UBI-hotspots, stakeholder value propositions on an open community test bed, and others. This short introduction of the research environment introduces the thesis. Next, the objectives and the scope of the thesis are described specifically.

1.2 Objectives and scope

For being able to design better technologies that truly have a positive impact on our everyday lives, it is important to understand how the existing technologies actually became embedded in the daily routines. Practice research must start with the assumption that technology is part of people’s routines and recurrent practices. It thus examines:

...historical processes and performances, longer-term actions which persist over time, and which must be studied along the full length of their temporal trajectory; they are situated in time and space, and are dependent on many features of the surrounding material and cultural environment, which cannot be simply seen as a surrounding “context”, but must be interwoven within the practice (Kuutti & Bannon, 2014: 3543).

Practice research is valuable as it is able to provide greater knowledge about human behaviour; however, it can also give useful information to ICT developers and designers on how technology-mediated practices emerge. Although designing new practices is hard or even impossible, since they will only emerge when the conditions and artifacts are there, having knowledge of the existing practices, any future artifacts will be better oriented toward people. The process by which practices emerge in the context of ubiquitous computing is still a question and one for which this thesis seeks possible answers.

The objective of this thesis, therefore, is to understand the factors that contribute to the emergence of urban computing practices. The thesis takes a holistic view of these practices and works to understand them as cohesion of numerous social, material, cultural and temporal factors. In addition, the study sheds light on the relationship between practices as well as their emergence and evolvement. Finally, the thesis presents how a methodological framework called practice toolkit, as derived from the various practice theories (Nicolini, 2012), can be applied to studying ubiquitous computing environments effectively.
This thesis concentrates on a network of multipurpose, interactive, public displays (UBI-displays) in the city of Oulu. The work sheds light on users’ practices with the UBI-displays and explores them from various aspects. According to the usage statistics (see Table 1) the swim center display was the only actively used display throughout the year. This knowledge indicated that possibly there were existing practices at that location. Thus, the focus of inquiry was targeted toward that specific display.

The work is grounded on practice theories and understands practice as a result of historical process and as an influence of varying forces. On the one hand, the thesis concentrates on the local accomplishment of practices, but it also tries to understand the connections between practices on a broader spectrum as well as the history, emergence and evolution of those practices.

The material for this thesis comes from three main sources: 1) the users of the public displays, 2) the developers and other stakeholders involved in the design process, and 3) the citizens’ writing about the display project in social media. The user data were collected using ethnographic methods. Eight researchers from the developer team were interviewed, and two interviews were also conducted with three city representatives. Finally, other material included 441 media texts.

This doctoral research contributes by offering a clear understanding of daily interactions with technologies in public spaces and their role in modern everyday life by shedding light on the practices surrounding public displays. In addition, the thesis sheds light on the processes and dynamics of emergence of the public display practices. The thesis also increases the understanding of carrying out and designing ubiquitous computing projects in a public urban setting. Finally, the thesis presents and evaluates a methodology for studying technology mediated practices in public spaces. The research questions for this thesis are presented in Table 3.

The results of this thesis show how urban computing practices are indeed a conglomeration of various factors and forces that influence on different levels. These practices are also affected by the development process, the everyday lives of the users and their practice networks as well as their ongoing societal and local discourses.
Table 3. The thesis research questions.

<table>
<thead>
<tr>
<th>RQ #</th>
<th>Research Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ 1.</td>
<td>What are the characteristics of technology-mediated practices in the public space?</td>
</tr>
<tr>
<td>RQ 1-A.</td>
<td>How are these practices performed?</td>
</tr>
<tr>
<td>RQ 1-B.</td>
<td>How are the spatial, temporal, social, material and bodily aspects involved in these display practices?</td>
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<tr>
<td>RQ 1-C.</td>
<td>What are the underpinning motives behind technology-mediated practices in the public space?</td>
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<tr>
<td>RQ 1-D.</td>
<td>What are the dynamics for the durability and variability of technology-mediated practices in these public spaces?</td>
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<tr>
<td>RQ 1-E.</td>
<td>How is the users’ creativity visible in public display practices?</td>
</tr>
<tr>
<td>RQ 2.</td>
<td>Where do the technology-mediated practices come from?</td>
</tr>
<tr>
<td>RQ 2-A.</td>
<td>How do different stakeholders influence the emergence of public display practices?</td>
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<tr>
<td>RQ 3.</td>
<td>How do these practices relate to other practices elsewhere?</td>
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<tr>
<td>RQ 4.</td>
<td>What are the effects of display practices in the surrounding community?</td>
</tr>
<tr>
<td>RQ 5.</td>
<td>How can we study technology-mediated practices in public spaces using Nicolini’s practice toolkit approach?</td>
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</tbody>
</table>

1.3 Original articles and contributions

The first four articles, (AI, AII, AIII, AIV) concentrate on the users’ perspective, and the next two (AV, AVI) focus on the developers’ and the other stakeholders’ points of view. Article VII summarizes the whole case, utilizing both user- and developer- based material. The order of author presentation in references reflects the amount of the writing effort expended in each article.


Article I is based on an ethnographic inquiry around the UBI-display at the entrance hall of the swim center. Both the observations and the field interviews were conducted by a student group that I coordinated and supervised. I transcribed and analyzed the material to come up with the main findings. The article was written along with Dr. Lanamäki, Professor Iivari and Professor Kuutti. I was responsible for writing the research method and the findings sections of the article. I also contributed to the discussion. The article answers RQ 1., RQ 1-A., RQ 1-B., and RQ 1-C.

Article II is based on the same ethnographic material as Article I. For purposes of the article I conducted the thematic user interviews and a re-analysis of the ethnographic material by utilizing the practice toolkit approach. The article was written with Dr. Jurmu, Dr. Lanamäki, Professor Iivari, Dr. Kukka and Professor Kuutti. I was responsible for writing the theoretical foundation, explaining the methods and results as well as the partially related research. The article addresses RQ 1., RQ 1-D., and RQ 5.


Article III continues mainly a discussion of the same material as the previous publications. In addition, the collaborating authors, Drs. Jurmu and Kukka included research material from their own studies. Dr. Lanamäki and Professors Iivari and Kuutti also participated in compiling the article. However, I was the key person who wrote this publication. I created the appropriation categorization and was responsible for writing the introduction, theory and related work, most of the results, and part of the discussion. The empirical examples for each category were discussed with the other authors. The co-authors also supported the finalizing and editing of the paper. The article addresses RQ 1. and RQ 1-E.


In addition to the afore-described “ethnographic” material, Article IV is based on a diary study that I both designed and conducted independently. I also analyzed the results, came up with the findings, and wrote most of the publication. Other authors
included Professors Iivari and Kuutti, who contributed to the discussion and helped in finalizing and editing the paper. The article addresses RQ 2., RQ 3., and RQ 5.


Articles V is based mainly on the stakeholder interviews that I conducted along with Dr. Lanamäki. I analyzed the interview material, reached the results, and wrote publications together with Dr. Lanamäki as well as Professors Iivari and Kuutti. In Article V, I was responsible for writing the research design, the results, and parts of the introduction, related work, and discussion. The article addresses RQ 2., and RQ 2-A.


In Article VI is also based mainly on the stakeholder interviews. I was again responsible for re-analyzing the material. For the actual writing, I was responsible for the research design, methods, the results sections, and partially responsible for the introduction and concluding discussion sections. The cultural lens section was written entirely by Professor Iivari. I edited the entire article together with the co-authors. The article addresses RQ 2., RQ 2-A.

VII. Ventä-Olkkonen, L. How do urban computing practices emerge, develop and affect the community? – Introducing a practice toolkit approach for CSCW. Manuscript.

In Article VII, I collected the media text material, analyzed it and wrote the entire article. Supervisors commented and helped in editing the article. Article VII addresses RQ 2., RQ 2-A., RQ 3., RQ 4., and RQ 5.

Table 4 summarizes the relationship between the articles and the offered research questions.
Table 4. The Articles and the Research Questions.

<table>
<thead>
<tr>
<th>RQ</th>
<th>A. I</th>
<th>A. II</th>
<th>A. III</th>
<th>A. IV</th>
<th>A. V</th>
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<th>A. VII</th>
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<td>RQ 1.</td>
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<td>RQ 1-A</td>
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<td>RQ 1-B</td>
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<td>RQ 1-C</td>
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<td>RQ 1-D.</td>
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<td>RQ 1-E.</td>
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<td>RQ 2-A.</td>
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<td>RQ 3.</td>
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<td>RQ 4.</td>
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<td>RQ 5.</td>
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The thesis is structured as follows: Section 2 presents the theoretical foundation of the thesis starting with ubiquitous computing, continuing on with children as ICT users, and finalizing the effort by using practice as a unit of analysis. Section 3 presents the methodological framework. Then Section 4 presents the methods and materials used for the thesis. This discussion is followed by a presentation in Section 5 of the original publications and their central findings. Finally, Section 6 summarizes the results by answering the research questions and discussing the implications and contributions of the research as well as its overall validity, reliability, limitations, and future directions.
2 Theoretical foundation

The central theoretical and technical focus for this thesis is the concept of ubiquitous computing. Thus, I start here by introducing the origins and the basic assumptions of that concept. Following the overall descriptions of ubiquitous computing, the focus moves on to the technologies in an urban context and in particular, the term, urban computing. Afterwards, I present the central technology of the thesis, public or pervasive displays, and the existing research on them, especially concentrating on long-term research experiments.

The initial observations in the field revealed that the main user group of UBI-displays were children. The selected practice lens approach encouraged an expansion of the study scope to the practitioners’ practice networks. Thus, the second focus area of this thesis is children as technology users, concentrating especially on children and families’ mundane practices with ICT at home. I then overview more specifically what has already been written about children as public display users.

The final focus area of this thesis is the practice theory or more precisely those practice theories that formed the basis of the analysis. Afterwards, I summarize how these practices have been studied earlier in the field of human computer interaction and its related disciplines. The focus areas of the thesis and their relationship are presented below in Figure 2.

![Fig. 2. The main focus areas of this thesis and their relationship.](image-url)
The theme of this thesis also links to people’s behaviour in public spaces. Behaviour in public spaces and urban life in general has been studied vastly and as part of urban sociology and anthropology studies since Simmel’s writings in the 1800’s (Castells, 2002; Goffman, 1963; Simmel, Huuhtanen, & Noro, 2005). These theories provide interesting frameworks that reflect public display practices. However, although considerable interesting literature on human behaviour in such conditions is available, that focus is not included in this thesis, because the related study here had to be narrowed down to those subjects closest to human computer interaction.

2.1 The Vision of ubiquitous computing

_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: 3)._ 

This is how Weiser (1991) first described the central idea of future ubiquitous computing a quarter of a century ago in his essay entitled _The Computer for the 21st Century_. Weiser was a computer scientist and Director of the Computer Science Laboratory at Xerox PARK in the United States. Five years after his first essay, Weiser published another article with his colleague, John Seely Brown, entitled _The Coming Age of Calm Technology_, wherein he updated his visions and continued imagining of the possible future by highlighting the calmness of the technologies (Weiser & Brown, 1997). In this article, the authors predict not only technological innovations, but also related socio-cultural changes. Through these two visionary epoch-making articles, a new research paradigm called ubiquitous computing (also ubicomp) was created. (Bardzell & Bardzell, 2014; Bell & Dourish, 2007)

Weiser’s articles have been cited many times since they were written (Bell & Dourish, 2007). The problem is that these citers have adopted the same rhetorical style as Weiser had and then continued to envision a proximate future that is not yet here, but right around the corner. According to Bell and Dourish, this focus resulted in at least three issues. When ubiquitous computing is considered as something that is about to come, the progress made today is not seen as ubiquitous computing. Due to this rhetorical focus in the literature, ubiquitous computing has been framed as something that has yet to be achieved, leading its writers to absolve themselves of any responsibilities to implement anything for real - as though the
technological issues will solve themselves given enough time. The third drawback of these ubiquitous computing predictions is that they assume that the future will be homogenous. In reality the truth is considerably messier. (Bell & Dourish, 2007).

According to Bardzell & Bardzell (2014) while the technology agenda has progressed steadily over the years, the ubiquitous computing vision agenda has been fractured, so that its relevance is now question. The Bardzells argue that as the technology has evolved, so have the conceptualizations of ubiquitous computing.

We live in a different empirical reality than Weiser did, and accordingly, the vision agenda needs an overhaul both to reflect what we know and above all to update what it is now possible for us to imagine (Bardzell & Bardzell, 2014: 793.)

Today, we live in the future that Weiser did envision, but much has happened since the first introduction of ubiquitous computing. Some of his predictions have been realized, and some have not. Today, the term ubiquitous computing refers to technologies that are everywhere around us and can be used with any device at any location. Ubiquitous computing can be also described as the third wave of computing after the mainframe, and personal computing phases (Bødker, 2015). According to Weiser’s vision, ubiquitous computing is invisible, it functions unobtrusively, and it merges with its environment. In reality, ubiquitous computing consists of a wide amount of separate technologies (e.g. mobile, wearable, distributed and context-aware computing applications) which are brought together to serve a mutual single goal (Bell & Dourish, 2007).

Bell and Dourish also argue that the ubiquitous computing future is already here, but in quite another form than the one envisioned by Weiser. For example, Singapore and Seoul can be seen as ubiquitous computing -like environments. As a consequence of the difference between reality and foresight, the present achievements are thus neglected. (Bell & Dourish, 2007.) Yoo indicated that recent technological achievements, such as the miniaturization of computer and communication hardware, combined with ever-increasing processing power, storage capacity, communication bandwidth, and more effective power management, has made the vision of ubiquitous computing very close to a reality (Yoo, 2010).
2.1.1 Urban computing in smart cities

Urbanization is one of the global tendencies seen around the world. Urban growth burdens city infrastructures, i.e., transportation, healthcare, and safety. People are searching for a solution from ICT for a variety of emerging problems, including reducing costs and increasing efficiency. Ubiquitous computing technologies located in urban contexts are often called urban computing or urban informatics. Urban computing refers to the integration of computing, sensing, and actuation technologies in everyday urban settings and lifestyles (Kukka, Ylipulli, Luusua, & Dey, 2014; Paulos & Jenkins, 2005). According to Zheng and his colleagues, urban computing tries to solve the problems of urbanization through the data that the city generates. Urban computing is an interdisciplinary field that involves the computer sciences, transportation, civil engineering, environment, economy, ecology, and sociology in the context of urban spaces. (Zheng, Capra, Wolfson, & Yang, 2014).

A partially overlapping term to urban computing is smart city. Ylipulli boils down in her thesis that urban computing is roughly a research agenda while smart city is a political and economic strategy (2015). Many smart city visions are also built on the basis of Weiser’s ubiquitous computing visions (Dourish & Bell, 2011: 31 - 36). During recent decades, different smart city experiments have been established worldwide. The smart city concept is somewhat ambiguous, but from one perspective, smart cities are something that can be monitored, managed, and regulated in real time with the ICT infrastructure and ubiquitous computing (Kitchin, 2015; Naphade, Banavar, Harrison, Paraszcak, & Morris, 2011).

Urban computing also has four sub-themes: Place, community, infrastructure, and traversal. The challenge is to understand how this future fabric or digital and wireless computing will influence and be integrated into people’s social patterns in the urban landscape. (Paulos & Jenkins, 2005.). In this thesis, I am referring to urban computing when I talk about ubiquitous technologies that are embedded in the urban context and the public (streets, parks) or semi-public settings (such as offices, schools etc). One form of urban computing is those community technologies that can support communities in future smart cities, e.g., rapidly spreading public displays.

2.1.2 Public displays in the urban landscape

Specific technology, which is easily perceived as part of urban computing systems, are public, pervasive displays. Public displays have been part of the urban
landscape for a long time. Already in the 1980’s low resolution digital displays were used for advertising and promotions, but then along with plasma and liquid crystal display (LCD) techniques, the digital signage become capable for displaying full-size video streams with reasonable costs (Kostakos & Ojala, 2013). Public displays distribute information in airports, motorways, sports stadiums, and shopping centers. To put it briefly, public displays are located where the people are. The main purpose of these displays is many times commercial. Most digital signage displays advertisements, and function as a one-way communication channel.

The interactive public displays are a more recent branch of the digital public display tree. Interactive displays enable user interaction and transfer the media to a two-way communication channel. These public displays have started to appear in various public spaces, such as museums, shopping malls, libraries, and squares, where they interactively offer information and visual experiences for people (Hinrichs, Carpendale, Valkanova, Kuikkaniemi, Jacucci, Vande Moere, 2013). The importance of this new media has been noticed, and it is predicted that public displays could become the communication medium of the 21st century, having the same impact on society as radio, TV and the Internet have already had (Davies, Langheinrich, José, & Schmidt, 2012).

Along with the invasion of these public displays into our urban surroundings, research in the area has been flourishing. Public displays have gained interest in many research disciplines, including human computer interaction, architecture, social sciences, design, art, and media theory. The advantages of the public display technologies have been studied, for example, through collaborative and educative scenarios (see e.g. Du, Jiang, Rosson, & Carroll, 2010). These scenarios, however, differ in various ways from the public display scenarios in truly open and public settings in terms of the variety of the users and use cases (Hinrichs et al., 2013). It has indeed been revealed that while studying public ubiquitous urban technology that predicts how people uptake, appropriate or use them is hard or even impossible without proper in the wild experiments wherein the displays are truly integrated into public settings (Kukka, 2012).

Alt, Schneegaß, Schmidt, Müller and Memarovic (2012) carried out a literature survey of the interactive public display research and revealed there are different types of studies that do vary according to the phase of the project. First phase studies, wherein the prototype is only in the design stage, are often ethnographic or carried out using different types of interviews, questionnaires, or focus groups methods (Alt, Memarovic, Elhart, Bial, Schmidt, Langheinrich, Scipioni, 2011). Second phase studies are many times executed in laboratory conditions with more
or less functional prototypes (Cheverst, Taylor, Rouncefield, Galani, & Kray, 2008; Häkkilä, Koskenranta, Posti, Ventä-Olkkonen, & Colley, 2013). During the third phase, these prototypes are brought outside from the controlled laboratory conditions to be studied in the field in actual public settings (Colley, Ventä-Olkkonen, Alt, & Häkkilä, 2015). The fourth and final phase is deployment-based research, wherein the prototypes now become more stable longitudinal deployments.

Deployment-based research introduces the technology into the social setting. Previous research has explored public display usage in a number of different settings, such as urban areas, cafes, working environments, and rural locales (Memarovic, Langheinrich, Cheverst, Taylor, & Alt, 2013). These deployments enable researchers to study long-term impacts and practices without the novelty effect. (Alt et al., 2012; Hosio, Goncalves, Kukka, Chamberlain, & Malizia, 2014). According to Alt (2012: 4) only in deployment-based studies can the technology be integrated into the everyday life of people and seen as a natural part of their surroundings. However, as witnessed in the UBI-Oulu case, that adoption of technology does not always go as planned (Ylipulli et al., 2013).

In addition to the UBI-Oulu initiative, other examples of public display deployments are built for research purposes, as, for example, in the rural areas Wray display in a English rural village (Taylor, Cheverst, Wright, & Olivier, 2013) as well as Nnub in a suburb of Brisbane, Australia (Redhead & Brereton, 2009) and the Hole-in-the-wall experiment in a rural area in India (Mitra, Dangwal, Chatterjee, Jha, Bisht, Gapur, 2005). Examples of deployments in the city arena are the screens in the wild project in London and Nottingham (Fatah gen. Schieck, Schnädelbach, Motta, Behrens, North, Ye, Kostopoulos, 2014); the MobiDIC network installed on public telephones and showing coupons for nearby shops in the city center of Münster, Germany. (J. Müller, Wilmsman, Exeler, Buzeck, Schmidt, Jay, Grüger, 2009). Examples of shorter deployments include the Confession booth (Leong & Brynskov, 2009) in Aarhus, Denmark, and the CityWall in Helsinki, Finland (Peltonen, Kurvinen, Salovaara, Jacucci, Ilmonen, Evans, Saarikko, 2008). In addition, an e-Campus display network was installed on the Lancaster University campus in England (Storz, Friday, Davies, Finney, Sas, Cheridan, 2006). Three longer-term deployments in an urban context are presented below in more detail.

The Wray display project was conducted between years 2006 and 2010 in a small village in Northwest England. The project created a public display to support the local community. The focus was to explore how the use of public displays emerged over time and how authentic experience with the technology could help
its community members to engage in the participatory design process. The first display prototype, a Wray photo display, simply displayed photographs uploaded by the users. The second version, the Wray display, also displayed users’ event information and advertisements. The experiment was successful and over the years the displays became an integral part of that community’s information sharing practices. (Taylor, Cheverst, Wright, Olivier, 2013.)

The Lancaster University e-Campus project consisted of three built and deployed experimental display systems. Two of them were first short-term technical probes (digital signage solution at a conference event and a display system as an element of an interactive exhibition). The last one was a more permanent installation at a campus underground bus station. It consisted of three large projected displays that displayed artistic material, textual information, and videos created by the researchers. (Storz et al., 2006.)

Still another example of a project of studies on urban public display deployments was the Screens in the wild project, a collaborative project between researchers from Bartlett, University College London and the Mixed Reality lab at the University of Nottingham. Their focus was to study how media screens in urban spaces could be designed better to benefit public life, e.g., by fostering community participation instead of simply distributing commercial content. (Fatah gen. Schieck et al., 2014.)

2.1.3 Public displays and the practices around them

Alt (2012) identified the seven most popular research issues from the recent public display studies: Audience behaviour, user experience, user acceptance, user performance, display effectiveness, privacy and social impact. Most of the public display research so far has concentrated on audience behaviour around the displays (Alt, Schneegaß, Schmidt, Müller, Memarovic, 2012). For example, various public display studies have identified the so-called honeypot effect, wherein those people interacting with a display attract still more people to interact with it (Brignull & Rogers, 2003; J. Müller et al., 2009). The audience funnel describes the passing by display phases, which can include viewing and reacting, subtle interaction, direct interaction, multiple interactions, and possible follow-up actions (Michelis & Müller, 2011). The landing effect refers to how passers-by return to the display after first passing it (J. Müller, Walter, Bailly, Nischt, & Alt, 2012). In addition, display blindness is a well-known phenomenon that refers to people who tend to ignore the
public displays (Huang, Koster, & Borchers, 2008; Memarovic, Clinch, & Alt, 2015).

The studies that have concentrated on the user experience have investigated the overall user experience of the public displays by comparing, different interaction techniques. For example, Redhead and Brereton studied the navigation on a digital community noticeboard during their long-term evaluation of the Nnub system (Redhead & Brereton, 2009). Interaction has been studied also, in (Ojala, Kostakos, Kukka, Heikkinen, Linden, Jurmu, Zanni, 2012; Peltonen et al., 2008) User acceptance studies investigate users’ motives for interacting with the displays (Cheverst, Taylor Rouncefield, Galani, Kray, 2008). Another niche of these studies investigates effectiveness from the user perspective or looks at users’ privacy concerns (Alt, Kubitza, Bial, Zaidan, Ortel, Zurmaar, Schmidt, 2011). Also, the social impacts of the displays (J. Müller, Walter, Bailly, Nischt, Alt, 2012) and prototypical user roles (Goncalves, Ferreira, Hoiso, Liu, Rogstadius, Kukka, Kostakos, 2013; Peltonen et al., 2008) have been studied.

All the above-mentioned research topics concentrated on short-term usage of public displays. Another growing field of public display research has examined the use and adoption of technologies over a longer period of time. The burning question, however, still is how public displays are adopted and integrated into users’ everyday lives (Taylor et al., 2013). So far, urban computing practices have been studied relatively little. Unforeseen appropriations have been studied by Dalsgaard and Halskov (2010) and learning by seeing addressed by Marshall, Morris, Rogers, Kreitmayer and Davies (2011). Although comprehensive practice research on public displays has not yet been conducted, some hints of these practices have been revealed in previous public display deployment studies. As described above, there have been a few long-term deployments (see e.g. Clinch, Davies, Friday, & Efstratiou, 2011; Friday, Davies, & Efstratiou, 2012; Kukka, Luusua, Ylipulli, Suopajärvi, Kostakos, Ojala, 2014; Memarovic, Fatah gen. Schieck, Schnädelbach, Kostapoulou, North, Ye, 2015a; Taylor et al., 2013; Ylipulli, Suopajärvi, Ojala, Kostakos, Kukka, 2013) that have revealed traces of use practices.

For example, the e-Campus system had a number of regular users during its many years of operations. These users become capable enough to be able to manipulate the system for their own benefit (Clinch et al., 2011). Also, the Wray Photo Display system was used considerably according to the log data. Wray Photo Display users uploaded, viewed, browsed, categorized, and commented on photos. The photos recorded the community history, shared news, and integrated new members into the community. Residents moderated the content and thus gained
ownership of the system (Cheverst, Taher, Fisher, Fitton, & Taylor, 2012; Memarovic et al., 2013; Taylor et al., 2013).

The Screens in the Wild network has been active for several years in London and Nottingham (see e.g. Memarovic et al., 2015a; Memarovic et al., 2013). For example in the Moment machine experiment, where a camera application was integrated into a public display network, the researchers found certain use patterns and several returning users that had developed use practices with the displays during a 12-week observational study. Also, user interviews confirmed that discovery and revealed that the photo-taking practice was becoming part of the recurrent group activity. (see e.g. Memarovic et al., 2015a.)

The Open UBI-Oulu log data revealed that the use of the open WiFi network grew steadily, but use of the public display network remained low or even decreased over time (Ylipulli et al., 2013; Ylipulli & Suopajärvi, 2013). However, some promising exceptions to this trend were reported in (Kukka et al., 2014; Ylipulli et al., 2013), which indicated that there were some existing practices around UBI-Oulu displays as well. In the UBI-Oulu context, Suopajärvi, Ylipulli and Kinnunen (2012) have studied ICT practices of young adults and the elderly and their perceptions of public UBI-displays through interviews and diary studies. Still, the existing research on UBI-Oulu has not yet focused on emerging public display practices and studied them more in depth.

2.1.4 Running public display projects

Recent studies have reflected on the issues related to running public display projects. These studies have stated that building such an environment is not an easy nor a simple task. Public display and urban computing systems in general have three components, namely, space, people, and technology (Foth, Choi, & Satchell, 2011; Kukka et al., 2014). Thus, a trans-disciplinary understanding of social, cultural, and political contexts is essential when building such systems (Kukka et al., 2014). During recent years, there have been several urban computing and specifically public display (research) projects around the world (Dalsgaard & Halskov, 2010; Fortin, Hennessy, & Sweeney, 2014; Friday et al., 2012). These projects have revealed there are a number of challenges for these conditions in terms of research, development, maintenance, and handover of the technology to the designated communities (Fortin et al., 2014; Kukka et al., 2014; Mäkelä, Sharma, Hakulinen, Heimonen, & Turunen, 2017; Memarovic et al., 2013; Storz et al., 2006).
To be able to run a successful public display project, there are several external challenges to address. Memarovic and his co-authors concentrated on community interaction design through public displays. They proposed a \textit{P-LAYERS} framework that provides a layered overview of the challenges that researchers face when building and deploying public display systems that will support community interaction. The framework has five layers of the main challenges that influence public display deployments: 1) First the hardware may hinder smooth operation of the system; 2) Secondly, the complexity of the system architecture may become an issue; 3) Third, getting appropriate and fresh content that appeals to the community is challenging; 4) Next, problematic is how to offer intuitive ways of interacting with the system, especially for passers-by; and 5) Finally, all these factors do affect the actual community interaction that takes place. (Memarovic \textit{et al.}, 2013.)

The recent work of Mäkelä and his colleagues reviewed 71 research papers to reveal certain typical challenges that have been reported on public display deployments. They categorized these reported challenges into six groups: Weather, events, surroundings, space, inhabitants, and vandalism (Mäkelä \textit{et al.}, 2017). A well-known challenge is weather. For example, rain and sunlight may cause problems with the installations. This problem is especially relevant in locales with drastically varying climate conditions, such as in Finland. (e. g. Dalsgaard & Halskov, 2010; Ylipulli, Luusua, Kukka, & Ojala, 2014). Space related issues are also important. For example, it is essential to have sufficient physical access, the ability to control the deployment space, and full knowledge of the rules and regulations (Storz \textit{et al.}, 2006). In addition, it is important to know the existing physical space and tailor the solutions to fit it (Dalsgaard & Halskov, 2010). Lastly, it is essential to develop and manage suitable content (Dalsgaard & Halskov, 2010; Memarovic \textit{et al.}, 2013; Storz \textit{et al.}, 2006). All of these elements require considerable time and effort.

In addition, people-related recommendations have been discussed. It has been emphasized that people’s expectations are important to take into account, but there might be conflicts in them as well (North, Schnädelbach, Fatah gen Schieck, Motta, Ye, Behrens, Kostopoulos, 2013). It is always important to prepare for public scrutiny (Friday \textit{et al.}, 2012; Storz \textit{et al.}, 2006; Taylor \textit{et al.}, 2013). Crucial also is collaboration with the local media, information providers, and other opinion leaders (Storz \textit{et al.}, 2006). When operating in any public space, it is necessary to involve a variety of stakeholders and balance their interests (Dalsgaard & Halskov, 2010; Dalsgaard & Eriksson, 2013; Storz \textit{et al.}, 2006). Designers should also prepare for the fact that computing solutions may be appropriated by their users in a multitude
of ways, which may then diverge from the original intentions (Dalsgaard & Halskov, 2010). Finally, technical support skills and availability as well as human resources are required to be able to hand over the systems to the user communities successfully (Taylor et al., 2013).

**2.1.5 Summary of ubiquitous computing and public displays research**

The vision of ubiquitous computing (Weiser, 1991) was realized differently than originally expected. However, it is justifiable to say that we live in a world today where technology is truly ubiquitous (Bell & Dourish, 2007). Urban computing fulfils the ubiquitous computing vision in cities. UBI-Oulu is one example of such projects, the aim of which was to realize a ubiquitous computing vision. Urban computing systems are based on a triangle made up of people, technology, and the city (Foth et al., 2011; Kukka et al., 2014). Hence, urban computing deployments are not simply intended to deploy due to this complex structure of influencing forces, factors, politics, and culture.

Public displays are a visible part of the urban computing landscape today. Public displays have been studied vastly over the last decade. Also deployments, wherein public displays are embedded in-the-wild, are numerous (Memarovic et al., 2013). This type of study, compared to, for example, lab- based ones, are necessary in order to see how technologies integrate people’s lives and mundane practices and support communities (Alt et al., 2012). Although public display deployments do exist, not many of them are truly long term. In addition, the mediated practices of public displays and their emergence and dynamics have not been studied yet in depth. This thesis tries to address this research gap by providing an in-depth analysis of the dynamics of public display practices as well as their emergence, characteristics, and effects.

**2.2 Children as IT users**

Today children and families also have an ever growing body of technological artifacts at their fingertips. These technologies offer increasing opportunities for both entertainment and education. TV sets and video recorders have been part of the domestic fabric of everyday life for decades, but the recent development of smart technology has made the ICT an even more pervasive and inseparable part.
of everyday life of even younger children (see e.g., the study of babies and toddlers’ using iPads (Hourcade, Mascher, Wu, & Pantoja, 2015).

Research, for example, in education as well as in media and communication fields has shown that ICT can offer valuable experiences for young children. Researchers have found several benefits of consuming/using ICT at an early age, for example, young children’s communicative and creative competencies can be supported using domestic digital technologies (Neumann & Neumann, 2017; Plowman, Stevenson, Stephen, & McPake, 2012). In addition, it is known that ICT can foster creativity and collaboration (Yuill, Rogers, & Rick, 2013). It has also been found that the problem-solving skills pre-schoolers learn on touch-screen devices transfer to physical skills (Huber, Tarasuik, Antoniou, Garret, Bowe, Gaufman, 2016).

Still, the public debate on children’ and families’ ICT usage has become a complex topic. Common beliefs are that childhood and ICT should not be mixed and ICT hinders social interaction and dominates children’s lives and their cognitive, emotional and social development are then under threat (Plowman, McPake, & Stephen, 2010; Plowman & McPake, 2013). The younger the children are that are involved, the more critical the opinions are. Also academic discussion on ICT consumption of children has risen to prominence in different disciplines. For example, more than 2000 scientific studies and reviews have learned that significant exposure to media violence increases the risk of aggressive behaviour in certain children and adolescents (Strasburger, 2010).

2.2.1 Children and domestic ICT practices

Parents have commonly taken on the ICT as part of the repertoire of parenting tools. Wartella and her colleagues revealed that parents use ICT for managing their daily lives with children. Many parents turn to ICT when they need to get things done (make dinner, do chores, take a shower etc.). ICT is also used for calming an upset child and rewarding good behaviour. Most likely, the media used in such moments is TV, whereas mobile devices are used more often when a child is older. Parents did not report having conflicts about their children’s ICT use but they also did not think that ICT made parenting easier. Parents were also less likely to use ICT as an educational tool when compared to other activities, such as books or toys. (Wartella, Rideout, Lauricella, & Connell, 2013.)

The discourse on appropriate screen time has been vibrant. The American Academy of Pediatrics, provides recommendations, such as, “For children ages 2
to 5 years, limit screen use to 1 hour per day of high-quality programs” and “for children ages 6 and older, place consistent limits on the time spent using media, and types of media, and make sure media does not take the place of adequate sleep, physical activity and other behaviors essential to health” (American Academy of Pediatrics, 2016).

Popular culture, news, and articles regularly suggest that parents should monitor and control their children’s experiences with media. Parents are thus encouraged to establish clear rules for technology exposure, screen time, and access to content. (Mazmanian & Lanette, 2017.) Hiniker and his colleagues published an article wherein they interviewed 27 parents and conducted a diary study on ICT usage, concentrating on how parents regulate the media usage of small 1–5 year old children. They found out that transition times are the defining features of children’s media experiences as well as their parents’ mediation practices. Parents enforce transitions away from ICT when they have finished attending to their own needs and when ICT provides a natural stopping point. Technology-mediated transitions were also significantly more successful than parent-mediated transitions. (Hiniker, Suh, Cao, & Kientz, 2016.)

At home, technologies are not only used for occupying children. Wartella found out in the survey that parents used ICT with their children, but the amount of shared use sessions dropped vastly when the child turned six years old. (Wartella et al., 2013.) According to Horst, families do like to spend time together and many times watch TV or play console games together which is considered a time to relax and take a break from the fast pace of life. Many families also use ICT as a way to facilitate communication and bonding. Some families, especially fathers and sons, primarily bonded through ICT experiences. (Horst, Mahendran, Martinez, Pascoe, Perkel, Manio, Lead, 2009)

A most recent concern has been turned to parents’ and their (over)use of smart devices and that influence on children (Mantere & Raudaskoski, 2015). Besides being truly harmful, using ICT devices at home while with others is considered annoying. Oduor found out with his colleagues that people often become frustrated with their family members when they are using personal mobile devices when family is together. Usually people thought that collocated mobile device usage should wait until later because of its perceived non-urgency. (Oduor, Neuestaider, Odom, Tang, Moallem, Tory, Irani, 2016) Moser et al. also found out in their survey that parents tried to minimize their mobile phone usage while with the children and using a mobile phone at mealtimes was considered inappropriate, especially if children were present (Moser, Schoenebeck, & Reinecke, 2016).
In the human computer interaction research, children were neglected for a long time. During the past few decades, however, more child-centered views have emerged. Still, these are mostly related to design for and with children (Plowman et al., 2012). Such studies are usually conducted in schools and clubs and mostly do not concentrate on technology use in homes or other private settings. In turn, domestic human computer interaction studies that do examine homes concentrate typically on smart home applications and not on their practices, let alone examine children as users (e.g. Niemantsverdriet, Broekhuijsen, Van Essen, & Eggen, 2016; Ylirisku, Jylhä, Lehtiö, Ahmed, Stewart, Sellen, Jacucci, 2016). However, there is still a need to study how ICT is being consumed at home and in other private settings and how it becomes integrated with and is shaping everyday practices in these settings. More research on children’s technology-facilitated practice is also warranted in human computer interaction because of the huge prominence of smart devices present in the lives of today’s children.

2.2.2 Children and public displays

The children’s role in public display research so far has been rather limited. Some observation-based studies on public and community display installations have provided evidence on children and young people’s frequent use of such systems and their enthusiasm for playing with them (Hosio, Harper, O’Hara, Goncalves, & Kostakos, 2015; Mitra et al., 2005; J. Müller et al., 2012; Peltonen et al., 2008). In the studies of Memarovic and his colleagues, most display users were children who used the display on their way home from school, for example. Children also appropriated the display by innovating their own games and contests using it. (see e.g. Memarovic et al., 2015.)

In the hole-in-the-wall experiment, a publicly available computer was installed into a brick wall near a slum in rural India. The display was designed especially for children who were free to interact with it. Experiments proved how the inexperienced children were able to browse, create documents, and play games with the computer within a few days without any support. Mere curiosity drove the children to interact with the display. (Mitra et al., 2005.)

In addition, there have been public display experiments wherein children have been the main target group. Children’s use of these systems have been studied in museums (Anthony, Stober, Luc, & Wobbrock, 2016), parks (Morrison, Manresa-Yee, Jensen, & Eshraghi, 2016), schools (Matic, Hayes, Tentori, Abdullah, & Schuck, 2014; M. Müller, Otero, Alissandrakis, & Milrad, 2014; Tentori, Escobedo,
Hernandez, Matic, & Hayes, 2016) and on playgrounds (Belim, Lyra, Teixeira, Caraban, Ferreira, Gouveia, Karapanos, 2014). Some studies have focused on learning (Du, Jiang, Rosson, Carroll, 2010; Mitra et al., 2005) and some on behaviour change (Belim et al., 2014; Matic et al., 2014). A branch of these studies have also concentrated on public display use to help children with autism (Tentori et al., 2016).

2.2.3 Summary of the research on children’s ICT practices

Technology is a significant part of families and children’s lives today. Recent studies have shown how technologies are integrated in family lives. They might make the parenting easier, but they also generate tension. (Wartella et al., 2013.) Parents have to regulate their children’s media use (Hiniker et al., 2016), but parents also tend to overuse the devices themselves (Mantere & Raudaskoski, 2015; Oduor et al., 2016). Several studies have found that technology usage can benefit children in many respects, for example, boost creativity and collaboration (Yuill et al., 2013). However, the discourse on the disadvantages of technology has also become stronger (Plowman et al., 2010; Plowman & McPake, 2013).

It has already been noticed that children use public displays eagerly. This was the case with UBI-displays too. In the UBI-Oulu case, the dominating user group turned out to be children. Albeit children’s role as early adapters has been noticed (Wohlwend, 2009), the mechanisms of how their technology-mediated practices at public setting emerge and development have not been studied profoundly. Children of today seem to be on the frontline also for the adoption of technologies, and thus, studying how children adopt these technologies and integrate them into recurrent practices is especially interesting. These findings may also be applicable to the context of other type of technologies and even user groups.

2.3 Practice as a unit of analysis

What is a practice? Different practice theories use different vocabularies to describe the world and thus define practices differently (Nicolini, 2012). In this current thesis practice describes rather stable routines that consist of various inseparable elements, such as physical and mental activities, material environment, artifacts and their use, human capabilities, affinities, and motivation (Kuutti & Bannon, 2014). This chapter starts by presenting six central practice theories from which Nicolini derived the practice toolkit that was utilized as the central methodology in
After presenting the practice theories, it shortly describe how different practice theories are applied to technology-related disciplines. The concept of appropriation is then presented. Appropriation describes how the practices emerge and how technology becomes part of everyday life. Although Nicolini does not use the concept of appropriation in his toolkit approach, it is presented here since it was used as a sensitizing lens in one of the publications (A III).

### 2.3.1 Practice theories

There is no such thing as one uniform practice theory. Rather, there are several competing practice theories wherein all are based on different scholarly traditions and also highlight different aspects. Nicolini names six different ways of theorizing practices: 1) Praxeology, 2) practice as tradition and community, 3) practice as activity, 4) practice as accomplishment, 5) practice as the house of social, and 6) practice as discourse. All these theories also have their own vocabularies which are used to define practices differently. (Nicolini, 2012.)

Although the theories are different, they so share some common elements. All theories foreground the importance of: activity, performance and work; the critical role of material aspects and body; individual agency and agents; the centrality of interests in human matters, and they emphasize the importance of power, conflicts and politics as constructs of the social reality. (Nicolini, 2012; Schatzki, 2001). Next, the basic tenets of these six practice theories are briefly offered.

#### Praxeology

Nicolini bundled together practice research programs from two leading figures of contemporary social sciences, Giddens and Bourdieu, and referred to them as “social praxeology” (Nicolini 2012). According to Giddens and Bourdieu, the social life is a contingent and continuously evolving nexus of human practices. Most of the features of daily experiences (such as institutions, power relations, and social boundaries) can be understood as effects of these structures and the connections between practices. (Nicolini, 2012).

Giddens wanted to develop a social theory that too into account a subject but was not subjective. He developed the theory of *structuration*, which is a theory of recursive production and the reproduction of society. The concept of structuration highlights the interdependence between structure and agency. He calls this aspect the “*duality of structure*”. The relationship between structure and agency can be
compared to the relationship of language (langue) and speech (parole). The actual speech of speakers is governed by the rules of language. Language does not exist without parole, the actual use of language. Speech can alter the rules of language, making the language constantly change. Thus, structure is both the medium and the outcome of the reproduction of practice. (Giddens, 1984; Nicolini, 2012)

For Giddens, practices have three main characteristics. First, practitioners are knowledgeable actors who rely on rules (codes and norms) and resources (material and symbolic). Secondly, practices are always temporally, spatially, and pragmatically situated (Giddens, 1979). Thirdly, practices are interdependent and persist in any reciprocal relationship. Practices are connected to social life both locally and globally. Thus, practices form constellations of social systems which then exist in space and time and differ from structures that only exist virtually. (Nicolini, 2012.)

For Bourdieu, the primary goal of sociology was to develop a theory of practice that was capable of capturing the different levels of daily life. He thought that the fundamental importance of studying humans was appreciation and representation of real-time practices. Representing a practice is not enough, however, as the practice needs to be explained, and it is essential to understand why the practices are the way they are. For Bourdieu, practices were what people do in everyday life. (Nicolini 2012.)

Bourdieu’s central concept in his theoretical construction was habitus. Habitus is a theoretical device that accounts for the regularity, coherence and order in human conduct, taking into account a negotiated strategic nature. Bourdieu defines habitus as a set of mental dispositions, bodily schemas and know-how that are operating at a pre-conscious level. Events activate these factors to generate practices. According to the habitus model, practices are always generated by agents who are involved with daily endeavours trying to proceed unhampered with their daily matters. Habitus is part of these agents’ way of being, and thus, they simply respond to events according to what makes the most sense. (Nicolini, 2012.)

**Practice as tradition and community**

According to Nicolini, socialization and learning are inseparable elements of any coherent practice-based theorizing (Nicolini, 2012). When understanding practices as tradition and community, practical knowledge cannot be translated into words; it can only be transmitted through customs, institutions, and the processes of handing down traditions. (Nicolini, 2012)
Stephen Turner understands practice as a form of tradition. This argument contains two aspects: 1) practice implies an element of habituation and learning, and 2) practice refers to something that goes beyond the individual and persists in time. However, Turner does not support the practice-based explanations of social phenomena. To understand why practices, ways of doing, persist in time and why people stick to them, we need to support the argument with a coherent theory of learning. The process of socialization and apprenticeship provide such a theory of learning. (Nicolini, 2012)

Lave and Wenger founded a theory of legitimate peripheral participation. It sees learning both as related to and a specific form of, a particular practice, a social process through which a novice obtains a legitimate role that grows along with skills and capabilities and which is characterized by participation, commitment, belonging, and identity. (Kuutti & Bannon, 2014; Lave & Wenger, 1991; Nicolini, 2012).

Lave and Wenger introduced first of all the notion of ‘community of practice’. According to them, “A community of practice is an intrinsic condition for the existence of knowledge, not least because it provides the interpretative support necessary for making sense of its heritage.” (Lave & Wenger, 1991: 98) This community of practice is defined by 1) mutual engagement, 2) a joint enterprise negotiated by the community, 3) a shared repertoire, and 4) shared histories of learning (Wenger, 1998).

To summarize, understanding practice as both tradition and community, the durability, constancy, and stability of practices is thus emphasised. Thus, practice tends to lose its material, procedural, temporal, and social as well as conflicting character. However, there are important aspects of treating practices through community that should not be omitted, such as practice counts only for those who are able to recognize it. People learn through communities precisely ‘how things are done here’ (Nicolini, 2012).

**Practice as activity**

The cultural historical ‘activity theory’ approach that emerged from the Soviet Union through the early work of Vygotsky and then was developed more fully by A. Leont’ev, is a practice approach grounded on the earlier ideas of Marx on practice. In this approach, the notion of human activities and their motives is the fundamental unit of analysis. Nicolini sees this activity theory as one of the most radical approaches to practice, emphasizing many issues not discussed by other theories and having an
interventionist program or focus of changing practices 'from the inside'. Activity Theory has also developed one of the more detailed conceptual apparatuses for articulating practice. (Nicolini, 2012.)

Activity theory is not a unified theory. The term covers a family of related research programs. According to Nicolini (2012), the cultural-historical activity theory (Engeström 1987) tackles more explicitly the issue of theorizing practice. Nicolini designated five principles that are particularly useful when describing this approach.

1. First is the mediated nature of practice - Mediated practice means that all practices are carried out through and made possible by a range of ideational and material apparatuses and devices that we draw from cultural heritage. Especially language has a basic mediatory role.

2. Second is the notion of activity system - Collective and mediated activity is the fundamental unit of analysis for understanding human behaviour, not individual behaviour. The key to understanding and explaining a variety of phenomena is to foreground the system of mediated activity in which people are involved.

3. Third is object-oriented nature of human activity – Activities have a built-in directionality that derives from the objects towards which the activities are oriented.

4. Fourth is its historical and contradictory nature – Activity systems are internally fragmented and inconsistent. The tensions and conflicts’ emerging from such conditions are actually the origin and source of energy for continuous change.

5. Fifth, is the necessarily interventionist and developmental nature of the study of practice – As Engeström puts it, “Research makes visible and pushes forward the contradictions of the activity under scrutiny, challenging the actors to appropriate and use new conceptual tools to analyse and redesign their own practice” (Engeström, 1987: 6).

When viewing practice as an activity, its historical and changing nature is emphasized. Practices change through both impulses from the outside as well as those internally as a result of the practitioners’ own actions. To summarize, in the notion of activity, several aspects are emphasized (the role of artifacts, the historical and constantly changing nature of practices, the role of conflict, and the organizing capacity of objects).
Practice as accomplishment

Although it is not fully correct to call *ethnomethodology* (Garfinkel, 1967) a theory because of its opposition to the very notion of *theory*, Nicolini characterizes it as an approach that sees practice as an accomplishment (2012). Ethno-methodologists consider practices as the inescapable texture of everyday life and the contingent, but ongoing, accomplishment of the same practices. Ethnomethodology investigates practices as spatio-temporal accomplishments obtained by knowledgeable actors who use a variety of *ethno-methods*, tools, techniques, and procedures. As ethnomethodology practices are locally produced by using a selection of certain ethno-methods of interaction that make up practices, thus all social activity is possible. These ethno-methods are the central object of ethno-methodological studies. (Nicolini, 2012)

The key characteristics of ethnomethodology are accountability, reflexivity, indexicality, and membership (Lynch, 1993; Nicolini, 2012). Accountability means that social activities are orderly: they are non-random and meaningful. Order is public and observable. In addition, actions are ordinary, oriented, and rational, and they are describable by those who master the relevant natural language. Common sense knowledge allows us to understand meanings within situations. (Lynch, 1993; Nicolini, 2012). Reflexivity in ethno-methodology describes how, for example, the sense of a question or silence in a conversation, is achieved as part of the setting in which both occur (Lynch, 1993). Reflexive achievement of sense is an endogenous part of the practice. Accountability and reflexivity are inseparably connected. For example, an extended hand when meeting a person probably means that the person wants to shake your hand. Indexicality means how meaning is embedded in practical action. Nothing has a fixed meaning and everything is dependent on context. Membership highlights the idea that an individual is not at the center of the focus. Instead it is interesting to study what ethno-methods are necessary for a person to participate in the accomplishment of an activity and become a member of a group. (Garfinkel, 1970; Nicolini, 2012)

In summary, the ethnomethodological interpretation of real-time practices situates descriptions in materially embodied practices. Ethnomethodology focuses on a local accomplishment of the social order and refuses to study social structural phenomena. (Nicolini, 2012) Ethnomethodologists consider strict localism as in contrast to the functional sociologists’ tendency to study the society as a big thing through the events of daily life (Lynch, 1993).
Many of the contemporary practice theories are based on the legacy of Heidegger, Wittgenstein, or a combination of them. These kind of theories have been offered by authors like Charles Taylor, Ernesto Laclau, Chantal Mouffe, Joseph Rouse, Berry Barnes, Andrew Pickering, and Theodor Schatzki. All these authors elaborated on Heidegger and Wittgenstein’s initial thinking that knowledge, meaning, identity, activity, power, language, social institutions, and transformation are housed in and originate from social practices. (Nicolini, 2012.)

Nicolini leans a lot on Schatzki’s work, and thus he is mainly referred to here. According to Schatzki, people do what makes sense for them to do in all circumstances. For Schatzki, the meaningfulness of human actions play a central role. People respond to their conditions of life on the basis of how they understand of what is going on. Thus, humans are not rational decision-makers nor cultural, role or habitus driven fools. Schatzki calls this ‘action intelligibility’. (Schatzki, 1996) It is historically formed and different from abstract rationality. Practices form the natural horizons for meaningfulness, thereby allowing humans to respond to different matters in different ways. (Nicolini, 2012)

According to Schatzki, practices are open-ended and spatially and temporally diverse actions (Schatzki, 2005). For example, writing a thesis or cooking can be called practices. Practices are not always regular or routine alone since practices entail irregularities and unexpected elements. Basically, practices are sets of doings and sayings. Nicolini highlights the centrality of the human body and bodily skills as a characterizing feature of practice theories, but he also recognized that other material aspects can interfere with the accomplishment of these practices. Practices are social and help us to combine as groups. (Nicolini, 2012).

Practices and materials constitute, when taken together, social phenomena and a ‘house’ of them. Sociality takes place and transpires through nets of interconnected practices and material arrangements. Practices are collective phenomena, and they let participants co-exist and come together for specific projects and horizons of intelligibility. Interaction is the effect of practices. Practices are responsible of establishment of any social order. In any social arrangement, like the university or disco, humans co-exist, and their actions are coordinated through social mechanisms like chains of actions, commonalities in and the organization of projects and emotions, prefiguration actions, and material arrangements. Mechanisms that keep actions together in a practice also sustain the relationships between practices. Chains of actions thereby become chains of
practices. These nets are linked together as a single gigantic and evolving mesh of practices. In summary, sociality is established through practices and takes place within a group of interconnected practice bundles. (Nicolini, 2012; Schatzki, 2002.)

Practice as discourse

According to Nicolini, there are number of research programs that have an idea that discourse is fundamentally a form of action through which things are made to happen in the world, not merely a way of presenting the world (Nicolini, 2012). Thus, language could be considered as a discursive practice and a form of social and situated action. The term discourse is used for at least two phenomena. First it is used when talking about the way which people engage with each other in daily face-to-face communication, meaning as local achievement. Secondly, the term is used in a broader sense about how humans integrate linguistic and non-linguistic features to enact and recognize identities, then give the material world specific meanings and make meaningful connections. The latter understanding is interested in studying how social structures shape discourse and understanding the relationships between discourse, knowledge, and power. (Gee, 2014; Nicolini, 2012; Scollon & Scollon, 2004)

Nicolini classifies conversation analysis, (Sacks, 1984) and Foucault’s work (Foucault, 1972) as practice theories that focus on discourse. Conversation analysis tries to understand the social organization of linguistic conduct, and its origins which are in ethnomethodology. Foucault’s approach is different; he is interested in the material and discursive practices that regulate social life. In addition, Nicolini presents critical discourse analysis (Weiss & Wodak, 2007) as a successful attempt for developing Foucault’s perspective in a direction that combines an interest in the production mechanism of discourse or practice as well as concerns about the relationship between discourse, power, and social change. Finally, mediated discourse analysis (Scollon & Scollon, 2004) tries to solve the problems of critical discourse analysis by putting the social practice as the center of the study. Mediated discourse analysis forms a theory of social action with a specific focus on discourse as a kind of social action as well as a component of it. (Nicolini, 2012; Scollon & Scollon, 2004)

2.3.2 Practice research in IT-related disciplines

The practice trend originates from the social sciences wherein the so-called practice turn has over the years legitimized practices as a unit of analysis (Kuutti & Bannon, 2001).
practice theories have been popular especially in organization and work studies, but also expanded in recent years to other disciplines, for example, strategy research (e.g. Jarzabkowski & Spee, 2009), learning research (e.g. J. S. Brown & Duguid, 2001), and many other fields. In information systems (IS), research practice-based theorizing has already a longer tradition (Orlikowski, 1992; Pentland & Feldman, 2005). Giddens’ structuration theory was used for the first time in the 1990’s (Orlikowski, 1992). According to Nicolini, it was related to a shifting focus of organizational studies (OS) that started to study organizations as discourses and processes, thus forming the groundwork for practice theories. After that, practice theories established their position as a genre or research topic in organizational studies. (Kuutti & Bannon, 2014; Nicolini, 2012). Since the 1990’s, information systems scholars have become increasingly interested in practice theories. Tavakoli and Schlagwein executed a literature review on practice theory in information systems. According to them, practice theory has been shown to be useful for all sub-areas of information systems. These studies have mainly utilized the central concepts of agency and materiality by focusing on the sociomaterial lens. (Tavakoli & Schlagwein, 2016.) Kuutti and Bannon criticized, however, the recent information systems research for its over-elaborative articulation of theoretical frames and neglecting both practical work activities and settings (Kuutti & Bannon, 2014).

In addition, participatory design (PD) and specifically Scandinavian Participatory Design has since the 1970’s always been practice-oriented and concentrating on worker knowledge and skills in their everyday working practices. In Computer Supported Cooperative Work (CSCW), and especially in European Computer Supported Cooperative Work (ECSCW), Practices has always been in the mainstream of research. Ethnomethodology and activity theory have been the basic forms of practice theories in computer supported cooperative work. (Kuutti, 2013). Today, the practice-oriented approach to computer supported cooperative work research has been extended beyond the workplaces to study human practice in a variety of non-work settings, such as home care (C. Müller, Neufeldt, Randall, & Wulf, 2012), family coordination (Bødker & Grönvall, 2013), and tourism (Bjørn, Ciolfi, Ackerman, Fitzpatrick, & Wulf, 2016; B. Brown & Chalmers, 2003). In addition, examples of more recent computer supported cooperative work include studies of collaborative practices in Palestine (Boulos-Rødje, Bjørn, & Ghazawneh, 2015), appropriation of ICT by non-tech savvy people (C. Müller, Hornung, Hamm, & Wulf, 2015), and how writers handle delay in terms of real-time collaborative note-taking (Ignat, Oster, Fox, Shalin, & Charoy, 2015).
Lately, practice approaches have started to gain more ground in human computer interaction. At some level, practice theories have been around in human computer interaction since 1980’s through, for example, Lucy Suchman’s studies in Xerox PARK (Suchman, 1987). In addition, in the 1990’s, another practice-oriented approach, activity theory, arrived. However, according to Kuutti, the focus of the human computer interaction has still been on interaction, usability, and user-centered design. The third wave of human computer interaction has started to bring more practice-like elements into the human computer interaction research. These include understanding the context of interaction, interest in appropriation, research in the wild, solving complex real-world problems, materiality, embodiment, performance, and digital ecologies (Kuutti & Bannon, 2014). Examples of recent practice-oriented studies in human computer interaction have concentrated, for example, on sustainable transportation practices (Hasselqvist, Hesselgren, & Bogdan, 2016) and designing self-care technologies (Nunes, 2015).

Practice theory-based approaches can benefit both human computer interaction and computer supported cooperative work in different ways. Practice approaches have been utilized previously in designing practices, aiming to transform practices through design (Pierce et al., 2013). Tomlinson uses the notion of practice to anticipate a possible future of scarcity and to design to support this future and the practices that might be in it (Tomlinson, Blevis, Nardi, Patterson, Silberman, Pan, 2013). In addition, Pink has been interested in designing technologies that fit into the current practices and places instead of trying to change those existing practices through further design (Pink, Mackley, Mitchell, Hanratty, Escobar-Tello, Bhamra, Morosanu, 2013).

This sub-chapter has presented different practice theories and how these theories are applied in technology-related research fields, such as information systems, computer supported cooperative work, participatory design, and human computer interaction. Positioning this thesis in one specific field is thus challenging, as partially the thesis belongs under to human computer interaction tradition, partly to computer supported cooperative work, maybe a little also to information systems. On the other hand, it is questionable if this sort of categorization is even relevant. In addition, this thesis does not lean on one specific practice theory, but rather utilizes Nicolini’s practice toolkit approach, which combines features from all six of previously described theories (Nicolini, 2012). The next section presents the appropriation concept, which is another approach used for studying technology-mediated practices, and then the methodology of practice toolkit is described more profoundly.
2.4 Appropriation

The related research has also explored technology-mediated practices through the concept of appropriation. While technologies are often designed for specific purposes, possibilities also exist to use them otherwise. The process by which people integrate new technologies into their existing practices can be called appropriation. Appropriation can mean fitting technologies into existing practices or evolving new ones (Dourish, 2003). Although appropriation cannot be perceived as a practice theory, and it is not mentioned by Nicolini in his book (Nicolini, 2012), I do present the concept here, since it is also utilized as a theoretical approach in this current thesis. Appropriation relates to practices in the way that it describes the mechanism for how new practices emerge, old ones change, and technology is modified in order to fit the existing practices better.

Appropriation has been studied since the 1990’s in technology-oriented research fields (Salovaara, 2012). During those years, several interpretations of appropriation have emerged in the literature concentrating on, for instance, the invention of new use purposes (Dix, 2007; Dourish, 2003), improvisation (B. A. T. Brown & Perry, 2000), customization and adaptation (Pipek, 2005), integrating with the existing practice (Balka & Wagner, 2006), and making the technology one’s own (Silverstone, Hirsch, & Morley, 1992; Sørensen, 2006). In all appropriation interpretations 1) users are active actors who adapt technologies for their own purposes; 2) the focus is on the changes in technology use, which concern either integrating technology into existing practices or inventing uses that differ from the common use patterns; and 3) appropriation as both the process of evolving technology-related practices and the outcome of emerging uses (Salovaara, 2012).

The designers’ anticipated purpose: Especially in human computer interaction, appropriation has been seen as the user’s ability to invent new purposes for that use. The assumption is that technologies were designed for specific purposes and interesting is whether users use the systems for those purposes in anticipated manners, or whether they find novel, unexpected uses (Dix, 2007; Dourish, 2003; Krischkowsky, Maurer, & Tscheligi, 2016). A recent interpretation of appropriation, representing the ‘designer’s purpose’ approach, was demonstrated by Flint and Turner (2016), who see appropriation as an “active purposive exploitation of the affordances offered by the technology” and as a “natural consequence of this enactive use” (Flint & Turner, 2016: 41). These uses, which do differ from designers’ anticipated purpose, are also called ‘behavioural adaptations’ (Muller,
Neureiter, Krischkowsky, & Tscheligi, 2016), and have been studied as such (Kim & Lee, 2012; Salovaara, 2009; Salovaara, 2012).

In organizational studies, especially in adaptive structuration theory, technology is seen to include structural features as well as its spirit, which is the intended use of the technology (DeSanctis & Poole, 1994). The spirit of technology guides the users’ behaviour and use patterns. The users either follow the designers’ intentions and spirit or use technology in ways inconsistent with its spirit. Poole and DeSanctis (1994) call use that is in line with designers’ intended use as faithful appropriation and use that differs as unfaithful appropriation. Orlikowski (1992) uses a more neutral terminology and calls the faithful appropriation as a design mode and unfaithful as the use mode, thus professing also the possible benefits of the unintended appropriation.

Purpose-in-context: Another appropriation approach studies the process of technology use that is becoming embedded within existing social practice (Dourish, 2003). Appropriation includes activities that are necessary to ‘make technology work’, such as adopting and restructuring work processes and environment (Balka & Wagner, 2006; Salovaara, 2012). For example, Bødker and Christiansen studied the appropriation of smartphone applications using this perspective (Bødker & Christiansen, 2012).

A viewpoint of appropriation that can also be located within this approach studies it through the framework of domestication, namely, how one makes technology one’s own. Domestication research takes both functional and symbolic perspectives on technology. (Silverstone et al., 1992; Sørensen, 2006). Technology that is embedded into existing practices and routines becomes familiar and personal. Domestication research studies the process of technology becoming embedded into the local context of use, so that it becomes nearly invisible in people’s daily routines (Silverstone et al., 1992; Sørensen, 2006).

According to Sørensen, three main dimensions of technology domestication are: The practical, which highlights the construction of artifact-related practices (e.g. routines); the symbolic, which stresses the construction of the meaning and role that the artifact has; and the cognitive, which highlights the processes related to learning the practices and their meaning (2006). If the domestication process is successful, technology becomes an integral part of everyday life, although sometimes technologies do refuse to be tamed. People confront technologies and either work out how to fit them into their everyday routines (adoption) or simply reject them (non-adoption) (Haddon, 2006). Technological artifacts are rarely domesticated fully and re- and de-domestication can occur as well (Berker, 2006).
Customization: An alternative approach to readymade appropriation is to study appropriation as customization: Users intentionally modify technology to make it more suitable for their particular needs. This behaviour can be anticipated and encouraged by developers and designers by making the systems adaptable. (Pipek, 2005) In addition, some modifications may also be performed by users to systems that are not specifically designed to be modified by users. Appropriation in this sense can also emerge even without the designer’s special support of it (Pipek, 2005)

This section presented the many faces of the concept of appropriations. I utilize different appropriation concepts so as to understand the relationship between practices and urban computing technologies. Appropriation helps us understand how practices emerge and evolve in relation to the original purposes set forth by the designers.
3 The methodological framework - Practice toolkit

In this thesis, public display usage is studied through the practice lens as defined by Nicolini (2012). The approach is suitable for the case since it explains long term usage instead of single use events. Compared to for example appropriation theory the focus is on the actual use practices and not on differences between the design and use. However, practice lens also requires taking into account the different dimensions of the practice (e.g. historical, material, and spatial). All these dimensions help in drawing the trajectory of the public display practices.

As pointed out in previous sections, practice theories do not form a unified theoretical corpus, but rather they are based on different approaches and traditions (Schatziki 2001, Nicolini 2012). Although practice theories are different, they do share a number of similarities, and as Nicolini describes:

*The idea of family resemblance allows us to think of all these theories as being related, in some partial ways, through a complicated network of similarities and dissimilarities, without assuming that they share one inherent common feature* (Nicolini 2012: 214).

Common in the previously described practice theories is for example, the concept that practices are materially mediated and tied to a specific time, place, and historical context; social accomplishments; and connected to each other to constitute nexuses of practices (Nicolini, 2012).

Nicolini argues that since these theories constitute complex webs of similarities, they can be mobilized all together to enrich our understanding on practices (2012). All the aforementioned practice theories have advantages and disadvantages when considering the empirical study of practices. Thus, Nicolini proposes a theory-method package, the so-called toolkit approach, to utilize different practice approaches together. There are many advantages of using these theories together. By combining several practice theories, rather than creating only a synthesis of them, we are able to provide a thicker account of the world in which we live. A practice toolkit provides tools for understanding what people do and also to explain and understand the meanings behind the performances, namely, why people do what they do. (Nicolini 2012). Nicolini describes the positive outcomes of practice approach:
The great promise of practice lens is that of explaining social phenomena in processual manner without losing touch with the mundane nature of everyday life and the concrete material nature of activities with which we are all involved (Nicolini, 2012: 9).

The toolkit package is composed of a set of sensitizing concepts and questions to be discussed in different phases. The approach consists of two basic movements: Zooming in on an actual accomplishment of practices, zooming out to the relationships of practices in space and time. Zoom in and out phases will follow each other. A practice study should start by zooming in and only after doing so, that scope should be expanded to make sense of the collected data and identify connections through zoom out lenses. (Nicolini 2012). Both zooming phases provide analytical lenses through which one can focus the attention on different aspects of the practice now in focus. One can study practices that concentrate on a specific lens or aspect. Especially, a researcher can select suitable zoom in focuses afterwards zoom out to meaningful direction. However, according to Nicolini, without the zooming out movement, the zoom in study remains superficial. Practices “never happen in isolation” and in order to understand practices and finding connections with other practices besides just describing them as a zoom out study is essential (Nicolini 2012: 229). The relationship between practice theories and the toolkit approach is summarized in Table 5. The next sections describe where to focus the attention in each instance.
Table 5. Central features of practice theories and the theoretical resources of Nicolini’s practice toolkit (Nicolini, 2012).

<table>
<thead>
<tr>
<th>Practice theories</th>
<th>Praxeology</th>
<th>Tradition &amp; Community</th>
<th>Practice as Activity</th>
<th>Practice as Accomplishment</th>
<th>Practice as House of social</th>
<th>Practice as Discourse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central authors</td>
<td>Giddens, Bourdieu, Turner, Lave &amp; Wenger</td>
<td>Engeström</td>
<td>Garfinkel, Lynch</td>
<td>Heidegger, Wittgenstein, Schatzki</td>
<td>Sacks, Foucault, Scollon &amp; Scollon</td>
<td></td>
</tr>
<tr>
<td>Focus</td>
<td>Duality of structure Habitus</td>
<td>Way of doing things, Learning, Community of practice</td>
<td>Human activities &amp; motives, mediated, activity system, Object-oriented, developmental</td>
<td>Ethno-methods, Accountability, Reflexivity, Indexicality, Membership</td>
<td>Meaningfulness, Action intelligibility, Practices establish social order</td>
<td>Local linguistic, accomplishments, Discourse, Power, Social change</td>
</tr>
<tr>
<td>Practice toolkit</td>
<td>Accomplishment</td>
<td>Interactional order, Timing &amp; tempo</td>
<td>Sayings &amp; doings</td>
<td>Interactional order</td>
<td>Sayings &amp; doings</td>
<td>Sayings &amp; doings</td>
</tr>
<tr>
<td>Material aspects</td>
<td>Bodily choreography</td>
<td>Tools</td>
<td>Tools</td>
<td>Bodily choreography</td>
<td>Practical concerns</td>
<td>Practical concern</td>
</tr>
<tr>
<td>Aim</td>
<td>Creativity</td>
<td>Creativity vs. normativity</td>
<td>Creativity vs. normativity</td>
<td>Creativity vs. normativity</td>
<td>Legitimization and stabilization</td>
<td></td>
</tr>
<tr>
<td>Durability</td>
<td>Legitimization and stabilization</td>
<td>Legitimization</td>
<td>Legitimization</td>
<td>Legitimization and stabilization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associations</td>
<td>Associations between practices</td>
<td>Associations between practices</td>
<td>Effects of the practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effects</td>
<td>Historical analysis</td>
<td>Historical analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergence &amp; evolution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


3.1 Zooming in on practice

Zooming in lenses focus their attention on different aspects that relate to the actual practice in a specific place and time. The focus of attention is on actual performances, related material and its bodily aspects, the aims of the action, creativity and durability. The zoom in approach heavily takes its inspiration from ethno-methodologically influenced approaches. The aim of the zoom in movements is not to expose the actors’ inner value systems, but rather rely on the level of observation and the description of conduct. (Nicolini, 2012.)

3.1.1 Practice as accomplishment

Fundamentally practices are real-time doings and sayings in specific times and places, and they only exist while they are enacted and re-enacted. Thus, studying them should start by focusing on the everyday activities at hand. It is interesting to study the

- sayings and doings,
- interactional order and
- temporal sequences.

Highlighting the performances when studying practices is inspired by the ethno-methodological and conversation analytical approaches. The analysis relies only on observations and descriptions of conduct. (Nicolini, 2012)

The questions to ask at this stage are, for example, What are people doing and saying? How do the patterns of doing and saying flow in time? (Nicolini, 2012).

3.1.2 Practice through both material aspects and the body

Zooming in on mere action, however, might end up concentrating on the level of details that leads away from the observable practice. Thus, other aspects should also be taken into account. Accomplishment of practice always involves an active contribution of tools; thus the second step is to zoom-in by focusing on the active role of material aspects involved in practicing such as:

- Bodily choreography as well as
- Tools, artifacts, and mediation work.
Accomplishing a practice includes an observable bodily choreography. Study should focus also on a contribution of other artifacts, both the material and the symbolic tools. It is important also to study the active role of all material artifacts and how they establish the relationships between practices. The material aspects are especially highlighted in the Heideggerian approach to practice theory as well as activity theory. (Nicolini 2012).

The questions to ask at this stage are for example: How is the practice accomplished with the body? How is the body shaped by the practice? How do the artifacts contribute to the accomplishing of practice? How are they then used? (Nicolini, 2012)

### 3.1.3 Aim of the practice

According to Heideggerian tradition, practice means to care for or take care of something. Practices are always performed for a reason; they carry both a meaning and a direction. The practitioner has an understanding of what to do and what should be done. The third type of zooming in is to articulate the aim of the practice. There are always cognitive and moral terms involved in practicing. The concept of good is guiding the practice. Practical concerns are always verbally addressed, for example, through motives, goals, or explanations make distinctive the more abstract and indirect values, beliefs, or inner motives. (Nicolini, 2012)

The questions to ask at this stage are: What matters to the practitioners? What do they care about? Where do they direct their efforts? To catch the goal of the practice, we can use, for example qualitative interviews. (Nicolini, 2012)

### 3.1.4 Creative, but bounded, practices

Practices are re-produced every time they are performed, but at the same time, they are bounded. Two practices are never identical, but still hold have something in common. (Nicolini, 2012). It is interesting to study how much a practice can vary, but still be categorized as a practice by studying the tension between creativity and normativity. The ethno-methodological approach foregrounds this tension between a repetition of the same and reproduction (Garfinkel, 1967). The boundaries of practices are expressed and kept discursively within the practitioners. The novices learn the “rules” of the practice through socialization. They learn what is acceptable and appropriate and what is not. Still, practices are also dynamic and evolving continually. The boundaries are materially and discursively contested and
modified. (Nicolini, 2012). To understand this aspect of practices, especially long-lasting research set-ups are required.

The questions to ask at this stage are: What are the main ways that practitioners make themselves accountable in practice? What are the formal and informal rules? Where are the main tensions? (Nicolini, 2012)

### 3.1.5 Durability of the practice

The final focus for zooming-in is to study its durability from the perspective of legitimacy and learning. Practices consist of resisting systems of activity. Practices are socially shared by communities of practice. Practices are countable only for those who are able to recognize them: People who understand what is going on and are willing to accept the action. Zooming-in requires shedding more light on patterns of the relationships of individuals, how the patterns are learned and how they are made durable. There are four aspects that contribute to the durability of the practices: Learning; mediating tools and instruments; other people, and other practices. Norms of the practice have to be learned in order to practice and be maintained. Thus, one has to focus on learning while studying practices. Learning happens through communities of practice. People with similar skills and concerns are making these practices durable. Also, tools and instruments maintain the durability of practices – they carry the scripts of the practices, which the designers and developers embodied in them. Finally, the durability of the practice may be achieved by a practice becoming part of larger configuration as a resource for another practice. (Nicolini, 2012).

The questions to ask at this stage are: How are the novices socialized? Do practitioners use the practice to identify themselves as a community? How are practices made durable? (Nicolini, 2012)

### 3.2 Zooming out on the associations between practices

Practices never happen in isolation and cannot be carried out separately from other practices. Practices are involved in a number of relationships and associations that are forming nexuses of connections. For this reason, practices cannot be studied fully by focusing only on the details of their accomplishments through zooming in lenses. After achieving the in-depth understanding of the accomplishment of local practices, we are able to proceed to identifying and trailing the connections between practices. It is important to consider how local practices are affected by other
practices and vice versa. In Nicolini’s words, “In order to understand what happens here and now, we also need to understand what happens somewhere else.” (2012: 229).

To expand the scope in time and place, Nicolini suggests the zooming out approach. The zooming out approach is based on the actor-network theory and the sociology of translation, and thus, in the zoom out studies Nicolini, recommends using methods derived from them, i.e., following actors and observing the effects of the socio-technical arrangements. The following can be done through a different type of shadowing (Czarniawska-Joerges, 2007). On the other hand, one could retrace the steps, the strategies, and the events that led to the emergence of the practices using historical methods. (Czarniawska-Joerges, 2007; Latour, 2005).

3.2.1 Connections between practices

Zooming out starts by following the associations between practices. In other words, one should empirically track the practices and their connections. We can ask how the considered practice is causally or materially connected with other practices. This can be done, for example, by shadowing the practice to different places where it appears by following the intermediaries (people, artifacts) in space. It is interesting also to see how practices and their connections are kept in place. Associations between practices need to be bounded and kept in place by the coordination of human and non-human mediators like forms, software, and spaces. This analysis also sheds light on how practices in different locations are actually connected. (Nicolini, 2012)

Questions to ask at this stage are: What are the connections between ‘here and now’ of practising and the ‘then and there’ of other practices? Which other practices affect, enable, constrain, conflict, and interfere with the practice under consideration? What are the mutual dependencies between the practices? (Nicolini, 2012)

3.2.2 Effects of the practices and their relationships

Secondly, zooming out requires studying the effects of the practices and their associations and how the local practice acts at a distance. Interesting is how the practice contributes to a wider picture and how the phenomena take place in distant times and places. Zooming out to the effects of the practices is essential when providing fundamental understanding of the practice in focus and when it cannot
be studied merely by observing. A broader view is achieved by expanding the hermeneutic circle in space and time. (Nicolini, 2012)

The core questions are: How does the practice under consideration contribute to the ‘wider picture’? In which ways does the practice generate tension and conflict? Where and how are the effects of the practice under consideration felt? How does the practice contribute to the state of affairs? (Nicolini, 2012)

3.2.3 The emergence and evolution of the practices

So far, the zooming out steps have expanded the hermeneutical circle in space by following the practices and intermediaries. Now, we should expand the scope in time and study the emergence and evolution of the practices through historical investigation. Historical analysis helps to understand the power relations determining the current situation. This focus is essential, especially when conducting critical research that aims to change. Historical reconstruction, together with historical shadowing, helps shed light on how local practices contribute to larger configurations. (Nicolini, 2012)

The core questions here thus are: How did we get where we are? Why things turned out this way and not differently? (Nicolini, 2012)

3.3 The Approach of This Thesis

The definition of practices, as used in this thesis, is a compiled understanding of several practice theories. It understands practice as something that is done routinely again and again using tools, discourses and our bodies. Practices are thus:

- stable performances (routines) continuously produced and reproduced
- physical and mental activities of human bodies
- materially mediated
- tied to a specific time and historical context
- tied to a specific place
- social accomplishments
- connected to other practices to form nexuses

Although public display interactions are typically ephemeral and last from a few seconds to a few minutes, I treat the display interactions in this thesis as practices. It is also acknowledged that treating these interactions as practices is not problem-free. For example, the toolkit is designed for a different type of work-related longer
term practices. However, I believe that practice is also a suitable concept for analysing public display interaction for several reasons. The practice approach reflects how technology use is integrated into everyday life, not just single use events. In addition, the earlier listed features of practice are fulfilled in the scenario of using public displays. Using the displays is indeed materially mediated, since the display is a material entity, and using it through touch-based interaction involves bodily choreographies. Display practices are also time and space specific. Although identical displays exist in other places, only the swim center display seems to be frequently in use. Display practices are also tied to historical context, for instance the technological atmosphere of the moment. Practices are most probably influenced by the proliferation of Smart phones in general, as if the displays would have been established a decade earlier, the practices might have turned out to be completely or at least somewhat different.

Public display usage is also a social accomplishment in the sense that although it would be used alone, there are almost always other persons in the space sharing in one way or another a usage situation. Although display usage is not an essential part of other practices, in the same sense as using, for example, a ticket machine is part of a train trip, it is probable that practitioners have integrated the display use as part of their visits to the swim center. Thus, the display has become part of the network of practices in that context.

As my interest was studying the characteristics of local public display practices, this work utilized various Nicolini’s zoom in lenses. I utilized Nicolini’s sensitizing questions and foci as an analytical lens to view the same ethnographic material. Nicolini recommended drawing from the following aspects: Sayings and doings; interactional order; temporal sequences; bodily choreography; tools, artifacts, and mediation work. In this study, the most suitable methods turned out to be those concentrating on doings, interactional order material aspects, and bodily choreographies. Also, here space is treated as a material aspect.

In the second phase, I continued analysing the ethnographic material through analytical lenses concentrating on practical concerns; tensions between creativity and normativity; and processes of legitimatization and stabilization. The practical concerns are treated in this thesis as motives for use, and legitimatization and stabilization are treated as learning, and tension between creativity and normativity as evolving the precise motives for use. Creativity of users is also studied using the appropriation concept.

After conducting the zoom in analysis, the zooming out studies center on studying the emergence and evolution of public display practices through an
historical analysis. In addition, the connections between public display practices and other practices as well as the display practice effects on the society are analyzed. The next section describes the material used in detail.
4 Methods and materials

To understand the factors contributing the practices surrounding an open public display installation, it is essential to consider research material from various sources. For this reason, the research material in this study is versatile. The zooming in analysis material was collected through a different type of ethnographic methodology at the swim center entrance hall as well as thematic user interviews. For the zoom-out studies the data inquiry consisted of semi-structured time-line interviews with stakeholders, a diary study with user families, collecting a corpus of media texts published in the local newspaper, and a discussion forum. Altogether, 83 informants participated in the data inquiry at different stages. Three individual informants participated in more than one study. All in all, the data includes approximately 26 hours of interview material, 55 hours of observations, 80 pages of field notes, 25 headline stories, and 416 comments as well as 60 pages of diaries. A summary of that material is presented in the following Table 6.

Table 6. The qualitative research materials used in this study.

<table>
<thead>
<tr>
<th>Type of material</th>
<th>Time</th>
<th>Participants</th>
<th>Data &amp; participants</th>
<th>Responsible researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnographic field study</td>
<td>2015</td>
<td>Swim center visitors, display users</td>
<td>55 hours of observations, 80 pages of field notes, 24 hours of video recordings</td>
<td>Student group* &amp; Author</td>
</tr>
<tr>
<td>Structured field interviews</td>
<td>2015</td>
<td>42 Display users (and 8 parents)</td>
<td>37 interview recordings</td>
<td>Student group* &amp; Author</td>
</tr>
<tr>
<td>Thematic semi-structured interviews</td>
<td>2015-2016</td>
<td>9 display users (9-13 year old)</td>
<td>7 interview recordings</td>
<td>Author</td>
</tr>
<tr>
<td>Semi-structured time-line interviews</td>
<td>2015</td>
<td>11 Stakeholders (8 developer team members, 3 municipality representatives)</td>
<td>1-2 hour interviews recorded, individual time-line pictures</td>
<td>Author &amp; A. Lanamäki</td>
</tr>
<tr>
<td>Media texts</td>
<td>2017</td>
<td></td>
<td>25 headline stories in local newspaper (Kaleva) and 416 comments in a related discussion forum (Juttutupa)</td>
<td>Author</td>
</tr>
<tr>
<td>ICT use diaries and semi-structured interviews</td>
<td>2016</td>
<td>3 families with children</td>
<td>6 interviews (approx. 30 min each), 60 pages of diaries</td>
<td>Author</td>
</tr>
</tbody>
</table>

4.1 Zoom in to users at swim centre through ethnographic field study

As said, a practice study always should start by self-immersion in the actual accomplishment of the practice (Nicolini, 2012). This research began with ethnographic field work (Pink & Morgan, 2013; Van Maanen, 2011). The location of the ethnographic study was selected according to the use statistics for the displays in the public display network. Based on longitudinal quantitative logging of interaction events (e.g., clicks made on the screen surface), the swim center display was the only display of the network that was used continually throughout the year (excluding the summer maintenance break, when the swim center is temporally closed) and was used more frequently than those for the other displays (See Table 1). Focusing these ethnographic efforts on other displays would have been inefficient since they were used only casually. The statistics of frequent use indicated that there might be a community of display users who regularly visited the space and used the artifact in our focus and there was something special in the swim center display. Thus, the ethnographic field work was conducted at the entrance hall of that swim center.

Ethnographic studies understand and analyze phenomena placed in focus through long-lasting participant observation in the field. The roots of the method are in anthropology. The ethnographic studies concentrate on everyday life situations and are based on observations, interviews, and discussions. The basic assumption is that the researcher collects the research material in the field by him/herself. The goal is to describe and understand the action in closer focus. (Metsämuuronen, 2006)

There is considerable debate in anthropology about what it means to be ‘doing’ ethnography. At minimum, most would agree that ethnography requires a period of field work where the ethnographer becomes involved in the everyday activities of the people studied. While ethnography often includes a description of the activities and practices of those studied, it is more importantly an attempt to interpret and give meaning to those activities. (Blomberg, Giacomi, Mosher, & Swenton-Wall, 1993: 124-125.)

Traditionally an ethnographer has been a ‘lonely hero’ working alone in the field (Metsämuuronen, 2006). Recently, however, collaborative group ethnography has become more common and offers advantages, for example, through shared interpretations (Gerstl-Pepin & Gunzenhauser, 2002). In addition, through
technological developments, different digital video-based ethnographic methods have become more popular. The advantage of video ethnography is that recorded videos increase the scientific rigour since videos retain the sequences of observed behaviour for later scrutiny and as a result can increase the quality and reliability of statements made on the activity (Schaeff, 2009: 255). However, this sort of video ethnography brings about ethical issues, for example, privacy (Czarniawska, 2014). Traditionally an ethnographer spends at least a year doing fieldwork. Especially in anthropology, ethnography requires long-term field work. In practice, however, in other fields, for example the design field, ethnography is not necessarily a long-term research effort. Rather, it means

\textit{intensive excursions into their lives, which use more interventional as well as observational methods to create contexts through which to delve into questions that will reveal what matters to those people in the context of what the researcher is seeking to find out} (Pink & Morgan, 2013: 352.)

Rapid-ethnographical efforts last typically months or weeks, rather than years, and use a mixed method of data inquiry (Pink & Morgan, 2013).

The main ethnographic efforts of the zoom in phase of this study were executed by a group of four students as part of their assignment for research and development course work. In addition, the author visited the space and observed the people there unsystematically throughout the thesis process. The principles of the ethnographic studies were bent since the author received field notes and video recordings from which the main findings and zoom in analysis was made. However, the video recordings, together with the author’s own participation in the field, provided a possibility to study the actions in the space rigorously.

\textbf{4.1.1 Field study - Observations}

The study period at the entrance hall of the Oulu swim center was executed between February and April of 2015 during a student research and development project. A group of four students conducted the main part of the fieldwork during that time. The students took turns in doing observations, and usually one person at a time observed the space and took field notes. The observers wore name tags, so they could be identified as researchers. The author supervised the group closely and participated in the observing occasionally. The collected material totalled 55 hours of observations at varying times of the day and week, but concentrating on the busy hours. These observations are reported in the field notes. In addition, for
approximately half of the time (24 hours) the space was also video recorded. The hidden camera filmed the space around the public display and the users from the back and diagonally from the top. In addition, photographs of users’ interacting with the system were taken.

Prior to the systematic ethnographic fieldwork at the swim center, I conducted interviews with three swim center cashiers, who regularly worked near the display in order to gain some initial perceptions on the dynamics of the display practices.

4.1.2 Field study - Structured user interviews

The observational data had 39 structured field interviews with the display users and their parents. Participants were recruited in situ. Interviews were audio recorded and transcribed. The interview guide included a list of semi-structured questions. The aim of the questions was to study the phenomenon as comprehensively as possible. As the original intention was to utilize domestication theory to understand the display use and its adoption, the field interview questions were also informed by domestication theory (Silverstone et al., 1992; Sørensen, 2006). The questions viewed the display usage from three perspectives: 1) concrete routines with the displays; 2) symbolic meaning and the role of the displays in users’ lives; and 3) cognitive aspects for how users learned to use the displays (cf. Sørensen 2006). The field interviews were carried out until the saturation point was reached and the answers began to repeat themselves. This circumstance happened around the time of the 30th interview.

4.1.3 Analysis of the field study material

The field study material was analyzed qualitatively through a data-driven analysis method. Although the analysis was highly inductive, the practice toolkit approach (Nicolini, 2012) was used as a sensitizing device and applied when applicable. As in any qualitative research, the researchers’ interpretations cannot be separated from their own background (Creswell, 2013). Thus, in this case, my interpretations on the research data were influenced by my knowledge of every day life in Finland. The analysis proceeded as follows. Overall, the interest in the interview and observational data was in: 1. Concrete accomplishments around the displays, 2. cultural-spatial, temporal, social and material dimensions related to the display performances, and 3. meaning of technology mediated practices for the people, and finally 4. creativity versus normativity and durability of the practices.
1. For studying the concrete accomplishments with the displays, the observational data (video recordings and field notes) was at first utilized; in addition, field interview material was used as supporting material. In addition, to understand the local accomplishments, the interview and observational data were categorized according to the (estimated) age group. The number of users from each user group was counted and the type of usage recorded using the observational data to find behavioural patterns.

2. For investigating the cultural-spatial, temporal, social and material dimensions related to the display practices, we utilized observational data as well as interview data concentrating, for instance, on the following questions: How often do you use the display? How long do you use the display at a time? When or in what kind of situations do you use the display usually? Do you use the display alone or with someone else?

3. The aim and motives of the display usage was noted by analyzing the participants’ answers to the following questions: What do you like and what do you dislike about the displays? (For parents) What meaning does the display have for you as a parent of a child? Do you consider using the display as cool or simply embarrassing?

4. Finally, all the material was analyzed using sensitizing lenses for the creativity versus normativity as well as for the durability of the practices.

4.1.4 Thematic user interviews

The ethnographic field material was supported by more profound user interviews with nine display users (ages 9 to 16). Half of the participants (4) were recruited through field interviews, during which volunteers could leave their contact information. The rest of the participants were recruited through design workshops organized in a comprehensive school (1), where one of the UBI-displays was located as well as through use of the snowball method (4) (Brace-Govan, 2004). All participants had used the swim center display, but five of them used it more frequently as a UBI-display located at a comprehensive school since they attended the same school. Interviews were semi-structured. The questions that loosely guided the interviews were inspired by the practice toolkit approach (Nicolini, 2012). Each interview lasted approximately 30 minutes. Most of the interviews were individual interviews, but two were as conducted in pairs. Interviews were audio recorded and conducted as solos by the author.
The material from the thematic user interviews was at first transcribed and after that utilized at first to support the ethnographic study findings. This material was selectively coded into pre-defined groups defined by the zoom in the lens (Nicolini, 2012). Especially the interview material was used to support the findings related to the aims/motives of the use; different aspects related to the durability and the creativity of the practices.

Secondly the material was used for studying users’ interpretations of the technology compared to the developers’ values and other stakeholders’ requirements. The users’ interpretations were studied using both the thematic and field interviews. After analysing the interpretations, they were categorized into three groups: Preferred reading, negotiated reading, and oppositional reading according to Hall’s encoding/decoding framework (Hall, 1980) (See figure 3).

Fig. 3. The encoding and decoding processes for public displays as inspired by Stuart Hall’s decoding and encoding framework (Hall, 1980). (Ventä-Olkkonen, Iivari, Lanamäki, 2017.)

4.1.5 Ethical issues related to field studies

The methods used in the ethnographic field study (video recording in a public space, child users) produced a few ethical issues that had to be considered before conducting the study. The first concern related to video recording people in the public space. According to Kuula (2011), a researcher is allowed to observe people in public spaces without informing them beforehand. However, when using recording equipment, it is recommended to inform people about the ongoing research although Finnish law does not require doing do. Also, if it is likely that sharing the information about ongoing research may affect the results pivotally, but some people may be informed afterwards. (Kuula, 2011). To protect people’s
privacy, it was decided to place the camera to film an overview of the swim center entrance hall. It filmed people, interacting with the display mostly from behind. In addition, close-ups were not taken. However, as we did not want the camera setting to change people’s behaviour in the space, the camera was fixed unobtrusively above the vending machine in the corner of the space that it would not attract too much attention. The problem of informing people was solved by placing research information posters on the swimming hall bulletin boards in visible locations. In addition the researchers were wearing university badges so it was easy to recognize them. The information of the ongoing filming was available, and people were able to refuse being filmed, but the research set up did not attract too much attention.

Another ethical issue was raised, when it was noticed that most of the display users were children. When conducting any research with children, one has to consider whether a statement has to be obtained from the ethical committee. However, in this case, applying the statement was not necessary since the six ethical committee principles did not concern this study. These principles are presented in Table 7.

Table 7. Ethical principles of the ethics committee of human sciences at the University of Oulu.

<table>
<thead>
<tr>
<th>#</th>
<th>Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The study addresses the physical integrity of the subjects.</td>
</tr>
<tr>
<td>2</td>
<td>The study does not abide by the principle of information-based consent (however, an evaluation is not required for the research of public and published information, registered and documented material and archived material).</td>
</tr>
<tr>
<td>3</td>
<td>The study is not part of the usual operations of an early education operating unit or school and addresses those under 15 without their guardian’s express consent or without the guardian being informed; on which basis, the guardian can tell the child to refuse the study.</td>
</tr>
<tr>
<td>4</td>
<td>Studies where the subjects are subjected to exceptionally powerful impulses where the evaluation of possible harm requires special competence (e.g. studies involving violence or pornography).</td>
</tr>
<tr>
<td>5</td>
<td>Studies that involve the risk of causing long-term mental harm (trauma, depression, sleeplessness) to the subjects and the harms exceed the limits of usual daily life.</td>
</tr>
<tr>
<td>6</td>
<td>Studies that may involve a security threat to the subjects (e.g. studies related to domestic violence).</td>
</tr>
</tbody>
</table>

In any case, when dealing with children, researchers need to inform and ask for permission from their legal guardians (Kuula, 2011). This goal is also assured to in the ethical principles (Table 7, Principle #3). The problem was solved during the ethnographic field interviews by interviewing children when their parents were
present or permission was at first given by the parents by phone. The interviews were not executed, as neither of these conditions was fulfilled.

4.2 Zoom out to origins and effects of the practices and associations between the practices

To not fall into the trap of localism, scope could be expanded from the actual accomplishment of practice to different directions (Nicolini, 2012). For this study, we started by looking back in time to understand the process of designing and implementing the display network. The initial interest was in shedding light on the appropriation process, but later, the practice toolkit guided the analysis in this direction. Thus, we decided to interview the developers who had been involved in the display project in their different roles. After that, we became interested in the practice networks and conducted a study on zooming out in space. We also wanted to extend the observation into other places where the practice showed up (Nicolini, 2012). This was done by following display users in space using a diary study. Finally, zooming out in virtual and cultural space was done through an analysis on the discourses in comments published in the discussion forum of the local newspaper.

4.2.1 Semi-structured time-line interviews with stakeholders

To understand the appropriation (DeSanctis & Poole, 1994; Dix, 2007; Flint & Turner, 2016) of public displays as well as understand the historical process that led to current display practices (Nicolini, 2012), it was important to shed light on the emergence and development of the display network that mediated the practices. For this purpose, it was decided to interview various stakeholders involved in the development process of the public display network. We started by interviewing those developer-researchers involved in distinct roles at different stages of the project, involving such tasks as management, software development, maintenance, and research. Using the snowball method (Brace-Govan, 2004), we recruited new participants, once their name came up in previous interviews. This method led us also to interview representatives of the municipality. Using these methods, we ended up interviewing nine researcher-developers and three representatives of the municipality.

The stakeholder interviews were loosely semi-structured (Myers & Newman, 2007), but informants were free to talk about anything that related to the project.
To support the informants’ narratives, a timeline method was used especially for the developer-researcher interviews. Timeline interviews have a tradition in the humanities and nursing (Adriansen, 2012; Sheridan, Chamberlain, & Dupuis, 2011; Tolvanen & Jylhä, 2005). The interviewee marks important events on a trajectory during the interview. Although this approach is rarely used for technology studies, we found it useful in reconstructing the projects after the fact. During the interviews, the participants were asked to draw a timeline of the project from their own perspective. They were asked to mark the highlights of the project and report personal events that related to the project. The timeline was used to outline the process and progress of the project and as a memory support for the informant and the researchers during the interviews. Each developer interview lasted for 56–156 minutes, while the interviews with municipality representatives were shorter and lasted for only 40 minutes each. Most of the participants were interviewed once, but due to scheduling issues, one participant was interviewed twice. Most of the interviews were individual interviews; however, two municipality representatives were interviewed together. The interviews were audio-recorded and fully transcribed, and the hand-drawn timelines were also photographed. I conducted the interviews and recruited informants together with Dr. Arto Lanamäki.

Analysis of the stakeholder interview material

Stakeholder interview material was analysed through several rounds using data-driven analysis methods. Existing research was also used as a sensitizing device at different stages. All the audio-recorded interview material was first transcribed after which the transcriptions were closely read for accuracy.

For the purpose of Article V, the material was first analyzed using Pentland’s (Pentland, 2011) categorization of factors that contribute to the emergence of routines. According to it, there are four points of origin for routines (Pentland, 2011):

1. Technology can embody a routine.
2. Routines can be created through managerial design.
3. Routines can be necessitated through institutional rules and norms.
4. Routines can begin through experience, in that an action once proven to work is subsequently repeated.

The data was first looked at using this categorization. The data-driven analysis process is offered as refined categorizations that were then further iterated. The
Second analysis round was purely data driven. The affinity diagram technique was used to develop a model for how different stakeholders and abstract forces influenced the emergence of the use practices. Using this second round of data analysis, we identified 5 main stakeholders who had an influence on the installation: 1) Developers, 2) advertisers, 3) funders, 4) city representatives, and 5) city dwellers. In addition we identified 4 other influencing factors that had an influence on the emerged display use practices: 1) Media attention, 2) financial crisis, 3) institutional rules and norms, and 4) technology.

In the third stage (for the purposes of Article VI), the analysis was supported by the cultural lens as a sensitizing device. First, we identified the issues that each stakeholder group, as identified in a previous analysis round, considered important. After that, the first draft of cultural value categorization that was based on the developer perspective was sketched; we identified the findings for what the developers preferred, held dear, or desired (Giorgi, Lockwood, & Glynn, 2015) for the project and its outcomes. Additionally, the material was used for categorizing the technology requirements of the advertisers and the municipality. Also, the material from city dwellers and users was analysed through that same lens.

After the initial value and requirement categorizations, quotations from the categories were highlighted in the text, and the categorizations were iterated. This phase led to the identification of the conflicts and compatibilities associated with the developers’ cultural values and other stakeholders’ requirements and users’ interpretations. To categorize the findings on cultural values, the requirements and interpretations (together with findings from other studies), we used Hall’s (1980) decoding and encoding framework (see Fig. 3).

**4.2.2 The diary study**

After zooming out the display practice on time, the focus turned to the practice networks. Expanding that scope was done by following the practices and by extending our observation to other places where other display practices occurred. As the public displays are location dependent, it was interesting to extend the scope to compare smart device practices elsewhere. To find these practice networks, it was decided to follow the practitioners and their families. This effort was conducted via a self-observatory diary study method (Czarniawska, 2014). Diary study was selected as the method, as it provided an unobtrusive possibility to study what happens in people’s homes.

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Recruiting the participants for the diary study turned out to be challenging. The criteria stated that at least one member of a family used the UBI-display more or less regularly and the families also utilized ICT at homes. Face-to-face recruiting in the swim center resulted in one voluntary family and two families recruited through the friend and family networks of the author. All the recruited families had 2–3 children, and at least one of them used the public display sometimes.

During the study period, the participants kept a diary of their UBI-display as well as other ICT use (e.g. using tablet computer, smart phones) for several weeks. The diaries consisted of descriptions of 20 uses of smart devices. In addition to the display usage, the families were asked to report on other smart device usage in their daily lives, and concentrate specifically on their children’s smart device practices. The participants were also asked to report every time some of them used the public display and at least twice a week on the usage of another media device at home or somewhere else. The diary thus consisted of 20 device usage events.

The study also included two semi-structured interviews with 1–2 adult members of each participating family. The first interview was conducted prior to the diary period, and the second interview was conducted after the period, thereby providing the interviewees the possibility to reflect on their experiences after the self-observatory diary period. There were also children present in some of the interviews. The interviews were semi-structured: Some questions guided the conversation, but the interviewees were free to chat about whatever related to their families’ smart device usage. The questions were related to smart devices at home, who was using them, the rules related to device usage in the families, possible conflicts related to smart devices, and their practices at the swimming center.

The collected material of the diary study was analyzed qualitatively using data-driven methods. As described earlier, a researcher cannot interpret the qualitative research material entirely objectively, but the background is inevitably influential (Creswell, 2013). Especially in the case of diary study, my interpretations on the research data were influenced by my knowledge of everyday life of families with children in Finland. The analysis proceeded as follows: At first, the interview material was transcribed, and the diary material was tabulated into tables and read carefully. Next, the interview material was categorized using the data-driven method into initial categories: (babysitting, entertaining, parent control, social interaction, concerns, calming the child, positives, and negatives…). This initial categorization helped to identify the correspondences with findings on the ethnographic study at the swim center. After that, the zoom in lenses for the toolkit approach (Nicolini, 2012) was utilized as a sensitizing device for all the material (diary and interviews). The analysis
concentrated on a) each family’s recurrent accomplishments with the displays; b) spatial, temporal, social and material dimensions of the practices; and c) meanings / aims / motives of the practices. Point c) was done by classifying diary entries using predefined groups: Entertainment, babysitting, time killing, and social interaction. At this stage, a new category of information seeking was also created. Most of the entries were labelled as belonging to more than one group.

4.2.3 Discourses in the media

In publicly open urban computing efforts, the role of the public discourses in media and the press cannot be neglected (see e.g. Storz et al., 2006). In the interviews, several developers brought up the role of the media, especially in the beginning of the display project. Indeed, the public debate on the UBI-display network and the whole research project was vibrant, especially in the discussion forum for the local newspaper (Kaleva). Public opinion might well have had its influence on possible users, such that they either were encouraged to try the artifacts or did not. In a wider sense, these UBI-project-related discourses also might affect or be affected by the ongoing societal discourses and their effects on people’s mindsets. Thus, it was interesting to extend the hermeneutic circle to the writings in the media and include an analysis that zoomed out into the virtual space through these writings. Although the discussion in social media was surely polarized toward the display project defenders and its opponents, it was assumed that the analysed texts reflected at least to some extent, the public opinion about the UBI-displays in the city and the spirit toward the whole UBI-Oulu project.

Discourse can be understood basically in two ways: Firstly as a local achievement and secondly as a broad system for formation and articulation of ways of thinking, behaving, and eventually, being (Gee, 2014; Nicolini, 2012: 190). The first way is interested in the nature of the action and its internal dynamics, and the second on how social structures shape the discourse and the relationships between discourse, knowledge, and power. (Nicolini, 2012.)

In this study, I partly utilized both of these notions and relied on the assumption of mediated discourse analysis, namely, that discourses are both a kind of a social action and practices as well as a part of one (Nicolini, 2012; Scollon & Scollon, 2004). Actors operate at an intersection of a number of discourses, social identities, and goals that are carried to the scene through the discourse and other media tools. However, actions do not happen in a vacuum; they are a part of the circuits of discourses that extend in space and time. To put it differently, all activities take
place at the intersection of multiple discourses that are brought to the scene by speech, texts, tools, and spatial arrangements. Each action can extend one or more circuits of that discourse. (Nicolini, 2012.)

The material consisted of newspaper articles mentioning UBI-displays and the project and readers’ comments in a discussion forum of the local newspaper, which: 1) commented on an article concerning the UBI-displays or the research project or 2) mentioned the UBI-display but commented on a newspaper article that had nothing to do with the displays or 3) started its own conversation concerning UBI-displays or commented that conversation.

In total, this material consisted of 25 UBI-display-related articles in the local newspaper and 416 comment texts. Altogether, the material consisted of 155 pages of text. The material was collected through on-line archives of the newspaper, using the keywords UBI and UBI-display (UBI-näyttö). The texts were collected using an eight-year time frame: The first text was from October 2008, a year before the launch of the first display, and the last came from October 2016, when the removal of the displays from the city was announced.

The analysis was data-driven. The material was first collected and read through several times. After that, it was categorized to initial for the data driven categories, such as usefulness, money, technology development, research, and usability, to name a few. After that, the categories were divided into project opponents and defenders to form the two main discourses in the material. Most of the comments were categorized into more than one group. In addition, leading posts or newspaper articles on each conversations chain was analysed as follows: Whether the leading article related to the UBI-displays or something else, and how many comments the text contained. In addition, the media text corpus was used to analyse the city dwellers’ interpretations of the technology for the purposes of article VI.

4.2.4 Additional data

The supportive material utilized in the thesis is the usage log data of the displays (See Tables 1 & 2). Log data provided a means to peek at the usage of the other displays to reveal possible practices. The UBI-display system records a different type of user information, such as the faces detected and the number of clicks by each display. Part of the data was openly available on the Web. For the purposes of this study, the information about the number of clicks on the screen surface of each display and the number of different types of application launches at the swim center display were utilized as information. This quantitative data was used to support the
qualitative findings as well as to select where to run the systematic field study. Zooming through log data guided us to concentrate on the major efforts on the swim center display which collected more clicks on its surface than other displays all together.

Secondly, for the purposes of this study, so-called process data were used. The process data included some anecdotal evidence collected by the developers during maintenance visits in the field as well as their informal observations. This data enabled us to pinpoint novel findings on appropriation for the public display use. These data were used in Article III. The author did not collect or analyzed this part of the data.

4.2.5 Summary of the research methods and materials

The ethnographic material and user interviews were mainly utilized for a zoom in analysis, whereas the stakeholder interviews, diary study, and media texts were utilized for zooming out studies. Table 8 summarizes materials, analysis, and lens utilized.

Table 8. Summary of the material, utilizing the zoom in/out lens, and the focus of the analysis.

<table>
<thead>
<tr>
<th>Material</th>
<th>Motivation</th>
<th>Focus of the analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnographic field study</td>
<td><strong>Zooming in</strong> on local accomplishments of practices</td>
<td>Especially accomplishments, material aspects, and aims of the practice</td>
</tr>
<tr>
<td>Thematic user interviews</td>
<td><strong>Zooming in</strong> on local accomplishments of practices</td>
<td>Especially aims, creativity, and durability of the practice</td>
</tr>
<tr>
<td>Diary study</td>
<td><strong>Zooming out</strong> through following the associations between practices through following practitioners in space.</td>
<td>Thematic analysis: Focusing on accomplishments that are cultural-spatial, temporal, social, and material dimensions of the practices</td>
</tr>
<tr>
<td>Media texts</td>
<td><strong>Zooming out</strong> through studying the effects of the practice &amp; the bigger picture; how displays generate tension and conflict with citizens.</td>
<td>Thematic analysis: UBI-display discourses on social media, negative and positive opinions</td>
</tr>
<tr>
<td>Stakeholder interviews</td>
<td><strong>Zooming out</strong> through studying the emergence and evolution of the practices</td>
<td>Thematic analysis: Influencing forces and power relations regarding the development of the urban computing infrastructure</td>
</tr>
</tbody>
</table>
5 Findings

The three first articles (I, II, III) describe different aspects of actual display performances and address RQ 1 mainly. Articles I, II and III are based on the ethnographic inquiry at the swim center as well as user interviews’ focusing on the users’ perspective. Article I identifies four emergent practices and describes them, Article II continues the analysis of the display practices by providing a more systematic and complete analysis using a practice lens. Article III approaches the display practices from the appropriation lens, comparing the developers’ original intentions to the users’ actual performances. Article IV expands the scope from the swim center to the network of practices by following the practitioners in space through the diary study and answers RQ 3. Articles V, VI and VII deliver answers mainly to RQ 2. Articles V and VI study the display network from the point of view of various stakeholders. Article V investigates the different stakeholders involved in the public display project and the impact of each on the display network development. Article VI tries to understand the development process more deeply and concentrates on the conflicts of values and the requirements of different stakeholder groups in the design. Finally, Article VII broadens the scope by shedding light on community reflections on the displays and the whole public display network project. RQ 4. is further elaborated on in the discussion. The results of the individual articles are presented in this chapter categorized by each research question.

5.1 RQ 1: What are the characteristics of technology-mediated practices in the public space?

This chapter summarizes the results from Articles I, II and III by presenting the central characteristics of public display practices and answering RQ 1. and its sub-questions: RQ 1-A., RQ 1-B., RQ 1-C., RQ 1-D and RQ 1-E. The research material for these articles was collected using ethnographic methods: Observations at the swim center entrance hall near the most frequently used UBI-display, field interviews, and thematic user interviews.
5.1.1 RQ 1-A, B, C: How are the practices performed? How are the spatial, temporal, social, material, and bodily aspects involved in these display practices? What are the underpinning motives behind the technology-mediated practices in public space?

Article I (Use with discretion: identifying emergent practices around interactive public displays) was the first article based on the ethnographic material. The material consisted of field notes, video recordings of the swim center entrance hall around the UBI-display, and recordings of the field interviews. The goal of the article was to provide an “autopsy” of the swim center display practices. The research questions in the article were: What kind of technology facilitated practices have emerged around the interactive multipurpose public display? What is practiced using technology by whom, when, why, and where?

Nicolini’s practice lens was applied the analysis phase practice (Nicolini, 2012), and the findings were categorized into three classes: 1) Concrete performances around the displays; 2) spatial, temporal, social, material and bodily dimensions related to the display performances; and 3) motives behind the technology related practices. Next, the central findings of each category are summarized.

1) Concrete performances around the displays, sayings and doings as well as interactional order (Nicolini, 2012): The usage peak for the displays occurs during school class visits and before swimming classes start when children may even line up to use the displays. The main user groups of the public display are primary school age (7–12 year old) children, younger children, and indirectly also their parents (see Table 9). In contrast, senior citizens, who are another frequent user group of the swim center, only rarely interact directly with the displays. When noticing the display, they usually just look at it and read the annotations on the screen.

The primary school age children are also the most determined users. They seem to know what they want to do with the display; they know how to play the games and where to find them. They are also tall enough to reach and open the wanted applications and they are capable of browsing through the interface. Although the younger children are keen toward using the display, they rarely are able to open a game by themselves and end up just randomly tapping or slapping wherever they can reach. The youngest users tend to play alone or with their parents or siblings. Older school age users play in smaller or bigger groups. However, pre-teenagers, mainly boys, play the display alone and also have long lasting (even 20 minutes long) interaction sequences.
Table 9. Observed number of display use sessions for each user group and session type (Ventä-Olkkonen, Lanamäki, Iivari, & Kuutti, 2016b)

<table>
<thead>
<tr>
<th>User group &amp; estimated age</th>
<th>Use session</th>
<th>Random Tapping/Browsing</th>
<th>Watching (ads/others using)</th>
<th>Playing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Infants 2–6 years old</td>
<td>90</td>
<td>27,0</td>
<td>63</td>
<td>70,0</td>
</tr>
<tr>
<td>School students 7–12 years old</td>
<td>142</td>
<td>42,6</td>
<td>42</td>
<td>29,6</td>
</tr>
<tr>
<td>Teenagers 13–17 years old</td>
<td>10</td>
<td>3,0</td>
<td>6</td>
<td>60,0</td>
</tr>
<tr>
<td>Adults 18–70 years old</td>
<td>48</td>
<td>14,4</td>
<td>9</td>
<td>18,8</td>
</tr>
<tr>
<td>Users from more than one age group</td>
<td>18</td>
<td>5,4</td>
<td>9</td>
<td>50,0</td>
</tr>
<tr>
<td>An adult and a child user</td>
<td>23</td>
<td>6,9</td>
<td>4</td>
<td>17,4</td>
</tr>
<tr>
<td>Total</td>
<td>333</td>
<td>100</td>
<td>133</td>
<td>39,9</td>
</tr>
</tbody>
</table>

2) Spatial, temporal, social, material and bodily dimensions related to the display performances (Nicolini, 2012): The physical restrictions and possibilities of the display played a big role on the observed emergent practices. In the case of the swim center display, many material features were contributing to the emergence of display practices. The nature of the space as an almost empty space where a lot of waiting occurs and becomes fruitful ground for developing practices with the display. In addition, the big size of the display supports group activities. However, the observations revealed occasions where groups of 10–20 classmates were participating in the same social gaming session, but in different roles. At the same time, the big size increased the publicity of the display and hindered the display usage by adults who were more conscious of others in the space. Moreover, the size and the high position of the display might also be a restriction when the actors are smaller. For the smallest children, the display and its touch controls were located too high to physically reach. To alleviate this, some children tried to climb on a pedestal or jump up to reach the screen. Sometimes parents also raised their children up to reach for the touch panel, thus engaging in display interactions with their children. This action also has had a direct impact on what smaller children could do with the display. Since they cannot reach the game menu, many times they ended up tapping the screen surface randomly wherever they could reach something.

3) The underpinning motives behind the people’s technology-mediated practices (Nicolini, 2012): Four emergent practices with the public display at the swim center were identified. In each, the role of the display varied. Small children used the display often as an entertainer. Using the display was important in and of itself, and it was used every time when visiting the space. Often the use was only
random tapping the display surface. When small children were entertained by the display, parents used it indirectly as a *babysitter*. Parents left their children for a while in front of the display when paying a swimming fee, parking the car, chatting with each other or relaxing for a while. Third, the swim center display was used as a *supporter of social interaction* in group situations. The display was used by groups of friends while waiting for something. In these situations, being with friends seemed to be more important than actually using the public display. In these situations, users were also older, mostly school age, as they were in the last identified practice, namely, using the display as a *time killer*. These users were least eager to display users. They just used the display to spend time when they had nothing else to do. When possible, a phone was preferred over the public display. The central findings are presented below in Tables 10–14.

Table 10. Summary of the empirical findings on the nature of 'Display as entertainer' practice as performance, its motives, and its spatial, temporal, social, and material, including bodily dimensions (Ventä-Olkkonen *et al.*, 2016b).

<table>
<thead>
<tr>
<th>Emergent Practice 1: Display as entertainer</th>
<th>PERFORMANCE</th>
<th>DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display is used always while visiting the space</td>
<td>Random tapping/slap, or browsing the display</td>
<td>SPATIAL: Many children and families visit the space regularly; Many times waiting occurs in the space (e.g. waiting for swimming school to start, waiting by parents to line up to pay the swimming fee, and waiting for companions to arrive from the dressing rooms.); No toys, games or other entertainments available in the space.</td>
</tr>
<tr>
<td>when it is available and working; Usage is the primary action; Used even while not waiting for something particular; People head directly to the display when entering the space; Display is an important part of the space-related routine; Display preferred over phone usage</td>
<td>Playing what is on or where and what one can reach; Having favourite games</td>
<td>TEMPORAL: While waiting occurs in the space, especially during evenings before and after swimming school.</td>
</tr>
<tr>
<td>MOTIVE / MEANING</td>
<td>PERFORMANCE</td>
<td>DIMENSION</td>
</tr>
</tbody>
</table>

**Table 10.** Summary of the empirical findings on the nature of 'Display as entertainer' practice as performance, its motives, and its spatial, temporal, social, and material, including bodily dimensions (Ventä-Olkkonen *et al.*, 2016b).
Table 11. Summary of the empirical findings on the nature of ‘Display as babysitter’ practice as performance, its motives, and its spatial, temporal, social, and material, including bodily dimensions (Ventä-Olkkonen et al., 2016b).

<table>
<thead>
<tr>
<th>Emergent practice 2: Display as babysitter</th>
<th>PERFORMANCE DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTIVE / MEANING</td>
<td>PERFORMANCE DIMENSION</td>
</tr>
<tr>
<td>Displays highly valued as child entertainers when required to spend time in the space while waiting; Displays ease the situation for the parent by offering something “socially appropriate” for the child;</td>
<td>Parents direct the kids to the display and leave the children at the display while doing something else; Opening an application for the children;</td>
</tr>
<tr>
<td>Displays highly valued as child entertainers when required to spend time in the space while waiting; Displays ease the situation for the parent by offering something “socially appropriate” for the child;</td>
<td>Social: Parents of small children (Adults, teenagers, who are responsible for small children)</td>
</tr>
<tr>
<td>Parents especially value games with educational content; Display an important part of the space and the situation-related routine for both child and the parent.</td>
<td>Social: Parents of small children (Adults, teenagers, who are responsible for small children)</td>
</tr>
</tbody>
</table>

Table 12. Summary of the empirical findings on the nature of ‘Display as supporter for social interaction’ practices as performance, its motives, and its spatial, temporal, social, and material, including bodily dimensions (Ventä-Olkkonen et al., 2016b).

<table>
<thead>
<tr>
<th>Emergent practice 3: Display as supporter for social interaction</th>
<th>PERFORMANCE DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTIVE / MEANING</td>
<td>PERFORMANCE DIMENSION</td>
</tr>
<tr>
<td>Displays considered a nice way to spend time with friends while waiting for something; Playing fun and cool, but actually being with friends more important than playing with the display; Phones used when spending time alone, and display used only when spending time with friends; Display valued for its great size which</td>
<td>Playing games together in smaller or bigger groups; Playing with friends; Cooperation, group is having the same goal, discussing the moves of the game; Cheering, laughing loud, having fun; Lining up to</td>
</tr>
<tr>
<td>Displays considered a nice way to spend time with friends while waiting for something; Playing fun and cool, but actually being with friends more important than playing with the display; Phones used when spending time alone, and display used only when spending time with friends; Display valued for its great size which</td>
<td>Social: Groups of friends (2-20 persons) (Often approximately 10-14 year old children from school class or sports training groups); advisers behind them, watchers &amp; cheerers behind the advisers)</td>
</tr>
<tr>
<td>Displays considered a nice way to spend time with friends while waiting for something; Playing fun and cool, but actually being with friends more important than playing with the display; Phones used when spending time alone, and display used only when spending time with friends; Display valued for its great size which</td>
<td>Social: Groups of friends (2-20 persons) (Often approximately 10-14 year old children from school class or sports training groups); advisers behind them, watchers &amp; cheerers behind the advisers)</td>
</tr>
</tbody>
</table>

85
Emergent practice 3: Display as supporter for social interaction
allows a bigger number of people to participate in the game. Continuing games previous users started.

Emergent practice 4: Display as time killer

<table>
<thead>
<tr>
<th>MOTIVE / MEANING</th>
<th>PERFORMANCE</th>
<th>DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displays used solely for spending time while waiting; The meaning of the display not big, if the display was removed from the space, that wouldn’t have any effect; The phone is often preferred over the display for time passing activities, such as playing games, surfing on social media or information seeking; Especially when alone, the phone is selected over the public display; The display considered a digital sign.</td>
<td>Playing games while waiting; Playing alone; Long interaction sequences (&gt;15 minutes); OR Looking at the display from a distance; Rarely touching the display to interact; If interacting with the display, viewing housing ads or notifications; Interacting with the display is rare and interaction sequences are short.</td>
<td>SPATIAL: A lot of waiting occurs in the space (e.g. waiting for swimming school to start, parents to pick up children, family members to arrive from the locker room); The display in the middle of the space and use very public; Adults may be afraid of losing face if they fail to use the public display, or they feel that others can see what they do is unpleasant; Using the display is considered too public. TEMPORAL: While waiting occurs in the space SOCIAL: Lonely hangerouters: Teens, children, adults’ spending time alone in the space MATERIAL: TOOL (VIRTUAL): Games are available, but the display does not necessarily provide the desired games; More serious content targeted for adult audience is offered, but rarely used; Not all people are aware of the interactive content of the display.</td>
</tr>
</tbody>
</table>

Table 13. Summary of the empirical findings on the nature of ‘Display as time killer’ practice as performance, its motive, and its spatial, temporal, social, and material, including bodily dimensions (Ventä-Ollkonen et al., 2016b).

5.1.2 RQ 1-D: What are the dynamics for durability and the variability of technology-mediated practices in these public spaces?

In Article II (Emergent Practice As a Methodological Lens for Public Displays In-the-wild), we continued analysing the display practices at the swim center. The goal of this article was to provide a comprehensive zoom in (Nicolini, 2012) analysis of this context. The idea was to introduce the practice method to the public display
community through examples of what one can consider while studying these practices.

The material for this article was the same ethnographic material used in Article I. The analysis, however, consisted of five aspects: 1) Performance, 2) material aspects, 3) aim of the practice, 4) creativity vs. normativity, and 5) durability. Three first categories were addressed already in Article I, but the completely new lenses for this article were creativity versus normativity and durability of practice. Next, our findings are summarized for these aspects.

Although practice evolve over time, they differ from single events in the sense that they form durable systems of activity (Nicolini, 2012). There are at least four aspects which affected the durability of the display practices at the swim center as follows:

- **Communities of practice.** Communities of people with similar skills and knowledge make practices persistent (Nicolini, 2012). Members of this community are not necessary aware of the community, so external observation is required to identify them. In the UBI-display case, children are forming the display user communities. Some children played regularly games alone or with others. Children notice others playing with the display and are drawn to it, whereas others might not even notice the displays.

- **Learning dynamics.** Novice users learn the practices from old stagers. In the case of public displays, this happens mostly through learning by seeing. (Brignull & Rogers, 2003). In the context of the swim center display, practices were inherited from users to others for seven years. Observations and interviews confirmed that usually the practices were learned through observing others first.

- **Tools and instruments.** The “artifacts carry the script their designers embodied into them” (Nicolini, 2012: 228). Tools and instruments enable the practices to resist over time and bring historical and social dimensions. In the case of UBI-displays, the role of artifact is crucial. It offers a certain type of content (e.g., games) which enables a specific type of interaction (e.g., group sessions). The affordances of the display are stable; thus when people visit the space, they are always able to use the same services. These display affordances makes the practices durable.

- **Practice networks.** When a practice becomes part of other practice, its durability increases. In the case of the UBI-displays, display practices are tied to practices related to visiting the swim center (e.g., schools’ physical education
-class visits; swim training; families’ swim visits). When users regularly visit the space, display practices also persist.

In terms of the creativity of the practices, there were recognizable common elements in each accomplishment of practice, and yet two events are never identical. Practices are reproduced every time they are performed, but at the same time they are bounded (Nicolini, 2012). When studying the practices we should focus on the norms and rules’ limiting and constraining practices, but at the same time understand the nature of creativity, change and evolution. So how much practice can vary, but be still accepted into the practice?

The common element of the display practice of the smallest children is the random tapping of the screen surface without any explicit goals. The goal seems to be just to reach the screen and receive a response from the screen by touching it. For older children, clear patterns were also observable and the same random tapping would not be acceptable and possibly cause conflicts or tension, e.g., during the group usage sessions of pre-teenagers, who prefer playing a particular game in a more goal-oriented manner.

The observations revealed that a different type of display practices can be combined with each other creatively. Practices may also evolve and transform one into another. It is not rare that during one use session, a user has several aims for the practice which can vary. For instance, a lonely time-killing session may turn into a social group play when more players join in. An example of such evolving and changing practice is also identifiable in the display use by 11 and 9-year-old brothers, who regularly use the display while visiting the swimming pool. They described how they play games with the display, but sometimes they compete which each other while playing. In this case, the brothers have added a more competitive element into the social gaming practice.

5.1.3 RQ1-E: How is user creativity visible in the public display practices?

Article III (People lining up to use a cool new gadget in the city? Surprise and variety in the technology appropriation of multipurpose public displays) approaches the display practices from the perspective of technology appropriation (Flint & Turner, 2016). The goal of the article is to present the various faces of appropriation concepts and apply them in our study of public displays (See Table 14). The paper concentrates on the differences between designers’ original
intentions and the ideas of the display usage and the actual use of the systems seven years after by particularly focusing on surprising ‘unfaithful’ (DeSanctis & Poole, 1994) appropriation and discussing unanticipated users, usages, circumstances, and design for the unanticipated.

The key empirical material for this article is the same as was used in two previous articles, but now the data is completed with developer interviews, user interviews, and anecdotal evidence from other displays. This article studies the use of four different displays. Three of them are part of the UBI-display network, and the fourth is a separate community display experiment.


<table>
<thead>
<tr>
<th>WHY?</th>
<th>HOW?</th>
<th>THE CONSEQUENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designer’s anticipated purpose</td>
<td>User’s unanticipated purpose</td>
<td>Practices with the product</td>
</tr>
<tr>
<td><strong>Readymade</strong></td>
<td>The user uses the product for the designer’s anticipated purpose</td>
<td>User uses the designed product for purposes other than the designer’s anticipated purpose without customization.</td>
</tr>
<tr>
<td><strong>Customized</strong></td>
<td>User uses the product for its designed purpose, but makes customizations.</td>
<td>User uses the product for other purposes and makes customizations.</td>
</tr>
</tbody>
</table>

Designers' anticipated purpose

As mentioned, one of the original aims of the display project was to create a network to serve as a ubiquitous computing test bed. The main intention was to build an infrastructure to enable ubiquitous computing experiments in the wild. The developers’ focus was on the technology and making it functional. As the municipality was an important stakeholder (it provided locations and funding), it was crucial to find a mutual goal that would benefit the municipality and its residents. The goal was to use the displays for improving communication between residents and the city and offering various services to people in the urban context. Designers expected that the services designed for users’ potential information needs, so-called serious services like maps, public transportation schedules, events, and news, would gain the biggest audience. Developers also expected positive reaction from the citizens.
Unanticipated users

As said, there were examples of ‘unfaithful’ appropriation in terms of unexpected users as well as unexpected usages. Although the developers fantasized that people would line up for the displays and have a willingness to try out new technologies, in reality, the people did not act as expected. Usage of the displays slowly decreased after their launch (Ylipulli et al., 2013). However, some displays gained significantly more clicks on their surface than others did. The designers envisioned that the displays would cater to a large and diverse user population. Content and services were targeted toward all ages: There were games for children, media content for teenagers, and news for adults. Contrary to the original intentions, however, observations at the swimming center showed that the display users were mainly children (see Table 9). Although children were considered as possible users in the development phase, the degree of their role was a surprise.

The display, therefore, did not support their use in the best possible way. Children, especially younger ones, had difficulties in even reaching the content, as the display was on a pedestal. Moreover, the game menu was located at the top of the display. Children were still very eager to play games on the display (see Unanticipated usages section). The original design did not target such a small user group. Problems in reaching the content led to various types of appropriation activities: Using mittens as hand extensions, pushing chairs to use as standing stools, and moving other furniture from the space to the front of the display to facilitate contact with it.

Unanticipated usages

After six years of deployment, the statistics showed that the most-used content type was games (Table 2). Seven of the 13 most-used applications were different types of games. The popularity of a simple hangman game especially surprised the developers (Ojala et al., 2012). A surprising use for the displays was random tapping. Randomly tapping the display surface seems to have been popular among the youngest user group, partially due the reaching issues discussed above. Surprising also was how parents of young children started to use the public display as a babysitter or child entertainer during difficult or long waiting situations.

Moreover, our empirical data showed that gaming practices around the displays were versatile in style. Games were used to support social communication between groups of children and either for entertainment or for killing time. Related to
gaming, another surprising indirect purpose for the displays at the swim center was babysitting. Parents often left their small children at the display while lining up to the cashier, parking their car, and/or communicating with each other, thus using the display as a babysitter.

**Unanticipated purpose**

This example concerns a case in which the digital content did not contribute to the emergence of a practice, but rather the material artifact itself became integrated into the existing practices. This case is also an example of users’ unanticipated purpose for the display. These examples concern a UBI-display placed in a Pedestrian zone in the downtown area of the city of Oulu. One existing practice that proved relevant in terms of technology appropriation was the parking of bicycles, which took place in certain locations around the downtown.

Especially in the summertime, people tend to bike downtown where they then continue their activities on foot. Thus, certain areas of downtown are crowded with rows of bicycles. The location where the display was installed in this example was interesting for the city, as it featured parked bikes although it was not intended as a bike-parking area. The location of these parked bikes partially obstructed access to certain local businesses. When the locations for the display installations were discussed with the city, this area was chosen based on the premise that the display, as a visible technological artifact, would drive away the parked bikes, and thus end this unwanted practice.

After installation of the display, however, the bike-parking practice persisted. That meant that not only did the bikes remain in the unwanted parking area, but also that the display quickly became inaccessible due to the parked bikes that consistently encircled it. It is also interesting that, although signs were attached to the display stating that the parking of bikes was prohibited near it, the parking practice persisted, thereby transforming the display into a useful bike stand, but hindering its intended use for other purposes.

**Unanticipated customization to meet a user’s unanticipated purpose**

The example of customization appropriation concerns a display placed in a lobby area of an elementary school, where a school child found a way to use the display for browsing the Internet. This use was not supposed to be possible with the public display and it was not considered the desired behaviour by the developers.
Especially in this school location (but also in other public locations) controllability of the displays was important to avoid misuse, e.g., uploading inappropriate content or committing any vandalism, which had been witnessed in other locations with specific services.

One of the children started to disconnect and reconnect the UBI-display’s main electrical plug during the recess periods of the school day. During the boot-up sequence caused by this power disconnection, this child saw a chance to launch a web browser instance. The child then used this additional “rogue” web browser to load certain flash-based game apps and play them during the recess break. Eventually, other children learned about it and gathered around the UBI-display to watch this one child play. This practice of manipulating the electrical plug came to our attention after it caused a relay in the UBI-display to malfunction, prompting the janitors to contact us for maintenance. Eventually, the electric plug was covered with a metal casing, to prevent the direct manipulation of the plug. After this, we no longer received reports of this kind of misappropriation.

5.2 RQ 2: Where do the technology-mediated practices come from?

This chapter takes a broader perspective and tries to find out the origins of current display practices. The section also seeks answers to RQ 2 and its sub-questions. First the analytical lens zooms out in time and looks at the history of the display project. This is done by interviewing people involved in the development process: the researcher-developers and representatives of the municipality. Then, the zoom out lens is targeted toward the city dwellers’ comments on social media. Finally, the analytical lens zooms out in space by following users and comparing the public display practice to other mundane ICT practices users expressed.

5.2.1 RQ 2-A: How do different stakeholders influence the emergence of public display practices?

To understand the practices more thoroughly, it was crucial also to consider the design process and find out why the displays turned out the way they did: What were the underlying forces and factors behind the solutions? For this reason, we decided to conduct interviews with developers and representatives of the municipality as well. Articles V and VI are based mainly on these stakeholder interviews. The goal of Article V, *It’s a Pain in the... Wild? Struggling to Create*
Conditions for Emerging Practices in an Urban Computing Project, was to provide a framework for making sense of and managing the complexity of such urban computing projects. The developer interviews revealed a bunch of stakeholders and more abstract forces for both defining and explaining the outcomes: The five main stakeholder groups were the developers, funders, advertisers, city representatives, and city dwellers.

Developers affected the display project the most. They had the original vision of a display network as a starting point. They also acquired the hardware and implemented the software as well as most of the service content. Funders were crucial since they offered funding for the project. However, they also had requirements (the network had to be maintained for 5 years) and restrictions (they did not fund the content creation package of the project). Advertisers also offered funding for managing the maintenance costs; however, they required full-screen advertisement time which resulted in changing the user interface, decreasing the visibility of the interactive services, which had a direct impact on the use levels of the services. City representatives decided the locations for the display installations and restricted the appearance of the display modules. City dwellers affected the display service content in 3 ways: 1) active use of specific services led to an increase of those service types; 2) not using a service led to dropping that service; and 3) inappropriate use of services resulted in removing or modifying some of the applications. In addition, citizens’ complaints led to more modifications.

Besides the stakeholder groups, three more abstract (negatively) influencing forces were the media, financial crisis, and smart technology development. At first, the Media distributed information about the project to the city dwellers, but after the display network launch local media started to publish negative stories and maintain the negative discourse among city dwellers on social media. This focus stigmatized the project and spread a negative spirit among the developers, the advertisers, and the public. The financial crisis influenced the project indirectly by decreasing the direct project funding and the advertisers’ willingness to invest in the new media. Smart technology development created competitors for the UBI-display concept, thus decreasing the need for the system and blurring the original idea which was sharing information in a public urban context. The displays were originally designed before the proliferation of smartphones, and thus many of the originally designed services become useless when everyone had easy access to the Internet right in their pockets.

The impacts of each factor are summarized in Tables 15-17. Tables 15-17 also classifies the forces that influenced the display project based on three criteria:
1. **The level of contribution to the project goals**: The forces or stakeholders might have had both negative and positive influences on the project.

2. **The level of interdependence**: Interdependence between the forces and stakeholders in relation to other factors could have varied. Some forces were more dependent on others, thus affecting the chains of consequences, while others did not affect others.

3. **The level of foreseeability**: In an urban computing context, the element of surprise is central. The level of foreseeability for influencing factors varied; however, most of the factors were not foreseeable.

<table>
<thead>
<tr>
<th>LEVEL OF CONTRIBUTION TO THE PROJECT</th>
<th>POSITIVE</th>
<th>NEGATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developers created a grand vision that defined the frames for the project and planned and implemented the content and the technology.</td>
<td>Developers supplied less than optimal display technology, concentrating more on technological innovations and research than on creating meaningful services for the citizens.</td>
<td></td>
</tr>
<tr>
<td>Advertisers offered funding to cover the maintenance costs.</td>
<td>Advertisers demanded increase in the visibility for the full-screen advertisement mode.</td>
<td></td>
</tr>
<tr>
<td>Funders offered funding for research and development and supported that research.</td>
<td>Funders required the infrastructure to remain in place for 5 years, which the caused incorporating advertisement mode. They also cancelled the content project, which caused a lack of high-quality content.</td>
<td></td>
</tr>
<tr>
<td>City representatives allowed the displays to be installed in central areas of the city and supported the project.</td>
<td>City representatives demanded the displays blend in with the street view by their appearance and location.</td>
<td></td>
</tr>
<tr>
<td>City dwellers used particular services.</td>
<td>City dwellers did not use particular services, complained about disturbances, and abused some services and displays.</td>
<td></td>
</tr>
<tr>
<td>Media shared information about the project.</td>
<td>Media coverage provided a negative view of the displays.</td>
<td></td>
</tr>
<tr>
<td>City dwellers: Sought meaningful, up-to-date services</td>
<td>Smart technology development: Emergence and proliferation of competing technologies (smart phones).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Media attention: Negative attitude spread in the social and traditional media.</td>
<td></td>
</tr>
</tbody>
</table>
Table 16. Level of interdependence of the forces' shaping the public display project (Ventä-Olkkonen, Lanamäki, Iivari, & Kuutti, 2016a).

<table>
<thead>
<tr>
<th>LEVEL OF INTERDEPENDENCE</th>
<th>HIGH</th>
<th>LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funders</td>
<td>demanded to keep up the infrastructure for 5 years &gt; Developers had to implement the advertisement mode &gt; Advertisers demanded visibility for ads &gt; Full-screen ad mode decreased the visibility and use of the interactive services.</td>
<td>City representatives chose the locations for the displays, which led to either increased or decreased use.</td>
</tr>
<tr>
<td>City representatives</td>
<td>chose the locations for the displays, which led to either increased or decreased use.</td>
<td></td>
</tr>
<tr>
<td>The financial crisis</td>
<td>caused the funders to cut the funding for the content project, which led to the developers producing the content, which led to a lack of high-quality services, which led to the city dwellers' decreased usage of the services and negative media attention, which led to a negative public spirit.</td>
<td>City dwellers used, did not use, misused, or complained about the services, which led to popular services gaining more prominence, less popular services being dropped, and either misused or complained services being modified and necessitating a cleaning service.</td>
</tr>
<tr>
<td>City dwellers</td>
<td>used, did not use, misused, or complained about the services, which led to popular services gaining more prominence, less popular services being dropped, and either misused or complained services being modified and necessitating a cleaning service.</td>
<td></td>
</tr>
</tbody>
</table>

Table 17. Level of foreseeability of the forces' shaping the public display project (Ventä-Olkkonen, Lanamäki, Iivari, & Kuutti, 2016a).

<table>
<thead>
<tr>
<th>LEVEL OF FORESEEABILITY</th>
<th>YES</th>
<th>NOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>City representatives</td>
<td>Have rules and regulations concerning public furniture and street view</td>
<td>City dwellers found it difficult to anticipate which services and displays they would use or not use and how the displays would be appropriated and misused.</td>
</tr>
<tr>
<td>Developers</td>
<td>Prepare for demanding maintenance of the public installations (costs, labour); involve relevant stakeholders; select mature technology; prioritize high quality services; test before public deployment</td>
<td>Funders found it difficult to anticipate which projects to support and for how long (depending on the economic situation).</td>
</tr>
<tr>
<td>Advertisers</td>
<td>Seek airtime</td>
<td>Developers could not anticipate accidents/incidents to the hardware (such as the accident in display transportation).</td>
</tr>
<tr>
<td>City dwellers</td>
<td>Sought meaningful, up-to-date services</td>
<td>Smart technology development: Emergence and proliferation of competing technologies (smart phones).</td>
</tr>
<tr>
<td>Media attention</td>
<td></td>
<td>Media attention: Negative attitude spread in the social and traditional media.</td>
</tr>
</tbody>
</table>
5.2.2 Developers’ values, stakeholders’ requirements, and users’ interpretations

After finding out the influence on stakeholder groups and their impacts as well as the flow of decisions made for the project (Article V), it became clear that there were certain conflicts of values and requirements between the stakeholder groups. Different groups valued different aspects and had different requirements for the displays. Article VI, *In sweet harmony or in bitter discord? How cultural values and stakeholder requirements shape and users read an urban computing technology*, continues the analysis of the stakeholder interviews at a deeper level discovering the leading values behind the decisions as well as analyzing the other stakeholder requirements and users’ interpretations of the technology being used and finding out the conflicts between them.

The analysis offered in this article was inspired by Stuart Hall’s conception of encoding/decoding. According to that conception, *technological artifacts reflect the cultural values of their creators, while users, in their encounters with these technological artifacts, may decode those artifacts in various ways that are shaped by the users’ cultural values* (Ventä-Olkkonen, Iivari, & Lanamäki, 2017). Hall’s conception and practice theory do not fit together seamlessly of course, but the focus of the paper was not on practice theory. However, Hall’s concept did help visualize the meaning making process. Encoding/decoding analysis helped deepen the practice analysis on different levels for both the zoom in and out stage. Using this approach, we conducted a structured analysis and reflected on the cultural issues of urban technology design. The focus was on the role of the developers’ cultural values and other stakeholders’ technology-related requirements and interpretations. Figure 3 demonstrates this concept of encoding/decoding in the case of UBI-displays.

The findings also revealed how stakeholders (advertisers, municipality) requirements and developers’ values were encoded within the public display network and how users interpreted them. Users decoded the encoded values in three ways: preferred readings were in line with the developers’ original intentions; opposite readings went against them; and negotiated readings fell between these two (See Figures 3 & 4).
Technology is always encoded with the designer’s cultural values. In addition, in the UBI-Oulu case, the developers’ values were clearly visible, shaping the project and its outcomes. In the UBI-Oulu case, the leading ethos of the developer team was the importance of the research. The value of world-class research links to all the other shared cultural values of the developers as identified in the project. While the researcher identity became stronger in the team, the second value, freedom of the researcher did start to raise its head. The developer-researchers did not want to be “code slaves” or simply “engineers”. They wanted to do their own research and promote their own academic careers. Their research on the project thus concentrated mainly on technological innovations.

One of the values noted at the beginning of the project was new cutting-edge technology and scientific innovations. To produce better research contributions, the developers did not want to settle with off-the-shelf solutions, either for hardware or software. Another value of the developer team seemed to be a trust in the “power in numbers”. This aspect is related to respecting quantifiable data and statistical research, as well as aiming for a larger number of services and displays, and larger screens. Finally, gaining recognition is another value associated with this kind of
research. It was important to gain global recognition in the international academic world, as well as gain local attention for the project and its displays.

The municipality played a big role in the implementation process of the public display network. The displays were installed in the city area, so the municipality had a say about their locations and their appearance. The municipality also had an impact on the display content. Later on, the city used the displays mainly to promote municipal events. The main purpose of a municipality is to serve its citizens. One motivation of the municipality for involvement in this project—and thus the main requirement for the technology—was to provide useful services to its citizens. Another important issue for the municipality was maintaining a coherent and aesthetic streetscape. This aspect was relevant from the perspective of the project, and in the end, this issue strongly affected how the displays looked.

An advertisement channel was developed to cover the maintenance costs (electricity, the Internet, and cleaning) and fulfill the public-private partnership terms that required maintenance of the set-up for eight years, even after the original funding period. Selling advertising time was seen as the easiest way to cover these costs. The advertisers required visibility: They wanted as much visibility as possible for their advertisements. Innovativeness was not a high priority. What mattered to the advertisers was that they could rely on the displays showing precisely the advertisements the companies had paid to show.

After the developers and other stakeholders of the urban computing project had encoded their values and requirements in the technological artifact, the users got to interpret them. Users’ interpretations were in line with the designers’ encoding as it related to the following aspects: In the interviews, frequent users of the displays said the displays were used for entertaining and games were thus the most interesting and most often used content type. Friends and peers were mentioned many times in the interviews with the child and teenage display users. It was important that the display supports sociability since using the display was usually something that is done in either smaller or bigger groups.

Users’ interpretations that were negotiated were 1) usability of the public displays. Usability relates to the user interface of the display itself and to each service offered. According to many of the user interviews, usability was accomplished well during the project. However, usability as a concern was also raised by many inhabitants. Poor usability of the first user interface version of the display raised some debate in the discussion forum among the inhabitants. 2) Secondly, the usefulness of the services was something negotiated by the users. The
inhabitants complained about the lack of useful services, but that area was rarely mentioned by the young display users.

Interpretations that resulted in opposing the reading were 1) Using the display felt too public. Playing with the public display attracted an audience. The visibility of the user’s actions to others raised privacy as a relevant issue. Although using the public display was often social, having others watch one play does not always feel positive to the user. 2) The displays felt dirty. One perhaps unanticipated issue for the users was hygiene, which came to play an important role for the public interactive touch screen installations. The need to clean touch screen surfaces became obvious, but maintenance problems then occurred. 3) Displays were unreliable. Users expected the UBI-displays to be reliable, but this expectation was not always fulfilled. Reliability problems were still present six years after the launch, although not as frequently as in the beginning. For users, it was annoying, however, when the displays did not function as they were supposed to function. 4) Displays were disturbing. Users expected calmness from the displays. The displays should not visually or audibly disturb passers-by at their location. However, both users and inhabitants interpreted the technology as disturbing. Its sounds and too bright lights disrupted the calmness of the technology.

In general, users and citizens and the municipality seemed to have similar type of practical requirements for the systems (usable, useful, and reliable services) and these requirements did not align well with the developers, whose values were research and more innovation oriented (world-class research, researchers’ freedom, and cutting-edge technology). Users, citizens and the municipality did not fully understand the value of research and technical innovations. In addition, advertisers sought reliability, but they were also very interested in the visibility of their advertisements.

The cultural values of the developers’ driving the display project caused conflicts with other stakeholders. The users were disappointed in the usefulness, usability, and reliability of the services after the launch. As a consequence, the project received bad publicity in the press and on social media. The advertisers’ requirement for full-screen visibility was also problematic for the developers since it necessarily reduced the visibility of the research-related content. Reduced visibility of the interactive content prevented adoption of the services. Although the display project originally had a for all ethos, the stakeholders’ values, requirements, and interpretations confused that focus. Thus, the project became mostly reactive and was constantly shaped by these influences.
The values also transformed during the process. On the development team the value of local research and development shifted during the project to try and emphasise the world-class research. This shift caused tensions within the developer team: Nobody wanted to do the maintenance work and just be a “code slave” but rather concentrate on the research. In addition, there was some divergence in the group of users. Adult users’ seemed to seek informative and educational content in the displays, while children were happy with entertaining (social) services, such as multi-player games. Table 18 summarizes the findings for these conflicts between the developers’ values and other stakeholders’ requirements and their technology interpretations.

Table 18. Summary of the findings on the conflicts between the developers’ cultural values and the requirements and interpretations of other stakeholder groups (Ventä-Olkkonen et al., 2017).

<table>
<thead>
<tr>
<th>Developer values</th>
<th>Conflicting requirements and interpretations</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORLD-CLASS RESEARCH/</td>
<td>Municipality: USEFUL SERVICES</td>
<td>The municipality expected useful services for citizens, while the developers did not see enough research contributions in merely developing services for citizens.</td>
</tr>
<tr>
<td>CUTTING-EDGE TECHNOLOGY</td>
<td>Advertisers: HIGH VISIBILITY</td>
<td>The advertisers demanded visibility for their ads, while the developers required cutting-edge technological solutions, which turned out to be vulnerable and caused interruptions. The developers needed visibility for their interactive research applications while doing research in the wild, while the advertisers demanded more visibility for their ads, which then reduced the visibility of the interactive research applications.</td>
</tr>
<tr>
<td></td>
<td>Advertisers: RELIABILITY</td>
<td>The advertisers sought risk-free advertising with traditional digital signage, while the developers wanted to do research and experimenting with innovative solutions for advertising. Interruptions in the service, however, created a bad reputation for the displays as an advertising forum.</td>
</tr>
<tr>
<td></td>
<td>Users: USELESS SERVICES</td>
<td>Users expected useful services, while the developers did not see enough research contributions merely in developing services for users.</td>
</tr>
<tr>
<td></td>
<td>Users: UNRELIABLE TECHNOLOGY</td>
<td>Users expected reliable technology, while the developers sought a forum for testing the applications for research purposes and saw the system overall as a research prototype, not as a readymade commercial product.</td>
</tr>
</tbody>
</table>
### 5.3 RQ 3: How do these practices relate to other practices elsewhere?

In Article IV (*Digital technologies in everyday environments: Zooming in and out to children’s and their families’ smart device practices with public and private screens*) the focus remains still on the display users. The goal of the article is to investigate the associations between practices and shed light on the practice network of the display users. Several weeks of lasting diary study revealed surprisingly similarity of practices on media devices at home to the public display at the swim center. Also, the at home displays were used for *killing time, entertaining* and *babysitting* as well as in *social situations*. Families in the diary
study reported that children used smart devices eagerly for entertainment. Devices were often so captivating for children that adults had to restrict their usage at times. For this reason, adults also used the technology in babysitting. Smart devices kept their children occupied for a while when adults had to do house chores, work, or steal a moment for relaxation. In addition, displays were used in social situations. Families used them together and shared moments with each other on these smart devices.

Although we have no actual evidence, we can assume that display practices at home affected the public display practices at the swim center. Parents easily left their children in front of the public display for a while as they did in home. Children also eagerly used public displays for entertainment like they used smart devices at home. We can also assume that such practices have travelled in space the other way as well. Public display practices might have affected in “private” display practices, for example, by increasing the social and collaborative uses of ICT at home.

5.4 RQ 4: What are the effects of display practices in the surrounding community?

The developer interviews pointed out the important role of the media in the trajectory of the display project. The co-operation with press was not smooth and caused bad publicity and low spirits on the developer team and the community (Ventä-Olkkonen et al., 2016a; Ventä-Olkkonen et al., 2017). Article VII, *How urban computing practices emerge, develop and affect the community? – Introducing practice toolkit approach for CSCW*, adds an analysis of citizens’ writings in the discussion forum of the local newspaper, revealing certain common discourses for and against the urban computing project. The goal of the analysis on the UBI-Oulu discourse was to shed light on how the public display project affected the community. Discourses communicate values and thus through them we could identify the underlying cultural valuations and investigate how the practices can reproduce existing social arrangements and/or alternatively generate tension and conflict (Gee, 2014; Nicolini, 2012).

In this article, the data acquisition scope is expanded by zooming out into (virtual) space. We also zoomed out to consider the wider picture and find connections between practices and ongoing societal discourses. The influence between discourses and actual social practices is two-way. Discourses may have an effect on actual practicing, and display practices can influence discourses directly. The next section starts by analyzing the reaction of the community to the display
installation through discourses in social media by describing what kind of discourse displays have been generated in the community. Finally the chapter takes a look at the on-going societal discourses.

5.4.1 Reactions of the community

Reactions of the community toward the public display installation are visible in comments on social media. There are common themes in the comment threads linked to local newspaper articles. Themes and their tone vary throughout the length of the project, but all the time, the discourse was polarized. There were those who tried to defend the project and those who had a negative attitude toward it; the latter group was constantly dominating. In the beginning, the writing in the media was most vivid. Most of the stories related to the UBI-displays were written during the first summer when the displays were installed. The tone of the readers’ comments during that time was mostly hostile, even aggressive. Discussion was clearly polarized and divided into display haters and display defenders. During the third summer, the displays were again frequently visible in local media, and afterwards, UBI-display related comments appeared at regular intervals. The tone of the comments was ironic, and the UBI-display comments started to appear in newspaper articles which had nothing to do with UBI-displays. Most of the comments related to money. Some considered the whole project a total waste of tax money, but the opposing voice was saying that in order to build a better future, it was necessary to invest in technology development. Next, we introduce the most prominent discourses related to the UBI-displays and some discussion.

*Investing in UBI-displays is a complete waste of tax money*

The loudest discourse, especially at the beginning of the project, was that which considered the project as a waste of tax money. The common belief was that displays were sponsored by the municipality. Many writers commented that the municipality should invest in people, not in “useless technology”. Another argument that supported the waste of money was that the public display experiment was not executed at the level it should have been. Critics were concerned about usability, especially as it related to the sun reflections on the display surface. The engineering skills of the developers were criticized and the idea of testing the displays with city dwellers was not well understood. Also a lack of reasonable content was frequently mentioned. The displays were considered useless. The main
reason for the displays was being questioned. As a consequence of all these shortcomings, it was concluded that the money was wasted because *nobody actually used the displays.*

While debate over the wasting of money was vivid at the beginning of the project, both usefulness and use of the displays become more prominent in the discourse over time. Ironically, display use concepts began to appear as well, such as filling the UBI-displays with water to use them as aquariums or utilizing them as shelters for wind and the stones ricocheting from the construction site nearby.

*Investing in technology development is investing in the future*

The opposite discourse to wasting tax money defended the investments in technological experiments. The main argument was that to maintain a high tech image of the city, so it is necessary to invest in ICT development. A direct response to the wasting money accusation were statements of saying that *investing in displays is not relatively expensive.* It was also pointed out that there were several funders and the municipality was paying only a small portion and advertisements were being used to cover the maintenance costs. As a response to not to invest in people, it was also highlighted that the display *project has employed several people.* There were also attempts to defend the accusation of system incompleteness.

5.4.2 Connections to the ongoing societal discourses

The discourses related to the UBI-displays have many confluences with the ongoing societal discourses in a wider spectrum. According to mediated discourse analysis, discourses are both a kind of social action and practices as a part of them (Nicolini, 2012; Scollon & Scollon, 2004). Activities, such as discourses in social media, take place at the intersection of multiple discourses, and each action can extend one or more of the circuits of discourse. (Nicolini, 2012; Scollon & Scollon, 2004) Thus, discourses in social media are part of the public display practices and a practice all their own. In addition, these discourses are, on the one hand, influenced by the display practices, as they would actually not exist without them. On the other hand, they affect the local accomplishments of practice by generating tension toward the displays.

Third, we can see that discourses related to UBI-display network are extensions of certain larger and ongoing important, interesting and influential discourses in Finnish society. For example, discourse on the importance of research in the wider
spectrum is directly affecting the UBI-display discussions. One might argue that the value of research has declined during recent years in Finland. The decline of such valuation is visible, for example, in cutting to university and research funding. People also tend to criticize what public funding is used for. Halkola and her colleagues discovered that accountability for tax payers and the society for any public ICT infrastructuring project is considered highly important (Halkola, Iivari, & Kuure, 2015). In our case, the accountability to the taxpayers was hardly considered when the decisions were made in the design phase, but in the media discourse, for example, funding for the UBI-project was compared to the funding of social services. It was stated that the money used for the project was directly taken away from needed services for the poor, children, elderly and mentally ill.

Another societal public discourse which might influenced the display practices as well as the discourses related to them has been the debate on children’s use of the new ICT. Children’s increasing use of media devices has been a public debate over the last few years (e.g. Hartikainen, Iivari, & Kinnula, 2016). The proliferation of ICT devices has actually increased their use. The common belief is that technology hinders social interaction and dominates too much children’s lives (Plowman & McPake, 2013). The discussion is more critical when younger children are involved. Using UBI-displays as babysitters has produced negative comments in social media. This view is visible, for example, in the following quote commenting on an interview where the project leader said that displays were used as babysitters: And you dare to tell us this! YUCK!

We can speculate that these afore-described discourses have had an effect on the legitimacy of the public display practices. At least, adult users may be aware of the ongoing societal debates and regulate their behaviour in public spaces based on them. When the use of these displays is truly public, people have to act according to what is socially accepted, and thus, “public opinion” can have a greater impact on the behaviour. The child users are probably not aware of these discourses, and they don’t have to act the way that is generally accepted. Rather they can hedonistically do what they feel like doing. Some parents also make an exception to the general adult usage pattern by utilizing the display as a babysitter despite the general opinion that children are using digital screens too much.
6 Discussion

The ever increasing body of new technological artifacts has the power to transfer’ and change our everyday practices: New practices emerge, and existing ones may change when new technologies are introduced. To be able to design systems that truly have an impact in our lives, it is important to understand how technology-mediated practices emerge, develop, and affect the community. This thesis aimed to understand the characteristics of urban computing practices and factors contributing to their emergence. The thesis further sheds light on both local accomplishment of practices as well as on the design process, users’ practice networks and the related ongoing discourses present in the media.

Computer supported cooperative work research has traditionally emphasized practices, but in human computer interaction, they are a relatively new issue. Although practice theories are commonly known, there is still a lack of a systematic method for studying contemporary technology mediated practices. This thesis introduces and demonstrates the use of Nicolini’s practice toolkit approach, which combines elements from several practice theories (2012). Using this approach, the thesis analyzes citizen practices regarding an open and interactive public display infrastructure. The use of a practice toolkit is demonstrated by providing a zoom in and zoom out analysis of practices considering multipurpose interactive public displays.

The next part of this discussion summarizes first the findings presented in the previous chapter, answering at the same time the research questions. After that the theoretical and practical implications are elaborated on, and the validity, reliability and the limitations of the study are then discussed.

6.1 Summary of the findings and answers to the research questions

This section answers each of the research questions briefly. The research questions are answered in numerical order starting with the first research question and its sub-questions.
6.1.1 RQ 1: What are the characteristics of technology-mediated practices in the public space?

It was interesting was to study the special characters the practices in this relatively new context of public urban computing involved. The characters in focus were selected using Nicolini’s toolkit approach and the sensitizing questions and foci it recommended for studying local practices and their accomplishment. Nicolini’s recommendations were utilized as a unique analytical lens for studying empirical material. Thus, I next briefly address each of the sub-questions for RQ 1.

How are the practices performed? How do the material, spatial and bodily aspects influence these practices?

The Nicolini’s toolbox approach guided the analysis of the ethnographic material by concentrating on accomplishments (sayings and doings, interactional order, timing and tempo), the material aspects (bodily choreography, tools and artifacts), aims (practical concerns), durability (processes of legitimising and stabilizing) and creativity (tension between creativity and normativity).

Sayings and doings and Interactional order: Children mostly used the displays while waiting. They either headed directly from the door to the display or ended up using it while hanging around in that space for a while. Through a zoom in analysis we found that different age children interacted with the display most frequently and adults usually either ignored the display or just watched it from a distance, like they would an average digital sign.

Spatial, temporal, social, material aspects and bodily choreography: Children had difficulty reaching the contents of the display and performed different bodily choreographies for reaching them better. In addition, the size of the display screen lured folks for social sessions, wherein many people thus interacted with the display together. In this case, the role of the tool itself and the space were crucial in the emergence of the display practices.

What are the underpinning motives behind technology-mediated practices in the public space?

When concentrating on the aims of the display practices, we were able to distinguish different practice patterns that had varying motives. Displays were used for entertaining, killing time, social playing and babysitting. Since using the display
was voluntary, all the motives were basically hedonic. For example, public displays were rarely used for an information search. However, the main purpose of using the system did vary: For entertaining, using the artifact itself was important, for killing time it was important to pass time, and the public display was just a tool for that; for social playing being with friends was more important than using the device, and when the display was used as a babysitter, the actualbenefiteof the practice was the guardian of the children using it.

**What are the dynamics of durability and the variability of technology-mediated practices in the public spaces?**

The third sub-question concerned the *evolvement of practices*. The zoom in tools creativity (*tension between creativity and normativity*) and durability (*processes of legitimization and stabilization*) from Nicolini’s toolbox shed light on the evolvement of the display practices. In addition, the concept of appropriation helped to answer this question. Durability of the display practices was much enhanced by display location. Factors that contributed to the durability of the display practices at the swim center were the following:

1. Central location which enabled learning through observing to happen.
2. Regular (child and adolescent) visitors in the space enabled communities around the display practices to develop.
3. Display use practices became tied to other practices, since the practice of visiting the swim center always included using this display.
4. Display itself enabled the practices to persist by offering content suitable for child users.

However, although these elements made the practices persistent, that does not mean that they didn’t change. Practices always change, and the next paragraph describes mechanisms of such changes.

**How is user creativity visible in public display practices?**

When it comes to the creativity of the practice, we can say that most of the children’s usage patterns were creative (but unfaithful) appropriations in the sense that they differed from the developers’ original intentions. The emerged use practices of the UBI-displays differed from the designers’ original intentions in four ways:
1. Unanticipated users: Although developers thought children would use the systems too, children as the dominant user group was surprising.

2. Unanticipated usages: For example the games were more popular than anticipated. Different user groups also had their own ways of using the system. Small children tapped randomly on the surface, older children played actual games alone or with others. Mixing these interaction types caused conflicts. In addition, different types of practices blended with and transformed one into others.

3. Unanticipated purposes (motivations): Using the display module as a bike stand is an example of unanticipated, but not desired, use.

4. Unanticipated customizations: Hacking attempts into the school context were not anticipated nor desired by the developers.

6.1.2 RQ 2: Where do the practices come from?

The second main research question concerned the origins of the practices. As a tool to approach this question the zoom out movements from Nicolini’s toolbox as well as the appropriation concept were utilized. An analysis revealed that current display practices are the consequence of at least three sources:

1. Forces and stakeholders shaping the development and implementation process
2. Users’ lives and their existing practice networks and associations
3. Community members’ writings about the displays in social media

The next section describes the stakeholder groups and their influence on the display project, thus answering the sub-question:

How do different stakeholders influence the emergence of public display practices?

The appropriation theory (Dix, 2007; Dourish, 2003; Kim & Lee, 2012), as well as, Nicolini’s zoom out in time lens (Nicolini, 2012) encouraged a study of the developers and the development process. It was interesting to learn the original intentions in order to be able to compare them with the outcome and better understand the entire trajectory of the public display project. The findings revealed that several stakeholder groups (developer-researchers, municipality representatives, advertisers, funders, and city dwellers) were involved in the design process, while the requirements of each group, and the power relations between
them influenced the decisions made during that design process. Factors contributed positively or negatively and were interdependent of or dependent on each other. Some factors were more foreseeable than others were.

In addition, Stuart Hall’s encoding and decoding framework was utilized to make sense of the conflicts between the designers’ values and the users’ interpretations (Hall, 1980). The greatest conflicts of interests were between researcher-developers and the citizens. Although the displays were officially targeted for the citizens, their requirements were least listened in the process, where decisions were made relying much on advertisers’ and municipality’s requirements and researchers own cultural values.

6.1.3 RQ 3: How do practices relate to other practices elsewhere?

Secondly, practices were influenced by the users’ lives and existing practice networks. This was learned through Nicolini’s first zoom out step that followed the connections between practices (Nicolini, 2012) as well as through appropriation study. The appropriation study shed light on cases where displays were integrated with existing practices in unforeseen ways (e.g., use as a bike stand). Diary study of the practitioners and their families revealed surprisingly similar usage patterns with smart devices at home and the public display at the swim center. We assumed there was a link between private and public display practices, so that practices from other contexts with private screens also migrated to the context of public screens. In addition, we noticed that the existing practices with smartphones prevented many adults and teenagers from using public displays.

Again, studying the connections between practices (Nicolini, 2012) led also to the practice of ongoing discourses in the media. An analysis of these texts indicated that display practices are probably influenced by discourses as well, as both local discourses related to the UBI-displays and the whole UBI-Oulu project and the ongoing societal discourses in the wider spectrum. For example, a decrease of appreciation of the research in general and considering its funding unnecessary reflected directly on the UBI-display project and its related discourses in social media, which considered the whole display project as simply a waste of money. Social media writings clearly demonstrated, how the discourse related to displays in the community was surprisingly negative, hostile and even aggressive. We can speculate that this negative tone in social media had an effect especially on the adult city dwellers’ willingness to use or even try the displays. They might have been
more aware of these ongoing discourses and thus the local accomplishment of the practices.

6.1.4 RQ 4: What are the effects of the display practices in the surrounding community?

The practices’ effects on the community were addressed in the next question. Nicolini’s zooming out steps encouraged the study of how practices contribute to the “wider picture”. The aim was to see how local practices can act at a distance and produce effects in different places and distant times. (Nicolini, 2012) The analysis revealed there were two-way relationships between the afore-described factors (See Figure 5). If we start with users’ lives and existing practices, public displays seem to increase children’s ICT consumption in general. As observed, the children have accepted the public displays as part of their recurrent routines. The diary study revealed that children and families also used media devices a lot in homes and the same sort of practices are typical in the home environment as in public context. Children seemed to equate public displays with media devices (tablets and smart phones). We can thus assume that public display usage patterns may affect practices in other contexts as well. The unintended consequence of UBI-displays might be that public displays, as one more ICT, have reinforced the technology use of children.

Secondly, along with the progression of the display project, the developers were influenced by the emergent display practices and thus the users. Nicolini suggests in the zoom out movement to study where the effects of the practices are felt and how they are used (Nicolini, 2012). In this case, the use statistics are direct effects of the practices. These statistics also guided the further development and design of the public displays, which again influenced the practices. The direct consequences of the usage statistics (which reflected the use practices and the popularity of games) was that the amount of game type content increased while unused services were removed. In addition, different types of misuse practices and vandalism caused modifications to the system and its related practices.

Third, the local UBI-display discourses, of course, were influenced by the displays and their use or their lack of use. Actually these discourses are closely tied to the UBI-displays, and without the displays, these discourses would not exist. Writers commented that nobody used the systems, and that they were not functional, useful, or usable. In addition, the local discourses connected to the wider societal
discourse themes related to research funding as well as to the children and technology.

6.1.5 RQ 5: How can we study technology-mediated practices in public spaces by using Nicolini’s practice toolkit approach?

Finally, the last research question concerned the methodology of practice toolkit approach for studying technology-mediated practices in public spaces. This approach offered interesting perspectives to study the phenomenon. The zoom in lenses were useful for profoundly understanding the local accomplishment of practice, and the zoom out movements helped in contextualizing these local practices. The zoom in movements (accomplishment, material aspects, aim, creativity, durability) concentrated on users, user communities and the artifact. Zoom in studies were implemented through ethnomethodological methods, both observations and field interviews. These methods are already well known in the public display research. For studying accomplishments of practice, Nicolini recommended focusing on sayings and doings, interactional order, timing and tempo as well as bodily choreography, tools and artifacts. In the case of technology-mediated practices in the public space, an especially relevant lens turned out to be concentrating on the immediately observable bodily choreography as well as other material aspects of the practices. On the other hand interesting information was derived also through the legitimation and stabilization lens, which explained the durability of the practices.

The zoom out movements were three: the historical investigation helped to understand why the artifact was the way it was; connections between practices concentrated on the users’ perspective and how the display practice settled into their nets of practices; the effects of the practices offered the possibility to contextualize the practice in a bigger societal picture. For the zoom out methods the methodological plan was also expanded enabling the usage of different types of data sets. Nicolini recommends studying mediators, such as documents, which act as localizers and generalizers of practices, and through which, for example, historical reconstruction can be made and the distant effects of practices distant can be traced. In this case the expansion of the scope was undertaken through interviews (historical analysis), diary study (connections between practices), and analyzing documents (effects of the practices). In the case of technology-mediated practices in public spaces, the connections between practices is not always obvious. The practice in focus is not tied to other practices directly, as for example work
practices usually are, nor do official documents or guidelines of the practice exist. Also shadowing the practice to other places is impossible, as the installations are stable. Thus, in terms of the zoom out studies, the toolkit required the most customizing when studying technology-mediated practices in public spaces. The use of a practice toolkit is further elaborated on in the following sections.

6.1.6 The Findings in a nutshell

In summary, the main finding which this thesis provides for the research relates to increasing the understanding of the dynamics of urban computing practices, their emergence and development. The study showed how practices are conglomerates of various changing factors’ influencing the practices on spatial, temporal and cultural levels. These factors come from at least the following origins: The design process, users, and the public discourses (See Figure 5).

Local accomplishment of urban computing practices is influenced by the tool. The tool is a result of the design and implementation process during which various factors and forces are affected. At the least, design is a compromise between designers and various stakeholders in urban computing projects. Designers script the seeds for the emerging practices. They implement the specific services which either are adopted or abandoned or modified by the users.

This finding gets us to the second factor, namely, the user. The user plays the leading role in generating the practices. The user brings in his/her everyday practices, which are either beneficial for the emergence of the practices or disadvantageous. Naturally, in the latter case, if the practice networks do not bring the user into the scene regularly, for example, then the practices simply will not emerge. In addition, the user has the motive either to use the system or not use it.

The user is affected by the communities of practice, where he/she also belongs. These communities keep the practices alive by determining the “rules” and by socializing new practitioners in the group. I also raised the space as a material aspect that is relevant in the context of urban computing. Actually space is part of the users’ practices and enables, for example, learning by seeing and thus affects the durability of the practices. The last defining factor of urban computing practices is the spirit, which is affected by the public discourses as well as the cultural factors. The influences of these discourses was not explicitly studied here, but I do
speculate on the influences they probably had on the emergent practices. Contributing factors are summarized in Figure 5.

Fig. 5. Characteristics of local accomplishment of technology-mediated practices in urban space, and the factors' contributing to the emergence of the practices. The figure was inspired by (Shove, Pantzar, & Watson, 2012).

6.2 Implications and contributions to the research

…it is timely for the field to begin theorizing about all aspects of behavior as it occurs in the wild (Rogers, 2011: 60).

Here, Rogers asks about theories that suitable for research happening in-the-wild. At the same time, Rogers advocates for an approach which 1) imports theories into the field to explain human behaviour as it occurs; 2) reconceptualises the theory to be utilized in the wild; 3) entails the development of new in the wild theories based on the findings (Rogers, 2011: 60). This thesis answers the Rogers call and demonstrates a theory, uses it, and offer suggestions for the future research. The main contribution of this thesis, therefore, lies in introducing a theory and methodology package for human computer interaction and computer supported cooperative work communities that suits the particular field studies. This thesis also
Implications of public display practices

This thesis also contributes to ubiquitous computing and especially to urban computing research communities. The thesis supports the earlier literature by highlighting the role of the triangle of people, place, and technology in urban computing systems (e.g. Foth et al., 2011; Kukka et al., 2014). In terms of the perspective of the emergence of practices, these three factors play the leading roles. In addition, the thesis highlights the role of discourses in media and their possible effects on the practices. The role of media and opinion leaders has been acknowledged earlier by (Storz et al., 2006). Compared to other ubiquitous computing projects, urban computing, and especially public display experiments tend to generate significant interest among citizens as well as in the media (Storz et al., 2006).

This study also highlighted the discussions in social media, as being a factor for defining public opinions and discourses among city dwellers. However, in this case, social media and the press were tight with each other, since the discussion mainly took place in the discussion forums on the leading local newspaper website. In this case, the virtual debate was negatively polarized, even hostile, and thus it affected the project, its outcomes, and use practices negatively. In addition, when the public funding aspect is attached to a public experiment, transparency becomes highly relevant and accountability to both citizens and society is highlighted (Halkola et al., 2015; Valkama & Ojala, 2011).

In addition, this study confirmed the earlier findings from public display deployments and stakeholders and the forces influencing such projects. This study also highlighted the conflicts between the stakeholders and their hopes. Finally, the power relations between stakeholders defined which expectations were fulfilled. These findings are in line with those of (Dalsgaard & Halskov, 2010; Storz et al., 2006; Ylipulli & Suopajärvi, 2013).

When it comes to the local accomplishments of public display practices, partially the same findings have been found in earlier public display studies that have concentrated on audience behaviour and interactional aspects. For example, public display research has acknowledged such phenomena, as the audience funnel (Michelis & Müller, 2011), the honeypot effect (Brignull & Rogers, 2003; J. Müller et al., 2009), and display blindness (J. Müller et al., 2009). All of these were also
observed to be part of identified display practices in this study. The honeypot effect can be related to communities of practice and their ability to spot each other, and learn to display usage from each other. Adults who did not belong to the same community of practice, on the other hand, suffered great display blindness. In addition, the importance of visibility of interactions, so that learning by seeing can actual happen has been acknowledged earlier (Huang, Mynatt, & Trimble, 2006). This visibility of interaction especially affected the durability of the practices, when new users adopted the practices by seeing others using the system. Findings related to user tendency to use technologies differently, than they were originally designed and expected, namely, so-called creative appropriations, were also reported by (Dalsgaard & Halskov, 2010; see e.g. Memarovic et al., 2015). Although, all aforesaid elements describe the aspects of local accomplishment of practices have been acknowledged in the existing literature, the findings of this study, however, further understand and contextualize these existing findings of prior studies that concentrated mainly on interactional aspects and audience behaviour. By understanding the reasons behind these behaviors, designers are able to find new solutions to overcome these issues on a more fundamental level.

In terms of the people, the public display users, this analysis supported earlier findings by noticing that children used public displays creatively without prejudice for different motives, while adults rarely interacted with the system. A similar type of finding of children using public displays has been published earlier, for example, in (see e.g. Memarovic et al., 2015; Mitra et al., 2005; J. Müller et al., 2012). A new finding here was that children’s display practices seemed to continue their other mundane ICT practices directly, as displays were used for similar purposes in public and also in private settings – for killing time, entertaining, supporting social interaction and babysitting. The same behaviour patterns have been reported earlier in young people’s online behaviour and having family members’ bonding through screen media experiences (Horst et al., 2009) as well as in children and their families’ screen media usage (Hiniker et al., 2016; Wartella et al., 2013). However, children’s public display practices might have unintended consequences, such as an increase in children’s ICT consumption or even the potential for technology addiction (Hiniker et al., 2016; Plowman et al., 2010; Plowman & McPake, 2013).

The complexity of the stakeholder network and the other forces’ shaping the project’s progress hints at why in-the-wild studies are not attractive to many human computer interaction researchers. Human computer interaction researchers can maintain their focus in controlled lab environments, but in an in-the-wild context, the messy character of social life becomes inescapable. In these kinds of conditions,
several factors besides just the technology become influential, for example, power, politics, values, norms and rules, constant and recurrent translation, and negotiation. In addition, the in-the-wild setting puts the researchers into a vulnerable position where each trip and failure are only public. Thus, the maturity of the technology becomes essential, as acknowledged by (Dalsgaard & Halskov, 2010; Memarovic et al., 2013). One can only speculate how these failures in the public research affect the flow of research discourse in the society.

This thesis has drawn an overall picture of public display practices and their design. Although partly similar findings have been reported earlier in different studies, this thesis presents the complexity of emerging practices in a pervasive display network profoundly through the practice toolkit approach that uses zoom in and zoom out lenses. This thesis builds a bridge between the practical interactional oriented studies and the purely theoretical studies, which in the best case end up as offering high-level generalizations and principles (Rogers, 2011: 60).

The Implications of Nicolini’s toolkit approach

One of the theoretical implications of this study was on suggesting the practice toolkit approach to human computer interaction and ubiquitous computing research. This is the first study as far as I am aware, which grounded the analysis and the data inquiry on Nicolini’s toolbox approach in the field of human computer interaction, albeit particular practice theories have been applied traditionally especially in computer supported cooperative work. Nicolini’s approach collects aspects of several practice theories under one umbrella providing tools for achieving thicker accounts of the practice in focus than with one particular theory alone. This approach not only describes the characteristics of the local accomplishment of practices rigorously but also contextualizes them by studying the connections between practices (Nicolini, 2012).

Spaargaren speculates that clear guidelines for researchers is one of the reasons of the popularity of contemporary practice theories:

The present contemporary social theory that inspires and appeals to many (PhD) students, since they expect the theory to offer them guidance on how to organize social science research, when using the lens of practice theories, researchers show particular sensitivities and preferences, while being keen on avoiding well-known pitfalls. (Spaargaren, Weenink, & Lamers, 2016: Chapter 1).
I agree with him. The practicality of especially the toolkit approach set frames for the study, which made applying it easier. The toolbox gave concrete points to focus the attention and questions to ask in different stages of the analysis.

Although Nicolini originally presented the practice toolkit for studying the context of work and organization and targeted for instance the sensitizing questions specifically keeping eye on this context (Nicolini, 2012), this study shows how same approach is applicable (with some modifications) also in a different type of setting. The urban computing context differs from organizational context in many aspects: the use of technical artifacts is completely voluntary and not necessarily goal oriented, there are no regulations of use other than what is generally appropriate (Goffman, 1963), users might be heterogeneous, in principle they do not share same knowledge or skills and they are not necessarily aware of belonging to the community of practice. In addition, the circumstances of designing such systems are perhaps more complex involving surprisingly many stakeholders and their complex power relations. Our study demonstrated that toolkit approach is helpful also in this type of contexts, and enables understanding urban practices, their emergence, development and effects comprehensively and profoundly.

This thesis squeezes different level phenomena (e.g. actors’ use practices and appropriations, development process, citizens’ discourses in social media) into the frame of practice toolkit. One can say that there are of course specific weaknesses in this sort of approach which combines different type of datasets and levels of analysis compared to approach which concentrates on just one level. However, this sort of approach has also its strengths, which in my opinion, in this case are stronger than the possible drawbacks. Typically technology development studies have concentrated either on development or use of technology, but as Hyysalo says:

*When, for instance, design, development, marketing, implementation, and appropriation of technology are studied separately, the other sites and times in the shaping technology become assumed rather than studied in relation to the topic at hand... When one actually goes beyond a single focal area and grain size of analysis ... the effects of differently framed “snapshots” of technological change become striking.* (Hyysalo, 2010: 30.)

In this study the actors’ use practices are analysed in the light of development process and developers decisions. The possibility to combine both the development and the use of the artifact is enabled through the long timeframe of the display setup, although the actual data acquisitions has been conducted within a shorter time span.
On the other hand the approach helps in controlling the complexity and tying together different type of data sources. Especially in zoom-in stages the observatory data is essential, however, when expanding the scope in zoom-out stage and trailing the connections through different type of material is applicable. The advantage of this approach is the flexibility related to data sources. In addition, the method supported analyzing and helped in understanding relationships between practices in different levels. We can say that through this method relationships between practices become visible.

Although the Nicolini’s practice toolkit gives concrete questions to ask and points to focus the attention, utilizing the toolbox rigorously is not simple. It requires a lot of efforts and time. This has been acknowledged by van Der Poel & Bakker: “It seems likely that it requires a lot of time working with the praxeological toolbox (Nicolini), a process of trial and error, in order to develop the necessary methodological experience and skills to use the various concepts in a precise, efficient and effective manner” (van Der Poel & Bakker, 2016: Chapter 8). This was also the case in this study. Next challenges and advantages of each step are presented.

When the practice toolkit is used, observational studies are essential in order to gain insights into people’s behaviour especially during the zoom-in stage. Conducting such observational studies is relatively easy in publicly open settings; this is acknowledged in public display research that often utilizes the method (Alt et al., 2012). However, conducting observational studies in private settings such as in people’s homes is much more complex and requires a trusting relationship between the researcher and the informants (Plowman et al., 2012). In addition, observations study efforts are laborious and time consuming and requires the researcher personal efforts. Observations offer essential information especially about the actual performances and material aspects, but also gives hints of aims, creativity and durability. In addition, different types of user interviews enrich the picture.

In the urban computing context, the research should start with observations of the accomplishment of the practice. Given that my interest was to study accomplishment of practices. Particularly relevant was Nicolini’s recommendation to draw from sayings and doings, interactional order, timing and tempo as well as bodily choreographies and tools and artifacts. The most suitable methods for such a research are based on ethnographical research approaches, more specifically observations. For example Michels & Müller (2011) and Brignull & Rogers (2003) as well as Müller et al. (2009a) has applied these methods in their public display
studies revealing phenomena such as audience funnel and honeypot effect. Audience behaviour in general around public displays have been studied earlier for instance in (Brignull & Rogers, 2003; see e.g. Memarovic et al., 2015; Memarovic et al., 2015; Michelis & Müller, 2011; J. Müller et al., 2009).

In this study, I could not focus on the talk. There were at least two reasons: First, people did not speak much when they used the display especially when they were alone, and second, during the public observation, recording people’s speech did not feel ethical. Due to these reasons, the accomplishment study concentrates on studying the pure observations. This has been the procedure in other observational public display studies, which usually try to appreciate users’ anonymity (see e.g. Memarovic et al., 2015; J. Müller et al., 2009; J. Müller et al., 2012).

The second step of zooming in was foregrounding the role of tools, materials and the body. Although Nicolini does not mention the space in the toolkit approach, space is associated with the material dimension in this thesis. The role of materials, especially the tool in technology-mediated practices, is obviously crucial. Especially the role of the space is highlighted in (Dalsgaard & Halskov, 2010; Foth et al., 2011; Kukka et al., 2014). Moreover, Akpan et al. have investigated the effect of the space and place in either promoting or inhibiting public display interactions and gen Schieck the role on place in urban screen installations (Akpan, Marshall, Bird, & Harrison, 2013; Fatah Gen Schieck, Briones, & Mottram, 2008). Public display has traditionally relied on touch- (Ojala et al., 2012; Peltonen et al., 2008), mid-air gesture- (Michelis & Müller, 2011; Walter, Bailly, & Müller, 2013), and mobile-based (Boring, Jurmu, & Butz, 2009) interaction, all having clear bodily implications. The virtual and physical affordances of the display influenced heavily the practices (e.g. playing games or using the display module as bike stand). However, research should even more extensively focus on the display and other tools involved. In this case, for example, the role of smart phones strongly affected the emergence (or the lack thereof) of the display practices. The displays where originally designed before the proliferation of smartphones, and thus, many of the original services became useless when everybody had access to the Internet in their pockets.

Applying the third zooming in aspect, the meaning or the aim of the practice, was not that straightforward in the context of ubiquitous computing and public displays. While Nicolini highlights at this point practical concerns and the object of work:
The aim of zooming in is, … to surface the practical concerns which govern and affect all participants, and a way to appreciate that from the perspective of the members … sense of what needs to be done. (Nicolini, 2012: 225.)

Such thing “which need to be done” cannot be applied to the context of public displays. Nothing really “needs to be done” when people are using the displays at their own discretion. However, the interviews and observations revealed different motives for using the displays. These motivations were not necessarily always directly expressed by the informants but could be interpreted from the answers. However, considering the aim of the practice, the toolkit revealed interesting insights and increased understanding of the meaning. Motives for the use of public displays have also been studied in (Cheverst et al., 2008; Ylipulli & Suopajärvi, 2013).

Categorizing practices according to their aims directed attention to the question of how much practice can vary and still be part of the same practice. According to Nicolini, the next step of zooming in includes studying the tension between repetition of the same and reproduction (Nicolini, 2012). This was also a bit difficult to apply to the context of discretion use of public displays. Although the community of users existed, they did not share very clear common practical concerns which would guide the users. When studying the creativity in the case of public displays, I thus merely focused on use sessions that did not fit into one category of specific display practice. These creative use sessions mixed different type of practices together or evolved from one type of practice into another. In addition, users invented creative purposes for the displays and thus, created new practices or modified old ones.

The last zoom in movement focused on legitimacy and learning. This aspect was particularly relevant and fruitful in the public display context providing information about the durability of the practices. This step explains why some displays of the display network become used and others not. This step links with for example notions of learning by seeing (Huang et al., 2006; Marshall et al., 2011).

Zooming out movements contextualizes practices and thus this stage required versatile data acquisition phases. The local accomplishment of practice depends on practices taking place outside or before the immediately observable scene at the swim center. For this study, I expanded the scope first by shedding light on the history of the development process. I would say that this historical analysis constructs the main material of this thesis, besides the ethnographic material. According to Nicolini:
By shedding light on the power relations that determined the current state of affairs, a historical investigation provides vital clues to the type of power relations and interests that are inscribed in the current practice (Nicolini, 2012: 236).

Nicolini suggests expanding the scope through studying the mediators: documents preceding the practice and acting as localizers and generalizers. However, the historical analysis was done here mainly through developer interviews. Studying the emergence of practices through historical analysis could have been done for example through document inquiry but also by interviewing people involved in the design and implementation.

I found the interviewing extremely useful in contextualizing the project and understanding the motives behind the solutions. Through interviews, I also was able to interpret the power relations that, again, provided better understanding of the overall setting. This sort of analysis could also been done with practitioners for finding out their history as ICT users (see e.g. Ylipulli & Suopajärvi, 2013). However, this is partially done through following step of zooming out the connections in the space.

The other zoom out steps, following connections and effects of the practices were more difficult to apply in the context of ubiquitous computing and public displays. First of all, following artifacts could not be considered, since the installation was stable. However, I decided to follow the practitioners and their ICT practices elsewhere through diary study method. This turned out to be fruitful approach, but required more prolonged involvement of users and could have been done more thoroughly. Also studying the effects of the practices was challenging, the studies did not provide evidence on effects of the practices. While the practice in focus did not really produce anything, compared to work practices which should do that, I could not follow the effects in that sense. However, expanding the hermeneutic circle into the online discourses turned out to be useful in studying public installations. Still the linkage between the public discourses and the practice lens remained rather weak. The discourses in media are an interesting dataset, but from the point of view of the practice approach it might remain rather separate.

Finally, while toolkit may provide thorough understanding of the practices in focus and their development, the findings may not be easily applicable in design as such. You cannot receive straight forward design guidelines through utilizing practice toolkit approach. Table 19 summarizes advantages and limitations of the
practice toolkit approach. Table 20 summarizes the zoom in and out studies and the focus of attention in each step.

Table 19. Advantages and limitations as well as suggested modifications to Nicolini’s practice toolkit in the context of technology-mediated practices in a ubiquitous computing setting.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Feature</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>Providing clear guidelines</td>
<td>Providing guidelines for how to study practices and where to focus attention in the different steps</td>
</tr>
<tr>
<td></td>
<td>Controlling the complexity</td>
<td>Contextualizing local accomplishments of practices; Ability to combine (tie together) different types of data sources;</td>
</tr>
<tr>
<td></td>
<td>Making things visible</td>
<td>Visualizing the characteristics of practices and the connections between practices</td>
</tr>
<tr>
<td><strong>Limitations</strong></td>
<td>Laborious &amp; time consuming</td>
<td>Conducting observational studies takes time (weeks, months or even years)</td>
</tr>
<tr>
<td></td>
<td>Ethical issues</td>
<td>Observational studies in the public space create privacy issues</td>
</tr>
<tr>
<td></td>
<td>Usable findings</td>
<td>Method provides an understanding of certain practices that are not necessarily immediately in the most usable form.</td>
</tr>
<tr>
<td><strong>Modifications</strong></td>
<td>Material aspects</td>
<td>Adding the role of the space to the focus</td>
</tr>
<tr>
<td></td>
<td>Meaning</td>
<td>Concentrating on the motives for a use</td>
</tr>
<tr>
<td></td>
<td>Creativity</td>
<td>Focusing on use sessions that do not fit into one category of a specific display practice</td>
</tr>
<tr>
<td></td>
<td>Following the practices</td>
<td>Following practitioners instead of artifacts.</td>
</tr>
</tbody>
</table>

Table 20. Central focuses of Nicolini’s practice toolkit and the author’s suggestions for suitable research questions for studying technology mediated practices in a public setting. Suggestions are inspired by Nicolini's toolkit (Nicolini, 2012).

<table>
<thead>
<tr>
<th>Zoom in / out</th>
<th>Focus of the inquiry by Nicolini</th>
<th>Suggestions for sensitizing research questions when studying technology-mediated practices in the public setting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Zoom in</strong></td>
<td>Accomplishment</td>
<td>Sayings and doings, interactional order, timing and tempo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What are people doing? What are they trying to do? How do the patterns of their doing flow in time? What temporal sequences do these patterns produce?</td>
</tr>
<tr>
<td></td>
<td>Material aspects</td>
<td>Bodily choreography; tools, artifacts and mediation work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How does the tool, space, and bodies relate to the practices? How are artifacts used in the practice? How is the practice accomplished through the body? How does the space support or prevent the practices?</td>
</tr>
</tbody>
</table>
### 6.3 Practical implications

Practical implications of this study mainly concern ubiquitous computing system designers and developers, but also technology developers in other fields. The study increases the understanding of already acknowledged influencing factors, stakeholders, and forces present in urban computing experiments. Understanding this study helps the designers to predict the pitfalls and prepare for them. The study demonstrates how urban public spaces are multi-dimensional design opportunities that have varying factors. Deploying urban computing systems into public spaces...
requires listening to the various stakeholders. Therefore, building such systems that can please all is extremely difficult, even impossible, as was proved in the UBI-Oulu experiment. The number of compromises become too high, especially when the stakeholders have highly distinctive values and expectations of the system, so making solutions that fulfil all the stakeholders’ expectations is impossible. As a consequence, building systems for semi-public spaces, might be easier. These spaces can involve fewer stakeholders, but also the user population may be narrower and more homogeneous, and it might thus be easier to fulfil its needs and requirements.

In addition, this thesis sheds light on technology adoption and how on its behalf, complexity is influencing the emergence of use practices for a new type of urban computing artifacts. The thesis contextualizes the earlier findings attached to audience behaviour around public displays. By understanding the diversity of the contributing factors and the emergence of the urban computing practices, we can design technologies that truly weave themselves into the fabric of everyday life.

This thesis offers practical hints for designers when building public interactive deployments. In order to build systems that truly get adopted for years, one should specifically concentrate on the design phase of factors that support the durability and the practices. These are, for example, learning and relevant content creation. The content should be updated and renewed regularly, and the whole system should be maintained regularly and effectively. Learning by seeing has been acknowledged to be essential for public display deployments (Huang et al., 2006). In addition, enhancing the communities of practice to develop makes the practices more durable. For example, multi-user applications and placing the artifacts in a place where the network of practices cross (i.e., where people regularly visit as part of their regular practices) can support the emergence of user communities (Alt et al., 2011; O'Hara, Perry, & Lewis, 2003). The place of installation also defines the future users. If the technology is in a place where young people visit regularly, it is probable that they will appropriate the system and adopt it as part of their recurrent practices. Thus, preparing for child users would be reasonable.

On the other hand, it is not meaningful to search for solutions that merely enhance the use of systems’ concentrating on the technology. The target should be more on the actors, practitioners, and users and their needs and desires. The design should start with questions about what makes the lives of the users easier and more meaningful. For example, multi-purpose systems, which try to offer everything for everybody, might actually end up having no purpose at all. Smart phones today replace many needs and have many advantages compared to the public display
network (for instance they offer constant accessibility and better privacy). We can assume then that it is better to focus the displays on a specific need or purpose clearly related to the location.

This thesis also implicates the various directions from where ubiquitous computing practices might take inspiration. Not only understand the design process, but understand the users, their motivations, the lives and existing practices is also significant. It is also important to understand that it is not necessarily obvious where the technology-facilitated practices originated or derived their inspiration. In the swim center case, it was mainly children and their families who found that the uses for the public display, and their existing smart device practices at home bore a clear resemblance to the practices in the public space. This use might have been difficult to anticipate by only the developers. It is a challenge to figure out from where the potential practices might be migrating. One natural way to start approaching this is to identify potential users and start examining their baggage using technology-facilitated practices with a broad scope. Of course, one could try to concentrate on practices with somewhat similar technology, but that does not always clearly indicate what that somewhat similar technology involves.

Finally, people are creative beings, and although careful when preparing, designers cannot anticipate all the appropriation possibilities their systems might have. Designers should also prepare for those appropriations, usages and motives, which they could not imagine. This focus applies both to the use of the software and the physical display module. This thesis offers evidence of using a display for different unanticipated purposes (babysitter and a small children’s entertainer) and different ways (e.g., children’s random tapping, a bike stand). As some appropriations might be surprising, the evolution of systems should not end at the design and development process. Their development should be agile and continuous, and developers should be open to new ideas, listen and observe all users, and be sensitive to their suggestions and willing to develop the system continuously.

6.4 Validity and reliability

Reliability and validity of any research effort can be achieved differently and there are different connotations from qualitative studies compared to quantitative ones (Creswell, 2013). Qualitative validity means that the researcher checks for the accuracy of the findings by employing certain procedures, while qualitative reliability indicates that the researcher’s approach is consistent across different researchers and different projects (Creswell, 2013). Any Validation of findings occurs basically at
all steps of a data analysis, so that all stages are conducted carefully and rigorously. Creswell (2013) named different validity strategies to assess the accuracy of findings. Next, the strategies applied in this research are discussed.

Triangulation of different data sources of information can increase the validity of the study. That is, use evidence from different sources to build a coherent justification for the research themes (Creswell, 2013). Triangulation is the main validation strategy of this current thesis. The material was collected from various sources by using various strategies: Observations, field interviews, thematic interviews, time line interviews, statistics, diaries, texts in media. All materials were used for drawing the big picture regarding urban computing practices and their dynamics.

Another method for adding validity to the findings is rich and thick descriptions, which communicate those findings. These descriptions transport readers to the setting and make the findings more realistic. (Creswell, 2013) Also, ethnographic approaches and a selected practice lens will highlight this aspect by suggesting how to describe the practices. This research also provides thick descriptions from different settings such as swim center, homes, and the actual development process.

Self-reflection is an essential part of the validation of qualitative research for clarifying bias. According to Creswell, good qualitative research contains comments by the researchers on how their interpretation of the findings is shaped by their background, such as gender, culture, history, and socioeconomic origin (2013: 251-252). The author’s involvement in the development process could have caused a bias in this current research. In this sense, however, the concern is unnecessary. I started to work on the UBI-Oulu project, when I began this thesis work three years ago in 2014. At that point, the public displays had been installed for five years. In addition, I worked with another research group, separate from the developer team. During these three years, I have worked occasionally with some of the persons more involved with the UBI-project, but I remained separate from the team, as preserving objectivity is clearly necessary to be able to study their decisions, culture and values. As a female researcher with a background in humanities, I assumed I could see underlying structures within the male-dominated technology driven developer team as an outsider. However, several years experience in human computer interaction also gave me ability to understand the underlying cultural assumptions in that field.

What it comes to studying the users and their families’ display practices at the swim center as well as at their homes, the case was more complex, since the
informant group was closer to my own life. I visited the swim center more or less regularly even before starting the research, I have children who fit the target group and are interested in interacting with the display. I also use display and smart devices for babysitting, and my children regularly entertain themselves with ICT. Thus, interpreting the material I gathered objectively was more difficult or sometimes even impossible. However, in this case, I believe that understanding the users, the families and the dynamics of everyday life of families with children is an advantage in data analysis. I also acknowledge and am aware of the bias that scenario entails. These preconceptions might cause the analysis to take specific tracks while overlooking other aspects.

Spending prolonged time in the field, I developed an in-depth understanding of the phenomenon under focus. The more experience a researcher with a setting, the more accurate and valid his or her findings will be. (Creswell, 2013). This is also the basic principle of the ethnographic method (Metsämuuronen, 2006). As described here in Methods section, in the actual ethnographic study phase at the swim center, I received help from a group of students. Yet my unsystematic observation of the space and the dynamics around the public display there had started well before that time, indeed right when I was given the topic of my thesis. When I knew I was going to study the UBI-displays, I started to observe them and their users during my visits to the swim center, and also anywhere else where was an UBI-display. I was also familiar with the swim center and the practices there from a regular visitor’s perspective.

According to Yin (2003) qualitative researchers have to document the procedures of their studies and steps as rigorously as possible to achieve gain reliability of their findings. In this research, I tried to describe the study procedures as precisely as possible. Also, during the processes, I tried to be as careful as possible. Transcriptions were checked and should be correct, codes were unified, and some codes, especially in the developer study, were cross-checked by a team of researchers.

The fundamental purpose of a qualitative study is not to create generalizable truths, but to understand a phenomenon. According to Creswell “the value of qualitative research lies in the particular description and themes developed in context of a specific site” (Creswell, 2013: 253). For example, Yin (2003) says that it is possible to generalize a qualitative case study to apply to some broader theory. In the case of this study, the findings were very much space dependent. However, the purpose of this study was to demonstrate how the users’ technology mediated the practices in public places and summarize the various factors. These factors are
surely different in every setting, and thus, the results are probably not generalizable in every public display setting per se. At least, any generalization of these conditions is not straightforward. However, the findings of this study indicate that any ubiquitous urban computing, and public display practices are a result of various factors that include the design process, the users’ lives, and the discourses in the community. These findings are surely also relevant in other technologies and contexts, although the role of the tool, the body and space may vary.

6.5 Limitations of the study and future directions

There are also of course limitations to this study and these have to be taken into account. First of all, this thesis studies actually studied public display practices rigorously only at a single setting. Analyzing practices in other types of settings could reveal additional critical factors that contribute to the emergence of practices. In addition, the associations between practices could have been studied more widely, and more diary study participants could have revealed more different types of practices. In addition, more rigorous data would have been gained through extending the ethnographic approach into the users’ homes. Also, the present material could be elaborated on further to gain an even better picture of the overall dynamics of urban computing practices.

The discourse analysis of the media texts in this effort included only the voices of a small portion of city dwellers; thus, their opinions cannot be claimed to represent all the citizens. Although I consider the material in this thesis as the voice of many city dwellers, I also assume that in reality, the majority of citizens did not have an opinion on the displays, and the ones who actually commented on the project and the displays in social media were polarized and negatively so. In addition, the discourse material could have been further analyzed.

Finally, as there are indeed limitations, this thesis also leads one down a number of interesting paths for future work. One can say that the themes of each of the papers could be elaborated further. For example, the value collisions between developers and users is an interesting phenomenon that touches similar type of projects generally. The conflicts of interest could be clarified with more rigorous material from the users. This comment of course, could also be applied to the context of any different type of technologies, but the case is especially interesting for public and possibly urban computing technologies which always involve a greater variety of forces and factors than let’s say, the computing systems within organizations.
Secondly, the theme of practice networks and how they actually influence urban computing practices would be an interesting future research path to take. Especially interesting would be how do urban computing practices transfer from one place into another? This study raised key questions for how display practices from homes and schools travel to other contexts and vice versa.

Third, it would be interesting to research further how ongoing societal and local discourses affect users or potential users’ behaviors and ICT practices. Do ongoing discourses really have an effect at the practical level? In this study, I did not have enough evidence to claiming this point, but there was strong speculation that this current debate really affected users and their willingness to try the systems. At least the tone of talking about UBI-displays arrogantly and negatively seems to have become the norm, which did not at least inspire to use the displays.


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THE CHARACTERISTICS AND DEVELOPMENT OF URBAN COMPUTING PRACTICES

UTILIZING PRACTICE TOOLKIT APPROACH TO STUDY PUBLIC DISPLAY NETWORK