Getting users’ input to product and service development has been proven to increase the success of the product or service under development. During the past decades numerous methods, guidelines and standards have been developed in order to support human focus in development processes. However, in real life, organisations do not or cannot always follow these guidelines, although they might have the will and capability to have a human focus in their development.

This thesis focuses on a case study where a human-centred design mature organisation could not involve external users directly in a product development project. How did they overcome this challenge and manage to conduct a human-centred design process? This thesis answers this question and, in addition, provides guidance for practice on human-centred design without direct contact to users. Throughout the thesis still highlighting the importance of human-centredness and direct contact to users.

Department of Design

Human-Centred Design When Direct Contact with Users Is Not Possible

Kaisa Savolainen
Human-Centred Design When Direct Contact with Users Is Not Possible

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Abstract
Developing technologies and technological innovations is difficult and technological innovations often fail. However, user involvement has had positive effects on system success and user satisfaction and can, therefore, clearly be seen to be valuable. For decades researchers and practitioners have developed ways to get user and customer input into product and service development and this has taken place under several different study fields, such as marketing, ergonomics, ethnography, participatory design, usability, human-centred design (HCD), user experience, service design, and science and technology studies.

This dissertation focuses on HCD and inspects whether HCD can be practiced without direct contact with users and, if so, what are the practices applied. These situations are quite common in organisational settings, and they can occur due to several reasons, such as not having enough time or other resources, too strict confidentiality issues or the user group cannot be contacted.

This research is based on a longitudinal case study at a Finnish industrial company that has been a forerunner in HCD. The research has been conducted during 2014–2019 through semi-structured interviews, meeting observations and inspected company documentation.

The practices of HCD were viewed from the methods and user representations points of view. In addition, a more holistic perspective on the ways HCD was practiced without direct user contact and an analysis of the ecologies of user knowledge were provided. In the end it could be seen that HCD can be practiced responsibly without direct user contact in HCD-mature organisations. In an HCD-mature organisation, user knowledge is drawn from a variety of sources and gathered through various methods and method mixes, and it has accumulated during the history of each employee. In addition, organisations can have more specific resources, such as the in-house users employed by the case company, that can provide additional input to the design and testing phases.

This research further contributes to efforts to aid in assessing whether an organisation is applying HCD and how design can be recognised as HCD although there is seemingly no user contact. In addition, it underscores the importance of studying the HCD practices in real-life environments and highlights the importance of conducting research at the crossing of several research fields (here it was HCD, science and technology studies, and design and innovation research). In conclusion, the research results provide guidance for practicing HCD when direct contact with users is not possible.

Keywords  Human-centred design, Design research, User research

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Kaisa Savolainen

Väitöskirjan nimi
Ihmikeskeisen suunnittelu, kun suora yhteyts käyttäjiin ei ole mahdollista

Julkaisija
Taiteiden ja suunnittelun korkeakoulu

Yksikkö
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Tiivistelmä

Uusien teknologioiden ja teknologisten innovaatioiden kehittäminen on vaikeaa, ja tämän vuoksi teknologiset innovaatiot usein epäonnistuvat. Käyttäjien osallistamisella on havaittu olevan positiivisia vaikutuksia tuotekehityksen onnistumiseen sekä asiakastyytyvyyteen, ja sillä voidaankin selkeästi nähdä olevan merkitystä. Tutkijat ja ammattilaiset ovat vuosikymmenten ajan kehittäneet menetelmiä, joilla käyttäjien ja asiakkaiden näkemykset voidaan liittää osaksi tuote- ja palvelukehitystä. Tätä toimintaa on harjoitettu useilla eri aloilla: markkinoinnin, ergonomian, etnografian, osallistuvan suunnittelun, käyttävyyden, ihmikeskeisen suunnittelun, käyttökokemuksen, palvelumuotoilun sekä tieteen ja teknologian tutkimuksen alalla.

Tämä väitöskirja keskittyy ihmikeskeiseen suunnittelun ja tutkii, voiko ihmikeskeistä suunnittelua harjoittaa ilman suoraan käyttäjäkontaktia ja mikäli voi, millaisia käytäntöjä silloin hyödynnetään. Nämä tilanteet ovat suhteellisen yleisiä erilaisissa organisaatioissa, ja ne voivat aiheuttaa monista syistä, kuten ajan ja muiden resurssien niukkuudesta, liian tiukoista luottamuksellisuustasoiosta tai siitä, ettei käyttäjäryhmää voida tavoittaa.


Ihmikeskeisen suunnittelun käytäntöjä tarkasteltiin menetelmien ja käyttäjärepresentaatioiden näkökulmista. Lisäksi tarkasteltiin kokonaisvaltaisesti tapoja, joilla ihmikeskeistä suunnittelua harjoitetaan ilman suoraan käyttäjäkontaktia, ja suoritettiin käyttäjiä koskeva tietoekologian-työ. Näiden avulla havaittiin, että ihmikeskeistä suunnittelua voidaan harjoittaa myös ilman suoraa kontaktia käyttäjiin organisaatioissakin, jotka ovat korkealla maturiteettitasolla ihmikeskesäisessä suunnittelussa. Tällaisissa organisaatioissa käyttäjätietoa saadaan useista eri lähteistä, eri menetelmällä sekä menetelmäohjelmistomallilla ja tieto on kumuloitunut jokaisen työntekijän työhistorian aikana. Lisäksi organisaatioilla voi olla omia resurseja, kuten tässä tapauksessa organisaation sisäiset käyttäjät, jotka tuottavat tietoa suunnittelua- ja testausvaiheissa.

Tämä tutkimus myös tuottaa ohjasta tilanteisiin, joissa arvioidaan, harjoittaa koordinoidaan ja käyttäjien tietoa ihmikeskeistanta ja tuotteita käyttäjiä ovat ihmikeskeisen suunnittelua voidaan tunnistaa, vaikka näennäisesti käyttäjäkontaktia eiltä. Lisäksi tutkimus korostaa tarvetta tutkia ihmikeskeisen suunnittelun käytänteitä tosielämän konteksteissa ja eri tieteenalojen risteyskohdissa tapahtuvan tutkimuksen tärkeyttä. Tässä tutkimuksessa näintä tieteenaloja ovat ihmikeskeinen suunnittelu, tieteen ja teknologian tutkimus sekä muotoilun ja innovaatioiden tutkimus. Lopulta tutkimuksen tulokset tarjoavat opastusta ihmikeskeisen suunnittelun harjoittamiseen silloin, kun suora käyttäjäkontakti ei ole mahdollista.

Avainsanat
Käyttäjäläätiöinen tuotekehitys, Muotoilun tutkimus, Käyttäjäätutkimus


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I started my doctoral studies in 2013 after working for several years in the industry. My aim was to challenge myself, deepen my knowledge in human-centred design as well as design practices in general and take advantage of studying interesting topics in Aalto university. These years have surely provided all this and more. In addition to research and studies, I have had the chance to participate in interesting projects and work with amazing people.

When I started, I was lucky to get Sampsa Hyysalo as my supervisor to guide me through this research project and to advise me about academic practices. In addition to having an incredibly broad knowledge on nearly any topic, Sampsa has an amazing psychological ability to know when you need support and space and when he can demand results from you. Sampsa, I would never have been able to accomplish this without your guidance, so thank you.

During my research I have had the opportunity to be a part of the INUSE research group. I would like to thank the current members as well as the alumni for all their support during my research, whether it has been practical tips for interviews or commenting on my research papers. It has all been extremely valuable and it has helped me in producing better quality research. In addition, I’m grateful for all the discussions related to research or to life in general.

This research case would not have been possible without the excellent case company I got to work with. I am deeply grateful for all the company employees who have participated in my research giving me their time and discussing their work with me. Thank you, I wish you all success.

I was privileged to get two highly-respected professionals for pre-examiners. Thus, I would like to thank my pre-examiners Netta Iivari and Gilbert Cockton for their valuable comments on improving and finalising this dissertation.

Regarding funding, I would like to thank the Department of Design for making it possible for me to work full-time on my research as well as The Finnish Science Foundation for Technology and Economics KAUTE. In addition, I would like to thank my previous employers for allowing me to conduct my research also during working hours.
Finally, as life is not only about work or research, I want to thank my family, Jaana, Emil, Iina and Eros for their love and support and for reminding me constantly where the truly valuable things in life are. Furthermore, my gratitude goes to my parents and sisters for their support and encouragement, as well as my family members in a larger context. And finally, I would like to thank my friends for their support and great company.

Espoo April 16th

Kaisa Savolainen
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Article 1

Article 2

Article 3

Article 4
The Author’s Contribution to the Articles

Article 1
The author provided one of the studied cases for this article. In addition, the author has participated in commenting on the article. In this article the author has only made a minor contribution; however, it provided a basis for the rest of the articles (especially article 2).

Article 2
The author was the main author of this article. The study is based on the research conducted by the author, and the writing was done collaboratively with the second author.

Article 3
The article was written in co-operation with the second author. It is based on the research conducted by the author. In addition, the author had the main responsibility for writing the methods and results sections and commented on the other parts. The second author had the main responsibility for writing the introduction, theory and conclusions of the article and edited other parts.

Article 4
The author is the sole author of this paper and thus responsible for the research, as well as for writing the article. Others have commented on the paper and given suggestions for improving it.
Preface

As a foreword I would like to describe my motivation for starting this research.

I studied human-centred design (HCD) and user research during my master’s studies. From there on, I proceeded to work in the private sector in different roles related to HCD, user experience and user research. During the whole time I was bothered by the fact that the realities in companies did not meet the academic recommendations and teaching, even in organisations that were very advanced in HCD and had design deeply integrated in their processes. There were many reasons for this, the most common one being a lack of resources. However, confidentiality reasons also prohibited user testing; non-disclosure agreements seemed to be too bureaucratic and not reliable enough. Often there was not enough time to conduct research as the deadlines were so tight. At times, it did not seem reasonable to conduct new research and studies for each project. Sometimes, finding potential users for testing was seen as too difficult. Also, there were situations where guidelines seemed to be trusted more than actual contact with the users; this was especially the case when the target user group was very broad and diverse. With less-mature organisations, the lack of knowledge and skills was one of the main reasons for not contacting the users. In addition, the development cycle might not allow for user participation or the user group could not be reached for some reason.

I decided to start the doctoral research with the focus on how HCD is practiced in the private sector and how this may differ from standard academic HCD since I got the chance to conduct such research with a wonderful case company. This research project has been a very interesting one, and I hereby invite you to join the results of the research journey in the following pages. Its relevance has recently gained a new aspect: during recent year we have experienced a time when user involvement could not be achieved due to the Covid-19 outbreak and social distancing.
1 Introduction

1.1 Background

Developing technologies and technological innovations is difficult and technological innovations often fail as they develop far slower than producers have anticipated or because the outcome is different than initially predicted. In addition, the socio-economic impacts of the innovations are difficult to predict (Williams, Stewart, and Slack 2005). It has been discovered that user involvement has positive effects on system success and user satisfaction and is, thus, clearly useful (Kujala 2003; Iivari 2006). However, this user involvement is not always easy for designers (Kujala 2003; Voss et al. 2009), and there are projects where user involvement is not even possible to achieve.

Throughout the past decades, up to a century ago, people have come up with different approaches and methods in order to develop better products and services – ones that would be more desirable for people (the users, customers and consumers). The need to develop ways to gain user and customer information became necessary when mass production distanced the users and customers from the developers and manufacturers (Hyysalo, Jensen, and Oudshoorn 2016; Marchand 1998). This problem was first tackled by marketing and consumer research at the beginning of the twentieth century, but many other fields have addressed this area since (Hyysalo, Jensen, and Oudshoorn 2016). Later on, more methods and approaches have been established to study users (or consumers) and increase their involvement in product and service design. These fields of study include (but are not limited to) marketing, ergonomics, ethnography, participatory design, usability, human-centred design (HCD), user experience (UX), service design, and science and technology studies (STS). What all these have in common is the study, or participation, of users and customers, and taking advantage of user information. Information in this context is defined following inferential and semantic approaches as well-informed, meaningful and truthful data that is, however, dependent on a person’s valid inference (Floridi 2011). At times in this thesis, the term knowledge is also used. This refers to information that has been processed and combined with understanding, experience and/or learning (Rowley 2007). Also co-design is linked to HCD; co-design allows users and other stakeholders to participate in the design process and share ideas with a set of tools or instruments that facilitate the process (Mattelmäki and Visser 2011). Thus, it
can also be seen to cover different variations of user input and participation in the design phase. These levels of involvement range from inspiring the design to very independent user innovations.

HCD is a field which aims to develop products, services and systems that are easy to use, meaningful and provide pleasure for people (van der Bijl-Brouwer and Dorst 2017). Numerous methods and guidelines (including standards) have been developed throughout the past decades to ensure that products and services are designed in a human-centric manner (Beyer and Holzblatt 1998; Hackos and Redish 1998; Hollingsed and Novick 2007; Nielsen 1993; ISO/IEC_13407 1999). In addition, effort has been put into validating and comparing these methods (Karat, Campbell, and Fiegel 1992; Alhadreti and Mayhew 2018; Molich et al. 2004; Nielsen and Phillips 1993). The prevailing approach in academia has been that every project includes all the necessary phases of user orientation. However, this has been questioned as, in reality, companies operate with scarce resources and thus do not contact the users in every project and at every stage (Hyysalo 2010; Johnson et al. 2014; Johnson 2013; Kotro 2005; Pollock and Williams 2008). In addition, other criticism has emerged towards HCD, claiming that it does not fit the realities of today’s organisations (Cockton 2012; Cockton et al. 2016). These realities also appear in high-maturity HCD companies, which in general know how to and want to gather user insights and involve the users, but are at times faced with the situation where they need to create the design solutions without the possibility to study or involve the users. Thus, there is a need to conduct studies in real-life settings to discover how user knowledge is used in these cases since the designers are not trying to avoid user research but may not need it or may find themselves in a situation in which they have been blocked from making first-hand user contact.

Research has also been conducted on HCD in organisations, including surveys on the state of HCD in organisations (Bygstad, Ghinea, and Brevik 2008; Gulliksen et al. 2004; Venturi and Troost 2004; Venturi, Troost, and Jokela 2006; Vredenburg et al. 2002; Folstad, Jørgensen, and Krogstie 2004), recommendations on how organisations should apply HCD (Gulliksen et al. 2003; Seffah, Gulliksen, and Desmarais 2005) or the kinds of methods that could be used when integrating HCD in processes (Eriksson and Swartling 2013; Kashfi, Feldt, and Nilsson 2019). In addition, research has provided insights into the challenges that organisations face when applying HCD (Iivari and Abrahamsson 2002). More about research on HCD in organisations is presented in section 2.1.1. However, these research cases rarely report how organisations, especially ones that are mature in HCD, have overcome these different challenges.

Studies in company environments have demonstrated that companies do not conduct user studies for each project and they tend to mix different methods (Woolrych et al. 2011; Johnson et al. 2014). As Mäkinen et al. (2019) stated:
effective user insight in an organisation consists of both informal ways of knowing the user and formally generated user studies, blended with existing stocks of previous studies, and is typically adapted piecemeal for new purposes and with new strategic considerations in mind.

This reflects the reality in many organisations, which is often quite far from the recommendations and guidelines provided by academia and standards. In addition, the reality of development projects was described aptly by one of the interviewees in my research, a UX professional:

I would briefly summarise it like this: when a product development project has started, it’s too late to collect any user information. It won’t affect the project anymore. The goal of the product development project is to get the product ready and on the market. Then there’s a rush to manufacture the product, and any work done on something else takes away from reaching the target. If there is time to visit the user sites, the information comes too late as the main concept has already been formed. We can then note that ‘Here we got this part right’, but that’s where it remains. We can rest assured that we are on the right track. If we want to influence the product, the customer insight and user needs should be gathered before the actual work begins.

What comes out quite clearly in this comment is that the grounding research needs to be conducted in advance, and this means it is carried out with some separation from a given product development project, indicating a different role for user information than that which academic HCD suggests. Fortunately, organisations have usually run earlier projects and conducted user research from which they can draw on what has been learned in order to apply it to ongoing projects.

1.2 Case Description

This dissertation is based on a longitudinal case study at a Finnish industrial HCD-mature company. For anonymity reasons, the company shall be called CompanyIM. I selected CompanyIM for the study as it is a company that has been a forerunner in utilising HCD practices in its sector in Finland. I have worked with many companies and CompanyIM has had a very systematic approach to user centeredness. In addition, CompanyIM is interesting as its products are mainly targeted towards the industrial sector and, thus, is not the most common HCD-focused company. Furthermore, their products are a combination of hardware, software and services. Its main customers operate in the shipyard and offshore industry, the construction industry, the automotive and transportation industry and pipe and pipeline manufacturing. Since the founding of CompanyIM, around the 1950s, it has grown into a company that exports to 70 countries, has over 500 employees and has a yearly turnover of over €100M.
One product development project from CompanyIM was followed in more detail. The project shall be called ProjectND for reporting purposes. ProjectND started at the beginning of 2014. It was preceded by a concepting project that had conducted some pre-work, such as trying out different shapes for the device being developed. The goal of ProjectND was to design and develop a new type of portable device for CompanyIM – a battery-operated device, whereas the company’s earlier devices and machines have been wired. This would allow for new usage situations and open new markets for CompanyIM, both from the sales channels point of view as well as from the user group point of view. The top management had defined a very strict confidentiality policy for ProjectND and, thus, all external tests and user involvement activities were prohibited. This left the design team with the challenge of how to create a successful new product that would be valued by the users and customers without involving any external stakeholders.

ProjectND started with a quite straight-forward task of designing a portable battery-operated device with an ingress protection level of 67. The ingress protection level defines the water and dust resistance level of a device, level 67 indicating that the device can function in up to one-metre-deep water. (In the industry, this is referred to as the IP level; for example, an electronic item that needs to function in a household bathroom needs to be IP44.) In addition, the device was intended to be practically maintenance free, which would have opened up new markets and distribution channels for CompanyIM. As battery-operated devices had become more mainstream in several industry areas, it was seen as a natural step for CompanyIM as well. Usability was considered as an important aspect of the product from the beginning, although external users could not be involved in the process. The shape of the device was already roughly designed during the concepting stage, and some of the main target users were already planned as well; therefore, the project started with a tight schedule and a high ambition level. However, as the project proceeded some challenges appeared with balancing the ingress protection level and the duty cycle (operating time) of the device. The ingress protection level also affected the charging system, since it too had to withstand water. These all caused some more work for the technical solutions of the device, which then caused delays to the project. Towards the end of the project, as the device had found its form and most of the technical challenges were solved, the device was presented in a public event, as well as to some customers visiting CompanyIM and some customers during site visits. The responses were very positive: the device was seen as useful, and the features and usage of the device were praised. However, in the end, the safety of the battery construction couldn’t be ensured and the production had to be postponed. There had been news about other products with battery problems (exploding batteries) and CompanyIM could not take any risks with the safety of their devices and their reputation as a high-quality brand.

Although, the case project could not involve external users, CompanyIM does have a strong background in innovation, design and user centeredness. It has
won, for example, Red Dot design awards and an iF design award among other innovation prizes. In addition, when considering the design infusion perspective of Dumas and Mintzberg (1994; see section 2.2), we can say that design infusion is happening in CompanyIM as it only employs a few dedicated designers but a larger group of employees have participated in the site visits and the project managers are dedicated to ensuring that user insights and human-oriented design solutions are integrated in each product. Furthermore, when I started this research CompanyIM had just recently finished a project with external stakeholders that included (among other targets) the planning and implementation of their model for customer site visits and user research. This model and the site visits related to it were discussed quite thoroughly during the interviews conducted as a part of this research.

I conducted an HCD maturity evaluation of CompanyIM based on the research data. The maturity level was evaluated based on the Human-Centredness Scale (Earthy 1998; see section 2.1.2). This evaluation method was used as it provides a quite thorough assessment model, including different viewpoints and levels or HCD activities. In addition, it provides an easy-to-follow evaluation sheet in order to guide carrying out the assessment. I used the evaluation sheet provided by the model and gave a grade for each evaluation point as if I were an external consultant conducting the evaluation. This was conducted after most of the research activities were done, and thus, the evaluation describes the situation at that point of time. There was enough data gathered at that point to conduct a reliable assessment.

Earthy’s (1998) HCD maturity scale assigns an organisation a maturity level on the scale of A to E, level E being the highest on the scale. The levels are named: A – Recognised, B – Considered, C – Implemented, D – Integrated and E – Institutionalised. On this Human-Centredness Scale, CompanyIM is mainly on level D, partly on level C, but has also implemented parts of level E. This also demonstrates well the common problem related to these evaluations: different parts of organisations are at different levels and the same applies to different projects within an organisation. Nonetheless, it is safe to say that, according to maturity scale evaluation, CompanyIM is an HCD-mature company. The combined assessment grades for all the attributes for CompanyIM are presented in table 1. As examples of the evaluation, I will present some of the attributes of level D and their evaluation:

- **D.1.1 Integrate human factors processes**
  - Rating: Largely.
  - Work had been put into the human factors process that would suit CompanyIM’s needs, but it was not fully integrated.

- **D.1.3 Use appropriate representations**
  - Rating: Fully.
  - The representations used in CompanyIM were based on real data and they represented the targeted users.
• **D.2.1 Ensure design feedback**
  - Rating: Fully.
  - The designers have an essential role in the development process, and they make sure they get the needed feedback during the process. In addition, external evaluators are usually used before launch to ensure the usability of the solutions.

• **D.2.3 The timing of feedback**
  - Rating: Largely
  - Feedback on the design was gathered throughout the process, but the design team also recognised that at times it could only be applied for the next product version.

• **D.3.2 Manage iteration of design solutions**
  - Rating: Largely
  - The designs were iterated constantly based on the feedback and ensured that they were a good fit for the technologies.

• **D.3.3 Use design objectives to control iteration**
  - Rating: Partly
  - The design objectives were not always utilised in the iteration process or they were not documented well enough to enable using them.

Table 1: The HCD maturity assessment of CompanyIM

<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level X</td>
<td>Unrecognised</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(no indicators)</td>
<td></td>
</tr>
<tr>
<td>Level A</td>
<td>Recognised</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A1 Problem recognition attribute</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>A2 Performed processes attribute</td>
<td>F</td>
</tr>
<tr>
<td>Level B</td>
<td>Considered</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B.1 Quality-in-use awareness attribute</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>B.2 User focus attribute</td>
<td>F</td>
</tr>
<tr>
<td>Level C</td>
<td>Implemented</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C.1 User involvement attribute</td>
<td>L/F</td>
</tr>
<tr>
<td></td>
<td>C.2 Human factors technology attribute</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>C.3 Human factors skills attribute</td>
<td>F/L</td>
</tr>
<tr>
<td>Level D</td>
<td>Integrated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D.1 Integration attribute</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>D.2 Improvement attribute</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>D.3 Iteration attribute</td>
<td>L</td>
</tr>
<tr>
<td>Level E</td>
<td>Institutionalised</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E.1 Human-centred leadership attribute</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>E.2 Organisational human-centredness attribute</td>
<td>L</td>
</tr>
</tbody>
</table>

N: Never; P: Partially; L: Largely; F: Fully
The maturity assessments as such did not fall within the scope of this thesis; however, they were utilised as a background with which to evaluate the level of HCD practices in CompanyIM.

1.3 Research Questions

The research questions of this thesis are cast in the context of HCD-mature companies. The main research question of the thesis is:

Can HCD be practiced responsibly without direct contact with users?

Further, to focus the question, some more aspects of HCD are looked at in more detail. Firstly, as (for example) Oudshoorn et al. (2004) have stated, there are cases in which directly contacting the users is not possible. However, this does not mean that the designers do not want to practice HCD, which leads to the first sub-question related to HCD without direct contact with users. In addition, as some of the main characteristics of HCD involve methods and sources of user information (see section 2.1.1), these aspects will be inspected in more detail with sub-questions 2 and 4. Finally, the ways in which users are discussed during the development project describe the role of user information and how well the organisation understands its users; user representations (Akrich 1995; S. Hyysalo and Johnson 2015) are used to describe the users during the design process. Therefore, these are also brought under deeper inspection in sub-question 3.

Thus, I examine the topic with four sub-questions, which are:

1. How is human centeredness ensured in projects in which direct contact with potential or existing users is not possible?
2. How are different methods used to gather user information?
3. How does the user-related information circulate within the organisation? What kind of user representations are used to carry out design work?
4. What are the sources of user information? How do they interrelate in informing design?

The term responsibly, as expressed in the main research question, indicates that HCD is practiced in a manner where the users’ viewpoints and usage environments are duly considered and where they have had an effect on the design process and outcome. It should be noted that the direct involvement of the users does not automatically make the HCD process responsible. At times, in some of the articles of this thesis, the term accountable has also been used for a similar purpose.
1.4 The Structure of the Remaining Part of the Dissertation

This dissertation is structured in the following way. After this introduction to the research (chapter 1), I will present the relevant background theory for the study in chapter 2. The literature review consists of HCD, design and innovation research, and user knowledge in STS. HCD forms the basis for this thesis and, in addition to the introduction to HCD, HCD methods, HCD in organisations and HCD maturity assessments are discussed as well. The design and innovation management section focuses on the basics of design maturity assessments and discusses users’ role in innovations. As this thesis borrows from the neighbouring field of STS, some basics of STS are presented, especially social shaping of technology (SST), as well as the concepts of user representations and ecologies of user knowledge. At the end, I will summarise these theories and discuss how this thesis is positioned at the intersection of these areas.

After discussing the theory, in chapter 3 I will present the methodology applied in this research. This will begin with discussing design research and then moving onto the data gathering activities. After this I will describe the research data and the analysis of the data, following discussion about the ethics, reliability and validity of the research. The methods section will end with a short summary of the methodology.

Chapter 4 includes short summaries of all four research papers included in this dissertation. Finally, in chapter 5, I will present the discussion and cross-cutting conclusions, including a synthesis of the findings wherein I will answer the research questions. This will be followed by the contributions to theory and practice, and the reflections on the methods and materials used. At the end, I will present suggestions for future research.
2 Literature Review

The practice of studying users stretches across numerous fields of research: marketing, social sciences, computer science and ergonomics, to name a few. This section covers the three main areas for this research that are linked to the study field. We will first start with HCD, continue onto design and innovation research, and end with STS.

2.1 HCD

The main application field of this dissertation is HCD. In HCD, experts from different fields cooperate with potential users to bring the users’ views to into the innovation process and, together, define problems and develop solutions (Steen 2012). The advantage of HCD is that it aids in developing products and services that are more easily acceptable and thus enhances the innovation process. This research studies how HCD is practiced in the case company, and therefore, the most integral field of literature is also HCD. In this section I will cover the aspects of HCD relevant to this dissertation with a brief overview of HCD, its methods, HCD in organisations, HCD maturity and method mixes.

It should be noted that at times the term user-centred design (UCD) comes up in this dissertation, as well as in HCD theories. UCD has a focus on the end user, whereas HCD acknowledges that there are also other stakeholders that are involved both with and by the solution that is being designed (Steen 2011). At times, in literature and in practice, these terms are used as synonyms, despite the difference in the point of view. Originally the term ‘user-centered system design’ (UCSD) was presented by Norman and Draper (1986). The initialism UCSD, was conveniently also the initialism for University of California, San Diego, the home university of the editors of this foundational book. As stated in the book: ‘So from UCSD, the University, has come UCSD, the project, and, eventually, the name of this book: User Centered System Design.’ (Norman and Draper 1986). Quite shortly, though, this initialism (of the practice) was shortened to UCD, which then was later further adjusted to HCD to highlight the importance of all stakeholders in the design process.

Furthermore, the difference between the terms user and customer should be recognised. An ISO standard defines a user to be a ‘person who interacts with the product’ (ISO 9241-11 1998). The user can be either the person that is
operating the product or using the service, or is directly affected by it (Johnson 2013), whereas the customer is the one purchasing the product or service. In my research case this difference is especially significant as, in industrial settings, those using the devices and machines rarely influence the purchasing decision. In addition, the one making the purchasing decision often differs from the one who actually makes the investment.

2.1.1 HCD in General

HCD has a history running over four decades. It has developed from several fields: including ethnography, anthropology, marketing, ergonomics, participatory design and computer science (van der Bijl-Brouwer and Dorst 2017; Giacomin 2014). HCD focuses on bringing forward the needs and activities of the people for whom a product or system is intended (Giacomin 2014).

During the 1980s and 1990s, the fields of usability and UCD widely grew together with the spread of different human–computer interfaces. These called for a deeper inspection of the user perspective and users’ goals in order to build usable systems and satisfy the users’ needs (Norman and Draper 1986). Participatory design, which can also be seen as a grounding field for HCD, was in turn established in the 1970s in Europe, especially in Scandinavia, in the working environments as a way to integrate the social dimension into the uptake of new technologies (Simonsen and Robertson 2013; Mattelmäki and Visser 2011; Kuhn and Muller 1993). One of the main concepts of participatory design is empowerment; the ones affected by design should also have a possibility to influence the design. Thus, participatory design has a wider social aspect to it compared with HCD (Mattelmäki and Visser 2011). Although in the beginning much emphasis was placed on the end users, it was later noted that a design affects many other stakeholders, not only the end user of a system, and thus, the perspective of HCD emerged:

Today's human centred design is based on the use of techniques which communicate, interact, empathize and stimulate the people involved, obtaining an understanding of their needs, desires and experiences which often transcends that which the people themselves actually realized. (Giacomin 2014)

HCD has grown into a field that is applied broadly. It provides tools and practices for supporting the design of usable, pleasurable and meaningful products and services for people (van der Bijl-Brouwer and Dorst 2017). The purpose of these tools is to guide practitioners in gaining information about the users and apply that information in product and service design (van der Bijl-Brouwer and Dorst 2017). One area where HCD has been applied broadly is in the area of information systems where user participation has been a notable research topic for decades (Iivari, Isomäki, and Pekkola 2010). Iivari and Iivari (2011) have defined user-centredness as consisting of four aspects: user focus,
work centredness, user involvement and system personalisation (Iivari and Iivari 2011). HCD has also been defined by ISO standards, which demonstrates that it has been considered to be a significant field. An earlier ISO standard – ISO 13407, 1999 – stated that HCD is based on four principles (Steen 2012):

1) Involving users to better understand their practices, needs and preferences
2) Searching for an appropriate allocation of functions between people and technology
3) Organising project iterations when conducting the research and generating and evaluating solutions
4) Organising multi-disciplinary teamwork.

Thus, the basis is that the users are placed centre stage throughout the iterative process, wherein evaluations and iterations follow each other until a functioning solution for the use of the technology has been developed.

The newer ISO standard, ISO 9241-210 (2019), recommends six principles for HCD:

1) Explicit understanding of users, tasks and environments
2) The involvement of users throughout design and development
3) The design should be user-centred evaluation driven/refined design
4) The process should be iterative
5) Consideration of the whole user experience
6) The adoption of multidisciplinary skills and perspectives.

Again, the involvement of the users throughout the process is underscored, as well as the iterative development process. However, the newer principles highlight the user experience as well as the design being more driven by user centricity than earlier. In addition, it should be noted that both of these highlight the importance of multidisciplinary development teams. These do, indeed, demonstrate the basic principles of HCD.

2.1.1.1 HCD Methods

In aiding these principles, HCD has developed a vast variety of methods for understanding the user and the usage environments, designing for a better UX and evaluating the designed outcome. These methods cover the range of the user, ranging from being an inspiration or an information source for the designer to being part of very deep forms of co-creation and user innovation. Within the range there are forms where the users and their environments are studied and where users are utilised for testing and validating designed solutions. There have been many attempts to list and categorise these different methods. I will present here a few examples with different viewpoints. However, these do not cover all of the method lists nor all the methods but are rather intended to give an overview of HCD method classifications. The first categorisation of different methods (Maguire 2001) is presented in Table 2. This
table by Maguire (2001) categorises different methods according to the phase of the development process as defined in the ISO 13407 standard. It includes 37 methods that are divided into five groups, the phases of the development process. As can be seen, not all of these methods are comparable: some are larger entities, whereas others are individual tools or techniques. In addition – for example, in the evaluation phase – some of the methods are related to iteration phases and others are rather for feedback after launch.

Table 2. Categorisation of HCD methods according to the phase of the development process according to ISO 13407 (Maguire 2001).

<table>
<thead>
<tr>
<th>Planning (Section 3)</th>
<th>Context of use (Section 4)</th>
<th>Requirements (Section 5)</th>
<th>Design (Section 6)</th>
<th>Evaluation (Section 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.3. Survey of existing users</td>
<td>5.3. User requirements interview</td>
<td>6.3. Design guidelines and standards</td>
<td>7.3. Heuristic or expert evaluation</td>
</tr>
<tr>
<td></td>
<td>4.4. Field study/user observation</td>
<td>5.4. Focus groups</td>
<td>6.4. Storyboarding</td>
<td>7.4. Controlled user testing</td>
</tr>
<tr>
<td></td>
<td>4.5. Diary keeping</td>
<td>5.5. Scenarios of use</td>
<td>6.5. Affinity diagram</td>
<td>7.5. Satisfaction questionnaires</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.7. Existing system/competitor analysis</td>
<td>6.7. Paper prototyping</td>
<td>7.7. Critical incidents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.9. Allocation of function</td>
<td>6.9. Wizard-of-Oz prototyping</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.10. User, usability and organisational requirements</td>
<td>6.10. Organisational prototyping</td>
<td></td>
</tr>
</tbody>
</table>

Goodman-Deane et al. (2008) recognised over 330 design methods and techniques in their research. They chose a sub-set of 57 methods for a further
card-sorting exercise with a group of designers. They grouped these methods under two main groups: user information methods (such as personas and user videos) and user involvement methods (such as interviews, usability tests and observations). They further grouped these into six main groups (examining the market, analysis, understanding users without direct user contact, prototyping concept design and direct user contact) and eight sub-groups, which were located under ‘understanding users without direct user contact’, ‘prototyping concept design’ and ‘direct user contact’ (Goodman-Deane et al. 2008). To conclude, they categorised the methods based on the purpose of the method.

Some method lists focus on UX. Although, UX is its own field, UX methods are often communicated as UCD or HCD methods. An example of a UX methods list is the methods for UX evaluation presented at www.allaboutux.org. The website provides information collected from the UX community and includes a list of 86 different methods and their descriptions. These methods have been categorised by method type (field studies, lab studies, online studies, questionnaires/scales), development phase (concepts, early prototypes, functional prototypes, on the market), the studied period of usage (before usage, snapshots during interaction, an experience of a task, long-term UX) and by who is the evaluator or information provider (a UX expert, one user at a time, user pair, groups of users) (http://www.allaboutux.org). These categorisations show the diversity of the evaluation methods. UX will be discussed further in section 2.1.4.

In the area of information systems development, Isomäki and Pekkola (2005) have divided user centredness into seven approaches: structured methods, prototyping and evolutionary approaches, the socio-technical approach, the soft systems methodology, end-user computing, participative design and human–computer interaction (HCI). Although this is not a method list as such, it does present a categorisation in the context of information systems design.

There are also method mappings that are related to HCD that focus on participatory design. Figure 1 presents a simplified version of the mapping by Kuhn and Muller (1993), which shows a variety of methods mapped according to the stage of the development lifecycle and users’ and designers’ engagement level. These methods vary from being different types of prototyping to evaluations but also include individual techniques, such as ‘contextual inquiry’, and categories of methods, such as ‘ethnographic methods’. However, this mapping manages to highlight the broad scale of methods from the point of view of the involvement level, as well as the usage of methods throughout the development process.
While most of these lists and categorisations have their deficiencies, such as the methods not being directly comparable or the selection of certain methods for the listing while excluding others, they can demonstrate how broad and versatile the range of HCD methods is, and they can be listed and categorised in several ways.

In addition to all these existing methods for HCD, new methods are also still developed, for example, to utilise the new technical possibilities, such as user-triggered usability testing (Pitkänen and Pitkäranta 2012) or data analysis applications for usability studies (Pitkänen 2017). Also, different design games that aid in getting all stakeholders’ views in the design process have been created (for example, Vaajakallio 2012); especially in regard to deeper user involvement and user-driven design, methods have been developed to widen the users’ innovation and participation possibilities.

Another research aspect of HCD methods is the validation and comparison of the developed methods. A large number of studies have been conducted where different HCD methods have been compared and validated. For example, the same user interface has been evaluated with two or more different methods (as in Karat, Campbell, and Fiegel 1992; Alhadreti and Mayhew 2018) or the same methods have been used by different experts (as in Nielsen and Phillips 1993; Molich et al. 2004). Some of these studies have resulted in controversial outcomes that have led to questioning the research approach of developing and validating new methods (as in Gray and Salzman 1998; Hornbaek 2010) and
instead suggesting a wider research focus in real-life cases (as in Woolrych et al. 2011; van Turnhout et al. 2014).

To summarise, the variety of HCD methods is quite diverse, but the main methods usually fall under the following: observations, interviews, prototyping, user testing, user participation and evaluations. For this research, HCD offers, on the one hand, research methods (such as observations and interviews) that were utilised in this research. On the other hand, HCD offers an area to be studied, including how its practices are applied in practice.

2.1.1.2 HCD in Organisations

HCD in organisations has been studied for nearly as long as HCD in general; however, it has been studied increasingly after the turn of the millennium. The research has had a strong focus in northern Europe and North America as well as in software organisations. Next I will present a summary of some of this literature, aiming to introduce the types of research that have been conducted in the area. In many cases the focus has been on introducing HCD to organisations and, as a more recent line, the integration of agile processes to HCD has been discussed.

One line of research has been to conduct surveys about the HCD practices in different companies. This was strongly focused on during the years 2000 to 2008. This type of research has been conducted by many researchers (Bygstad, Ghinea, and Brevik 2008; Gulliksen et al. 2004; Venturi and Troost 2004; Venturi, Troost, and Jokela 2006; Vredenburg et al. 2002; Følstad, Jørgensen, and Krogstie 2004; Mao et al. 2005; Grudin and Poltrock 1989), and in some of these research cases, similar questionnaires have been applied. In some cases, researchers have combined surveys with a more qualitative approach (Gulliksen, Boivie, and Göransson 2006). Although this has been an important research line, since it has provided a broader view on the state of HCD in different organisations, it is not elaborated further in this thesis. It provides a good overview of the state of the industry but does not inspect the practices of the organisations in more detail.

Another line of studies includes the integration of HCD into organisations. Iivari and Abrahamsson (2002) have studied the cultural aspect of introducing HCD in a software company (part of a broader KESSU project, which studied UCD practices in organisations at the beginning of the 2000s). They studied the organisation through three subcultures: software engineers, managers and usability specialists. They discovered differences in three aspects: views in the nature of HCD, the motives for implementing HCD and the experiences gained from HCD. This highlights the importance of mutual understanding between the subcultures and demonstrates well the challenges of less-mature HCD organisations. Furthermore, Iivari (2006) has proposed four ‘cultures of usability work’ and researched their fit in five case units from three different companies. She discovered that different approaches to usability work were
applied in these five different cultural contexts and, thus, recommended that
the integration of HCD into organisations should be fitted to each organisation’s
culture, indicating the need for different adapted approaches (Iivari 2006).
Kashifi, Feldt and Nilsson (2019) have conducted a more recent study on
integrating UX into software development organisations. They reported four
lessons learned and five pitfalls in UX integration. The lessons learned
highlighted considering: influencing events, success factors and challenges,
resistance towards UX and UX integration guidelines. The pitfalls included: the
transition from usability to UX, not understanding the differences of UX and
usability, only considering the graphical design as UX, pursuing the ownership
of UX in a single place and relying on past achievements in user interface design.
They highlighted the importance of organisational change’s nature in the
integration process (Kashifi, Feldt, and Nilsson 2019). Winterer et al. (2019)
studied the introduction of HCD processes in a manufacturing company and
reported violations of HCD principles as well as the causes for these. They also
highlighted the importance of the whole organisation in the change process
(Winterer et al. 2019). Marcus (2005) highlighted that the funding for the HCD
activities in enterprises needs to be guaranteed in order for the functions to be
fully established. In addition, he noted the importance of simplified processes
and marketing the HCD know-how inside the organisation (Marcus 2005).
These studies focus on what affects the integration of HCD activities and what
needs to be taken into account, and thus, they do not address organisations that
have already established HCD processes. A common result of these studies is
that they highlight the cultural aspects of organisations in the integration
process.

Several researchers have provided recommendations for organisations on
implementing HCD (Gulliksen et al. 2003; Seffah, Gulliksen, and Desmarais
12 recommendations for organisations:

1) the user perspective should guide the development from the early
   stages
2) user involvement should be active
3) systems’ development should be iterative
4) the design needs to be represented in a simple way to be easily
   understood by users and stakeholders
5) prototyping needs to be constant
6) design should be based on specified criteria
7) the design activities need to be dedicated
8) development should be carried out in multidisciplinary teams
9) usability experts need to be involved throughout the process
10) design should be holistic
11) the HCD process should be customised for each organisation
12) all people in the project need be committed to HCD.
Andreasson et al. (2015) recommend: raising awareness of the benefits of HCD work, getting management’s support for HCD work, supporting the personnel in the HCD work, recognising the negative impact of deficient HCD work and following-up on the results of improved HCD work. In addition, these research cases have provided valuable information on the organisational changes that should take place in order for HCD to fit an organisation’s processes. Furthermore, Peer (2017) has developed methods for supporting organisations in growing their HCD capacity. These are called User Data Spectrum Theory and Survey, and Rapid Meaningful Scenarios (Peer 2017). Eriksson and Swartling (2012) have studied a different type of organisation – the Swedish military defence. Their research aimed in introducing HCD to the organisation via user-centred activities. They described a method they called the guerrilla tactic, where the HCD practices are introduced gradually, with smaller examples. They noted that this type of work was likely to be applied in the industry, but not recognised in research settings. These studies provide valuable guidelines for organisations that want to implement HCD in their processes, but the work is rather normative and does not inspect how these recommendations have been applied in different organisations. Again, the more HCD-mature organisations have not been in the focus of these studies either.

The integration of HCD with agile methods has been an area of interest during the past few years as it has been reported to be problematic in many instances (see, e.g. Gregory et al. 2016; Bruun et al. 2018). Quick iteration cycles, incremental development, co-operation with the customer and individuals’ responsibility (Stickel et al. 2016; Cockton et al. 2016) are essential in agile development methods. Practices for integrating these two have been proposed by, for example, Kuusinen (2016) and Bordin and De Angeli (2017). Usually these include either a preceding research and design phase or conducting these in the same iteration cycles (Brhel et al. 2015). Kuusinen (2016) has proposed a best of both worlds (BoB) framework wherein the UX work is integrated within the iterations. The UX practitioners need to be integrated in the project teams and not be external resources, and the user views (as well as the iterations in general) are started on a small scale (Kuusinen 2016). Bordin and De Angeli have proposed a set of design techniques to help in overcoming the potential communication problems in the integration of HCD and agile processes. These included low-fidelity prototyping, usability testing, personas, expert evaluations and user task analyses (Bordin and De Angeli 2017). Sy (2007) recommended that HCD practices are also scoped as incremental mini-releases and that design activities are run at least one agile cycle sprint under a separate track ahead of the development. The work around agile processes addresses a very relevant study field for today’s software industry and, in some of these cases, real-world applications have been reported. The focus in these cases is naturally on software organisations and the maturity levels of the organisations can vary greatly.

What is notable in these research papers is that they have investigated the state of HCD in companies or the challenges in integrating HCD into design and
development processes and developed practices in order to support the integration. In addition, one stream of research has produced guidelines for organisations to implement HCD. However, they rarely describe how HCD-mature organisations have overcome these challenges and what practices they have developed, although some examples that are related to this topic can be found (see Hansson, Dittrich, and Randall 2006; Johnson 2013; Sy 2007).

### 2.1.1.3 Adoption and the Barriers to HCD

During the past decades, several studies have been conducted about the adoption of HCD in software companies. Software has usually been the context for these investigations, the area has not been specifically selected for this review. Investigations have been conducted in companies in Europe (such as those of Lauesen 1997; Bak et al. 2008; Dillon, Sweeney, and Maguire 1993; Bednarik and Krohns 2015; Iivari 2004, 2006), in Asia (such as those of Henry 2003; Ji and Yun 2006; Ronggang Zhou et al. 2008), in North America (such as those of Vredenburg et al. 2002) and in Africa (such as those of Ogunyemi et al. 2016; Teka et al. 2017). Other areas have not been intentionally left out of this inspection; rather, research has not been conducted as much in those regions. These studies conclude that the main obstacle for HCD adoption is a lack of resources, especially time and money, but also skilled personnel.

In one of the more recent studies, Bednarik and Krohns (2015) studied IT companies in Eastern Finland and discovered that, although the importance of user information was acknowledged, there is a misunderstanding of the basic concepts of user and customer, which can already be seen to affect the adoption of HCD. As the user and customer are rarely the same person in industrial context, it is essential to recognise which stakeholder is actually the one providing the information and to recognise who to target during the design process. However, the most common barrier for gathering user information was cost and funding. In addition, they discovered that communication issues (between users or customers and the company, as well as inside the company) were also among the most common problems companies faced regarding UCD (Bednarik and Krohns 2015). As a comparison, another more recent study of Nigerian software companies by Ogunyemi et al. (2016) discovered that there was a clear lack of knowledge of HCD methods and goals, and graphic design was the most common HCD-related activity performed in the studied companies. The authors concluded that there is a need for further education and networks that would spread HCD knowledge in the country (Ogunyemi et al. 2016). There seems to be a clear difference in HCD knowledge and awareness levels between different geographical areas and, whereas in some regions we can discuss the user involvement levels and techniques, in other areas there is more need for basic HCD introduction.

In addition to the cost and funding issues, other often-mentioned obstacles include a lack of experts, as well as a lack of easy methods and a lack of personnel. Kujala (2003) has focused on the earlier phases of the development
process and notes that user involvement can be difficult as contact with the users might be problematic (different user groups might have conflicting views, and the roles of designers and users might not be clear). Iivari (2006) stated that, especially in product development, even identifying and making contact with the potential users is laborious as the different parts of the organisation are isolated and the user information often comes to R&D through marketing. In addition, there might not be time to test iterations with users (Iivari 2006). Often the company culture can also be seen to limit user involvement (Iivari 2006). More recently, research has reported that combining HCD with the agile development of software has been problematic as the development sprints would require considerable upfront research activities (Cockton et al. 2016). If we consider what Gould and Lewis already discovered in the 1980s when studying designers’ attitudes towards (human-centred) design principles, we can see that many of the reasons hindering HCD adoption still exist. According to them, designers may not see, on the one hand, the differences between different users or the differences between themselves and the users; on the other hand, they may not see the purpose of only studying a few people since all the users are so different. Another often-heard argument was that users do not know what they need, although there are ways to overcome this (Gould and Lewis 1985). These arguments can still, over 30 years later, be heard in some organisations; however, most designers themselves seem to understand the advantages of direct user contact. Furthermore, Gould and Lewis discovered that some designers believed that reasoning or guidelines are powerful enough to guide the design work and that good design means getting it right the first time, that user testing will lengthen the design process, that iterations are just expensive fine-tuning and that technology will sell itself. In addition, they discovered that HCD principles are not understood or valued. These beliefs have also been discovered in a whole range of other studies, as Iivari et al. (2010) summarised:

As pointed out by several authors (e.g. Gould & Lewis, 1985; Grudin, 1991; Kyng, 1994; Alam, 2002; Kujala, 2003; Iivari, 2006) user involvement in the IT product development context is challenging as identifying and making contact with the prospective users is often difficult, and there may be not be enough time to involve the users or for iteration.

The fact that contacting the potential users is seen as one of the main challenges of HCD indicates that it is used as an excuse for not conducting user involvement, that communication within organisations does not function or that there is no clear understanding about who the target group for the designed product, service or system is.

Furthermore, in IT companies, confidentiality issues are one common reason for omitting user tests (Oudshoorn, Rommes, and Stienstra 2004). As Oudshoorn et al. (2004) stated:
Moreover, ICT companies are reluctant to test new products among potential users for fear that other firms will become aware of their plans at an early phase of product development (European Commission–DG XIII-C/E 1998, 22; Woolgar 1991).

This confidentiality reason also applies in my research case as the top management had forbidden involving external parties during the development phase.

As can be seen, there are many factors that affect the adoption of HCD in organisations – some of them have already been reported decades ago and some are more justified than others. There are also differences between geographical areas when looking at the adoption of HCD. I have summarised these in table 3, where the barriers for conducting user involvement have been categorised into three groups: a lack of knowledge, cultural issues and restrictions. The first category includes issues related to understanding the basic concepts and these often relate to organisations that are less mature in HCD. The second category covers issues related to company culture, such as communication issues or processes that do not support user involvement. The third category includes the restrictions due to resources and confidentiality issues.

Table 3: A summary of common reasons for abandoning user involvement.

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Culture</th>
<th>Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misunderstanding basic concepts</td>
<td>Communication problems inside the organisation</td>
<td>Lack of experts</td>
</tr>
<tr>
<td>Attitudes towards users and testing</td>
<td>Contact to users is difficult</td>
<td>Lack of resources (time &amp; funding)</td>
</tr>
<tr>
<td>Believing in the power of guidelines</td>
<td>User involvement does not fit the process</td>
<td>Confidentiality issues</td>
</tr>
</tbody>
</table>

2.1.2 HCD Maturity Measurements and the Development Level in Companies

HCD literature suggests several ways for evaluating a company’s maturity or capability level in HCD or related fields. Research suggests at least 15 different models for assessing a company’s HCD or UCD level, including models based on ISO standards, like ISO 18152 (Jokela 2004; Jokela et al. 2006; Lacerda and von Wangenheim 2018; Jokela et al. 2001). These methods include different organisational maturity models and usability capability maturity models, as well as more specific models, such as the Corporate User Experience Maturity Model, the AGILEUX Model and the STRATUS assessment (Jokela 2004;
Jokela et al. 2006; Lacerda and von Wangenheim 2018). During the past years, different capability maturity models in particular have evolved and been validated. Many of these evaluation models focus on software development and its usability, and some have been developed by software companies (Jokela 2004; April and Coallier 1995), but some can also be used in other environments. Several overviews of these different models have been provided in the related academic literature (see, e.g. Jokela 2004; Jokela et al. 2006; Lacerda and von Wangenheim 2018; Jokela et al. 2001). These models can be used by organisations to evaluate how well they incorporate HCD in their activities; however, these are often very focused on software development and its usability, and are not very applicable in other areas.

One of the earlier models (yet one of the most comprehensive models) that has been developed is the Usability Maturity Model: Human-Centeredness Scale (Earthy 1998). It includes five levels for evaluating the maturity of a company’s human centeredness, with level E being the highest and level A the lowest. The assessment scale has 12 dimensions that each contain one to four evaluation points (Earthy 1998). Table 4 presents the different levels and their main dimensions/attributes of the Human-Centredness Scale. Each level includes the attributes from the earlier levels and the new attributes for that level. The evaluation points include statements such as:

- **Human-centred methods training.** Staff are made aware that quality in use is achieved through the use of a series of human-centred processes during the development and support/use of a system. (Earthy 1998, p. 14, level B.1)
- **Use appropriate representations.** Representations of user requirements and changes to the system arising from user involvement should be understandable by system developers and programmers. (Earthy 1998, p. 17, level D.1)
- **Human-centred improvement of organisation.** The approaches used to ensure that systems are human-centred are also used within the organisation to improve its own processes and systems. (Earthy 1998, p. 19, level E.1)

These statements are each evaluated on a scale of four options: N – not achieved, P – partially achieved, L – largely achieved, F – fully achieved (Earthy 1998). For a company to achieve a certain level, it should have all its attributes rated as L or F (depending on the attribute).

As an example, I will present level B and its attributes in more detail. The ‘quality in user awareness’ attribute (B.1) includes three management practices to be evaluated: (1) How well are the staff aware that quality in use is a system attribute that can be improved? (2) How well are the staff aware that quality in use is achieved through the use of HCD processes? and (3) How well are the staff aware that human-centredness covers the total system, not only the user interface? The ‘user focus attribute’ (B.2), in turn, includes two management...
practices that are evaluated: (1) Are the staff aware that the end user needs need to be considered when developing the system? (2) Are the staff aware that the end users’ skills, background and motivation might differ from the staff’s? (Earthy 1998). The higher an organisation is on the scale, the more evaluation points there are. Although some of these may seem a bit outdated, most points are even very valid today and this model still provides a systematic and easy-to-follow way to conduct the assessment, also in fields other than software development.

Table 4. The levels of the Human-Centredness Scale (Earthy 1998).

<table>
<thead>
<tr>
<th>Human-Centredness Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ID</strong></td>
</tr>
<tr>
<td>Level X</td>
</tr>
<tr>
<td>Level A</td>
</tr>
<tr>
<td>A.1</td>
</tr>
<tr>
<td>A.2</td>
</tr>
<tr>
<td>Level B</td>
</tr>
<tr>
<td>B.1</td>
</tr>
<tr>
<td>B.2</td>
</tr>
<tr>
<td>Level C</td>
</tr>
<tr>
<td>C.1</td>
</tr>
<tr>
<td>C.2</td>
</tr>
<tr>
<td>C.3</td>
</tr>
<tr>
<td>Level D</td>
</tr>
<tr>
<td>D.1</td>
</tr>
<tr>
<td>D.2</td>
</tr>
<tr>
<td>D.3</td>
</tr>
<tr>
<td>Level E</td>
</tr>
<tr>
<td>E.1</td>
</tr>
<tr>
<td>E.2</td>
</tr>
</tbody>
</table>

In general, these scales and ways to evaluate a company’s maturity level can provide a way to analyse a company’s performance level, but even more than this, they can offer a way to develop the organisation towards having a more human-centred culture.

2.1.3 Method Mixes

Unlike some of the earlier HCD research suggests, in real life, companies combine and mix different HCD methods in order to get the needed outcome in their work (Johnson et al. 2014; Solano et al. 2016; van Turnhout et al. 2014;
There are numerous studies presenting combinations of methods for HCD (such as that of Keinonen, Jääskö, and Mattelmäki 2008). In these studies, it can be seen that the selection of the combined HCD methods can be formed either systematically (van Turnhout et al. 2014) or in a looser manner, by convenience or by preference (Keinonen, Jääskö, and Mattelmäki 2008). As can also be seen from many empirical studies, the methods are often combined by chance or habit, instead of the method mix resulting from analysing the needed information and the most suitable methods (Mäkinen, Hyysalo, and Johnson 2019).

A line of studies also exists called *mixed methods research*, which reports combinations of methods in different projects (Tashakkori and Teddlie 2010; Teddlie and Tashakkori 2008). Usually these have combined qualitative and quantitative methods (Arhippainen, Pakanen, and Hickey 2013; Johnson, Onwuegbuzie, and Turner 2007; Livingstone and Bloomfield 2010), but some have also described test setups similar to those in HCI research (Leech et al. 2010). However, what is worth noting is that most of the mixed-methods studies leave the previous information sources out. For example, Livingstone and Bloomfield (2010) discussed the mixed-methods approach, but they did not combine the newly gathered information with the already existing information. As Van Turnhout et al. (2014) stated, the combinations should be validated and they still lack integration with previously gathered information, which often happens in real-life settings.

This thesis includes analysis on method mixes that categorises the methods in four groups: formal methods, informal methods, results from prior studies and background resources. *Formal methods* include methods with established routines and HCD research methods. *Informal methods* cover instances where user involvement is not formally planned, and it can be a part of other activities; in these the documentation and communication of the findings requires significant efforts. *Results from prior studies* refers to studies and user involvement that have been conducted prior to the ongoing project but their results are utilised in the current project. *Background resources* covers earlier, wider research activities, such as market studies. These different types are further elaborated in article 1.

### 2.1.4 Newer Directions of HCD: UX and Service Design

As HCD has been applied and developed for decades, it is only natural that new areas have also emerged from it. Next, I will focus on two of the probably most popular areas: UX and service design. These two have especially been applied in companies and the public sector but have also attracted numerous research activities within academia.

Traditionally HCI, UCD and HCD have focused on avoiding negative incidents, such as usability errors. The shift towards UX evolved mainly after the turn of the millennium and was based on the idea of designing for experiences that
would affect the user’s emotions in a positive way (Vermeeren, Roto, and Väänänen 2016). This requires more empathy and design skills from the designer and also shifts the focus of the research onto more creative studies (Vermeeren, Roto, and Väänänen 2016). UX is thus about creating high-quality experiences, and designing for pleasure rather than the absence of pain (Hassenzahl and Tractinsky 2006). The ISO standard defines UX to be a ‘person’s perceptions and responses resulting from the use and/or anticipated use of a product, system or service’ (ISO_9241-210 2019). The original version was already defined in 2008 (Law et al. 2009).

The following definitions of experience and UX were formed by 34 UX researchers and practitioners in a 2010 Dagstuhl seminar. It gives a slightly deeper definition what experience is in than the ISO standard, and it widens the term’s use to include more passive interaction:

The notion of experience is inherent to our existence as people. Experience in general covers everything personally encountered, undergone, or lived through. User experience differs from experiences in a general sense, in that it explicitly refers to the experience(s) derived from encountering systems, where ‘encountering’ can be interpreted as using, interacting with, or being confronted passively, and where ‘system’ is used to denote products, services, and artefacts – separately or combined in one form or another – that a person can interact with through a user interface. (Roto et al. 2011)

Hassenzahl and Tractinsky (2006) presented UX as having three facets that each contribute to the complete picture of UX by describing one area of users’ interactions with technology: addressing human needs beyond the instrumental needs; the affective and emotional aspects of interaction; and the experiential perspective. UX is, thus, a consequence of the user’s internal state, the characteristics of the designed system and the context where the interaction occurs (Hassenzahl and Tractinsky 2006).

The methods utilised in UX do not differ significantly from the HCD methods, as was mentioned already (in section 2.1.1), the emphasis of UX methods being on designing for pleasurable use, empathy for the user and focusing on how users feel about the product, service or system. In practice, HCD methods are often also used in the context of UX. UX methods can be grouped in many ways, as presented in section 2.1.1. One way to categorise them is according to different stages of usage (before use, short-term usage and long-term usage) or momentary experience (Vermeeren et al. 2010). Before-use studies include methods such as Playability Heuristics and fun toolkit; short-term usage studies include methods such as the technology acceptance model scale, the hedonic/utility scale; long-term usage studies include methods such as longitudinal pilot studies and evaluation probes; and momentary experience studies include methods such as think-aloud and psycho-physiological measures (Vermeeren et al. 2010). To conclude, the driving force for the
emergence of UX has been designing for positive experiences instead of solely trying to avoid negative encounters, as well as bringing the holistic view of the user to the design of a product, service or system.

Service design, in turn, emerged during the 2000s – as the role of services has grown in society and during recent years, it has expanded in popularity. Service design has especially gained popularity in the public sector as it has been applied broadly in fields such as health care. It is closely linked to management research (Kimbell 2011). It should be noted when discussing service design that the term *designing for services* is also used at times as a synonym for *service design* and, at times, as a sub-category of service design (Kimbell 2011). However, the term *service design* has become the established wording outside academia.

Although it has roots in other design fields, during the past years service design has developed its own set of tools and methods for R&D purposes. Many of these are based on earlier HCD and co-design work or borrow from marketing, business or other fields, but they have been fit for the purpose of designing for services. Service design is based on co-design as the idea is that new solutions are created together with relevant stakeholders. The main methods and tools for service design include service blueprints and customer journey mappings, which are meant for identifying the customers’ contact points with the service, as well as different types of prototyping methods (such as bodystorming, experience prototyping and storyboarding) and idea creation tools (such as different workshops) (Miettinen 2009; Alves and Nunes 2013). Also, the use of personas, which are known from HCD methods, and research methods, such as observations and probes, are common (Miettinen 2009). Furthermore, it is also essential for service design to identify how the front end and back end of the service function (Miettinen 2009; Kimbell 2011). A rough mapping of different service design methods is presented in Figure 2. The mapping divides the methods and tools into three basic phases: background/research, ideation and prototyping/testing; this is not meant to cover the service design process in a comprehensive way, but rather to provide some means for classification of the methods and tools listed. Also, it does not cover all service design methods. However, it provides an overview of the most common service design methods and tools.
When discussing service design, the term *design thinking* is also often mentioned. Design thinking is slightly more innovation and business oriented, but part of its background is also in HCD (Brown 2008). This term will not be discussed further in this thesis as it is mainly covered with the other topics and the term has not been discussed in the case company.

### 2.2 Design and Innovation Management

This section shortly addresses the main issues of design and innovation management that are relevant for this thesis. Design management also covers the design maturities of organisations, which has a connection to HCD maturities.

Design management addresses how design should be integrated in an organisation, what kind of role it should have and how design processes function. Already in 1989 Dumas and Mintzberg described five different ways for managing the design process. These include:

1) Design being promoted by a champion
2) Design being institutionalised as a policy
3) Design being institutionalised as a programme
4) Design being institutionalised as a function (either lagging or leading)
5) Design being infused in the organisation (Dumas and Mintzberg 1989).

The first four ways of designing might act as a path to the design infusion model, which is seen as the most effective way to manage design processes. When design is infused in an organisation, everyone is committed to design and doing design, and design becomes ‘a way of life’ (Dumas and Mintzberg 1989). In this type of organisation, many aspects of design are carried out by managers in roles which are not traditionally seen as design related but they are in key positions in using design actively (Dumas and Mintzberg 1989).
In comparison to the HCD maturity assessments, today there are many ways and scales to evaluate how mature an organisation is in applying design – the Danish Design Ladder being probably the most widely known (Danish Design Center 2015). This model includes four stages that illustrate the varying state of design usage in a company. Figure 3 shows the Design Ladder’s stages (Danish Design Center 2015). With the ladder an organisation can better understand how design can be utilised and can assess their own capabilities to apply design on different levels. There are also other design maturity models – such as the four powers of design model (Borja de Mozota 2006), the Design Management Staircase (Best, Kootstra, and Murphy 2010), the Design Function Maturity Grid (Gardien and Gilsing 2013) and the Design Value Scorecard (Westcott et al. 2013) – most of which also divide design maturity into four stages, but those will not be addressed here in more detail as their constructs are roughly similar.

Non-Design
Design is not any significant part of the development process and it is not done by a designer. In addition, the user’s view only has a minor role in the process or no role in it.

Design as Form-giving
Design is only a matter of visualising a product or the final form-giving stage.

Design as Process
Design is an approach that is applied at every stage of the process. The solution requires skills from a variety of professionals and is driven by the problem and the users.

The focus is on the design process as a part of the company’s strategy and vision. The business concept is rethought in cooperation between the designer and the leaders.

In the Danish Design Ladder example, it is intended that an organisation climbs the ladder upwards. However, it should be noted that, in some cases, the organisation might not need to be at the highest level in order to apply design in a suitable way or in a way that best fits its purposes. In addition, we can look at user innovations. Often the target is that an organisation should move towards the more integrated user innovation modes until they reach the deepest or highest level. However, targeting being as high as possible in any aspect of corporate performance may not be effective or desirable as making the high investments that are needed to be on top of design, logistics, marketing, IT (and so on) areas that have maturity models would be wasteful resource use. Furthermore, real-life organisations move towards deeper design or user innovation and then return to a lesser form of user participation in their innovation processes or the adequate (or just realised) user involvement level might change from one project to another (S. Hyysalo et al. 2016). Thus, an
organisation might conduct one project in a user-driven mode and the next ones in other modes as user involvement often requires resources and the need for them might vary (S. Hyysalo et al. 2016). This leads us to one specific way of user participation in innovation projects: users being employed by the organisation (which will be discussed in the next section).

2.2.1 Users’ Roles in Innovation Management

Traditionally, in HCD, the design activities have been ongoing inside R&D organisation and the users have been considered to be ‘the people out there’ (S. Hyysalo and Johnson 2015). In innovation research this is considered to be the closed innovation model (Chesbrough 2003). However, as innovation research has demonstrated, today users are playing a more significant role in innovations and product development and a growing number of cases are being reported of organisations opening up their innovation processes to allow participation from outside as well (von Hippel 2005; Heiskanen et al. 2010; S. Hyysalo, Jensen, and Oudshoorn 2016). This is considered to be the open innovation model (Chesbrough 2003). This contribution or participation with users can be done in many ways: companies can build different innovation communities (Heiskanen et al. 2010), co-operate with lead users (von Hippel 2005; Helminen 2016) and utilise different co-creation and co-design processes (Botero and Hyysalo 2013; V. Hyysalo and Hyysalo 2018). Something these cases have in common is the fact that the users are participating actively in the innovation processes or product development, in some cases even leading them.

However, research has also discovered cases where users have been employed by the developing organisation (see e.g. Kotro 2005; Schweisfurth and Herstatt 2016; Schweisfurth and Raasch 2015). These cases are particularly relevant for this thesis. Kotro (2005) has reported about hobbyist knowing at Suunto, the sports equipment manufacturer, where she discovered that many of the employees were enthusiastic practitioners of the sports (e.g. diving) and, thus, also target users for the final products. Hobbyist knowing refers to situations where the employees have a passion for certain sports, participate in the communities of these sports enthusiasts and the product development; thus, they can also transfer the ideas and values from the sports community to the product development (Kotro 2007). In addition, Mäkinen (2006) has researched the development of the Nokia 770 tablet. Nokia used a group of hackers to develop its product and develop new functionalities for it. Most of this was done with external hackers and after the launch of the product, but some of the hackers were also employed by Nokia (Mäkinen 2006). As a third case, Schweisfurth et al. (2015, 2016) have reported on a company that manufactures mountaineering equipment and employs mountaineers in their development teams. They call these the embedded lead users (Schweisfurth and Herstatt 2016; Schweisfurth and Raasch 2015). Thus, it can be seen that, in addition to different user innovation communities, there are also cases reported with different types of users working inside organisations’ product development, and the relationships between the users and organisations are
quite diverse (Heiskanen et al. 2010). In the case company of my research, the in-house users were not hobbyists, as their profession was not their hobby, nor were they lead users, as they were not building their own versions of the products; they were professionals who used their knowledge in designing and testing the products the case company designed and manufactured. These professional users have the same dual capacity as the previously identified users inside R&D – they can convey and represent user-domain issues inside the company whilst being well-informed of company product development possibilities and limitations.

2.3 User Knowledge and User Representations in STS

HCD has further neighbouring fields that offer support for studying the ways technologies are born and how organisations work when developing new innovations. STS is a multidisciplinary field that addresses how science and technology are constructed (Sismondo 2008). STS has had an interest in users and how they consume and shape technologies (Oudshoorn and Pinch 2003). People shape the technologies they use and, as people view and value things differently, they eventually also shape the technologies they use accordingly. Thus, as people’s values and views vary, the designers cannot know how the designed objects will actually be perceived and adopted before they are actually in use (van den Scott, Sanders, and Puddephatt 2017). At the core of STS are case studies (Sismondo 2004). The use of ethnographic methods is highly valued in STS as it allows viewing the relationship between technology and the social world (van den Scott, Sanders, and Puddephatt 2017).

A line of study called social shaping of technologies (SST) exists under STS. It emerged when several scholars focused on the content of technology and the innovation process rather than on the impact of technological change (Williams and Edge 1996). Traditionally, technology has been taken as a self-evident process and ready to be applied for use or it has alternatively met market demands – with technological progress being taken for granted (Williams, Stewart, and Slack 2005). Later it has become evident that the technological focus itself was not enough to result in successful technological innovations or technology development that supports social wellbeing and economic performance. This resulted in research about the relationship of technology and society, and that is where SST steps in. SST demonstrated that ‘technology does not develop according to an inner technical logic but is a social product, patterned by the conditions of its creation and use’ (Williams, Stewart, and Slack 2005, p. 10). Technology changes our society constantly, but in addition, the innovation process is affected by choices that are influenced by social, economic, political and cultural factors (Sørensen and Williams 2002). These choices are constantly made (sometimes unconsciously) and they can lead to different technological routes, which can have different implications for society (Williams, Stewart, and Slack 2005). The process of developing technologies involves several different players – varying from technicians, suppliers and
designers to the different types of users – all of whom might have a substantially
different understanding of the technology and its use. The end result is, thus, a
result of negotiations between these players during a complex process
(Williams, Stewart, and Slack 2005). Social learning then is related to the users
and user research as it places the user and use in the centre point and combines
technology development with social uptake. It highlights how members of a
society learn about technology offerings and (an aspect which is more relevant
in this research) how designers and developers learn about users and usages
(Williams, Stewart, and Slack 2005). Thus, in order to support the creativity
needed for the successful application of technologies, a better understanding of
users and their activities is required (Williams, Stewart, and Slack 2005).

2.3.1 User Representations

STS includes ‘the sociology of user representation’, which studies how an
understanding of usages and users is achieved and turned into the
characteristics of products (Akrich 1995; Oudshoorn, Rommes, and Stienstra
2004; Williams, Stewart, and Slack 2005; S. Hyysalo and Johnson 2015; Jensen
2012). It emerged in the 1990s in order to address the stream of problematic
products and user interfaces, providing analytical tools and empirical sensitivity
with which to examine how and why an inadequate understanding of users
prevailed in companies (Akrich 1995; Oudshoorn, Rommes, and Stienstra
2004). This early research highlighted the design practices in which designers
used themselves as a reference for the future users rather than involving or
studying them adequately (Akrich 1995; Oudshoorn, Rommes, and Stienstra
2004). However, it should be noted that although STS, HCD and participatory
design all have similar goals, STS implies that there is a richer and more
complex empirical reality to address than that presented by the simple
guidelines offered by user involvement and user research. For instance,
regarding user representations, STS recognises the prevalence of various formal
and informal, as well as well- and ill-elaborated, user representations in design
activities, whereas HCD research treats representations of users as an objective
tool to characterise users and their contexts (e.g. Earthy 1998).

Madeleine Akrich (1995) argued that ‘innovators are from the very start
constantly interested in their future users. They construct many different
representations of these users, and objectify these representations in technical
choices.’ (Akrich 1995). Thus, user representations are a way for addressing the
user perspective during the development process. Actually, during the design
process the user is always represented (Hyysalo and Johnson 2015; Silvast et al.
2018; Iivari 2006). Although the products wind up with actual users, during the
design process the designers focus on representations of users, such as results
from user studies (Hyysalo and Johnson 2015). Redström (2008) discussed this
as a ‘use before use’ situation, as compared with ‘design after design’, where in
the first situation, the actual user is being represented and, in the latter, the
designed solution is already in use (Redström 2008). Thus, it can be seen that
when evaluating design processes, especially when focusing on user information, it is important to also focus on user representations.

The user representations can be of various types and sources (Akrich 1995; Hyysalo and Johnson 2015). Akrich (1995) separated representation types into implicit or explicit types, depending on their source. Implicit representations being ones that are based on the designer’s experience, either being inspired by the user or the designer also being the user. Explicit representations, then, are based on different external sources, such as user studies, market studies, parallel technologies, standards etc. Both of these are important for the design process (Akrich 1995; Hyysalo and Johnson 2015; Williams, Stewart, and Slack 2005).

Williams et al. (2005) presented three categories of resources for building representations of the user. These include:

- Indirect evidence about the user, such as market information on existing users, competitors and demand for other products
- Direct involvement of the user, such as user panels and market studies
- Constructions of the user, such as the vision of technology, fictions about the user and, for example, the engineers’ own experience.

They argue that this demonstrates that the information about the potential users is typically incomplete, and the development team has to put together the information from different sources (Williams, Stewart, and Slack 2005).

To continue with the different sources for user representations, Hyysalo and Johnson (2015) differentiated eight categories of sources for user representations that research literature has identified as having been the main sources of studied development projects. These different sources are listed in Table 5. These sources include both implicit and explicit representations, the two last ones being implicit. Of these sources the user involvement and requirements gathering involve, for example, different research and co-design activities. Business concepts often define target users for the specific product or service, but in addition, business concepts from other areas can also have an effect on the specific product as companies tend to find new usages for already existing technologies and infrastructures. Regulatory demands affect the representations as the new products need to comply with earlier related products, and in many fields, there are safety regulations and standards that the products must fulfil. Parallel technologies refers to related products or services which can provide features to also apply in new products. These are typically user interface solutions that can be applied in new contexts. Cultural maturation often affects the design as new products tend to utilise conventions that are already familiar to users. In article 3 (table 2) I have listed examples of each of these sources from the case company as well as the case project.
In addition to the sources of user representation, what is relevant is how the representations have been constructed and how they are used in the design process. Oygür (2018) has studied the construction of user representations and the different methods that are being used in the process. She noticed that the design process includes several deconstruction and reconstruction cycles of user representations (Oygür 2018). The user knowledge produced by a variety of sources and methods (such as quotations from user comments or formed personas) appears incomplete for the designers, and thus, the user representation needs to be constructed by the designer (Oygür 2018); this is a similar argument to that stated by Williams et al. (2005), who noted that a number of elements of the user and its context need to be pre-configured to develop a representation. In addition, Williams noted that design problems arise when the user has been misconstrued by highlighting the wrong attributes while overlooking others. Thus, the process of constructing and using the representation becomes as important as the sources and usage of the representation (Johnson 2007; Mäkinen, Hyysalo, and Johnson 2019).
2.3.2 Ecologies of User Knowledge

Ecologies of knowledge mapping can be used to describe how the different sociotechnical entities – such as actors, projects, skills, organisations and historical events – can be grouped into one practical set, including their relations and meaningful connectors (Mäkinen, Hyysalo, and Johnson 2019). It is a concept that was presented by Charles Rosenberg in 1997a (1979) in his essay titled ‘Toward an Ecology of Knowledge: Discipline, Context and History’. Akera (2007) had a new view of this concept and developed it further as the scientific world had been moving away from single studies in laboratories and institutions towards wide and loosely coordinated technical exchanges. According to Akera, one of the advantages of the developed ‘ecologies of user knowledge’ representation is that it combines the historical view with STS (Akera 2007). Thus, ecologies of user knowledge can be utilised to demonstrate how an organisation actually knows its users and how the knowledge has been compiled.

Ecologies of user knowledge visualises the different stakeholders, organisations, information sources and their relations (Akera 2007), showing which elements are linked with each other, and which affect the complete picture in other ways. Akera has divided networks into seven layers: actors, artefacts, knowledge/disciplines, organisations, institutions, macroscopic institutions and history. Akera approached the ecologies of user knowledge from an actor-network theory (ANT) perspective. ANT combines the human and non-human actors and their networks, and results in forming networks of actors that repeatedly perform the same actions – the actor networks (Porsander 2005). In his study, Akera used an earlier research example to demonstrate how complicated the ANT diagram becomes when presenting larger subsets of entities and networks. As an aid, he has presented the layered approach of ecologies of knowledge, which he further developed into ecologies of user knowledge by placing the entities into the different layers and drawing the connectors therefrom. These relations between entities help in understanding the connections between them more clearly than in flat network illustrations. In addition, it avoids flattening larger organisations into similar entities as the individual actors inside them and yet manages to help retain better clarity and focalisation beyond mere narrative description (Mäkinen, Hyysalo, and Johnson 2019).

Following the earlier model by Akera (2007), Mäkinen et al. (2019) brought the mapping forward to today’s design environments by slightly modifying the layers and adding layers for an organisation’s user insight methods, a project’s user insight methods and a layer presenting the media platforms and infrastructures. This allowed them to visualise, analyse and compare two different development projects from the Finnish National Broadcasting Company in order to discover their differences and possible reasons for their success or failure. Ecologies of user knowledge representation can, thus, provide clarity to the sources, actors and relations in a project; in so doing, it allows
connecting the method mixes to wider organisational processes, representations and ways by which usage and users become addressed in design organisation. The layers of the model are presented in Figure 4, where the layers added by Mäkinen et al. (2019) to the original layers by Akera (2007) are highlighted in a grey colour. In addition, the layer that was removed by Mäkinen et al (2019) has been drawn with a dashed line.

![Figure 4. The layers of the ecologies of user knowledge mapping. This figure includes the original layers by Akera (2007) and the modifications by Mäkinen et al. (2019).](image)

As an example, here I will shortly describe the first of the two cases found in Mäkinen et al. (2019), the online drama series called #lovemilla. As in my research case, this case consisted of a broad range of background resources and informal methods, especially ones relying on different social media channels. The original idea was based on two main sources: the producer’s sister, who represented the target group, and benchmarking. Figure 5 presents the ecologies of user knowledge mapping of this case. This highlights the fact that the small production team effectively combined informal knowledge with social media presence, complemented this with surrogate users and, thus, official customer research only acted as secondary background information (Mäkinen, Hyysalo, and Johnson 2019). What can also be seen in this mapping is how the
different actors are only connected to each other through the different platforms or ‘settings’ and key people and are without direct relations.

As a summary of the theory, I will describe how this research is situated within three study areas. Firstly, this is highly relevant to the area of HCD, which is closely related to HCI, UX, co-design and usability. Secondly, this research links

2.4 A Summary of the Related Literature: Positioning this Thesis

As a summary of the theory, I will describe how this research is situated within three study areas. Firstly, this is highly relevant to the area of HCD, which is closely related to HCI, UX, co-design and usability. Secondly, this research links
to STS and especially its area of user knowledge and user representations. Thirdly, this research is related to design and innovation management as this study addresses the practices of a product design project. These relations and the main fields within them are sketched in figure 6, where this research is situated in the overlapping centre area.

Figure 6. The theoretical landscape of this thesis.

HCD provides the basis of this thesis as the research is about the utilisation of HCD in product development. Thus, in this research, the basic user research and involvement methods and practices are studied in a company context, a research focus that has been sought after in HCD research (Woolrych et al. 2011; van Turnhout et al. 2014). What HCD offers for this research are the different methods and their combinations, together with HCD maturity assessments. In addition, studies of HCD adoption indicate what are the reasons for organisations to not adopt HCD in their practices. However, HCD only addresses one aspect of design and the wider innovation perspective needed in this research is missing. In addition, the wider context of technology in society and some more in-depth methods for studying longitudinal case studies, as well
as analysing how user information is passed on and lives in an organisation, were still needed.

As this is a study in the design field and addresses design management, as well as innovation research, these topics have been briefly discussed. As this research has taken place in a company context and is related to how the company’s practices involve HCD, the design maturities of companies have been addressed with the Danish Design Ladder, providing an example of how to evaluate different design-maturity levels. In innovation research, the idea of users inside innovation organisations has been discussed in particular, and there are a few examples of earlier studies of such cases. Innovation research also provides other theories and aspects of user innovations, ranging from user-driven innovations to user-inspired innovations (Hyysalo et al. 2016), but these were not further addressed in this study.

Finally, STS has been used in this thesis for a research methodology, especially in the analysis phase. The reported results contribute to STS, especially in the form of user representations’ analysis and the analysis of ecologies of user knowledge. STS contributes to HCD as a neighbouring field which has a long history of studying the relationship between technologies and people with ethnographic methods. Under STS, SST in particular has been discovered to be relevant for this research. STS in general is a broad area of study that also includes studies of society, and in this research, only one area of STS was addressed. Although STS provides methods and theories to aid researching an organisation’s R&D practices, the detailed view of user knowledge in product development that HCD offers is needed.
Design research is a wide term that can include several types of activities, such as: design management, constructive design research, social sciences in design and practice-based research (Koskinen et al. 2011) (see Figure 7 for a wider mapping). In a simpler form, design research can be seen to have three functions: research for design, research through design and research into/on design (Frayling 1993; Forlizzi, Stolterman, and Zimmerman 2009). Research for design means that research is recognised as a part of designing products. Research through design means that design activities are the sources of generating knowledge. Research on design (or into design, as defined by Frayling) aims at describing the process of design (Forlizzi, Stolterman, and Zimmerman 2009). In addition, Frayling (1993) discussed the difference between Research ‘with a capital R’ and research with ‘a small r’, indicating whether or not the outcome is a research report of some kind (capital R) or an artifact (as in the case of research for design). However, in the case of research for design we can also discuss Research ‘with a capital R’ if the results of the research are understood and applied correctly. It can be seen that research is actually an important part of design and the research can be of various types, with several functions. This research is placed under the category of research into design as it researches a design process in order to better discover the practices of HCD.

<table>
<thead>
<tr>
<th>Psychology and design, design studies</th>
<th>The social sciences in design</th>
<th>Design history, aesthetics and philosophy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design management</td>
<td>Constructive design research</td>
<td>Practice-based research</td>
</tr>
<tr>
<td>Engineering and computer science</td>
<td>The natural sciences in design</td>
<td>Product semantics and semiotics</td>
</tr>
</tbody>
</table>

Figure 7: What design research consists of, as mapped by Koskinen et al. (2011).
Next, I will present the methodology of the research. First, the research procedure will be described in more detail together with theory on the applied methods. This section will end with a discussion on the ethics, reliability and validity of the research and a short summary of the methodology.

3.1 Data Gathering and Analysis

In this section I will describe the research process in more detail, starting with data gathering, continuing with a description of the gathered data and finishing with a description of the analysis. It should be noted that I have been the only researcher conducting the research activities – including data gathering, analysis and reporting – and I have received guidance and support from other researchers and my thesis supervisor during the process.

3.1.1 A Description of the Data Gathering

As mentioned in the introduction, the research setting was a case study in CompanyIM. The main methods for the data gathering included semi-structured interviews and observations. In addition to these, different documents were also inspected. The data gathering was conducted during 2014–2018. The timeline (see Figure 8) presents how the data gathering was spread during the above-mentioned timespan. The interviewees were selected by interviewing representatives from different parts of the organisation (mainly focusing on R&D but also including sales and marketing), by interviewing the participants of ProjectND and by snowball sampling. Snowball sampling is a method where the interviewees are asked to name other interviewees who would know about the topic in question or should be interviewed (Goodman 1961).

As the conducted research was a longitudinal study with an ongoing case project, some of the key employees were interviewed several times in order to acquire all the relevant details and cover the whole timespan of the project. These key employees included the project manager for ProjectND (interviewed six times), the responsible industrial designer of ProjectND (interviewed four times), the UX manager and the design manager (both interviewed twice).

The interview themes covered the interviewees’ work and work history, CompanyIM’s project practices and the methods for gathering user information. In addition, a list was gathered together with the interviewee, including the methods that the interviewee knows are used inside the company and the methods that the interviewee uses herself or himself. One project was selected that was looked into in more detail (ProjectND was chosen for those interviewees who participated in the project). In the end there was discussion about an internal development project that aimed at developing and systemising user information gathering practices with the interviewees who had participated in the project. The list of interview themes can be found in appendix A.
Figure 8. The timeline of the data gathering during 2014–2018, presenting all the interviews and observed project meetings.
According to David Silverman (2011) there are four types of interviews: structured interviews, semi-structured interviews, open-ended interviews and focus groups. Semi-structured interviews are based on a set of mostly open-ended questions that guide the interview process (Flick 2014). This question set is applied flexibly, allowing additional topics and perspectives to arise from the interviewees (Flick 2014). This research mostly followed the general interview structure; however, some interviews had a specific topic, which was then discussed in an open matter. This was common, especially when interviewing a person for the second time or more.

Ethnographic observations were conducted at project meetings. Ethnography is a method that is grounded in anthropology and has a long history, starting from the nineteenth century, when anthropologists travelled to study pre-industrialised cultures (Silverman 2011; Gobo 2011). As described by Giampietro Gobo (2011), there are two types of ethnographic observations: non-participant observations and participant observations. In the first version, the researcher observes the participants from a distance, without extensive interaction with them (Gobo 2011). In participant observation, the researcher seeks to be part of the practices and communities of the participants in their natural environment, describes their social actions, interacts with them and tries to learn the meaning of their actions (Gobo 2011). In addition, there are also different variations that fall between these two extremes (Gobo 2011). This research is situated closer to the non-participant observation of the scale but was without strict formal distancing from the observed people: as the researcher, I was present at the project meetings, but as a rather silent observer, and sometimes only asked questions after the actual meeting has finished; thus, I tried not to interfere with the natural setting.

### 3.1.2 Description of the Case Data

The research data comprises of 37 interviews with 28 interviewees, 33 instances of meeting observations and 33 documents. The interviews and meetings were voice recorded and transcribed. In addition, some video recordings and pictures were taken during the interviews and meetings. Field notes were written during the data gathering, resulting in two notebooks full of notes. Table 6 summarises the research data and the full listing can be found in appendix B.
Table 6. A summary of the research data.

<table>
<thead>
<tr>
<th>Data type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interviews</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The main focus is on R&amp;D, and there is also a focus on sales and marketing</td>
</tr>
<tr>
<td></td>
<td>Lengths vary from 25 min to 2 h</td>
</tr>
<tr>
<td></td>
<td>The interviews were voice recorded and transcribed; field notes were taken</td>
</tr>
<tr>
<td></td>
<td>37 interviews</td>
</tr>
<tr>
<td></td>
<td>28 interviewees</td>
</tr>
<tr>
<td><strong>Observed meetings</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mostly weekly project meetings</td>
</tr>
<tr>
<td></td>
<td>Some larger project meetings</td>
</tr>
<tr>
<td></td>
<td>Lengths vary from 18 min to 89 min (average: 38 min)</td>
</tr>
<tr>
<td></td>
<td>An initial meeting when starting this study</td>
</tr>
<tr>
<td></td>
<td>The meetings were voice recorded and transcribed; field notes and some pictures and video were taken</td>
</tr>
<tr>
<td></td>
<td>33 meetings</td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td></td>
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<tr>
<td></td>
<td>Organisational charts</td>
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<tr>
<td></td>
<td>Project documentation templates</td>
</tr>
<tr>
<td></td>
<td>User study ‘guidelines’</td>
</tr>
<tr>
<td></td>
<td>Project documentation (requirements, specifications, concepts)</td>
</tr>
<tr>
<td></td>
<td>33 documents involving approx. 250 pages</td>
</tr>
</tbody>
</table>

3.1.3 A Description of Data Analysis

The analysis began with the transcriptions of the interviews and meetings, which were coded with Atlas.ti. The coding was based on open, or thematic, coding (Glaser and Strauss 1967; Strauss and Corbin 1990). The coding resulted in 65 thematic codes that were related to the investigated topic (i.e. how CompanyIM knows its users, how the information is transferred and how the projects function). This coding led to identifying how the process had evolved and what cross-cutting themes were found across the open codes. As the research was primarily a research into design process, axial coding (see below) was replaced by working the themes into and seeing them in relation to an overall process narrative that was constructed, which included a description of the studied project and the company. The narrative especially focused on topics that had an effect on the UX of the product, but it also included more general issues, such as project practicalities. The company documentation was not coded, but it was utilised as support material in comparing details and filling in
additional information that had not come up in the interviews or meetings. However, details (such as documented HCD methods and target user groups for ProjectND) were added to the analysis and the case narrative. The different information sources were cross-compared in order to recognise commonalities and discover additional information. In the later interviews, some new themes were added, based on the analysis, in order to fill any possible information gaps related to the sources of user information and ProjectND in general.

The thematic coding and further analysis of the materials are informed by grounded theory (Glaser and Strauss 1967), utilising ethnographic observations and semi-structured interviews as the main data gathering methods. The analysis process follows the first stages of a grounded theory process, which also resembles thematic analysis (Clarke and Braun 2017). As these different analysis approaches – grounded theory and thematic analysis – could not be explained in detail in the research papers, inspiration from grounded theory was referred to in those. Grounded theory identifies theorised patterns from data obtained from social research, and therefore, it fits empirical situations and provides relevant explanations, predictions and applications (Glaser and Strauss 1967). It has become a widely popular qualitative method (Charmaz and Bryant 2011). In grounded theory the data gathering and analysis occur simultaneously as an iterative process, which provides more focused data and more theoretical analysis (Bryant and Charmaz 2007). It should be noted that when generating a theory from data, the hypothesis and concepts that are derived from the data are systematically discovered in relation to the data during the research process (Glaser and Strauss 1967). However, this research case did not proceed to the theory formulation stage.

The basic data sources for grounded theory are the same as they often are in qualitative research: interviews, field observations and different kinds of documents (Strauss and Corbin 1990). The uniqueness of grounded theory is that it aims to form theories, and this is done through the constant comparison of meaning structures throughout the research process and data gathering (Strauss and Corbin 1990). Grounded theory is often connected with coding the data, and whilst this is important, comparing the codes and forming the theories is still the main goal.

Thematic analysis, in turn, is used to identify, analyse and report certain themes or patterns within research data (Braun and Clarke 2006). It can result in organising and describing the data set but often also results in interpreting different aspects of the research topic. Braun and Clarke (2006) also recognised the similarities between grounded theory and thematic analysis, and recommended that thematic analysis is used when the grounded theory approach does not aim to form a new, fully fledged theory, as is the case in this research. The themes may emerge either bottom up (inductive) or top down (deductive), the first one, again, resembling grounded theory. Although some quite exact processes for applying thematic analysis exist (such as those described in Braun and Clarke 2006), it should be noted that several versions
of thematic analysis exist and there is quite broad diversity within it (Terry et al. 2017). The advantage of thematic analysis is its flexibility in regard to the research question, sampling and data collection; it can be applied when analysing many types of data (Clarke and Braun 2017). To sum up, thematic analysis provides systematic procedures for coding qualitative data and generating themes from it.

There are some elements in the present analysis that render it closer to the early stages of grounded theory than to thematic analysis. The data gathering started in an empirical and data-driven fashion after the initial case sampling. The data analysis was partly done parallel with the data gathering, deepening the emerging empirical thematic codes. In addition, coding and cross-comparison of the information sources are the basis of grounded theory, and these have been applied in this research. Furthermore, this research applied theoretical sampling as the goal was to elaborate the concept of HCD without contact with users and its different aspects until a saturation point was found in the data. The differences to grounded theory are at least that conceptual notes were not taken constantly and the theoretical memos were integrated into writing a case narrative. This worked as the prime method by which to organise the thematic codes in relation to each other within the studied design process (a similar approach has been taken in other process-research cases as well; see, e.g. Pollock and Hyysalo 2014). The coding procedures were thus more geared towards understanding the local processes, and abstracting towards a more general theory frame was foremost done through case sampling and positioning the research within existing research literatures.

3.2 Ethics, Reliability and Validity

When conducting qualitative research (and research in general), the ethics, reliability and validity of the research should be considered carefully. Many different criteria for the evaluation are available (Flick 2014). Next, I shall examine the most relevant criteria regarding this research.

The ethics of qualitative research cover protecting the interests of the participants; this is especially crucial in fields such as the medical field but should be considered in other areas as well (Flick 2014). All interviews and meeting observation events were confidential; at the beginning of the study, I signed an non-disclosure agreement stating the confidentiality issues between the company and myself (as the researcher). These were mentioned at the beginning of each interview, together with mentioning my background and the research I was conducting. Most of the participants in the observed meetings were familiar with my research, and the ones that were not were informed about it. There was no reporting where the participants could be recognised. The gathered data was stored on personal data storages, to which no external parties had access. Due to these confidentiality issues, all data and the case company have also been anonymised. As this research focused on work practices and
processes, which is not a very sensitive topic, no extra caution or ethics committee acceptances were needed.

Reliability and validity are most commonly addressed in quantitative research, but evaluating them in qualitative research is not as straightforward (Silverman 1993). However, as Silverman stated, reliability and validity are also important issues in qualitative field research, and thus, they need to be addressed here as well.

Reliability consists of two points: firstly, it needs to be explicit about what in the data is from the studied subjects and what is the researcher’s interpretation; secondly, the research procedures need to be comparable between different interviews and between observation instances (Flick 2014). The first point especially applies to fieldnotes. This was ensured in my fieldnotes by using square brackets whenever reporting my own interpretations or comments. Regarding the second point, I was the only researcher conducting the field work, and for example, the interviews followed the same structure, with additional questions for only some participants. Furthermore, Silverman (1993) argued that, especially in qualitative research, reliability can be improved by using standardised methods in field notes and transcripts, and by several researchers analysing the same data. Unfortunately, the latter point could not be applied in this research case as I was the only researcher conducting the research activities and could not involve other researchers in the process on a regular basis; however, the analysis and findings were discussed with my supervisor during the process. The first point was addressed by me being the only researcher and, thus, using the same conventions throughout all the fieldnotes and interviews, and utilising only one instance for the transcriptions.

In addition, to increase the reliability of the research, care was taken with the sampling. The interviewees were selected to cover different parts of the organisation and different professions while highlighting the research topic and the case project. This was balanced with the extent of resources that was possible to use in the data gathering. The field notes mainly acted as a supporting element and the main data was the transcribed voice recordings. Thus, the results are not solely dependent on the subjective notes of the researcher.

The validity of the research covers the fact that the researcher’s findings are actually grounded on the researched field (Flick 2014). Quantitative research has many standardised ways to address validity, and the issue of validity should be discussed in qualitative research as well (Silverman 1993). Validity covers the production of the data as well as the results drawn from it. In this case the research and the findings were discussed with other researchers inside the same research group. The analysis was done under supervision and the initial results were presented and discussed in a research seminar. In addition, article 2 lists the sources for the main statements and articles 3 and 4 present quotes and transcriptions of the research data to support the validity. Furthermore, one
aspect of validity is that of ecological validity (Cole 1996); this points to how well the research design matches the naturally occurring phenomena it seeks to describe and conceptualise. The use of longitudinal ethnography and interview-based study in a real-life HCD-mature company case in order to study how HCD could or should be practiced if users cannot be contacted can be regarded to have high ecological validity. This is particularly so when the research design is contrasted with the majority of academic texts on the topic that are based on either academic projects or normative assessments by academics or practitioners.

When discussing the generalisation of the results, it needs to be kept in mind that this is a case study. This is typical in qualitative research (Flick 2014). As a case study, it represents the organisation studied. However, as literature indicates, HCD-mature companies do not tend to repeat their user studies for each project and they do utilise existing information (Woolrych et al. 2011; M. Johnson et al. 2014). Thus, this case study acts as additional evidence for this topic, adding information on how user information can be brought to product development in this type of high HCD-maturity companies.

3.3 Summary

This chapter has described the research methodology, which is a research-into-design approach. The research set-up was a longitudinal case study conducted in a Finnish industrial company that has been a pioneer in the utilisation of HCD and design in general in their product development. Longitudinal case studies have also been applied for similar purposes by other researchers (e.g. Kashfi, Feldt, and Nilsson 2019; M. Johnson 2013; S. Hyysalo 2010; Wardlaw 2016). An ongoing project was followed in more detail in order to discover how the project practicalities function. As has been reported to happen in companies (Oudshoorn, Rommes, and Stienstra 2004), the case project had a very high confidentiality level, and therefore, no external user studies and tests could be conducted during the development phases of the project. Thus, the project acts as a demonstrative case of how the project team overcame the challenge of creating a usable and desirable product without direct user involvement.

The main research methods included semi-structured interviews and meeting observations. In addition, company documentation was gathered and fieldnotes were taken. A total of 37 interviews were conducted and 33 meetings were observed during 2014–2018, which were all voice recorded and transcribed. The transcriptions were coded utilising open coding, and a descriptive narrative was written of the research case. Triangulation of the research material was utilised. The analysis discovered cross-cutting themes that were focused on and developed into final results.

These research methods were chosen as they provide a natural way to conduct longitudinal research in a company context. In addition, observations allowed understanding what actually happens in project meetings and semi-structured
interviews, providing a way to get more insights into the chosen topics while still allowing further discussion of relevant topics that came up during the interviews. Inspecting company documentation provided support and more formal information additional to the main research methods. These methods worked adequately together and enabled getting a thorough view of the HCD practices inside the studied company.
4 A Summary of the Research Papers

This section summarises the four research papers included in this dissertation. The actual articles are appended to the dissertation.

4.1 Article 1: From Recipes to Meals ... and Dietary Regimes: Method Mixes as a Key Emerging Topic in Human-Centred Design

The first paper differs from the others as it mainly covers other research cases and my research case is only presented among others. The article starts from the argument that whereas research has focused on reporting methods as recipes, in real life, companies mix methods and decisions are made based on cumulated knowledge about the users (Johnson 2013; Hyysalo 2010). The point of the argument in the paper is that (1) method mixes are the reality, regardless of the level at which the examination is conducted (company-wide, a project, a release or a single professional) and (2) these method mixes are not constructed by careful consideration but are rather based on previous studies, background information and skills, and informal methods.

The paper presents five cases from different companies and development projects. All of the case studies are longitudinal, two of the studies were already finished and three were still ongoing during the time the paper was written. The data consisted of interviews, documentation and observations. The text mainly focuses on two of the cases: a social media service for teenagers and a public service website for teachers. However, it also finds support for the argument in the three other cases (one of them being my research case). The main results comprised of analysing the method mixes from the different timespans of the two main cases, dividing the methods into four categories: formal methods, informal methods, implemented results from prior studies and background resources. These were then complemented with different method mixes from the three other cases: two healthcare start-ups and the industrial company of my research.

The article continues the recipe metaphor presented by Woolrych et al. (2011) but argues further that HCD work does not equate to applying a method from a recipe and instead consists of mixing a variety of methods, ranging from the individual level to the company-wide level. This work suggests that method mixes and dietary regimes should be focused on more in academia.
Furthermore, it suggests that method mixes should be studied more in order to identify the gaps and synergies of different mixes and that the results of methods should be related to earlier information and ways to know the users and customers. In addition, it calls for a focus shift from a focus on method development to a focus on methods deployment.

The paper concludes by stating that more focus should be placed on the different method mixes over a longer period of time as they characterise longer periods of service life cycle. In addition, when educating practitioners, focus should be put not only on how to use certain methods but also on how to choose and combine different ways to produce insights from users and customers as this is the reality of HCD work in practice.

4.2 Article 2: Cumulative and Combined: Analysing Methods Use in a Human-Centred Design Mature Company

This article continues with the same topic of analysing method mixes as the first article, but this paper only focuses on one research case (the one presented in this thesis), and it addresses the use of cumulated knowledge more deeply. In addition, it discontinues the use of the recipe metaphor.

The text starts by highlighting that during the nearly 40 decades of HCD, it has developed an impressive number of methods and methodologies for user research, design and testing. These methods have been developed and validated in numerous studies that have at times resulted in contradictory results (Gray and Salzman 1998; Hornbaek 2010; Woolrych et al. 2011). At the same time, as noted in article 1 as well, it has become general knowledge that practitioners combine methods in real-world settings, but there is still surprisingly little research on how these methods are combined in real company cases. In addition, what can be seen when studying the literature on method mixes and mixed methods is that the studies often exclude the use of the information that already exists in the organisations.

This article focuses on the research case presented in this thesis. It studies the different method mixes of CompanyIM with a special focus on the case project. This paper analyses a total of eight method mixes: the company-wide, the case project’s, marketing’s, the product manager’s, the project manager’s and three industrial designers’ method mixes. It summarises the main differences between them.

The paper’s main contribution is that it highlights how all the respondents and organisations have a unique method mix that includes a variety of methods and sources for user information. In addition, it underscores how significant the use of accumulated knowledge about the users actually is in an HCD-mature company. Furthermore, this paper notes that the seniority level of an employee might also affect their methods usage, as was the case here with a newly employed designer whose method mix contained looking at earlier study reports.
and utilising more market and competitor studies. These findings do not align with the academic research and HCD processes which state that projects should always involve new user research and the use of validated methods. This might be due to the early years of HCD, when companies had not applied HCD methods yet and they did not have the tradition of utilising user information. However, this situation has luckily changed as more companies have matured in HCD.

In addition, this work joins in the criticism (such as Woolrych et al. 2011) of single method development and validation and highlights that HCD has mostly been accomplished by a combination of methods and other sources. It also highlights the fact that the sources and nature of HCD information are actually complementary to other sources. In CompanyIM the information about the users come from R&D, and Sales and Marketing; for example, with the use of social media, Marketing has access to new types of user information. Thus, information from other sources can be valuable when combined with the insights of HCD. Other research cases can be found that report results where the complementary information of the users is provided by different parts of the organisation, especially in the age of social media (Stickel et al. 2016).

Finally, the article states that studying method mixes has proven useful for understanding the complete picture of the user information sources in a company. Thus, it recommends further studies in company contexts in order to discover the method mixes and other information sources used, as well as studying how the existing user information is actually transferred in an organisation.

### 4.3 Article 3: User Representations as a Design Resource: Achieving Accountable Design without Access to Users

The third paper moves into the area of user representations. It addresses the following research question: What kind of design resource does the construction of user representations provide for a design team who cannot have first-hand access to users?

The article describes the basis of the sociology of user representation as a part of STS. The sociology of user representation highlights that there is a richer and more complex empirical reality to be tackled in designing usage than that presented by the simple guidelines offered by user involvement and user research. The paper states that the use of user representations is far more diverse than what the designers usually recognise as user representations. In addition, what should be noted is that, as humans are quite unsteady, their needs and wishes change during design processes, which results in the users always being represented during the design process. The sources of user representations, then, are typically manifold, indistinct and potentially in conflict with each other. This indicates that all representations are resources rather than definitive facts upon which designers can ground their decisions.
Thus, the work aims at studying what kind of design resource user representations provide.

The results of this article are based on the whole data set of this research. First it lists the different sources of user representations based on the categories by Hyysalo and Johnson (2015). Examples of these sources are presented from the company in general, as well as from the case project (see table 2 in the article). The main user representations addressed in this paper are: (1) a worker up a mast; (2) a worker with a van; (3) a DIY person; (4) an oil platform maintenance worker; (5) a farmer; and (as a different type of representation) (6) competitor products and parallel technologies.

Several quotes from interviews and project meetings are displayed to demonstrate the representations in action. As an example of these is a quote from an interview:

So, a CompanyIM user can be anything from a farm maintenance team, factory maintenance team, a mobile [worker]. [He or she] can be [from] ship maintenance, ship repair, ship outfitting. [He or she] can be from the construction of large marine drilling platforms – so it can be heavy industry, oil-based sectors. It can be a pipe, plate ... (product manager)

After this, the paper moves onto analysing how the different user representations of the case project have contributed to the characteristics of the product. The most important user representations are inspected on a more detailed level, focusing on the descriptions of the primary user and other implied people, the context of use, the implied characteristics of the product and implications for design. In addition to user representations, an example was also presented of competitor devices and parallel technologies. Then the article pulls these different representations (user representations, parallel technologies, cultural maturation and regulatory demands) together and analyses how these representations and their implications have been combined in design decisions. It states that the variety of user representations (key and supporting representations) define the design space in which the product needs to operate and also clarify the key aspects that the design targets in different contexts. This, however, does not happen miraculously; instead, the product is targeted to work sufficiently for each group whilst each group elaborates the most demanding aspects of a feature of the device. For example, the key representation, a worker up a mast, sets very high demands for the portability of the device, but less so for the ingress protection level, a feature that is more relevant for the farmer representation.

The article concludes by stating that pursuing user representation carefully can be seen as an effective alternative strategy to first-hand study and engagement with users in companies that have a strong background in human centeredness. Thus, what the representations are capable of doing depends on the work that has gone into constructing them. The results support the argumentations by Johnson (2007) and Mäkinen et al. (2019) in stating that it is the nature of the
representational practice regarding the prospective users and usages that makes
the design work accountable rather than the user research or user collaboration
per se. Therefore, it can be seen that product development can be done without
direct contact with the users; it can be based on user representations and still
be accountable HCD if the user representations are anchored on accumulated
user knowledge and used as a reflexive guiding design resource. Thus, this study
has proven that the sociology of user representation continues to be a vital and
practically relevant strand of study in the intersecting areas between STS,
design research, HCI and information systems, and one that continues to
provide relevant new insights despite nearly 30 years of work in the area.

4.4 Article 4: User-Centred Design without Involving the Users: A
Longitudinal Case Study in a Human-Centred Design Mature
Company

The final paper is a cross-cutting paper addressing the main theme of how an
HCD-mature company can actually apply UCD when users cannot be directly
involved in the development process. Thus, it summarises the whole research
process and its results. In addition, it addresses the questions of how the work
can still be identified as HCD.

The starting point of the paper is that the processes, guidelines and methods for
HCD have been in place for decades and first-hand contact with users seems to
define whether a project is user centred or not. Yet these guidelines are not
always directly applied in company contexts. It discusses the different ways to
measure the maturity level of HCD in a company and advocates the inclusion of
STS perspectives and practices, from which HCD can learn, especially when in
the form of user representations.

This article is grounded on the whole research material that I have collected and
pulls together the different ways in which user information is gathered and
applied in the case company. It summarises the method mixes of CompanyIM
and ProjectND and the use of user representations. However, the main part of
the results is the discussion of one project meeting that addressed the target
users and use cases for ProjectND.

The sources for user knowledge are summarised in the following points: (1) user
representations, (2) in-house users and (3) the representations of usage. None
of these alone would guarantee adequate design of use and definition of user
groups; the combination of these makes it possible to design in a human-
centred way. Thus, what could be seen is that design acted as the glue for user
knowledge, combining the different information sources and creating meaning
from the different user and usage representations. In addition, it also answers
the second research question about how HCD can be recognised even when
users are not involved. Here the measurement of the company’s maturity level
in HCD can help, as well as recognising sufficient usage of user representations
and analysing their sources.
Finally, the article concludes by stating that responsible HCD can happen even without direct user input. Users and usage situations can be processed in many ways and they are a part of responsible discussion. In addition, the paper demonstrates how designers and engineers in an HCD-mature company find alternative ways to get the needed user insights when the primary source of user input is blocked.

The paper recommends further research on discovering how companies know their users, how the knowledge has accumulated, what kinds of sources are utilised and what has worked well in projects. This would help to gain a comprehensive picture of which practices bring user knowledge into design processes and help to discover the strengths and weaknesses of the processes.
5 Discussion and Conclusions

I started this research since I felt that the realities of how companies practice HCD do not match the academic recommendations, and this issue has also been noted in academic work. Whereas academic definitions of HCD take first-hand contact with users as one of the core demarcation points as to whether a project is HCD or not, the findings of this thesis indicate that there are ways by which organisations can still practice HCD in a responsible way without always contacting the users. The reasons for abandoning direct user contact during the design process are usually not due to the designers trying to avoid user involvement. Instead, they are sometimes faced with limited resources (time or money) or too strict confidentiality restrictions to carry on the design process as they would otherwise do. This research has brought clarity to how HCD-mature companies can practice responsible HCD without direct user contact.

This section pulls together the findings of this research by answering the research questions and presenting how this research contributes to theory and practice. At the end I will reflect on the methods and materials used in this research.

5.1 Synthesis of the Findings

In this section, I will answer the research questions briefly, after which I will elaborate more on the contributions of this research.

The main research question for this thesis was:

- Can HCD be practiced responsibly without direct contact with users?

This research case was of a development project conducted at an HCD-mature company where direct user input was blocked due to a strict confidentiality policy. As has been reported in other research cases, confidentiality issues are one of the most common reasons for abandoning user involvement (Oudshoorn, Rommes, and Stienstra 2004). As direct user involvement is usually considered to be part of the basis of HCD, the conditions for practicing HCD without direct contact with users need to be considered carefully.

In this research case, despite not being able to contact the user in the studied case project, the case company had conducted a vast variety of user studies and
different activities with the users, as the method mixes discussed in articles 1 and 2 demonstrate. The method mixes were different for every employee, but they all included valid HCD methods and direct user contact. Therefore, the company had already accumulated knowledge about the users upon which they could build the project. In addition, as discussed in article 3, the project utilised a broad range of user representations that were derived from both implicit and explicit sources. These all aid in a situation when product or service development needs to be conducted without direct access to users.

HCD maturity is also one aspect to consider when evaluating whether HCD can be applied responsibly without direct access to users. If an organisation has higher HCD maturity, it is likely that the company knows the practices of HCD and has a tendency to consider the users even in cases when they cannot contact or involve the users directly. In addition, higher HCD maturity ensures that the processes and ways for HCD are in place and the importance of direct user contact is acknowledged. Yet, there might be projects when direct user contact is not possible; in these cases the designers and developers need to consider how to overcome this barrier as they are, in general, not trying to avoid user contact.

This research case has demonstrated that HCD can also be practiced without direct user contact; however, the indicators for HCD in these cases need to be inspected. At least the following indicators (also presented in article 4) would entail responsible HCD being practiced without direct user contact: the organisation has accumulated user knowledge, which is utilised actively; the organisation discusses the users, their needs and usage environments in a thorough and explicated way; the organisation’s HCD maturity can be assessed and rated mature, indicating that the employees do not ignore users because of a lack of competence or experience; and the user representations are based on actual user insights, even if derived from multiple sources, and are discussed in a responsible way. In addition, it should be noted that direct user contact does not ensure responsibly practiced HCD.

In addition, there were four sub-questions that will each be answered separately:

- How is human centeredness ensured in projects in which direct contact with potential or existing users is not possible?

Based on this research, it could be seen that the complete view of user knowledge was based on a multitude of sources in this HCD-mature company. Firstly, there was the long history of CompanyIM and its culture of listening to customers and users. Secondly, there was the broad range of methods and method mixes for gaining user insights and information, and several field trips on which nearly all the project members had been at some point (as discussed in article 2). Thus, all the user representations that were used were based on actual contacts with the real and potential users (as shown in article 3). Thirdly, a culture of discussing users and their needs and usage environments existed
(as seen in article 4). This welcomed all the opinions and insights that the project members and other company employees had. This meant that the user representations were discussed and examined carefully in order to increase their reliability. And last, the company had its in-house users, who had worked in the industry and for their customers earlier and still used the developed machines daily. They conducted the initial testing and gave their insights for product development. In her doctoral thesis, Kotro (2005) described the concept of hobbyist knowing. Schweisfurth et al. (2015; 2017) discussed the concept of embedded lead users. At CompanyIM the internal professionals were neither hobbyists nor lead users, they were professionals who used their knowledge in designing and testing the products the company designed and manufactured.

To sum up, Figure 9 presents these different ways of ensuring both user and human centredness. The main contribution to existing research here is that it highlights that HCD can occur without direct contact with external users. This contravenes the basic assumption in HCD research that users need to be directly contacted in each design phase (ISO_9241-210 2019). In addition, it demonstrates that in real-life settings, HCD work constitutes a combination of different methods and approaches, as well as the history of the organisation and its designers, that together ensure good-quality design. Thus, it can be said that design acted as glue for user knowledge, pulling together the different information sources and creating meaning from the different user and usage representations.

Figure 9. Different ways in which human centredness was guaranteed in this research case.
• **How are different methods used to gather user information?**

As articles 1 and 2 describe, methods usage was very versatile and each employee had a unique method mix. Thus, it can be said that the methods palette at the company level was broad, different methods were actively used and the company was active in promoting HCD methods usage. However, the method usage can vary significantly between projects as the projects have different needs, restrictions and resources. In addition, this research highlights how thoroughgoing the usage of cumulative user knowledge is in a mature HCD company. The analysis of method mixes reveals that all of the sections and employees rely on information, both informal insights as well as formal study results, that has been accumulated during past projects. Furthermore, as article 3 demonstrates, the user representations were from a wide variety of sources, representing all eight categories defined by Hyysalo and Johnson (2015).

What this adds to the existing research is that it underscores, similarly to Johnson (2013), that HCD methods are often used as a combination and these combinations can often overcome limitations or hindrances related to the use of any one method. The result is a method mix that varies between projects and individuals. In addition, it highlights the importance of existing, accumulated user knowledge in HCD-mature companies, a fact that has often been ignored in research. Furthermore, this study also guides less mature organisations, teams and designers to inspect what information already exists and what new information needs to be gathered to support design work.

• **How does user-related information circulate within the organisation?**
  
  **What kind of user representations are used to carry out design work?**

The user representations used inside the company were based on a variety of sources, including implicit sources (such as all the employees having experience of using the company's products) and explicit sources (such as site visits, in-house users and parallel technologies). As mentioned, while answering the first sub-question and considering what is reported in article 4, discussion among the project participants was active, the users were discussed in project meetings and their needs were considered widely. In addition, the user representations were diverse, formed for the product that was being designed and referred to often in discussions, as article 3 demonstrates. The representations were elaborated during the early phases of the design project, but faded into the background once they became transformed into product characteristics.

This adds to existing research in two ways. First, it adds to findings on the representations that are used in a design process being from a wide variety of sources, even in single projects; in fact they span all the eight user representation source clusters identified in the reviews by Hyysalo and Johnson (2015; 2016). Secondly, this elaborated how product qualities derived from different representations are being pieced together in order for the outcome to work sufficiently for each representation and how the complementarities between representations allow clarifying the space for design. The
representations can guide the design work by delineating the design space, and the partially overlapping representations direct where the product’s key qualities lie.

- What are the sources of user information? How do they interrelate in informing design?

To analyse the different sources of user information in a way that goes beyond methods usage, such as method mixes or sources of user representations, I will return to the ecologies of user knowledge (Akera 2007; S. Mäkinen, Hyysalo, and Johnson 2019) as it demonstrates the sedimentation of user knowledge in a more comprehensive way. By mapping the ecologies of user knowledge of CompanyIM and especially ProjectND, it can be seen how the knowledge builds up, how the different methods are connected to the project and how the different layers connect with each other. I have used a similar mapping as that of Mäkinen et al. (2019), which is grounded in the work of Akera (2007).

The ecologies of user knowledge mapping of ProjectND is presented in Figure 10, where ProjectND and the main project team for the project have been highlighted. As can be seen, the knowledge is built up on several layers that mostly connect to each other through the project team or its supporting team. The figure also displays the long history of CompanyIM on the top layer, including various customer contacts during those decades, and its versatile methods use on the bottom layer. Inspecting the methods layers reveals that, although the methods used in ProjectND were rather unofficial and few, the project team had used a much larger variety of methods in the past and, thus, had a more in-depth knowledge of the users accumulated before ProjectND. These all affected the outcome of the project and brought the insights of the users and their working environments to the current project.

What this adds to existing research is that it highlights both how in organisations that have applied HCD for some years, the user knowledge has accumulated during their whole history and that all the different organisations and people have an effect on the design outcome. In order to understand how all the different sources interrelate and affect the design decisions during the process requires thorough longitudinal research cases.
In the end it can be noted that when all these findings are taken together, a company can build a comprehensive understanding of their users for a project without having to study and involve the users and customers for every single project as long as they have the basis and the HCD culture in place. This is also the main contribution to existing research.

5.2 Contributions to Theory

In this section I will analyse what contributions this research makes to theory. This research, though conducted from the starting point of HCD, is situated at the crossing of several study areas, such as HCD, STS, and design and innovation research. Thus, it firstly underscores the necessity for research in between these different, yet neighbouring, fields. STS and the sociology of user representation has proven to be a vital and practically relevant strand of study in the intersecting areas between STS, design research, HCI and information systems. The actual sources of user information and particularly the variety of responsible representational practice are wider than could have been anticipated in earlier academic literature. The work on user representations has
a slightly different view of designing usages than HCD, indicating that there is a richer and more complex reality to be covered when designing usages than the reality the simple methods offered by user research in HCD. In addition, the ecologies of user knowledge can provide a useful viewpoint and tool for assessing how the knowledge of the users has built up both for a certain project and in an organisation. Thus, there are many ways in which these different fields can prove useful for each other and, therefore, more research that situated in between these (and other relevant) areas should be conducted.

Secondly, this research has highlighted the importance of studying the actual HCD practices that take place in the companies and other organisations outside academia. A number of studies (mainly surveys) have been conducted about the state of HCD practices in organisations (e.g. Bygstad, Ghinea, and Brevik 2008; Jan Gulliksen et al. 2004; Venturi and Troost 2004; Venturi, Troost, and Jokela 2006; Vredenburg et al. 2002; Følstad, Jørgensen, and Krogstie 2004), but there is still room for longitudinal in-depth case studies. The recommendations and guidelines provided by academic research and standards are being applied, but organisations also practice responsible HCD in ways that differ significantly from these recommendations, despite the newer research conducted, especially that conducted around agile processes and HCD (Stickel et al. 2016; Cockton et al. 2016; Kuusinen 2016; Brhel et al. 2015; Sy 2007). This research has highlighted that the methods usage is far more versatile than the academic research has suggested for many decades (Beyer and Holzblatt 1998; Hackos and Redish 1998; Helander, Landauer, and Prabhu 1997; Hollingsed and Novick 2007; ISO 9241-11 1998; Nielsen 1993; Nielsen and Phillips 1993). As organisations have grown more mature, user knowledge has accumulated concurrently, and the accumulated knowledge is also being applied in many cases. Thus, when studying the methods usage in actual development settings, there should also be focus on methods usage and knowledge accumulation that has been ongoing before the studied case. This accumulated knowledge and the history should also be taken into account when studying single cases and projects. In addition, this research demonstrates that, despite the fact that first-hand contact with users has been considered to define user centredness in a project, in some cases responsible HCD can be practiced without direct access to users.

Thirdly, this study aids researchers in researching and recognising if HCD is happening, even if seemingly no users are being involved in the design process. Researchers may evaluate the organisation’s HCD maturity level with one of the available assessment tools, such as the Human-Centredness Scale (Earthy 1998). In addition to the actual human-centredness level revealed by the assessment, the evaluation provides an indication of how well the HCD practices and processes are in place, what these practices are and how actively they are utilised. In addition, the researchers can analyse the organisation’s method mixes to see how diverse the HCD methods usage is, which methods are applied and whether some essential methods are missing from the organisation’s methods palette. These will aid in assessing methods usage and processes.
Furthermore, researchers should also inspect the user representations and representations of use that are discussed and affect the design process. In this analysis the sources of the representations are notable, as well as the diversity of the representations and whether they are present in extensive, responsible discussion. Thus, evaluating the actual effects of the representations on the design process becomes significant.

In addition, this dissertation provides guidance for further research on assessing what are the essentials in today’s HCD. Now that many organisations have matured in HCD, there is a need to update the recommendations to match the realities under which organisations are operating. Traditionally HCD has assumed that research provides reliable results and does not recognise the need for the multidisciplinary discussion around the results that are actually happening in real-life contexts. However, as Johnson (2007) and Mäkinen et al. (2019) have also stated, it is not the user research or collaboration that defines as responsible design work, but rather the nature of the representational practice regarding the users. Academia can aid in providing new guidelines and recommendations for more HCD-mature organisations which have already accumulated user knowledge and run projects in parallel – not in isolation. Furthermore, this research demonstrates – similarly to, for example, Gray (2016) and Reeves (2019) – that, in general, a wider research focus in HCD and design practices would be advantageous.

5.3 Contributions to Practice

This thesis provides several contributions to design practice. The main question that has been discussed for practice is: How can you manage a design project if direct access to users is not possible? This situation, as undesirable as it may seem from HCD point of view, is in reality quite common, as noted already earlier in this thesis. Based on this research, this question can only be answered for organisations that have quite high maturity in HCD as they are not designing their first product and the concept of the user is already familiar for them. Despite the focus being on designing without direct contact with users, these contributions will likely also be useful in cases where users can be involved or contacted directly.

Firstly, when designing without direct access to users, the first phase is to recognise what user information already exists in the company. This discussion should include all the relevant stakeholders inside the company: the engineers, designers, sales and marketing representatives and the senior-level professionals who have been in the industry for a long time. This discussion is on-going throughout the design process. In addition, many companies have (or could have) employees who also belong to the user group (as in the work of Kotro 2005; Schweisfurth and Herstatt 2016; Schweisfurth and Raasch 2015); organisations often have some. However, it requires special attention to not design for yourself, but for the entire user group you are representing. Furthermore, referring to the user studies that have been conducted earlier
might provide helpful. In understanding how the user knowledge has accumulated inside an organisation and how all the sources have affected the complete view, an ecologies of user knowledge mapping can provide a useful framework.

Secondly, well-elaborated user representations can be used when designing without direct access to users. Here it should be noted that, in fact, during a design process the user is always represented (S. Hyysalo and Johnson 2015). User representations can come from a vast variety of sources, both implicit and explicit. In addition, parallel technologies, regulatory demands and cultural maturation also provide representations for the design process. Recognising all these representations and what they imply for the design aids in prioritising the requirements set by the representations and combining them into a functioning feature set and design guidance. Here, utilising a wider view of the users (as suggested by STS) than that which HCD or other design practices provide is necessary.

Thirdly, a contribution that does not directly answer the question presented above but has been a result of this research is how to get more out of method mixes. In HCD-mature companies, each organisation and employee often has their own method mix, though these method mixes are often not constructed systematically but rather according to familiarity and the ease-of-use of methods. When utilising method mixes systematically, they should be planned to cover different participation levels and required resources. Information about company-level method palettes should be conveyed to all projects with example method mixes and potentially be aided by company-specific software in order to help select appropriate methods for each project, as well as to build a shared knowledge base on the HCD methods that work the best for the particular company.

Guidelines for practice have been gathered in Figure 11, which can be seen as a tool for situations when direct user contact is not possible. However, it also provides guidelines for design work conducted with tight resources. These assume that the practitioners are familiar with the principles of HCD and have been in contact with the actual or envisioned users earlier. In addition, these guidelines are based on this research and, thus, are not a panacea, the only truth or the complete truth.

The figure has been divided into three sections, the top part including more general advice that is quite easy to follow. The middle part includes slightly more detailed pointers and analysis. And the third part, at the bottom, acts as a reminder of the most important issues. The starting point presented in the figure advises inspecting all the information already available in the company, including information from other parts of the organisation. Sales and marketing often have valuable user and customer information which often is not valued in R&D. Also, discovering the possible in-house users or hobbyists, or other internal user contacts, can aid in getting a user view and comments on the
designs. The discussions about users, their wishes and needs, and the usage environments should also be ongoing and active throughout the project. Finally, if some user research, testing or involvement is possible, they should be planned carefully in order to ensure that the information is new and complementary to the existing information.

When looking at the second part of Figure 11, more specific mappings are presented: the user representations, their sources and the ecologies of user knowledge. In addition to these, this part addresses the importance of induction to new employees, as well as the importance of having designers participate in the conducted user studies (at least as observers). These enable transferring user information better inside the organisation and also having the unreported insights available – the tacit information. This is also related to the reported multi-learning concept in highly innovative projects; the employees learn by different means – by observing the customers and markets, from each other and also through unconventional ways (Takeuchi and Nonaka 1986).

Finally, Figure 11 reminds us of the two main take-aways:

1) The goal is not to abandon user research but rather to take advantage of previously gained insights and to use the opportunities that method mixing offers. In addition, these recommendations do not apply to usability tests that are conducted to validate newly developed features as the company cannot have existing information that could cover the need for validating new features.

2) Always start with what is already known.
Human-Centred Design without Involving the User
– a Guide for Practice

The basics
What is already known?
Are there earlier study reports? Who has conducted the studies?
What information do other parts of the organization have, especially sales & marketing?
Keep the dialogue active about existing knowledge.

Are there any users inside the organisation? They can be interviewed or can test the concept or design.

Discuss the users, their needs and usage environments constantly throughout the project.

If there is a possibility to contact the users, plan carefully what input is needed and at which phase.

Going further
What are the user representations?
Where do they originate from?
Remember also the less-obvious sources, such as the competitors, parallel technologies and cultural maturation.

If there is a possibility for user studies, designers should participate in order to transfer the information better inside the organisation and also receive the unreported findings.

During induction for new employees, the user information and its sources also need to be transferred.

Ecologies of user knowledge can help to understand better how the user knowledge has been built.

Keep in mind
The purpose is not to abandon direct user contacts or user involvement.

Always start with what is already known.

Figure 11. The main principles for organisations when practicing HCD when direct user contact is not possible or when user contact is limited.
5.4 Reflections on the Methodology and Materials Used

In this section, I will analyse how the research methodology and used materials fit the research.

First, I will comment on the literature utilised in this research. As my background is in HCD and that was also the main research area, I started with the literature that was related to that field and the pieces of it that were familiar to me. I complemented this literature with newer sources and widened it to include participatory design and co-design, and STS. While conducting the research, I also discovered user innovation research to be closely related to my research topic and, thus, included this in the literature review. In addition, as a separate area, the maturity assessments were not investigated thoroughly as they were not in the scope of this research; they were rather utilised to support the analysis of the case company and its capabilities in HCD.

I chose to conduct more thorough research in one case company instead of researching several companies with less depth. This naturally sets some limits on the generalisability of the results. However, during the research, I discussed with my colleagues about my findings and also tried to ensure that my research would be comparable to the other case studies conducted, especially those within my research group. This could be seen, for example, in some of the interview questions, as well as in the analysis methods. This enables further widening the research scope in the future to include some cross-comparative studies of these different cases. However, this research case also functions individually as the data gathering was conducted thoroughly.

I started the research with a quite wide focus on the HCD methods and practices applied in the case company. Selecting the research methods – semi-structured interviews, meeting observations and inspecting company documentation – seemed like a reasonable choice as these methods provided an easy way to discuss with the company employees and follow what happens in the project meetings. In addition, these methods are quite commonly applied in similar research settings. The selected data gathering methods worked sufficiently, and I would again select the same methods. However, if something could be done differently, I would have arranged the follow-up interviews to happen more quickly after new questions arose.

When evaluating the selected methodology, one aspect to consider is the amount of data gathered. For this research I conducted over 30 interviews and roughly the same amount of meeting observations. In order to get a better coverage of an organisation with over 600 employees, even more interviews could have been conducted. Now the focus was on the case project and I interviewed practically all the project members, and in addition, I interviewed employees from different parts of the organisation. More participants could have been interviewed from R&D and other organisations. However, considering the resources available for my single-person research and the target of my research, I did attain a good coverage of the phenomena of interest with
the interviews. When considering the number of observed meetings, I managed to cover the project quite well. However, in the end, I recognised some meetings which I should have attended, but I heard about them too late. However, I tried to cover these meetings with retrospective interviews in order to understand what had happened. This resulted in a satisfactory outcome and, when considering the whole extent of this research, they were, in the end, quite minor details.

The analysis was conducted with open coding using Atlas.ti (similarly to grounded theory) and by writing a descriptive narrative of the whole research case. This part could have been improved by analysing the materials immediately after the data gathering instance, which might have affected the follow-up questions and interviews. However, in this case, as I have personally conducted all the interviews and meeting observations, I had a very good understanding of what had happened and what the data contained all along. Keeping filed notes during all research events was extremely helpful in this sense as well. In a case with more researchers, I would recommend more systematic analysis throughout the research process as well as constant reporting and cross-comparing of the data gathered by different researchers.

In my research I have studied the practices of the case company carefully and mapped their sources of user information. This has resulted in several Excel sheets that I have analysed in order to organise and find meaningful ways to present the results and simplify the complexity of the user information gathering. The analysis activity has proven to be important and highly useful. In this way I have been able to create a complete picture of the sources of user information and the cumulation of knowledge in the case project, as well as the company on a more general level. Thus, it is important to map the sources of user information for a single project, as well as on a higher company level, as the projects within a company are intertwined.

The data gathering lasted for roughly four years, albeit the most intensive period was during the first two. This resulted in a longitudinal ethnographic view but also provided a chance to observe how the company culture changes over time and what truly happens during a product development process. Thus, although being laborious, I do recommend this type of long research period when trying to understand what is really going on in a design project or in an organisation.

All in all, although many things could have been done differently and some parts could have been done better and more precisely, I do believe that this research was conducted in a reliable and proper way and that the selected methods fit this research case well. Thus, I would recommend semi-structured interviews and ethnographic meeting observations for others as well when trying to better understand the ways in which development projects function and how (user) information is gathered and utilised during the design process.
5.5 Recommendations for Future Research

I have conducted this research at the intersection of several fields: HCD, design research and STS. The starting point for this research was HCD, but throughout the process, neighbouring fields have contributed to my study. This type of diversity is definitely needed in the complex world of product and service development of today, and even more synergies between different fields should be discovered.

As this study has provided insights for academia as well as the industry, I would, on the grounds of this research, recommend further studies in real-life development settings for future research. This research should include at least mapping the sources of user information as well as the practices of addressing users in development projects. This work could include studying in more detail how user representations are used as a design resource, as well as studying their types and functions.

In addition, further inspection of how knowledge has been accumulated during past projects and how the information flows inside the organisation would be needed. This could involve research on how the method mixes vary over time and how the project meeting practices address the prospective users and usage environments. Furthermore, I would recommend examining how user information is utilised during the projects and how it affects the outcomes. In order to develop a complete and comprehensive mapping of the sources and communication of user information, I would also recommend developing ways for mapping the information sources and the flow of information inside organisations. The ecologies of user knowledge mapping (Akera 2007; S. Mäkinen, Hyysalo, and Johnson 2019) utilised in this thesis has provided a valuable starting point. However, this mapping should be developed further, to ensure its usefulness, from the ease-of-use, feasibility and content points of view.

Although the focus of this thesis has been on cases where direct user contact was not possible for different reasons, the results will likely also be valuable in cases where users can be contacted. Organisations are acting with scarce resources and contacting and involving users (and other stakeholders) requires resources. Thus, these results can aid in considering where and what kind of user input is really needed and where to direct the efforts. The goal would be to discover the optimal involvement level.

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To conclude this whole research, I would like to say that I started this research as I had noted that the realities in many companies do not comply with the recommendations and guidelines found in the academic literature and standards. Thus, I wanted to conduct research in an HCD-mature company in
order to discover where the realities and guidelines meet and where they do not meet and for what reasons. The results of this research have been reported in this thesis. When considering why this research has been worth conducting, the study has provided a rich elaboration on how the realities in companies are far more complex than assumed by most HCD research designs, academic advice and teaching textbooks. Real-life product and service development projects are not carried out in isolation but rather in complex networked settings where information and people flow from one project and organisation to another. This way of working can help organisations to meet the needs of users in contemporary rapid innovation cycles. When considering how to practice responsible HCD, the point is not to conduct new user research or involve the users every time throughout the project, but rather to conduct the necessary and possible user studies or user involvement activities. Due to confidentiality issues, resources or the pandemic situation we are facing at the moment of writing this thesis, there might be situations that prevent the designers and developers from contacting the users, and these situations need to be overcome. However, the objective is not to forget the users or to rely on applying the old information from one project to another but to use existing information when possible and to update the information regularly. I wish to highlight the importance of input and participation from the actual or envisioned users during the development project, and my intention has never been to recommend abandoning user research.
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Leech, Nancy L, Amy B Dellinger, Kim B Brannagan, and Hideyuki Tanaka.


Appendices

Appendix A: Interview Themes

This appendix presents the interview themes. These were mostly applied in the interviews conducted. However, at times the interviews also covered other themes, especially when interviewing the same person more than once or when the interview was intended to cover a specific topic.

1. Warm-up, confidentiality issues and the background for the interview

2. The interviewee’s background
   2.1. Job description
   2.2. Work history
   2.3. Most common co-workers
   2.4. A typical working week

3. Different project types – defining the user and customer
   3.1. Defining and differentiating different types of product development projects
   3.2. Differences between projects
   3.3. Defining the user and the customer
   3.4. Defining other terms used for the user

4. Single case/project
   4.1. The selection of a project in which the interviewee has participated lately
   4.2. The goal/target of the project
   4.3. The trigger for the project
   4.4. Project participants
4.5. Planned users and customers for the product

4.6. How user information was gained during the project (methods, who collected it, who analysed it, at which phases of the project was it gained)

4.7. The stages when user and customer information was especially used

4.7.1. How the information was stored

4.7.2. Whether the information was returned to during the project

5. Methods

5.1. The different methods used to gain user and customer knowledge at the case company (the interviewer lists these on paper to be discussed further)

5.2. The interviewee’s own methods and other methods used at the company (the interviewer adds these to the previous list)

5.3. Other methods used in the company that are still missing from the list (if such exists) (the interviewer adds these to the previous list)

5.4. Whether employees are taught or guided somehow to collect user insights

5.5. Going through the formed list with the interviewee and adding any missing methods or practices

6. Discussion about a large development project that targeted developing the ways of getting user insights at the company

6.1. Discussion about the project and the interviewee’s role in it

6.2. What should still be developed in the area of gaining better user understanding

7. Suggestions of other people to interview and knowledgeable people

8. Additional comments the interviewee would like to add
**Appendix B: Research Data**

This appendix presents the research data: meetings, interviews and documents.

**Meetings**

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Getting users’ input to product and service development has been proven to increase the success of the product or service under development. During the past decades numerous methods, guidelines and standards have been developed in order to support human focus in development processes. However, in real life, organisations do not or cannot always follow these guidelines, although they might have the will and capability to have a human focus in their development.

This thesis focuses on a case study where a human-centred design mature organisation could not involve external users directly in a product development project. How did they overcome this challenge and manage to conduct a human-centred design process? This thesis answers this question and, in addition, provides guidance for practice on human-centred design without direct contact to users. Throughout the thesis still highlighting the importance of human-centredness and direct contact to users.