Platformization

Co-Designing Digital Platforms in Practice

Anna Sigríður Islind
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Acknowledgements

It takes a village för att hjälpa en islänning utan lokalsinne hitta rätt i en doktorandresa. Ni är många som har bidragit och jag är evigt tacksam att jag fått stöd från så många kloka som på olika sätt har bidragit till mitt lärande och välbefinnande under de senaste åren.

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iv

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Kram & knús
Anna Sigriður Islínd
Populärvetenskaplig sammanfattning

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I denna avhandling undersöks plattformisering. Med plattformisering menas design-, utvecklings- och användningsprocesserna som äger rum i samband med framtagandet av digitala plattformar. Digitala plattformar börjar sakta men säkert bli en viktig del av både forskningen och arbetslivet. Plattformsbegreppet innefattar att en plattform är en typ av mjukvara, men också en förmedlare som fungerar som mellanhand mellan behov och resurser. I många fall kan detta innebära att en plattform är en mellanhand mellan säljare och kunder, eller mellan tjänsteleverantörer och användare. Plattformar är således hybrider mellan en marknad och ett samhälle, men också en organisatorisk, teknisk och regulatorisk konstruktion som underlättar värdeskapande. En hel del forskning som syftar till att belysa tekniska delar av etablerade plattformar har bedrivits, men forskningen har inte fokuserat på framtagningen av plattformar, vilket omfattar designen, utvecklingen och användningen av plattformar i tidiga faser av plattformiseringen. I de tidiga faserna står andra typer av frågor i fokus än de som är aktuella när plattformarna är etablerade. Frågor som rör designbeslut där vikten av engagemang från olika deltagare och hur detta engagemang kan påverka plattformsstrukturen på olika sätt, kan således vara aktuella i de tidiga faserna. Denna avhandling fokuserar på det forskningsgapet och har ett socio-tekniskt perspektiv på plattformisering och belyser design, utveckling och användning av plattformar för specifika praktiker och specifika ändamål. Avhandlingen bygger på aktionsforskning där empiriska resultat från två empiriska fall inom hälso- och sjukvård, ett 2,5 års fall inom hemvård och ett 2,5 års fall inom cancerrehabilitering, där användarna är vårdgivare och vårdtagare. I båda fallen belyses engagemanget igenom dessa användares deltagande i en så kallad co-designprocess, men den belyser även användningen av dessa digitala plattformar efter att designfasen har ägt rum. Med co-design menas att design-ansatsen är av kollaborativ karaktär och att användarna är aktiva medskapare i designprocessen av plattformarna genom samskapande och engagerat deltagande. Med stöd av teoretiska ramar som bygger på gränsliteraturen (i.e. boundary-litteraturen),
belyses design, utvecklings- och användningssituationen i tidiga faser av plattformiseringen i de två fallen igenom fem artiklar samt i denna kappa. Utmaningar och problem som lämpar sig särskilt väl att belysa med teoretiska perspektiv från gränslitteraturen är exempelvis när praktiker ska samverka på nya sätt, och ta sig an nya utmaningar. Eftersom en viktig utmaning i denna avhandling är design av nya digitala verktyg (som även kan kallas för gränsobjekt) som befinner sig i plattformstruktur, igenom co-design som innefattar nya samarbetskonstellationer mellan olika praktiker, utgör gränslitteraturen den huvudsakliga teoretiska linsen. Avhandlingen bidrar till plattformsdiskussionen genom att fokusera på hur användarna har inflytande på designen genom att bidra på varierande sätt till designen av plattformananas olika lager. Med plattformarnas olika lager menas att en plattform kan ses som uppbyggd av olika lager där själva plattformslagret bildar grundkonstruktionen. Ovan på grunden kan sedan olika moduler utgöras av gränsresurser som kan både vara av social och teknisk karaktär. Dessa gränsresurser kan sedan sättas ihop, så som pusselbitar tillsammans bildar ett större pussel, och tillsammans kan dessa gränsresurser bilda olika appar. Dessa appar, i denna avhandling, ses sedan som gränsobjekt i det sociala mötet mellan de praktiker som har bidragit till designen av plattformslagret, gränsresurserna och gränsobjekten. Dessa praktiker kan tillsammans, i sitt möte med gränsobjekten även utvecklas eller bilda nya praktiker i form av gränspraktiker. Genom co-designansatsen i båda de empiriska fallen belyses därför hur användarna har påverkan på a) designen av specifika gränsresurser (så som programmeringsblock och sociala gränsresurser i plattformen), b) designen av gränsobjekten och c) designen av gränspraktiker där gränsobjekten kommer till användning. Avhandlingen visar på hur samskapande (i.e. co-design ansats) påverkar de olika lager av den socio-tekniska plattformstrukturen. Det huvudsakliga bidraget är konceptualisering av plattformiseringsprocessen där både sociala och tekniska delar av plattformiseringen står i fokus. Denna konceptualisering landar i ett ramverk för plattformering samt sju principer, eller aspekter, av plattformering som kan appliceras av andra som befinner sig i plattformiseringsprocessen.
Abstract

Title: Platformization: Co-Designing Digital Platforms in Practice

Keywords: Platforms; Platformization; Co-design; Practice-based platforms; Healthcare; Care sector; Home care; Cancer rehabilitation; Nascent phases of platformization; Action research; Boundary resources; Boundary objects; Boundary practice; Platformization principles.

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Digital platforms are slowly becoming an important part of both research and everyday work. However, much of the research focus has been on platforms that are already established. Little focus has been on platformization (i.e., design, development and use of platforms in the nascent phases) and the socio-technical aspects of designing platforms for specific practices or purposes, i.e., practice-based platforms. While it is truly important to understand technological aspects and market logics of platform efforts, it is also to understand how platforms become platforms, when designing them alongside end-users. This thesis contributes to the platform discussion with research that focuses both on the technological sides of building platforms while also unpacking the social aspects of the collaborative design situation (i.e., co-design) and development where end-users meet and later use the platforms. This thesis explores the research questions: How can practice-based platforms be designed and developed? What impact does end-user engagement in platformization have on the practices involved? How can platformization efforts be approached and researched? through a study of the design of platforms in care settings, one 2.5–year study within home care and one 2.5–year study within cancer rehabilitation where the end-users’ practices involved in the co-design processes are caregivers and care recipients in both studies. This thesis thereby unpacks the platformization process through a roughly five–year longitudinal AR project, based on these two studies. With the help of the boundary literature, the design, development and use of platforms in the nascent phases of platformization is analysed in these two studies. Through a co-design effort in both studies, the practices that are going to use the platforms contribute to a) the design of which boundary resources (i.e., modules in terms of code blocks) will be developed within the platform; b) the design of the boundary object (i.e., working tools in terms of apps) that they are using together in consensus; and c) the design of a boundary practice in which they will later use the digital artifacts together. The end-users’ practices had impact on the design of
all layers of the platform through the co-design approach, including an influence on the boundary resources that were developed within the platform. The platforms also had impact on the practices, which designed new ways of interacting. The results thereby both show the impact of the end-users’ practices (caregivers and care recipients, which are heterogeneous) on the platform design, as well as the impact of the platform on the design of their boundary practice. In this thesis, the design and development of the two platforms is thereby researched and the design of the platforms is validated by studying the use of the platforms as well. The main contribution of this thesis is a conceptualization of the platformization process where the key characteristics of designing such platforms with heavy user engagement are illustrated in a platformization model and in seven platformization principles.
Included publications

Paper 1. Co-creation and Fine-Tuning of Boundary Resources in Small-Scale Platformization


Paper 2. From Co-Design to Co-Care: Designing a Collaborative Practice in Care


Paper 3. Learning in Home Care: A Digital Artifact as a Designated Boundary Object-in-use


Paper 4. Co-Designing a Digital Platform with Boundary Objects: Bringing Together Heterogeneous Users in Healthcare


Paper 5. Data Supported Practice for Co-Creation of Value in Healthcare

Other selected publications by author


# Table of Contents

Acknowledgements .................................................................................................... iii

Populärvetenskaplig sammanfattning ................................................................. v

Abstract ....................................................................................................................... vii

Included publications ............................................................................................... ix

Other selected publications by author ................................................................. xi

## 1 Introduction ............................................................................................................ 17

1.1 Problem domain ........................................................................................ 21

1.2 Aim & research questions ............................................................................ 25

## 2 Related research ................................................................................................... 29

2.1 Platforms ..................................................................................................... 29

2.2 Co-Design ................................................................................................... 35

## 3 Theoretical concepts ............................................................................................ 39

3.1 Boundary practice ...................................................................................... 39

3.2 Boundary objects ....................................................................................... 41

## 4 Research approach & context ................................................................................ 45

4.1 The empirical studies ................................................................................ 48

4.2 Selection ...................................................................................................... 50

4.3 Comparison ................................................................................................ 51

4.4 Researcher’s role ........................................................................................ 52

4.5 Study I: Home Care ................................................................................... 54

4.6 Study II: Cancer rehabilitation ................................................................. 58

4.7 Ethical considerations ............................................................................... 64

## 5 Platform architecture ........................................................................................... 65

5.1 Architectural choices: Home care ........................................................... 65

5.2 Architectural choices: Cancer rehabilitation ............................................. 69

## 6 Summary of papers ............................................................................................... 75

6.1 Paper 1 ......................................................................................................... 76

6.2 Paper 2 ......................................................................................................... 78

6.3 Paper 3 ......................................................................................................... 81
6.4 Paper 4.................................................................83
6.5 Paper 5.................................................................85
6.6 Synthesis of papers................................................87

7 Discussion.................................................................89
7.1 Drawing the line of platforms.................................89
7.2 Co-Designing boundary resources.........................94
7.3 Co-Designing boundary objects.............................99
7.4 Co-Designing boundary practices.........................101

8 Conclusion & research implications.........................107
8.1 Practical implications.............................................108
8.2 Future work & limitations.......................................109

References......................................................................111

Included Papers.............................................................124
   Paper 1........................................................................125
   Paper 2........................................................................143
   Paper 3........................................................................169
   Paper 4........................................................................183
   Paper 5........................................................................201
Included Publications:

**Paper 1.** Co-creation and Fine-Tuning of Boundary Resources in Small-Scale Platformization

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**Paper 5.** Data Supported Practice for Co-Creation of Value in Healthcare
1 Introduction

Digital platforms are becoming an emerging area of Information Systems (IS) research. The term “digital platform” takes into account that a platform is a piece of software, while it is also an intermediary that connects needs with resources; in some cases, sellers with customers, and in other cases, users with service providers. A digital platform (hereinafter simply “platform”) is a hybrid between market, firm and community and is an organizational, technical and regulatory construct that facilitates value creation.

There are different types of platforms, for instance, operating system platforms, e.g. iOS and Android are the foundation for mobile app development, and are nowadays also a part of the research agenda. Social media platforms such as Facebook, Instagram and Twitter have had large impact on the interaction patterns between people. Payment platforms, such as Apple Pay, PayPal and PayEx have completely changed the financial industry (de Reuver et al., 2017). Peer-to-peer platforms such as Uber and Airbnb have revolutionized the sharing economy and healthcare platforms such as PatientsLikeMe have had large impact on modern healthcare. All these types of platforms, researched from different angles, are a part of the research within the field of IS (cf. Baldwin et al., 2009; de Reuver et al., 2017; Eaton et al., 2015; Furstenau and Auschra, 2016; Gawer, 2009; Ghazawneh and Henfridsson, 2013; Yoo, 2013; Yoo et al., 2012).

The literature on platforms often either discusses the platforms from a rather technological standpoint or through market logic (which will be further elaborated on in the chapter on related work) (cf. Gawer, 2009) and there has also been a focus on third-party developers (cf. Ghazawneh & Henfridsson, 2013). Third-party developers are the developers of both boundary resources (i.e., technical parts such as code blocks and social parts in terms of social arrangements) as well as mobile apps that benefit from existing boundary resources within the platforms (cf. Ghazawneh and Henfridsson, 2013). Third-party developers are in that sense users of the boundary resources. However, they are not the end-users of the mobile apps. What has not been addressed in previous research are the practices that constitute the end-users of the platforms and the potential influence that these end-users can have on the design and development of the platforms they will use. Moreover, what has been the focus point in previous research has been on established platforms, but there is a gap in the literature regarding how platforms become platforms. My interest focuses on that gap and this thesis constitutes a study of the nascent phases of platformization (i.e., design, development and use of...
platforms) where platforms are being designed with substantial involvement of end-users, to fit specific purposes in specific practices. The process of designing, developing and using platforms in the initial phases, is what I call platformization in this thesis.

The platform efforts enable a wave of change that is ongoing. The shift towards increasingly easily built mobile apps, in a modular way, enabled by platform efforts and layered modular architecture (Yoo et al., 2010; Yoo et al., 2012; de Reuver et al., 2017). The platform itself, the boundary resources and the mobile apps can be seen as different layers of the platform infrastructure (Yoo et al., 2010). The increasingly easily built mobile apps, in a modular way, enable a vast majority of the population to build a mobile app, for any purpose. A large part of the mobile app development is done by young developers in Silicon Valley where there is a tendency to design apps with a rather narrow purpose in a “one-app-fits-all” manner, taking the point of departure from their own needs and to a large extent disregarding more frail end-user groups or complex purposes and situations. This makes mobile apps and platforms increasingly available for the mainstream population but not necessarily for more frail end-users, which could potentially benefit the most. Furthermore, due to speed in the development processes, the end-user detachment during design and development can continue to increase because of lack of time in speedy development sprints where each mobile app is seen as a whole that needs to be completed and deployed to the App Store as fast as possible. End-user involvement in agile processes has been studied by many researchers (e.g. Cockton et al., 2016; Jia et al., 2012; Kuusinen and Väänänen-Vainio-Mattila, 2012; Larusdottir et al., 2017; Sy and Miller, 2008). All these studies report challenges of integrating the end-users’ perspectives in speedy development; since one of the major values in increased agility is speed, leaving time to involve end-users increasingly limited. The development of smaller mobile apps in a modular way, rapidly, thereby has the potential to nurture the detachment between on the one hand the designers and developers and on the other hand the end-users and practices that will later be using the mobile apps and platforms. The increasing agility in software development alongside the layered modular architecture are thereby both potential obstacles for integrated end-user influence in design and development of mobile apps and platforms.

Within the platform literature, the relationship between third-party developers and the platform “owners” has been forwarded as an arm’s-length relationship, where keeping a distance through regulations is important (cf. Levina and Vaast, 2006). This arm’s-length relationship and detachment between the developers and platform owners is however promoted for established platforms whereas there is a gap regarding the level of closeness during platformization. The arm’s-length relationship, and distance between the platform owners and third-party
developers, is important when the platforms are already established, for increased agility when developing apps with established boundary resources. However, whether it is the right type of relationship in the beginning, during platformization, and whether the type of relationship should also extend to the relationship between the developers or designers and the end-users is up for debate.

The potential that platforms bring enables mobile apps and different ways to collect data to be interconnected in a platform. The platform efforts and increased interest in mobile apps thus also enable another trend: blurring boundaries (Yoo et al., 2010). For instance, blurring boundaries between work practices within organizations and everyday life practices, outside of organizational boundaries. When platforms and mobile apps are used both within and outside organizational boundaries, as a part of everyday life, it both changes the nature of the use and complicates the end-user situation (Islind and Lundh Snis, 2018). The platform phenomenon thereby has the potential to shift the focus towards designing a new way of working and living, while also increasing the understanding of these blurred boundaries when designing, developing and using platforms.

The focus on designing one mobile app after another, with a narrow purpose, might not be sufficient for some practices. One domain where the complexity is already high is within healthcare. Healthcare is a highly regulated context where new software that are brought in need to be thought through carefully. Moreover, IS research is paved with examples of failed implementations within healthcare due to usability issues or superficial understanding of the practices involved (Ellingsen and Monteiro, 2012; Fitzgerald and Russo, 2005; Monteiro et al., 2013) leaving us with a healthcare sector that in some cases can be sceptical towards IS efforts. Consequently, it is critical that digital artifacts, such as mobile apps or platforms, that are brought into healthcare are carefully thought through and designed. Within the domain of healthcare, there is a growing interest in personalization in care for patients as well as data work of caregivers, which has potential to both increase self-care and self-management in everyday life, while also influencing the caregivers’ work (Fitzpatrick and Ellingsen, 2013; Islind et al., 2018). The patients potentially have an increasingly important and empowered role in their own care, a role that they were unable to have without digital artifacts. Also, within healthcare, the end-users often are a part of different practices (i.e. caregivers that are a part of organizational contexts, and a part of a nursing practice whereas the patients might be a part of a everyday life practice, outside of organizational boundaries), meaning that there is often more than one complex heterogenous practice that needs to be taken into account during platformization.
For these practices, the context is key and due to that, there might be a struggle between on the one hand, the rapid software development and “one mobile app after another” type of focus and on the other hand facilitating the actual needs of the practices where the platforms are to be used. Designing platforms and digital artifacts (such as mobile apps) together with heterogenous practices (i.e., caregivers and care recipients), can thereby not necessarily be designed in the same way as the mobile apps and platforms used by the mainstream population, nor might rapid agile software development processes fit the purpose. These practices might need a more delicate approach. Designing platforms, such as those within healthcare, where the context is highly regulated and important, might thereby call for an approach where the end-users are heavily involved, and intimacy is key instead of an arm’s-length relationship, to take the practices of the end-users into account.

My research focus is therefore on understanding the influence of end-users during platformization in the spirit of the Scandinavian school, through a collaborative design (co-design) approach with a socio-technical view, in order to understand the impact of practices when designing and developing platforms as well as the influence of the platforms on the practices. The thesis thereby focuses on unpacking platformization and on how platforms come to be, what impact the practices have on the platformization and what impact the platforms have on practices involved. To do that, I dig deeper into specific parts of the platforms, to gain in-depth insights that can shed light on these previously rather un-researched phenomena, such as the design of particular layers of a platform, i.e., specific boundary resources within a platform and how these become mobile apps, and how these mobile apps become a part of the end-users’ work and everyday life. This will contribute to an understanding of design, development and use in the nascent phases of platform design, which is end-user driven in the spirit of the Scandinavian tradition.

Designing, developing and using such platforms in practice and alongside the practices, herein called practice-based platforms, in close collaboration with the end-users, by understanding the social aspects as well as the technological aspects, through a socio-technical lens, has not been addressed in the previous literature and is one of the key interests of this thesis. The practice-based platforms are an additional type to the abovementioned platform types. In this thesis, I thereby examine the platformization of practice-based platforms from different angles, to gain deeper understanding and insight into the design, development and use of platforms. This thesis thereby contributes to the understanding of platformization, before the platforms start to grow, both by examining the impact that the end-users’ practices have on the platform design through engagement in
design and development of different architecture layers, and the impact that the
platforms have on the end-users’ practices, where they are to be used.

This thesis more specifically offers a socio-technical view on the nascent phases
of platformization through two 2.5-year action research studies within care, one
within home care and one within healthcare. In both cases, the design and
development have been studied and the design of the platforms has been verified
by following the end-users’ initial use of them. The two studies constitute a five-
year longitudinal action research project on platformization. The main
contribution is a conceptualization of the platformization process, alongside
seven principles for co-designing practice-based platforms and a platformization
model.

The rest of the thesis is organized as follows. First the problem domain will be
discussed, followed by the research questions and aim. Chapter 2 discusses the
related work where the two large areas of interest are the platform literature and
the co-design literature. Chapter 3 presents the theoretical framing for this thesis,
beginning with the practice lens and continuing with boundary objects. Chapter
4 discusses the research approach of this thesis. Chapter 5 discusses the
architectural choices in the two platformization efforts. Chapter 6 discusses the
results of this thesis in terms of the five included papers and then summarizes the
results. Chapter 7 presents the discussion of the findings and the contributions of
this thesis as a whole. Chapter 8 summarizes the conclusion in terms of theoretical
and practical implications and ends with an indication of further work.

1.1 Problem domain

When designing, developing and using practice-based platforms, one domain of
interest is the healthcare domain. Within the healthcare system today, there is an
increasing need for digitalization caused by challenges linked to an aging society
and higher survival rates from serious diseases, such as cancer. There is also an
increasing need for caregivers. This puts even more pressure on finding other
solutions to cope with these societal challenges. One aspect of coping with these
increasingly pressing challenges is to digitalize various aspects of care. To explore
platformization, the care sector is therefore a domain where change is not merely
feasible, but entirely necessary to meet ongoing challenges. This makes care
settings interesting contexts to explore platformization. I will therefore be looking
specifically at care setting and societal challenges linked to an aging society and
advancement of medicine. These large societal problems constitute the problem
domain of this thesis.
Globally, aging is a demographic reality and the challenge of an ageing society due to higher life expectancy will continue to increase, because of demographic and epidemiological advancements (Harari, 2016; Kalache et al., 2002; Pin and Spini, 2016). There will be fewer children under the age of five than older adults over 60 by the year 2020 according to WHO (2014). This has never been the case in the world before. By 2050, WHO (2014) expects there will be 2 billion people over 60 years old (whereas the number today is approximately 840 million) (Pin and Spini, 2016; United Nations, 2013; WHO, 2014). The number of centenarians (people over 100 years old) is also expected to increase, from 441,000 in 2013 to 3.4 million in 2050 (Pin and Spini, 2016; United Nations, 2013). Even though most of us see this as good news, this most certainly brings new societal challenges that the world has not dealt with before.

By 2050, the ageing society in Sweden will lead to fewer health professionals (herein called caregivers) per elderly or patient (i.e., care recipients) within home care and simultaneously, the cost for healthcare services will increase. The need for caregivers is expected to increase between the years 2010-2050 by 24-28% within the whole healthcare system and specifically 67-76% in care for the elderly (Ekholm, 2010). What needs to be done according to Ekholm (2010, 2016) is to increase efficiency of care and perform proper healthcare. This will improve outcomes as well as reduce costs. Ekholm (2010, 2016) argues that innovation, development and research are needed within the home care and healthcare systems, in relation to digital solutions, to achieve these goals. The healthcare system needs changes in order to cope with fewer healthcare professionals per care recipient and in so doing there is a growing need to find other means to communicate between the healthcare system and care recipients. There is a call for higher productivity and efficiency while simultaneously enhancing the quality of care. This will most definitely be challenging.

Being in need of care should not mean loss of control. The empowerment of the elderly is important, now more than ever because the elderly are expected to be a larger part of society henceforth. WHO (2002) elaborate on the phenomena of “active aging”, an approach that distinguishes from “needs-based” aging. This has been happening over the years due to a shift in human rights for elderly (WHO, 2002). The phenomenon is based upon five principles: “participation, independence, dignity, care and self-fulfillment” (WHO, 2002, p. 13). Patient-centered care, now being more established all over Europe, has similarities, putting the care recipient in focus.

There are not enough nursing homes to take in the growing number of elderly and many care recipients want to be able to stay in their own space. Due to the shift towards active aging, society should most definitely help them do that. Hence, there is a growing need to help the elderly within their homes and to be
able to do that, new methods will need to be developed. Home care, as it is today, will not be able to expand to meet the needs described by Ekholm (2010, 2016). Because of that, home care needs to focus on using hands where hands are needed, meaning that they will have to rely upon new means to support their everyday tasks to handle the growing number of care recipients per caregiver. In doing so, the practice of working in home care will change, and some changes might be appreciated, others not. The changes might call for strengthening of some old competences or even developing new competences or practices that might not have been a part of the everyday work before. This thesis is based on the values of “active aging” and takes its point of departure in these aforementioned societal and practice-based challenges.

An ageing society and higher life expectancy does not mean that people are generally healthier; 23% of global healthcare today is directed towards illnesses and complications that people over 60 years old suffer from (WHO, 2014). The general trend of higher life expectancy can be linked to advancement of medicine which means that other parts of the healthcare system are facing new challenges as well. For instance, people that are diagnosed with cancer, or other similar diseases of the same severity, are more likely to survive today. Cancer treatments are proving much more successful nowadays which has both increased the chances of beating cancer as well as changed the nature of the after-care (Warrington et al., 2015). In Europe there are approximately 20 million cancer survivors and in Sweden the number is 390,000. In the United Kingdom alone, the number of people that have survived cancer is 2 million today, and this number is estimated to increase to 4 million by 2030 (Maddams et al., 2009; Warrington et al., 2015). This increase is considerable and again, good news for most of us, but brings new challenges that society needs to prepare for now to be able to handle them.

These are new challenges that the healthcare system is taking on, while simultaneously dealing with the ageing society and many other aspects of the evolving population and advancement of medicine. Both the aging society and survival rates of cancer are great, but in order to be able to handle the increased number of elderly as well as growing number of cancer survivors, new strategies need to be developed.

The digital landscape today, with growing interest in digital artifacts such as mobile apps, could be one aspect in preparing for these significant societal challenges that are underway. These shifts towards empowerment of the aging population and patient-centered healthcare also mean more involvement of the care recipients in their care. Consequently, these societal trends should be taken seriously in terms of a more active involvement in design processes that affect the
patients’ lives. These societal changes challenge various aspects of being a caregiver as well as being a care recipient, while also challenging the way we design platforms and digital artifacts.

There is a need to change the way work is done today to prepare for the increased elderly/patient flow while preserving the quality of care. Meeting a 93-year-old lady who has had no contact with computers or mobile devices before, and seeing her light up as she is being led into the digital age alongside her caregiver, means that the availability of digital artifacts has not reached everyone. Also, as this is her first time using a digital device, agility and rapidness are not suitable. She needs the design process to focus on more than merely the interaction design or technological features. Similarly, at the cancer rehabilitation clinic, the patients are trying their best to manage the symptoms due to their radiation-induced problems, and they need to be given a voice. Both types of care recipients have specific situations, which are instances of these societal challenges and for them it is important to be involved, to have a say. This makes the Scandinavian school relevant, where true end-users with their real problems are engaged in the design process. Even though the cancer survivors have used digital devices before, they do not have the right tools to help manage their everyday problems. Both groups have in common that they are peripheral to regular care and are therefore not the typical groups that are being engaged in healthcare digitalization projects.

The caregivers (i.e., auxiliary nurses in the study of home care and specialized oncology nurses in the study of cancer rehabilitation) will be using the platforms as well. They therefore need to have an active say in the formation of the digital artifacts (i.e. mobile apps and platforms). They have the potential to influence everything from the interface to modules developed, while also engaging in designing a new way of working in an increasingly digitalized work practice. The complexity of both design processes is high and the heterogeneity of the end-users extreme where one end-user group belongs to a caregiving practice and the other end-user group in both studies is outside of organizational boundaries, trying to manage their day-to-day life. The complexity has made it all the more interesting to design and develop platforms alongside and for these heterogeneous users. The accessibility and availability that digital artifacts bring, and the distributedness that the platform phenomena allow, alongside the notion that a platform is an intermediary that connects needs with resources and, in these studies, users with service providers, which is central in a platform perspective, are aspects that can be life-changing for people in need of care. It also has potential practice-changing attributes for the caregivers, which is what I study through involvement in the complex design processes.

Due to the seriousness of the societal challenges, and increasing need to digitalize more aspects of care processes, we need to understand more about
platformization than merely building platforms or mobile apps within platform contexts from a technological perspective. We also need to understand the impact of platformization in practice, where care practices are examples of heterogenous practices that are often complex and therefore intriguing settings to explore platformization. By doing that, it will be possible to understand more about relationships in platform efforts, such as the relationship between layers of the platforms and the practices of the end-users. Also, as the digital landscape and technology today allows for both rapidness and modularity, I want to re-examine the Scandinavian approaches and the end-user involvement through co-design in platform efforts and see to what extent end-users can influence different layers of the platforms. To understand the impact of the end-user involvement, I want to examine the design and development process as well as the use process, while in both scenarios the focus is on the interaction between the caregivers and care recipients. That is why I want to look towards the socio-technical aspects of co-designing platforms within care settings to understand the design, development and use situations as well as the technological resources in-depth. These societal challenges, these urgent practice challenges within care settings, and platformization are what this thesis takes into consideration, looking at instances of these healthcare challenges from different aspects within the co-design process, from an IS perspective.

1.2 Aim & research questions

This research is contextualized in care settings due to the pressing issues discussed above. The care settings involved in the studies are i) home care and ii) cancer rehabilitation, where mobile apps, built within platforms, are co-designed, developed and used as a part of work and everyday life. The aim of this thesis is to conceptualize the platformization process and to study what type of influence the end-users in care practices have on the design and development of digital platforms and what kind of influence platformization has on the practices involved. The aim is also to unpack how platformization efforts can be researched and to understand how practice-based platforms facilitate mediation between the end-users in care practices as a means to understand the design, development and use of digital artifacts in the nascent phases of platformization. The main research questions of this thesis are:

RQ1: How can practice-based platforms be designed and developed?

RQ2: What impact does end-user engagement in platformization have on the practices involved?

RQ3: How can platformization efforts be approached and researched?
Additional questions that will be explored within the cover text that connect to the research questions above and research focus, are also: Why is end-user involvement important to consider when designing platforms? And if it is important, when is it important?

To address the research questions of this thesis, five papers are included. Each paper connects to the overall aim, as well as to the research questions, by shedding light on different aspects of platformization. The approach towards identifying the research questions for each paper in this thesis has been explorative, meaning that each paper has triggered new questions which sharpened the focus for the following paper.

The aim of the first paper, was to understand the technological aspects of platformization, and to facilitate knowledge about building platforms. The platform was examined from a inside-out view, from within the design and development process. The research question was: i) How can small-scale platformization be understood in terms of the creation of boundary resources and how can the knowledge communication be arranged in such platformization?

The understanding of the platform architecture derived from this paper has been the foundation for designing the digital artifacts that were followed through design, development and use processes in the following papers. The results from the first paper raised further questions concerning the understanding of how to design specific digital artifacts (built up by boundary resources) within a platform. It also triggered questions relating to how such a design process can be organized to facilitate and form the interaction within the care setting.

The aim of the second paper was to develop new insights from collaborative design work on how to facilitate participation and collaboration between two practices, in order to foster the formation of a new prospective collaboration practice supported by a digital artifact. The empirical setting was the home care. The research question that this paper explores is: ii) How can the design process be organized in order to foster the formation of a prospective collaborative care practice and what aspects are important to consider when designing with a boundary practice perspective?

The aim of the third paper was to study the learning effects which can be derived from the use of the designed artifact from the second paper, by examining the impact of the digital artifact on the practices. The context for this paper was also home care. The research questions explored in this paper is: iii) In what ways do digital artifacts re-shape a home care practice and how does this affect the interaction between caregivers and the elderly and learning opportunities for the caregivers?
The fourth paper examines the design process and boundary objects further, now from within the empirical setting of cancer rehabilitation. The aim of the paper was to analyse how the boundary objects are engaged in different design phases, both concerning what type of boundary objects as well as how they play a role in the different stages of design. The research question that this paper explores is: \(iv)\) How are boundary objects engaged in different design phases?

The aim of the fifth and final paper was to dig deeper into the healthcare practice of cancer rehabilitation, where digital artifacts were being integrated into practice and examines how value can be achieved by using digital artifacts as a part of gathering health data in a data supported practice. The research questions that this paper examines is: \(v)\) How can patients, specialist nurses and oncological researchers achieve value from using digital artifacts in a data supported practice?

RQ1 and RQ2 are explored in the five included papers. RQ3 is explored in the cover text. The table below is to illustrate the relation between the research questions of this thesis and the research questions in the five included papers (see Table 1).

<table>
<thead>
<tr>
<th>Overall RQ</th>
<th>Study, empirical context and focus</th>
<th>RQ in paper</th>
<th>Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1</td>
<td>I (home care, design, development &amp; use)</td>
<td>i</td>
<td>1</td>
</tr>
<tr>
<td>RQ 1</td>
<td>I (home care, design)</td>
<td>ii</td>
<td>2</td>
</tr>
<tr>
<td>RQ 2</td>
<td>I (home care, use)</td>
<td>iii</td>
<td>3</td>
</tr>
<tr>
<td>RQ 1</td>
<td>II (cancer rehabilitation, design)</td>
<td>iv</td>
<td>4</td>
</tr>
<tr>
<td>RQ 2</td>
<td>II (cancer rehabilitation, use)</td>
<td>v</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 1: The research questions in the included papers linked to the overall research questions
This chapter focuses on further elaboration of the research domain, which has already been touched upon in the introduction, by discussing related work on platforms within IS research. After that, the chapter then continues by discussing the socio-technical perspective alongside the foundations and core aspects of co-design.

2 Related research

2.1 Platforms

A platform is “the extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interface through which they operate” (Tiwana et al., 2010, p. 676). Traditional IT solutions do not have built-in, default capabilities that allow for supply-side commercialization and user extension, whereas digital platforms have these built-in capabilities (Tilson et al., 2010; Tilson et al., 2013). Establishing trust between different parties is central in a platform context. This phenomenon is becoming increasingly important as shown by increased interest from IS researchers, economists and engineers (Gawer, 2014).

The previous research on platforms aims to shed light on different aspects of platforms. Some have focused on platform architecture (Baldwin et al., 2009), platform dynamics (West, 2003) the economics of platforms (Evans, 2009; Gawer, 2009), platform leadership (Evans et al., 2008; Gawer and Cusumano, 2002) and the role of boundary resources within platforms (Ghazawneh, 2012; Ghazawneh and Henfridsson, 2013). In terms of application areas, platforms are becoming an important part of various industries. Industries such as the financial industry (de Reuver et al., 2015), healthcare (De Reuver et al., 2013; Furstenau and Auschra, 2016), transportation (Svahn et al., 2015) and electricity distribution (Kiesling, 2016). This means that the literature on platforms is growing in terms of both different application areas and scope.

However, this research has been done on large, established platforms that have had a long time to grow. This expanding process is referred to as scaling. Scaling refers to when an IT solution (e.g. a platform) grows to support a larger part of the population then before (Monteiro, 1998). However, allowing platforms to scale requires an individual process where two or more actor groups adopt the platform (Furstenau and Auschra, 2016). Scaling happening in a platform context is more complex due to the necessity of two or more actors (both user and
supplier for instance) so that the platform can grow “within and out of existing target groups, offering new services” (Furstenau and Auschra, 2016, p. 4). As these are known start-up difficulties and this kind of “bootstrapping” can be difficult to achieve, according to Hanseth and Lyttinen (2010), it is interesting to study the nascent phases of designing, developing and using platforms, even before platform scaling has begun. Also, some platforms might not ever scale to match the previously mentioned established platforms in size, but instead will stay small-scale. It is therefore important to shed light on platformization as well, and not only focus on established platforms that have already gone through the scaling phases. As mentioned in the introduction, this thesis focuses specifically on practice-based platforms, during platformization, which by definition is early on, consequently the platforms are still small-scale. Due to lack of research on the nascent phases, the related work focuses on the existing platform literature and how the literature has discussed various platform efforts from different angles.

A growing body of literature concerns research regarding mobile and software-based platforms where the main focus is on platforms as two-sided markets (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013; Sørensen et al., 2015; Tiwana et al., 2010; Wareham et al., 2014). The lens has been growing since the early 2000s and has been referred to as two-sided markets, multi-sided markets or multi-sided platforms in the literature (Evans, 2003; Gaver, 2014; Rochet and Tirole, 2003; Rochet and Tirole, 2006). Viewing platforms as two-sided or multi-sided markets means that the platform facilitates exchange between consumers that have not been in transactions before and enables interaction, because the interaction takes place by way of the platform (Gaver, 2014). Much insight can be gained from studying this body of work as successful platforms with a significant digital element tend to fall into the category of two-sided or multi-sided markets where the platform brings parties together in open co-creation arrangements (Boudreau and Lakhani, 2009). Such platform arrangements are based on the exposure of APIs, sourcing of SDKs, and rely on standard Internet technologies for the development of new services. The two-sided or multi-sided market perspective on digital platforms allows for an intermediary boundary spanning actor groups such as suppliers and users (Furstenau and Auschra, 2016; Rochet and Tirole, 2003; van Astyne et al., 2016).

Even though much insight can be gained from this extensive literature, Rochet and Tirole (2003) point out that the view carries sensitivity with it because of the importance of having both sides “on board” when the platform is scaled from a smaller platform to a larger one as well as in the process of establishing the platform itself. Similarly, Furstenau and Auschra (2016) suggest that platforms within the healthcare sector tend not to be classical multi-sided markets in the sense described in the abovementioned literature as “[p]latform providers are
often main contributors to the platforms as well as their financiers, bringing further user and suppliers together for their own sake (e.g., to achieve a competitive advantage by offering the platform)” (Furstenau and Auschra, 2016, p. 3). Even though they raise valid questions, the multi-sided markets within healthcare can vary tremendously as there is not always financial gain from the main contributors, but rather a co-creation of value from within the multi-sided market. Multi-sided markets and platforms within healthcare are therefore different from the multi-sided platform that Spotify and other similar platforms build upon. Due to this difference, this thesis will focus primarily on platformization, and thereby focus less on the creation of multi-sided markets within healthcare, even though that literature has relevance for understanding the research on a more general level.

### 2.1.1 Boundary resources

The research on software and smartphone app platforms tends to explore features relating to the open and flexible models of collaboration facilitated by distributed development based on shared boundary resources, thus providing architectural leverage. To illustrate this, Ghazawneh and Henfridsson (2013) introduce the boundary resources model (see Figure 1). Boundary resources are “the software tools and regulations that serve as the interface for the arm’s-length relationship between the platform owner and the application developer” (Ghazawneh and Henfridsson, 2013, p. 174). The understanding of the dynamics of a digital platform should not be through the platform itself, but rather through understanding the boundary resources (Ghazawneh and Henfridsson, 2013). The modules and the core of the platform that interact through a standardized interface can be seen as building blocks (Tiwana et al., 2010; Woodard and Baldwin, 2008). In accordance with that, “we can see how standardized interfaces allow for dynamics and scale in the periphery while the core can be optimized for stability and reliability” (Furstenau and Auschra, 2016, p. 3).
Ghazawneh and Henfridsson (2013) use their boundary resources model (see Figure 1) to illustrate control in software platform situations and their model is useful to understand how the arm’s-length relationship between developers and platform owners is constructed when developing boundary resources within large-scale, established platforms.

Yoo et al. (2010) call for more research regarding boundary resources and their role in digital innovation, and from that call several significant research papers have been written of which Ghazawneh and Henfridsson (2013) paper on boundary resources is a significant example. There are two forms of specific platform boundary resources (Ghazawneh and Henfridsson, 2013). First, there are technical boundary resources typically consisting of software development kits (SDK) and application programming interfaces (APIs). Second, there are social boundary resources, typically incentives, intellectual property and platform documentation (Gawer, 2009; Ghazawneh and Henfridsson, 2011). These resources enable access to central modules of the platform (Yoo et al., 2010). This allows the necessary complementary innovation by third-party developers (Gawer and Cusumano, 2008).

Generally, third-party developers are those who develop applications that enrich a platform (Ghazawneh and Henfridsson, 2013) and involve a heterogeneous group of app developers (individuals or groups) who are dispersed. The research by Ghazawneh and Henfridsson (2013) is designated for established platform
development contexts, and they emphasize the distributed use of the boundary resources developed. Such processes are guided by principles of objectified and commodifying knowledge as well as arm’s-length relationships.

Regarding the creation of socio-technical platforms, tuning is a robust analytical lens to understand “the dynamic nature of boundary resources in service systems” (Eaton et al., 2015, p. 221). The notion of tuning is originally built on (Ghazawneh and Henfridsson, 2015; Pickering, 1993), while Barrett et al. (2012 extended the concept. In Eaton et al. (2015) the concept of tuning is further developed into an approach of distributed tuning. Based on an embedded case study analysis from Apple, their iOS service system and third-party developers, they offer a process model that accounts for the power-oriented dynamics of using and designing boundary resources. “Distributed tuning emerges from ongoing tensions among dispersed heterogeneous actors who deal with a set of technology artifacts in a network” (Eaton et al., 2015, p. 235). They also note that there is a power dimension in the relationship between the actors participating in a service system where there is not an equal degree of agency over both material and other actors in the service system (Eaton et al., 2015). The relationships of tuning and influence function as fundamental characteristics of how boundary resources are resisted and accommodated (Eaton et al., 2015). Even though tuning is of importance in the literature, it has been a peripheral concept in this thesis but is discussed as part of the related work to facilitate a deeper understanding of the notion of boundary resources.

The platform logic means connecting resources with needs, e.g. in terms of multi-sided markets. The creation of multi-sided markets means aiming for low transaction costs and network effects of the platform, where the winner takes it all. The platform logic facilitates value creation in open networks and in communities, as a means to try to take control over value capture (Evans and Schmalensee, 2016; Gawer, 2009). The community aspect is in sync with the theoretical lens of this thesis, which will be discussed below. The tensions between different logics, such as market logic, industrial logic, state logic, sharing logic and platform logic, makes it all the more interesting to investigate socio-technical platforms that touch upon different logics.

Considering the social boundary resources and management of knowledge at arm’s-length as a core function of design capability highlights the importance of knowledge communication and learning for platform innovation. Much knowledge in today’s society in general, and in platform innovation in particular, is based on technical knowledge (Scarbrough, 1995). Hence, the communication of knowledge mainly emphasizes the economic exchange of knowledge objectified in the boundary resources, which implies communication of knowledge through product-based economic transactions (Scarbrough, 1995).
Too much focus on technical knowledge can lead to an expert-driven approach (Sørensen and Lundh Snis, 2001). An opposite approach is that of knowledge communication through social processes of professionalization (Scarbrough, 1995). Here knowledge is co-created and shared among different groups of individuals, and examined from a boundary perspective. This thesis examines the phase when routines and standards are not yet set and when ongoing interaction does not depend on a robust structure of relationships (Hislop, 2002). To understand the nascent phases of platform innovation, the structure of such relationships in practice, at the boundaries, will be examined further in the following chapter (chapter 3).

### 2.1.2 Generativity

One of the core platform characteristics often discussed, is the generativity emerging from the digital characteristics supporting independent developers engaging in producing new and interesting boundary resource recombinations (Tilson et al., 2012). Zittrain (2006) claims that “Generativity denotes a technology’s overall capacity to produce unprompted change driven by large, varied, and uncoordinated audiences”, and further characterizes the following five dimensions of generativity: 1. Leverage in performing some task; 2. Adaptability and built upon with ease; 3. Ease of mastery for broad audience; 4. Accessibility of tools; and 5. Transferability of results.

This thesis focuses primarily on socio-technical platformization, that is, not only the technical components of the platform, the APIs or the SDKs. Even though these are important, they need to be understood together with social dimensions or contexts, i.e., the information requirements and knowledge communication among different actor groups. In line with Zittrain’s (2006) five dimensions, which are primarily of social character, the social aspects can be derived as equally important in platform research and I therefore draw attention to how boundary resources, designed during platformization, influence the practices of the end-users, where the boundary resources will eventually be used. To dig deeper into that specific aspect, co-design as a guiding design approach will be examined next.
2.2 Co-Design

The socio-technical approach is well known within the Scandinavian school, and is still thriving within modern IS research. The socio-technical approach within IS research is based on the relationship between the social and technical systems. The social system consists of professionals and their practices, cultures and roles, while the technical system consists of the technologies that support the work processes of the social system. It is thereby a grounded tradition within this field. The socio-technical approach was a response which aimed to overcome the opposition between technological and social determinism, but has been criticized for being an instrumental, normative tradition, and the practical impact of the practices involved in socio-technical research has also been questioned over the years (Bjerknes and Bratteteig, 1995; Kraft and Bansler, 1994; Kyng, 1994; Leonardi et al., 2012; Leonardi, 2012). It has also been criticized for either favouring the technical or the social (Cecez-Kecmanovic et al., 2014; Leonardi et al., 2012; Orlikowski, 2009). However, in recent years, the focus of research done from a socio-technical perspective has shifted. In the early years the research focused on altering the practices to fit the technical system, whereas today the focus is more on socio-technical design where both the practices involved and the digital artifacts are viewed in an interplay where both need to be carefully designed and adapted, not merely the social system (Leonardi and Barley, 2010). There is however, an inherent ontological distinction which has been preserved between the social and the material (i.e., technology) even in recent socio-technical studies, which validate “the viability of a socio-technical approach in which the ontological distinction between the social and the technical reality is maintained” (Robey et al., 2013, p. 385).

Within the Scandinavian school, there has also been a longstanding focus on end-user participation and engagement in the design process (Bødker et al., 2000). The collaborative creativity where the end-user is engaged as a co-designer (i.e., as a collaborative agent or actor in the design process) is not something new, within the Scandinavian school and in participatory design it has been the guiding philosophy for 50 years. An important building block in the move towards participatory design was written by Cross (1972) in the preface to Design Participation, where the theme was “user participation in design”:

Professional designers in every field have failed in their assumed responsibility to predict and to design out the adverse effects of their projects. These harmful side effects can no longer be tolerated and regarded as inevitable if we are to survive the future . . . There is certainly a need for new approaches to design if we are to arrest the escalating problems of the man-made world and citizen
When participatory design, and later collaborative design (which was ultimately termed co-design) emerged in the literature, the design approach was often targeted towards designing a specific service. However, we are not only designing products for, or with, end-users now; instead we are designing complete future experiences and digital artifacts that construct cultures and new practices. In co-design, the end-user is regarded as a partner who actively contributes to the design process. The fundamentals of co-design as an approach thereby entail the end-users having a voice in the design processes that ultimately affect their lives (Joshi and Bratteteig, 2016; Kensing and Greenbaum, 2013). Co-design is more specifically a collaborative creative activity where end-users, who are not trained in design work, and designers engage with each other in order to further the design process, which can be seen as a specific instance of co-creation (Sanders & Stappers, 2008).

In co-design, the goal is to involve relevant stakeholders, who will subsequently become the end-users of the digital artifact, early on in the design process (Joshi, 2017; Joshi and Bratteteig, 2016; Sanders and Stappers, 2008). In more complex situations, where the end-users consist of more than one stakeholder group, the core of the co-design effort is bridging the prevailing boundaries. The source of boundaries in co-design are rooted in the interface and dynamics among use practices, design practices, and work practices. In these design situations, pre-existing boundaries are embedded in differences related to competence, professions, values, interests, age, social status, or power (Sanders & Stappers, 2008). More specifically, this approach puts together the expertise of the designers with the situated expertise of the people whose situations will be impacted by the intended change.

According to Malmborg et al. (2010) a co-design approach in the area of elderly care can also create a number of other context-related issues, such as issues related to identity, self-image, and stigmatization when selecting users as co-designers. Accordingly, in a successful co-design process, where frail users are involved, it is vital that the participants are able to identify themselves as the future end-users of the digital artifact that is being designed (Malmborg et al., 2010; Woll, 2017). Facilitating the collaboration between the elderly or cancer patients and their caregivers early on can thereby function as a basis for the future use situation.

Co-design is thereby not new, and can be seen as well rooted in the IS community and as one of the fundamentals of the Scandinavian school, alongside the socio-technical tradition. However, with the abovementioned changes in the digital landscape where agility is increasing and detatchment is promoted in the platform...
literature, there is a gap regarding the way platforms are co-designed as previous research has not attempted to apply co-design within platform contexts. The previous literature has focused on platforms that were built for maximal scaling, developed in-house by private companies and designed to become standardized and widespread. This does not call for end-user engagement of the same variety as building practice-based platforms, where the primary goal is not scaling but rather facilitating communication and care between two practices, such as a caregiver and a care recipient. In platformization, where the context is important, the end-users can be seen as co-creators, making co-design an approach which can be of value.

Design approaches, such as co-design, where genuine user participation is key in the design process, are especially challenged by established, large platforms where detachment between platform owners and developers is promoted. This detachment can be characterized as an arm’s-length relationship (Levina & Vaast, 2006), and promotes a lack of collaboration and intimacy between the developers and platform owners. Even though the arm’s-length relationship is between the developers and the platform owners within the platform literature that focuses on established platforms, the developers are in some way one user that has a role within a platform context, alongside the platform owners. They are however not the end-users, as discussed above. They are, however, users which have been one of the focus points within the literature to date (c.f. Ghazawneh and Henfridsson, 2013).

The rapidness of the development of mobile apps today may nurture a tendency to move away from designing together and towards an arm’s-length relationship in the design process between designers and the practices of the end-users as well. User-centered design approaches, where relevant end-users are involved in the design process, are not constructed to accommodate the changes in the digital landscape and the rise of the platform era. When participatory design and, later on, co-design emerged in the literature, the design approaches often took on the design of a specific service. However, when designing platforms, the design process needs to take into account a variety of digital artifacts that are interconnected, feeding user data into a platform that is often used by various types of users that have different user goals. These users can for instance be platform owners and developers as well as the end-users and their practices. This means that the design process can be less focused on a specific service and more on a holistic view, taking the platform into account. Even so, it is not enough to merely design the platform, it also needs to be rooted in the practices that constitute the end-users’ situation where it will be used. This tension of increasingly easily built mobile apps and increasingly complex use situations and practices, and platforms which are influencing everyday life, practices and
research, triggered the interest in focusing on designing platforms and looking closer into the design of new ways of interacting between and within practice.

In this thesis, co-design has been the design vision in both design processes. In both design processes, the facilitation of the collaboration, through co-design as a design approach, primarily had to do with the way the processes were organized. Moreover, during a design process, products were being co-designed in terms of platforms, boundary resources, and mobile apps.
3 Theoretical concepts

This chapter consists of the concepts that constitute the theoretical lens for this thesis, to understand both the care practices and the change that occurs when participating in co-design processes where platforms are designed and developed from scratch and as they become a part of the practices through use. Up until this point, the focus has been on the platform literature and design approach and the building blocks and foundations in which such an approach is rooted, but to further illustrate the collaboration (the process) and the design product (the object), the focus will now shift towards understanding the interplay between the social and the technological. The chapter will thereby build on the socio-technical aspect and start by discussing i) the social system by theoretical standpoints from the practice lens, and then elaborate on ii) the technical system through theoretical perspectives such as boundary objects which can be useful in shedding light on the outcome of co-design processes.

3.1 Boundary practice

As a way to understand the social system, the practice lens has been widely applied within IS research, and used by various IS researchers in different forms. There has been focus on different aspects of what emerges from the practice of everyday work (Leonardi, 2015). For example, Wenger (1998) focuses on how social skills emerge out of the practice of work, Orlikowski (2008) focuses on how people develop shared technology patterns, Barley and Kunda (2001) focus on how networks emerge from the practice of work, Brown and Duguid (2001) focused on how knowledge emerges, Carlile (2004) on coordination, and Nicolini et al. (2012) on people’s ability to collaborate. This research is also grounded in different theoretical standpoints. Orlikowski (2008) applied Giddens’ structuration theory, Levina and Vaast (2005) applied Bourdieu’s theory of practice, and Klein and Hirschheim (2008) applied Lave and Wenger’s lens to understand practice. Carlile (2002, 2004) conceptualized division in practice and the creation of knowledge boundaries among different collaborating expert groups. However, in one form or another, the stream of literature is oriented towards the consensus of a practice being an ongoing production which emerges through everyday actions at work (Cetina, 2016; Knorr-Cetina, 2001; Leonardi, 2015; Nicolini et al., 2012; Pickering, 2001). The understanding of what constitutes a practice is one core foundation for this research.
Assuming a practice is an ongoing production that emerges through everyday actions at work, allows for the possibility of recognizing many practices within one setting. Practices are often complex and a practice is not an isolated instance; instead, one practice is often intertwined with other practices (Nicolini, 2012), and as practices emerge, it is interesting to see what happens when new collaborations are initiated with other practices.

To understand what happens when two practices meet, such as the practice of the caregiver and the practice of the care recipient (i.e., the elderly person or patient), I want to dig into the concept of boundaries, which is rooted in the idea of practice and originates from Wenger’s (1998) communities of practice. Akkerman and Bakker (2011) discuss how boundaries are becoming more explicit, because specialization is increasing and new ways of mapping and mobilizing across various cultural and social practices are emerging. Boundaries can include organizational, social and/or cultural distances among different stakeholder groups or practices in a collaborative setting. Practitioners need to cross boundaries when collaborating with new and unfamiliar work territories and thereby learn how to work with other types of professionals or in new contexts (Suchman, 1995). Such boundary-crossing collaboration is challenging because it requires learning and communicating with new and different practices.

Boundaries come from having different backgrounds and diverse ways of communication (Wenger, 2000). Within communities of practice boundary bridging is described as a boundary relation, which consists of two intertwined parts: boundary objects (artifacts, which will be elaborated on below) and brokering (activities and situations) (Wenger, 1998; Wenger et al., 2002). Understanding boundaries and differences between groups is crucial when considering “social learning systems” according to Wenger (2000).

Wenger (1998) argues for the concept of boundary spanning as activities that are performed by practitioners to connect, whereas the connections can, over time, be called boundary practice as the purpose of those practices is to sustain the connections between “several organizational practices” by “addressing conflicts, reconciling perspectives, and finding resolution” (Wenger, 1998, p. 114). During this process, a boundary practice has the potential to be co-created by the members and groups taking part in it. To connect to the previous chapter on platforms, a two-sided or multi-sided market perspective on the digital platforms allows for an intermediary boundary spanning actor groups such as suppliers and users (Furstenau and Auschra, 2016; Rochet and Tirole, 2003; van Astyne et al., 2016), making boundaries an interesting aspect for this thesis.

Important work has been done on the collaboration challenges within a company in the development of software (in particular computer games), where (Carlile,
2002; Carlile, 2004) conceptualizes division in practice and the creation of “knowledge boundaries” between different collaborating expert groups. Furthermore, practices can be developed to overcome and span these boundaries, where the developed practice shares a common understanding and shared language. Such boundary practice was found closely linked to developing a shared boundary object and allowed for the different groups to represent their own expertise and merge that expertise within the joint practice (Carlile, 2002; Carlile, 2004). This was found through the observations of the use of design drawings in the collaboration and interactions between the designers and the manufacturing engineer which supported defining “a shared problem and begin transforming their knowledge (the current design) and accommodating new knowledge (four subassemblies with snap-fit holes and clips)” (Carlile, 2004, p. 450). What Carlile (2004) shows is the importance of collaborative practices that have the ability to span boundaries between different communities. Carlile (2004) also emphasizes the capability of a well-structured boundary object as a representation of each group’s effort in the design process. The creation of the boundary object can in that way help to bridge the pre-existing knowledge boundaries between the two practices.

However, even though studies have been done of software development settings where different professional groups have created a shared practice (Bechky, 2003), studies of more ill-structured work settings have also been done (Kellogg et al., 2006; Majchrzak et al., 2012). The setting of studies by (Kellogg et al., 2006) and (Majchrzak et al., 2012) were of a more emergent quality then Carlile’s studies. The emergent quality can often be found in software development but has also been studied from within other design processes where design is the main focus point, such as in architectural design (Boland Jr. et al., 2007; Ewenstein and Whyte, 2007; Ewenstein and Whyte, 2009).

### 3.2 Boundary objects

To understand the effect of a technical system on the social system and vice versa, such as the impact of a digital artifact on practices (and vice versa), boundary objects can be a useful lens. The following text can thereby be seen as a way to dig deeper into the socio-technical interplay and the meaning of the technology (i.e., the digital artifact such as an mobile app in the application layer, or the platform as a whole) for the practices which it is being designed and developed for and later operated in.
An object becomes a boundary object when it serves as a device for transformation, translation and negotiation at the professional boundaries (Bartel and Garud, 2003; Bechky, 2003; Boland and Tenkasi, 1995; Carlile, 2002; Carlile, 2004; Levin and Vaast, 2005; Nicolini et al., 2012; Pawlowski and Robey, 2004; Star and Griesemer, 1989). More specifically, a boundary object is an artifact that has different roles for different groups that might have boundaries between them. Boundary objects allow groups to unite and form a working relationship and are instances that enable groups that do not share consensus, boundaries or professions, to consolidate and work together (Fischer, 2001; Kimble et al., 2010; Kimbler, 2010; Star, 2010; Star and Griesemer, 1989; Wenger, 2000).

Boundary objects serve to coordinate and communicate perspectives for some purpose (Star, 2010). Boundary objects are the links in the communication processes where different perspectives are to be negotiated and discussed into a co-created meaning and consensus. What then is needed to make this happen are models and applications, which can serve as boundary object systems to support knowledge sharing and co-creation of meaning (Boland and Tenkasi, 1995).

Boundary objects play important roles as shortcuts to communication, as well as playgrounds for knowledge sharing among different communities of practice (Brown and Druguid, 1991; Cook and Brown, 1999; Wenger, 2000). However, boundary objects can only facilitate parts of the communication surrounding a boundary object and due to that cannot replace communication and collaboration (Akkerman and Bakker, 2011). Boundary objects are often technological artifacts but can be other things that bind professions or stakeholders, such as drawings or prototypes (Bechky, 2003; Pawlowski and Robey, 2004), repositories, standardized forms or workflow matrices (Nicolini et al., 2012). Boundary objects can also be on a more abstract level, such as processes, methods (Swan et al., 2007), metaphors (Koskinen, 2005), or narratives (Boland and Tenkasi, 1995).

Boundary objects have been studied in various contexts where different kinds of artifacts have been conveyed as boundary objects. These include studies within museums (Star and Griesemer, 1989), using engineering drawings as boundary objects (Carlile, 2002; Henderson, 1991), and others that use cargo airway bills (King and Foster, 1995), aircraft maintenance requests (Lutters and Ackerman, 2002), human genome mapping (Winter and Butler, 2011) and medical patient records (Berg and Bowker, 1997) as boundary objects.

While the term boundary objects can be used for various types of artifacts, it usually applies to artifacts that are somewhat stable. Ewenstein and Whyte (2009 argue for the notion of making a distinction between closed and open boundary objects. Their arguments show the importance of closed boundary objects as stable and structured representations of expert knowledge. Closed boundary
objects are therefore well-structured and concrete boundary objects that span well-defined boundaries of expert practices (Ewenstein and Whyte, 2009), and these have been emphasized as having large capacity as mediators in the relation between groups (Carlile, 2004). Carlile’s boundary objects can be seen as closed boundary objects in accordance with Ewenstein and Whyte (2009). Open boundary objects are, however, ill-structured, open-ended boundary objects that raise questions and create dialog instead of being a well-structured solution. These open boundary objects are of help in evolving and raising questions about some aspects of the design process while also stabilizing other aspects (Ewenstein and Whyte, 2009).

Grand challenges have been studied as boundary objects within human genome mapping where it is argued that they allow for involvement of different communities that change over time, even though true consensus is often lacking when it comes to grand challenges (Winter and Butler, 2011). Seeing them as boundary objects still allow for collaboration and cooperation in situations (such as human genome mapping) where there is a struggle in sustaining initiatives over a long time frame (Winter and Butler, 2011).

Emergent boundary objects are boundary objects that have not yet been stabilized or gained final meaning, according to (Dalsgaard et al., 2014). In accordance with (Ewenstein and Whyte, 2009), they can also be seen as open boundary objects. The literature on boundary objects in general addresses boundary objects as something that is negotiated and interpreted differently by the different communities of practice involved. However, the boundary object itself is generally not transformed during the design process while emergent boundary objects and open boundary objects are often derived from complex wicked problems and begin in design concepts that continuously change and evolve during the design process (Dalsgaard et al., 2014; Ewenstein and Whyte, 2009). Open boundary objects can be especially applicable as a concept where non-artifacts are seen as boundary objects (Star, 2010; Star and Griesemer, 1989). The distinction made by (Ewenstein and Whyte, 2009) between open and closed boundary objects has grounds in Leigh Star’s (2010) distinctions “between the ‘ill-structured’ use of boundary objects between social worlds and more specific ‘tailored uses’ within those worlds” (Nandhakumar et al., 2013; Star, 2010).
This chapter will focus on the research approach. The chapter includes the research design as well as details in relation to the empirical contexts where the empirical data for this thesis have been collected. The role of the researcher is also reflected upon. The analytical methods will be reported on and finally, ethical considerations will be discussed.

This thesis is based on a qualitative research method that follows the methodology of action research (AR) in IS research. AR as a method has the distinction that researchers insert themselves into the context of their investigation (Järvinen, 2001). This is unusual compared to other methods, where the researcher typically acts as an unbiased observer (Reason and Bradbury, 2001). AR is essentially a change-oriented approach (Cole et al., 2005) and the core activity is to study complex social processes to the fullest extent (Avison et al., 1999; Baskerville, 1999) and to bridge the gap between theory and practice (Mathiassen et al., 2012). It is a democratic and participatory approach that aims to create practical knowledge such as lessons learned, principles or implications, in order to bring together action and reflection (Brydon-Miller et al., 2003; McKay and Marshall, 2001; Reason and Bradbury, 2001). AR goes beyond the notion that action can inform practice, as theory can be created through practice and AR puts emphasis on the collaboration between practitioners and researchers (Avison et al., 1999; Baskerville, 1999; Brydon-Miller et al., 2003; McKay and Marshall, 2001). In this thesis the collaboration has been between practitioners, patients/elderly, researchers from different fields, designers, developers and consultants (further developed below). To create theory through practice, action research suggests the introduction of change into social processes and encourages the researcher to use the technique of observations and interventions to study the effects in practice (Avison et al., 2001; Baskerville, 2000).

This thesis is based on two studies where AR has been the methodological approach. Together, these two studies constitute a longitudinal AR project. The intersection when the practices of caregivers meet everyday practices of the elderly and the patients, are the practices which have been studied and interacted with through this AR project. The developers have also been engaged in the collaboration and have been studied to some extent, and the same goes for the designers’ role. The theoretical framing discussed in Chapter 3 of boundary objects and boundary practice is the theoretical foundation. The choice of the theoretical foundation has been rooted in the change processes and interventions observed and is oriented towards solving the practice problems and challenges. The IS research domains of platforms and co-design, constitutes the background,
related work and the literature to which the thesis contributes. From this thesis, the main theoretical contribution, created through interventions and interactions with the practices, is the conceptualization of the platformization process. This contribution relies on change processes, observed and intervened within practices and the practical contribution mainly targets how to design and develop practice-based platforms that are to be used within care practices.

The method has a dual aim of being a tool for problem solving in practice as well as being an instrument for theory creation (Baskerville, 1999; Mathiassen et al., 2012; McKay and Marshall, 2001). This makes the method a win-win situation for the participants in an action research project as well as the researchers (McKay and Marshall, 2001).

There are various advantages to AR, where the ability to continuously refine the research question throughout the AR project is one such advantage. AR allows for studying the activities in authentic settings, which enables insights into the perspectives and actions that constitute the practices involved (McKay and Marshall, 2001; Willermark, 2018). In this thesis, the activities that have been studied are the co-design and platformization in the two care settings where the platforms are being designed, developed and used. The intervention aspect makes AR an appealing method when it comes to studying a change process, e.g. co-design where the researcher has an active role. The work situation of the practitioners, the everyday practice of the elderly and patients, as well as the two platforms, have all been designed in a co-design manner, in collaboration with the caregivers and care recipients, with the involvement of researchers, through interventions in practice. It is these advantages, and the closeness to the empirical settings, that justifies the choice of method.

Figure 2: The Mathiassen et al. (2012) model on style composition in AR publications
The Mathiassen et al. (2012) model above (see Figure 2) has inspired the description of the research approach. Below is the same model where I have applied the concepts of my research (see Figure 3). The stream of literature (A in the figure) has consisted of the related work of this thesis, the platform and co-design literature. The real-world problem (P in the figure) is the aging society, increasing number of cancer survivors, deteriorating resources in care alongside the research problem of how platforms can be designed and developed to be used in practice. The theoretical framing (F in the figure) consists of the practice lens and boundary objects. The method (M in the figure) is action research where two studies are examined. The research question is in the middle of the figure below and the contribution (C in the figure) is a conceptualization of the platformization process.

![Diagram](image)

**Figure 3: My AR research, inspired by Mathiassen’s et al (2012) model**

Even though AR is an appealing method with various advantages, AR is not without problems. The control structures in AR projects have been discussed as one of the main challenges of the method (Avison et al., 2001). The control structures concern issues of authority warrant and initiation which were carefully considered in both studies. These known AR challenges will be elaborated on for each study in sections 4.5 and 4.6 below.
4.1 The empirical studies

This chapter is a more elaborate description of what has been mentioned briefly in section 1.2, where the research questions are presented. In that section the research questions and the aims of the included papers are presented while here the studies from which the papers are written are the focus. To gain in-depth understanding into the impact of designing and developing platforms and using digital artifacts as a part of platformization efforts in care, two empirical settings have been studied within the care sector.

One setting is from primary care (home care) and one is from secondary healthcare sector (cancer rehabilitation). The setting from primary care is a home care organization in Trollhättan in western Sweden. The setting from the secondary healthcare sector is a cancer rehabilitation clinic at Sahlgrenska University Hospital in Gothenburg, Sweden. For lack of a better term that takes into account both primary and secondary care, I will refer to both sectors as “care sectors” or simply “care” from this point on.

Both studies were targeted towards the overall aim of this thesis as well as to the research questions. The studies have been of an explorative character, meaning the first study triggered the second one. The studies have also been abductive. The abductive nature of the studies refers to the interplay between the observations of real-world problems (which are inductively obtained) in combination with influences from theory (deductively inferred) (Gregory and Muntermann, 2011) by viewing “reality from the theoretical viewpoint or perspective” (Van de Ven, 2007, p. 104). The abductive nature thereby involves shifting between inductive and deductive reasoning as a way to continuously revise, sharpen and re-formulate the research design (Gregory and Muntermann, 2011; Samuels, 2000; Van de Ven, 2007). This explorative, abductive nature of the studies will be elaborated further below.

The aim of study I was initially to understand the technological aspects of building a platform. The platform was examined from within the design and development process. The understanding of the platform architecture has been the foundation for designing, developing and using the digital artifacts that were examined in the following steps in this study through studying the co-design, development and use of the mobile app. The aim therefore expanded to also include the understanding of how design practices can be formed through involvement in a co-design process while also studying the learning aspect that can be derived from the use of the designed artifact by examining the impact of the digital artifact on the practice. The context for this study was home care and this study resulted in three included papers.
The results from study I raised further questions concerning the understanding of how to design specific digital artifacts (built up by boundary resources) within a platform. It also triggered further questions relating to how platforms and digital artifacts can be designed, developed and used in other care settings and how such efforts could facilitate and form the interaction within that care setting. Study I also triggered curiosity about what and how different types of boundary objects can be used in a more active manner during the design process as a way to forward the design process.

Study II therefore examined how different types of boundary objects come into play during different steps in the design process. Building on the understanding from study I, study II examined the design and development of the digital artifacts and studied the platformization process. Study II also dug deeper into designing with heterogeneous practices that meet through their interaction with digital artifacts or platforms in care. This was done by studying the digital artifacts as they are being integrated into practice and examines how value can be achieved by using digital artifacts as a part of the gathering of patient-generated health data in a data-supported practice. This study resulted in two included papers.

The studies are in chronological order. The studies, in relation to the papers that are included, are illustrated in Figure 4 here below.
4.2 Selection

The two projects (from which the two studies are drawn) are independent of each other even though they are part of the same longitudinal AR project. Both were research and development projects involving different researchers and developers. The home care setting (study I) was a 2.5 year project (August 2012 – December 2014). The cancer rehabilitation setting (study II) is an ongoing project (which I am still a part of) but the empirical data gathered for the purposes of this thesis mostly concerns data gathered from February 2015 to June 2017. The empirical data from the two studies thereby roughly span 2.5 years each. The empirical data which is the foundation for this thesis therefore constitutes a longitudinal AR project which is grounded in roughly five years of empirical data.

Study I was part of a larger project called mCity and the home care project was a sub-project included in the umbrella project of mCity. The mCity project involved researchers from information systems, students, interaction designers and programmers from the software industry and consultants with various backgrounds (e.g. marketing consultants, project consultants). The home care project more specifically included interaction with the home care organization, politicians, the municipality, auxiliary nurses, the elderly, the grocery store owner, grocery store workers and others. This particular home care organization was chosen because of their willingness to participate in the research initiative. This organization had a public procurement contract with a specific grocery store, making the technological integration more targeted in programming towards the structure of the grocery lists from that specific store. The combination of these aspects grounded the decision of this particular organization.

Study II was part of a project called EfterCancern. The study was done at a cancer rehabilitation clinic which is also a research clinic, meaning that it is driven by research funds. The project was a multidisciplinary project, including researchers from medicine, nursing, information systems and pedagogy that were working together, alongside the nurses, physicians and patients and in collaboration with consultants with different consulting backgrounds (e.g. communicator, programmers, illustrator etc.). The project was initiated by a professor in oncology and he is one of the founders of the research clinic, and this specific clinic was therefore a natural choice as a research setting when the project was formed. The opportunity for me to partake in the EfterCancern project came when the mCity project was finished. I saw similarities from study I and saw my engagement possibility to complement to the results from study I.
4.3 Comparison

The two empirical contexts had similarities and differences. The design, development and use of digital artifacts and platforms that can contribute to the meeting between the caregiver and the care recipient is common to both studies. The research focus is the same in both studies: designing, developing and using digital artifacts (different artifacts for the two empirical settings) as a part of platformization efforts and to study the effects of these digital artifacts on the studied practices and the effects of the practices on the platforms. The notion of building a bridge between caregivers and care recipients (elderly in study I and patients in study II) that are peripheral to healthcare through co-design is also similar in both contexts.

As mentioned earlier, study I is from primary care (home care) and study II is from the secondary healthcare sector (cancer rehabilitation). There is a structural difference between the primary and secondary healthcare sectors but in this research, the structural differences and economic distribution models (which also differ within primary and secondary care) are disregarded as these have not had an impact on the platformization within the empirical settings. The differences have therefore not been seen as an obstacle. Instead, both studies have been included from a relevance perspective, where the societal challenges within the two studies are the point of departure alongside the drive to understand and inform research on the impact of co-designing practice-based platforms.

There is also another difference in the settings, which has been of importance. In home care (study I), there was no scheduled time for conducting a caring conversation or social interaction of any kind; the caregivers’ role was more of an assistance role before the AR interventions, whereas in cancer rehabilitation (study II) the consultation was a core part of the clinical work. This caring time was one of the outcomes of study I and triggered my interest in study II. That notion, alongside the heterogeneity of the practices involved (i.e., the caregivers and the care recipients) and the fact that the care recipient groups in both studies were peripheral to care contributed to the choice of cases. The aspect of truly helping those in need has been a personal driver for me, which has also affected my genuine interest in both studies.

The level of education is also different in the two contexts. In study I (home care), the caregivers were auxiliary nurses, while in study II (cancer rehabilitation) the caregivers were specialized nurses. In addition, there is the structural difference in the two studies concerning the primary and secondary care sectors, as pointed out earlier.
4.4 Researcher’s role

AR has been criticized for the notion that it can be hard for researchers to be objective about the research context while being heavily involved as a researcher within the context (Baskerville and Wood-Harper, 1996; Bryman, 2015). In both studies, I have had the dual role of designer and researcher. However, in the empirical setting of home care, my role was more interventional and complex. The role included being the project manager for the home care project, software architect, designer and researcher. I had a lead in designing the research interventions (in collaboration with my main supervisor Ulrika Lundh Snis), was a lead designer when it came to the digital artifact and collected all the empirical data. I was involved in the interaction design as well as in the software development. I did the initial prototyping, was active during the interaction design along with another interaction designer, was one of the developers of the Android application, and was the software architect developing and structuring the databases for all versions as well. The last version of the mobile app was developed by a consultancy, but with day-to-day contact with me during the development sprints (Scrum, type of Agile software development method). This rich engagement eliminated many research methods.

In the empirical setting of cancer rehabilitation, I have had the dual role of researcher and designer. It was a less complex role than in the previous study because I have not been the project manager in this project or involved in the programming or software architecture. Even though this role was simpler, it has not been without complexity. It is a complex thing being a designer and a researcher simultaneously. I have been present and active during design interventions within the project (such as development of personas, UX and other interaction design methods). These design interventions were done to support the design process, but had the dual function of both doing that and being data collection activities. The interviews have been conducted by me. The empirical data, which is analysed in the included papers has been collected to a large extent by me but some has been collected in collaboration with my co-author, research partner and collaborator, Tomas Lindroth. We have conducted most of the workshops included in the empirical data together. My fellow PhD students and I have collaborated on two workshops which are included in the empirical material. I have thereby participated actively in the design process, which also strengthens the argument for AR as the chosen method for this thesis.

My own involvement, the interventions in the empirical settings, the research questions, the problems and the complexity of the practices as a social situation all point towards AR as a suitable method for my research.
When reflecting upon my role in the two projects, my goal has not been to be “a fly on the wall”, but rather to be “a fly in the soup”. By that I mean that both as a designer and as a researcher, my aim has been to be a part of the change process, and to intervene, which eliminates the role of a neutral observer. Due to the known critique towards maintaining objectivity as an AR researcher (Baskerville and Wood-Harper, 1996; Bryman, 2015) it has been of importance to be a part of larger research groups involving researchers, practitioners and consultants. These constellations have called for project meetings on a regular basis where preliminary results and plausibility of the analysis have been discussed repeatedly between the involved researchers. The empirical results have also been frequently presented to, and discussed with, the practitioners in both studies. I have tried to shift between being empirically grounded and analytically focused in my research. I have focused on doing periods of empirical work, periods focused on design work, periods focused on theoretical framing, periods focused on analytical work and writing as well as periods focused on scientific reflections. In addition, my supervisors have acted as a sounding board when it comes to the results of the two studies, which has helped me distance myself from my role as a designer, and helped sharpen my research focus.

My main supervisor was the project manager for the overall mCity project, from which the home care project (for which I was project manager) was one of several sub-projects which gave her insight to my work in study I. My co-supervisors have thereby acted as outsiders when discussing the findings from study I. One of my co-supervisors was a part of the EfterCancern project in the beginning, which gave him insights into my work in study II. In relation to the results of that study, my other supervisors have acted as outsiders when discussing the results from study II. Shifting between discussing the findings inside and outside of the projects and between discussing it with researchers and practitioners has contributed to me being able to distance myself from the results and has, over time, helped me separate my roles. These structures and different contexts have helped me distance myself from the empirical settings and the role of a designer increasingly over time, and helped me sharpen my role as a researcher. Over time, I have realized that the roles are separate, but entangled. Wanting to forward the design process and limit waste during development, but simultaneously wanting to preserve rigour and give maximum room for reflection in the data collection, is a challenge I am aware of in my findings.

In addition to that (a notion that does not relate directly to my own role, but more to the validity of the findings), specific findings have been discussed with the practice, and some of the practitioners have read the papers, meaning that they have not only been a part of the co-design process and been aware that their
involvement is a part of the findings, but also confirmed that the analysis of the results is plausible.

4.5 Study I: Home Care

The first problem domain and empirical setting was home care. Home care in Sweden focuses on taking care of the needs and wants of those who have been assessed to qualify for such care. The home care is run by the municipality which is obligated to take care of all a person’s needs, based on a specific assessment. Most elderly people that have been assessed to need some help, are entitled to having their grocery shopping done as part of the service provided by home care. As this is one of the biggest service aspect for the elderly still living at home, the particular process of grocery shopping needs to run smoothly and be effective.

The home care organization that was studied is one of many home care organizations within the studied municipality. The organization is a part of the municipality, and therefore in the public sector, i.e., not a private home care organization. This home care organization consists of 43 caregivers and 26 elderly persons. This number of elderly includes a few individuals with cognitive impairment. The age span of this group of elderly is from 45–96 years old. The younger individuals are included in the elderly category due to lack of a better term and because home care primarily focuses on elder care. The number of elderly varies from time to time, as deaths occur frequently and are a very real part of their organization. The caregivers’ education level varies as well, but the vast majority of the caregivers have auxiliary nurse education (Swedish *undersköterska*).

4.5.1 Empirical context

To understand the situation where the digital artifact Skafferiet (a mobile app that was designed, developed and used within the setting of home care as a part of the platformization effort) was co-designed with practice, the background to the studied scenario needs to be described. Grocery shopping is a necessary part of everyday life, but for people with disabilities, diseases, impaired vision or other problems due to advanced age, grocery shopping is not always easy. These citizens are eligible for home care and receive help from caregivers, employed by the municipality which provides a range of service, such as grocery shopping. Those people are usually elderly or have cognitive disabilities and are known as “users” to the home care services and will simply be called “elderly” below.
The grocery shopping scenario within this municipality begins with the caregivers collecting handwritten shopping lists and either the elderly’s money or payment cards (and sometimes cloth shopping bags). Then the caregivers shop for five elderly users at a time. To do this in a service-oriented manner, so that the elderly are satisfied, the caregivers are required to know e.g. what kind of bread each elderly prefers (if the handwritten note says “bread” for instance). Some notes are precise but even in those cases, there is always a chance that the product specified on the note is sold out and in those cases, personal knowledge about that specific person comes into play. Then the caregivers are required to make an educated guess, based on their previous interaction with that person.

The caregivers are not “professional shoppers” so it takes time navigating in the grocery store. Trying to find products from a handwritten note is a somewhat random process, similar to when anyone else shops for groceries. This is therefore not the most efficient way to shop. When they have collected all the groceries for the five elderly, they are ready to checkout. The grocery shop has set aside a register for them, so that they do not have to stand in line. They need to sort through the groceries and know what belongs to each elderly and then pay with the right card or cash. They also need to keep track of who likes to pay for plastic bags and who wants to have their groceries packed in their own cloth bags and then pack all the bags. Then, they carry all the shopping bags out to their car and deliver the groceries, bring the shopping bags into the house and put the groceries away in the appropriate places (i.e., the refrigerator, freezer and pantry).

This process quite often results in mistakes, such as bringing home the wrong groceries. Problems have also occurred during the payment process. To hand money or a payment card over to a caregiver, which an elderly person might be meeting for the first time, is precarious since time to establish the necessary trust is not always available. Furthermore, the caregivers do not consider it optimal to handle cash with the added responsibility of bringing the right change back if necessary.

Some elderly persons have voiced mistrust of the caregivers and have occasionally made allegations against the caregivers, accusing them of stealing. These incidents usually have a logical explanation and are resolved in a good manner but put unnecessary stress on all parties involved. A side note is that some of the elderly suffer from dementia, meaning that they in some cases, do not remember how much money they gave to the caregiver, which results in increased mistrust. Additionally, the caregivers are trained in auxiliary care or nursing and should not have to go grocery shopping. Consequently, this is a process with numerous human factors that can go wrong and as long as the money factor is involved in this process, the possibility of mistrust will be there.
Having a tool that could facilitate the shopping and include the elderly in a more structured manner was discussed. As the elderly wanted to take part in grocery shopping, and the caregivers wanted to work with care, alongside the problematic process of handling money, a mobile app for this process was deemed a viable solution.

### 4.5.2 Action Research structures

AR is not without problems and the control structures in AR projects have been discussed as one of the main challenges (Avison et al., 2001). The control structures concern issues of authority warrant and initiation which were carefully considered in this research initiative. First, we appointed internal members from the home care practice and municipal management (who already possess authority of action) in addition to the researchers in a formal reference committee in order to have so-called staged domination as authority warrant. This staged domination made the AR interventions more collaborative and legitimized (Avison et al., 2001). Second, the initiation of this study was genuinely collaborative. The welfare problem as a whole was the initial starting point and from that, we found the more concrete problem in home care practice, i.e., the grocery shopping process. This concrete problem was “discovered” by the researchers, and agreed upon by the practitioners (Avison et al., 2001). Further, the development of the digital artifact, whose function was to trigger change and learning in the organization, was also legitimized through the collaborative initiation. All research activities have thus focused on change through action, as well as learning through reflection (Davison et al., 2004).

### 4.5.3 Data gathering & analysis

Study I generated a variety of data and I as researcher sought to be present in almost all activities concerning the AR project. Data was to a large extent captured through participatory observations, at key points in the project cycles, such as team meetings, discussion in on-line coordination tools, and education and training workshops. Furthermore, data was continuously collected through project documentation, such as minutes and email conversations from project meetings and from ad-hoc interaction. At the end of the project, a series of six semi-structured interviews were conducted, three with expert developers and three with local third-party developers in order to capture participant reflections on their experiences. While writing Paper 1, this data set was analysed with a
specific focus on architectural choices, boundary resources, and knowledge communication within the project.

The data discussed above was the empirical data that grounded the findings in Paper 1, which consisted of an inside-out view from within the development process while the main focus in Papers 2 through 5 is from a practice perspective.

The data which constitutes the core data for Paper 2 and Paper 3, from the study of home care, consists of the empirical data illustrated in Table 2 below.

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Data gathering</th>
<th>Duration</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caregivers</td>
<td>12 individual interviews * 6 workshops</td>
<td>1 hour each 2 hours each</td>
<td>* Done over a long period of time, to document the change aspect</td>
</tr>
<tr>
<td>Elderly</td>
<td>34 individual interviews * 6 workshops</td>
<td>1 hour on average 2 hours each</td>
<td>* 25 were interviewed and 9 (those who were still alive) were re-interviewed later on to document the change aspect</td>
</tr>
<tr>
<td>Caregivers &amp; elderly together</td>
<td>6 workshops 43 home visits</td>
<td>2 hours each 2 hours each</td>
<td>4 caregivers &amp; 4 elderly, mixed teams 2 caregivers &amp; 9 elderly repeated while the digital artifact was being designed and in use</td>
</tr>
</tbody>
</table>

Table 2: The core empirical data from the study of home care

The action research study was conducted in three phases, as three main interventions, even though the reflections of the problem perceptions and design activities occurred in an iterative cyclic process (Avison et al., 2001):

- **Initiation and understanding**: meetings and focus groups to set up the study and to analyse the problem
- **Design, development and intervention**: design activities, focus groups and home visits to discuss the development and the recurrent and continuous tests of the digital artifact in-use
- **Use and reflection**: in-use activities, home visits and interviews to establish understandings of a re-shaped practice

The empirical data for Paper 2 came from all three iterations. The empirical data comes from the design and development process, and the use with specific focus on the collaboration between the caregivers and the elderly in the design activities to analyse the formation of a boundary practice. The empirical data analysed in that paper consists mainly of 15 single-group activities per group (six workshops and nine interviews per group) as well as mixed-group activities which consists of six workshops besides home visits. The data constitute different types of design and use activities (ranging from requirement elicitation through workshops to mock-ups and use activities through home visits). The empirical data for Paper 3 came primarily from the last phase: use and reflection. Observations from 43 home visits, four semi-structured qualitative interviews with the elderly, and four semi-
structured qualitative interviews with the caregivers constituted the data material. In a typical home visit, the caregivers engage in caring tasks and small talk with the elderly. It was in this situation the digital artifact was brought to use for buying groceries with the elderly.

The material was analyzed through qualitative analysis where recurring themes were identified. The focus was on the formation of a boundary practice through the involvement in the co-design process (Paper 2) as well as on the role of and interactions around the digital artifact and how it came to re-shape the home care practice and the learning outcomes of that (Paper 3). The study was of abductive character (as discussed above), meaning that the interpretations in the analysis were inspired by the learning and boundary literature and the data collection informed by the literature. During the analysis for Paper 2, three activity types were analysed and the data gathered within each activity type was analysed from that lens. The activity types were a) caregivers and elderly designing separately; b) caregivers and elderly designing partly together; and c) co-designing with caregivers and elderly. Through these activity types, the empirical data was analysed with thematic analysis and the results are presented in Paper 2. During the analysis of the material for Paper 3, three process steps were conceptualized towards an evolved caring conversation. The analytical focus was on how the digital artifact affected a) the elderly; b) the caregivers; and c) the relationship between the two as well as what learning opportunities were emerging.

Alongside this material, which has been analysed for the purpose of the two papers included in this thesis, there is material from the managers, which has informed the understanding of the home care in general and the auxiliary nurses’ practice in particular. That data is peripheral to the focus of this thesis but was collected simultaneously. The data described above, alongside the additional data, has also informed other publications, which are not included in this thesis.

4.6 Study II: Cancer rehabilitation

Study II is from the second empirical setting which is a specialized cancer rehabilitation clinic where former cancer patients are being treated for complications related to their cancer treatment. The clinic has five staff members. Of these three are nurses, with one administrator and one physician. The three nurses have academic education and are all licensed practical nurses and have specialization in oncology as well. Two nurses have been working at the clinic for years, and have been active participants in the data collection which has informed my thesis while another nurse relocated (and has partly informed the research but is no longer working at the clinic) and a new nurse that replaced that nurse. There
are therefore a total of three nurses but one nurse replaced another in the data set. There is also an administrator working at the clinic. The work includes filing the survey which the patients fill out prior to their visits. The physician is specialized in oncology. In addition to that, there are other experts linked to the clinic that do not work there on a daily basis. Referrals can be made by the nurses and the physician at the clinic to these specialists, which include a dietician, psychologist, specialist in lymphedema and other specialists that can help specific patients.

The types of cancer that this clinic specializes in are cancer in pelvic area, ovarian cancer, cervical cancer, uterine cancer, endometrial cancer, colon cancer and bladder cancer.

As a background to the patient group, the clinic has been collecting extensive quantitative data (done by a survey) about the severity of their conditions for years. The number of patients passing through the clinic varies from time to time but the number of patients is around 200 a year. Over a thousand patients have been a part of the survey. From this, the physicians leading that initiative have been able to estimate how many are dealing with the most severe complications. Of 390,000 cancer survivors in Sweden, there are approximately 18,000 dealing with faecal leakage and 35,000 dealing with urine leakage. There are approximately 27,000 men dealing with sexual dysfunction and 20,000 woman in Sweden alone. The numbers in Europe are (of a total of 20 million cancer survivors): Faecal leakage: 1 million; Urine leakage: 1.8 million; men dealing with sexual dysfunction: 1.4 million and women 1 million.

4.6.1 Empirical context

The patients come to this clinic after their fight with cancer is over. Some patients come often, some once and there are even patients who never physically appear but have telephone contact with the clinic. The patients have all undergone treatment, some very extensive treatment with radiation therapy, surgery and chemotherapy while others have primarily received radiation therapy. The course of treatment depends on the stage and location of the cancer. The patients come to the clinic seeking help because of the complications linked to their cancer and their cancer treatment. Some are dealing with severe urinal leakage and others have faecal leakage where the severity varies. A large patient group is also, primarily or in addition, dealing with sexual problems. The sexual problems can usually be linked to complications from the radiation therapy.
Chemotherapy, surgery, and radiotherapy can trigger life-long pathophysiological processes that can be handled as diseases in terms of diagnosis, alleviation, and treatment. The patients’ symptoms are defecation and urination urgency, faecal leakage, excessive discharge of gas or mucus, and different aspects of decreased sexual health. At the clinic, the patient is part of a rehabilitation process that includes a survey and consultation with a nurse (face-to-face or video-mediated), and follow-up telephone calls.

Prior to the first consultation, the nurse reads through the patient’s EPR (electronic patient records), which requires experience to navigate the different types of records. Number of children, smoking habits, other underlying physical diseases, psychological problems, earlier problems related to the stomach, cancer type, cancer diagnosis time, and cancer treatment type are examples of the relevant information nurses seek in the EPR. The nurse attempts to understand what problems may be connected to the cancer treatment to rule out other possible explanations that must be treated differently. Information that sheds light on the possible damage the cancer and the subsequent cancer treatment has caused, is deemed relevant.

The patient answers a survey before having the initial meeting at the clinic. The survey has been a part of the clinical practice since 2012 and consists of 182 questions. Constructed as a scientific baseline survey, the survey feeds data into research while also functioning as a support for the consultation and the treatment. Before the consultation, the nurse skims through the survey and looks for answers that seem irregular compared to other patients with the same cancer diagnosis and treatment and compared to other information in the EPR. The questions cover the type of cancer, treatment, urine leakage, faecal leakage, urgency, sexuality, exercise habits, signs of depression, and quality of life. Many of the questions are formulated as “During the last six months, have you experienced…”; therefore, follow-up questions during the consultation are necessary to capture more recent information.

During consultations, a pressing topic is often defecation and urination frequency and urgency. Defecation consistency is relevant to the diagnosis and treatment plan. To identify consistency, the nurse shows the patient the Bristol Stool Scale (a scale used within healthcare to measure defecation consistency), and they discuss the consistency in relation to the scale. The nurse asks additional questions concerning the average number of bowel movements during the last few days and asks about specifics, such as smell, oiliness, and mucus. The nurse must ask about quantity and quality of bowel movements several days after the actual experience. Through the discussion, the nurse and patient decide whether to increase the medication dose to decrease bowel movement frequency and to improve stool
consistency. The nurse writes down the collective decisions to serve as a reminder to ask the physician to write a prescription.

The patients often have a hard time distinguishing the number of bowel movements days later. Having a tool that could document the details regarding urination, bowel movement frequency and quality alongside pain, was identified as a problematic process that could be an issue where a mobile app would be a viable solution.

4.6.2 Action Research structures

As said earlier, AR has critical aspects that need to be taken into consideration in each AR initiative. The control structures in AR projects have been discussed as one of the main challenges (Avison et al., 2001) and the issues of authority warrant and initiation were also carefully considered for this research initiative. First, by appointing internal members from the cancer rehabilitation practice (the nurses, besides the physician who is also the head of the clinical practice) and oncology researchers, together with a patient representative (who already possesses authority of action) in addition to the researchers. This was done, like in the previous study, through a formal reference committee (i.e., a project group) in order to have so-called staged domination as authority warrant, making the AR interventions more collaborative and legitimized (Avison et al., 2001). The patient representative only participated the first six months. This project group has met regularly over the course of the project. The researchers have met weekly through the course of the project (on Fridays, 40 minutes on average while some Friday meetings have been cancelled). These were status meetings with the aim of informing and including everyone in the data collection and interventions. These meetings then informed the discussions during the larger project meetings where practice and research met and collaborated. Second, the initiation of this study was also genuinely collaborative. The higher number of cancer survivors was a starting point and from that, together, we found the more concrete problem within the practice where different aspects were sought to be digitalized, one of which was increased data for clinical decision-making and a tool to facilitate self-care. These concrete problems were “discovered” by the practitioners, and agreed upon by the researchers (Avison et al., 2001). Furthermore, the design and development of the digital artifact, whose function was to trigger change in the organization, was also legitimized through the collaborative initiation. All research activities within this empirical setting, similar to the previous setting, have also focused on change through action, as well as learning through reflection (Davison et al., 2004).
4.6.3 Data collection & analysis

This action research study (study II) was conducted in three phases (as seen in Table 3 below), even though the reflections of the problem perceptions and design activities occurred in an iterative cyclic process (Avison et al., 2001).

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Data gathering</th>
<th>Duration</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurses</td>
<td>20 observation days *</td>
<td>Full workdays</td>
<td>* Done to increase the understanding of the clinical work Design and role-playing sessions</td>
</tr>
<tr>
<td></td>
<td>6 individual interviews</td>
<td>1 hour each</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 workshops</td>
<td>2 hours each</td>
<td></td>
</tr>
<tr>
<td>Patients</td>
<td>7 individual interviews</td>
<td>20 minutes average</td>
<td>Interviews were conducted after the video-mediated consultations and also during the use of the mobile app</td>
</tr>
<tr>
<td>Nurses &amp; patients together</td>
<td>5 face-to-face consultations</td>
<td>1 hour each</td>
<td>* Three nurses + Three patients + oncological researcher. These actors participated in different constellations in different workshops.</td>
</tr>
<tr>
<td></td>
<td>5 video-mediated consultations</td>
<td>50 minutes average</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 follow-up telephone calls</td>
<td>15 minutes average</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 workshops *</td>
<td>1.5 hours average</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: The core empirical data from the study of cancer rehabilitation

The empirical data presented in Table 3 has been the core data informing Paper 4 and Paper 5. However, there is more empirical data, which informs parts of the two papers, such as document analysis, meetings, field notes and more informal observations which have also been made. The empirical data in the table above is of more structured character. The empirical data for Paper 4 came from three design iterations, three interventions from the design process with specific focus on the design of the boundary object and how the negotiation process was conducted. The empirical data for Paper 5 comes from the data in Table 3 but in addition to that data, Paper 5 also includes data such as interaction patterns from the information portal discussed in that paper as well as analysis of the survey used at the clinic. Paper 5 also includes interviews with the patients regarding the use of the survey (an analogue artifact) as well as from using the same digital artifacts as the patients. In addition to that, what is also discussed in Paper 5 is an additional actor who is not included in paper 4, the medical researchers and that empirical data is based on minutes from meetings and interviews. More details on the empirical data in Papers 4 and 5 can be found in the included papers.

The material has been analysed using qualitative analysis through the identification of recurring themes to shed light on the negotiation process of the boundary objects in the design process. The focus was on the formation of the boundary objects and their emergent properties (Paper 4) as well as on the co-creation of value in the data-supported practice (Paper 5). During the analysis for
Paper 4, three snapshots were analysed. These snapshots illustrate the boundary objects’ different stages where the boundary objects were first a) ill-structured objects in terms of narratives; then b) semi-structured objects that were more in terms of metaphors; and c) structured classical boundary objects.

4.6.4 Synthesis & cover text analysis

In regards to the role of theory in the cover text, the two theoretical lenses are what I have shifted between, when balancing the empirical and theoretical reasoning concerning the platformization processes. The concepts from the practice lens have helped understand the social conditions that exist in and between specific practices that are co-designing and co-existing within platform contexts. The boundary object literature has helped in understanding the role of the object in the interaction between the practices when co-designing and interacting with the digital artifact or platform during the platformization process.

In the analysis, the literature presented in the related work chapter has also been influential, alongside the empirical knowledge from five years of empirical field work, which grounded the results in the five included papers.

The analytical approach for the cover text has been inspired by Presthus and Bygstad (2014 and their strawberry analysis. The analysis approach is solely for the purpose of making sense of the results in a paper-based PhD thesis. In the step-wise framework, there are four levels which help ensure that the “strawberries” (which are the papers in their metaphor) inspire the cover text as much as possible. The papers are the results, which are to be analysed for the purpose of the cover text. At first, I did initial analysis of the results of the papers and wrote the draft of the cover text, with the aim of not only summarizing the results of the papers but also making a stand-alone contribution in the cover text with more potential for generalization. Then, after my trial defence/final seminar, I re-read the papers and did a re-analysis, which is the basis of the material in this cover text. The papers included in my thesis are published in IS, workplace learning, CSCW and within care to facilitate the specialization of work-integrated learning which is a part of my PhD education. This distribution made the IS contribution in the cover text even more important. As the papers all have their own contributions, the purpose of the strawberry analysis for the cover text was to see how these strawberries fit together in a coherent IS argument. The strawberries all shed light on aspects of what happens during co-design, development or use of platforms in practice (or parts of a platform in terms of a mobile app), which landed the co-design and platform focus of the cover text with the theoretical lens of boundary objects alongside the practice lens.
4.7 Ethical considerations

As this research is conducted within care, there are some ethical considerations in play. Informed consent has been obtained from the participants. In both studies the end-users of the mobile apps registered and gave consent to being part of a research project. In study I, the home care study, there was no sensitive personal information stored in relation to the platform. The payment information was encrypted and stored in a token, which means that there was no way of getting to that information within the platform. However, in study II, the study of cancer rehabilitation, the personal health data was of more sensitive character. In that study, we applied for ethical approval to be able to conduct our research at the clinic due to the sensitivity of the data involved. In addition, we frequently discuss ethical issues as they come up.

In relation to funding, the studies included in my thesis have been financed by different research funding. Due to the different funding structures, I want to declare that I have no conflict of interest when it comes to the funding of my research and the funding structures have not affected my research. I also want to disclose which research funding has been applied in the different projects. The mCity project, where I conducted study I, was financed as part of an EU project. The EfterCancer project, where I conducted study II, was financed by ALF funding. My PhD education has been financed by a project called DigitaL (Learning in a Digital Region), funded by the VGR region in Sweden. I have been an employee of University West throughout my research involvement even though different efforts have been financed by research funds.

The data is stored in accordance with General Data Protection Regulation (GDPR). GDPR is a new EU regulation (2016/679, in effect as of 25 May 2018), which takes a broader, updated view on storing personal data, in particular health data (Blackmer, 2016; EU GDPR Portal, 2018). GDPR is the most important change in data protection and privacy since 1995, and aims to give control to citizens, or in my case patients, instead of giving control to the party storing the data (EU GDPR Portal, 2018). This means that there is a shift in ownership of data. GDPR is a unified regulation within the whole EU, and applies within EES as well (Albrecht, 2016; EU GDPR Portal, 2018). This change impacted the way we stored data in our project and forced us to critically examine the data storage. With regard to the EfterCancer project, which is an ongoing project, the platform is GDPR-ready.
The chapter also includes a description of the prerequisites for practice-based platforms that have been studied while the chapter also includes partial results from the design and development of the platforms. The chapter will present the technological frames and architectural choices that were taken in the two studies. The chapter takes its point of departure in the technological choices but also takes into consideration the socio-technical arrangements. Even though there is a socio-technical perspective present in all the papers, some papers lean more towards the social/practice-related aspects while my empirical data also includes rich data on the more technological parts of platformization, which I wanted to present as well to be able to contribute with a truly socio-technical view on platformization.

5.1 Architectural choices: Home care

Study I was a part of a project (previously mentioned as mCity), which was a regional business initiative with the goal to establish an arena for mobile commerce and stimulate local industry growth. To reach the goal we decided to design and build a mobile service platform that would function as a bridge between local entrepreneurship and mobile commerce. The aim was to lower the entrepreneurial threshold by providing the necessary prerequisites and components to cost effectively build and manage apps and thereby stimulate industry growth.

The project designed and built a socio-technical platform to support and manage the entire lifecycle of mobile app design, development and go-to-market strategies. The socio-technical aspect of the platform design meant designing everything around the platform, where the platform itself was one aspect. Other aspects consisted of involvement of practice, establishing a community of programmers and managers, being the driving force in design processes, establishing coding frameworks, SDKs and APIs, constituting generic code modules, and constructing go-to-market and knowledge transfer strategies.

In the platform a set of mobile apps would be developed. The mobile apps were focused for use by the local businesses and municipal community where one such community was home care (study I). Each mobile app was constructed out of a set of generic code components. If a certain component was missing, it was coded and added as a new generic component. Hence, over time, the number of generic components increased through each development cycle and each mobile app
project within the platform. The platform with its processes, frameworks, SDKs and generic components constitutes a comprehensive set of resources.

The third-party developers used the boundary resources to utilize the platform’s capabilities in developing apps. In this local setting, third-party developers were primarily local entrepreneurs, businesses and students at the university. The plan was that this group would subsequently use, enrich and develop new boundary resources in the platform after the contract with the IT consultancy firm ended. This linked the general ambition of stimulating entrepreneurship and regional business.

The architectural design choices turned out to have a number of consequences for the diffusion of knowledge and skills requirements. One of the first important architectural choices was regarding the platform architecture and development arrangement. Here, the following options were available: (a) Open, web-based architecture with plain vanilla versions of HTML, CSS, JavaScript etc., allowing to build what in effect would be mobile websites partly cached on the handset; (b) entirely native apps to be developed for and distributed through the two largest smartphone platforms, iOS and Android, written using the respective SDKs and APIs (for example Objective C, Swift, etc); (c) using more advanced high-level generator tools to produce a variant of a), for example such as PhoneGap, Angular.js, Telerik, Backbone.

Here, a first choice to be made was between basing the platform on native apps or apps based on enriched HTML web services. In this decision, the consultants’ standpoint was that the project should build hybrid (HTML) apps that would be modular and that the platform should be a self-supporting stand-alone entity. When it was clear that a native solution did not fit the project goals, other alternatives were considered. Different Platform as a Service (PaaS) solutions from Microsoft, Amazon and Google were evaluated and discussed.

In parallel, the platform owners evaluated a range of different platform architectures from their point of view. It was decided to go for option (c) with a specific arrangement of Javascript framework and cloud provision. The motivation for this choice was that with (c), the project would be able to maximize the number of modules that were built, and the degree to which these modules would be reusable. Both aspects were regarded as central to the generativity of the platform.

The platform was built in a cloud service called Cloudbees, which is based on Jenkins (De Loof, 2013). Jenkins is a continuous integration tool (i.e., a software engineering technique) that is open source and written in Java. This particular service platform was set up to handle hybrid apps (HTML) with complex user
interfaces and a Javascript library. This particular Javascript library is called Backbone and is fundamentally a Model View Controller (i.e., MVC) that enables the code to be modular and imposes calls to the server to be entirely done through RESTful API. This choice of Jenkins, Java and Backbone resulted in the platform in which Skafferiet is built (i.e., the mobile app co-designed with home care in study I). In general, this was not a bad choice, as it was a modern, state-of-the-art development suit, but it turned out to be a poor match of requirement and skills for the local third-party developers and the project in its nascent phase (further discussed in Paper 1).

To get the platform work started with relevant modules, the first step was to develop a set of mobile apps with associated code modules. When developing the apps within, the set of generic modules were seen as lego pieces in terms of functions that would fit together in different constellations to constitute new apps. The generic modules that were built were: i) QR code reader and generator (using the camera); ii) GPS locator/GPS positioning (using the built-in geopositioning technology of the smartphone or tablet in use); iii) payment integration to three different payment providers, which used different payment methods; iv) a shopping cart; v) nested categories; vi) secure login and creation of user accounts; vii) search, sorting and selection; viii) push notification (using built-in smartphone functionality); ix) uploading of photos and display of photos; and x) display of items (products in some apps, users in other apps).

The end-users of the mobile apps were also different; elderly and their caregivers (study I), consumers, merchants, visitors, tourists, students, teachers, unemployed. See Figure 5 for an overview of the platform architecture.

![Figure 5: The application layer and the boundary resources of the platform](image-url)
The generic modules were then used in several mobile apps, which was in line with the general strategy to reuse the modules and code. The modules used in the senior app (which is the subject of this thesis, also called Skafferiet, or the digital artifact in the study of home care), are marked blue in Figure 5. The connections to how the modules were reused for the purpose of other mobile apps, and which APIs were used for other mobile apps, are limited for the purpose of focus for this particular thesis.

In line with the literature on social boundary resources, this socio-technical platform also included a range of such resources. These include the contract with the image API provider, public procurement between the municipality and the grocery store and the payment agreements between the payment provider and the grocery store, facilitated and mediated through the platform.

5.1.1 The mobile app

The digital artifact that has been designed within the platform, is a mobile app with the aim of enabling those dependent on home care service (the elderly) to select and shop for their groceries, thus eliminating the scenario of the caregivers running around the grocery store. The mobile app is called Skafferiet and is a mobile app designed in close cooperation with the elderly and the caregivers.

Skafferiet was developed in two versions, first as a functional prototype (the version mentioned above as the Android version) mainly to capture early user experiences and then as a full-scale version (see Figure 6 below), where mobile payments were included. This full-scale version that was developed functions on all operating systems (built in the platform described above). The mobile app was built from the modules described above, and was one of many mobile apps within the platform.
5.2 Architectural choices: Cancer rehabilitation

The project where study II was conducted (previously mentioned as EfterCancer) had the goal of digitalizing parts of the clinical practice by designing tools that would facilitate data collection that would both support more structured clinical decision-making and involve the patients in a more organised way in data collection. The design of digital artifacts would facilitate the collection as well as the visualization of data, both for the patient and for the nurse. The transformation and interpretation of data in practice has also been a continuous design process within the digitalization process. We built a socio-technical ecology of digital artifacts with the aim of supporting different parts of the practice.

When describing this particular platform I will refer to the digital artifacts in this study as part of a platform ecosystem, and the reason is that the platform ecology is still forming. The first digital artifact that was built was an information portal. After a while, it was realized that there was a need for a backend, which needed to be connected to a mobile app. During that time, when it was realized that there was a need to build a more sustainable solution that would facilitate scaling, the aim shifted towards building a platform ecosystem.

Here, the first choice was also, like in the previous project, regarding whether to base the platform on native apps or apps based on enriched HTML web services. We decided to go in a different direction than in the last project and build native apps that would be modular. Similar to the architecture in the last project, this platform should also be a self-supporting, stand-alone entity.
There was an active decision made within the project, to stay under the radar. Staying under the radar meant that system integrations with heavy, legacy systems within the hospital would be limited. This particular choice meant that there were no attempts made to integrate with the EPR (electronic patient record) through an API for instance. The EPR is a complex system and the system integration would call for rather strict architecture. This design decision to not integrate with the legacy systems within the hospitals also meant that the platform ecosystem could be built on an open-ended architecture. The patients are not traditional patients, they have been declared healthy even though they are struggling with severe symptoms, but their “healthy” status within healthcare also meant that there was less pressure to integrate with the standard systems within the hospitals, such as the EPR.

The architectural design choices in this project, like in the first project, turned out to have a number of consequences. One of the first important architectural choices was regarding the platform architecture and development arrangement. Here, the following options were available: (a) Open, web-based architecture with plain vanilla versions of HTML, CSS, JavaScript, etc., allowing to build what in effect would be mobile websites partly cached on the handset; (b) entirely native apps to be developed for and distributed through the two largest smartphone platforms, iOS and Android, written using the respective SDKs and APIs (for example Objective C, Swift, etc.); (c) using more advanced high-level generator tools to produce a variant of a), for example such as PhoneGap, Angular.js, Telerik, Backbone.

In this project option (c) was also chosen where parts of the platform ecosystem have been built in web-based architecture with plain vanilla versions of HTML, CSS and JavaScript and the information portal, for instance, is built in that way (option a). The information portal is a traditional Wordpress, which is an open source solution. However, the backend (which is also a part of the platform ecosystem) is not as plain vanilla. The extreme openness of the information portal stands in contrast to the security of the backend, where the patients’ and the nurses’ logins are behind SSN because of the sensitivity of the patient data which is fed into the backend through the mobile app. The mobile app is built in more advanced high-level generator tools (option c) with Angular.js. The choice of the more high-level generator was central to the generativity of the platform ecosystem and facilitated the needs of the practice. The practice did not express the need to integrate with the legacy systems that they were already using as a part of their daily routine, on the contrary, meaning that these choices were in line with the practice’s wishes. For instance, building the information portal in Wordpress would allow the nurses to write the texts for the information portal themselves, which would not have been as easy if we would have built them such
a tool. However, the other parts of the platform needed much more hands-on
development, hence the different architectural choices in the modules of the
platform ecosystem. Even though the information portal is an important part of
the platform ecosystem, it is not strictly a part of the platform in software
development terms; it is however a part of the socio-technical platform structure
as it is an important facilitator of the multi-sided market, creating means for the
nurses and patients to meet in a new way.

The other parts (everything except the information portal) are however a part of
the platform in technical terms, while the information portal, along with the
backend, video-mediation tool and mobile app are all important elements in the
socio-technical platformization process. The information portal is mobile
friendly, meaning that it would be possible to deploy it to the App store and Play
store in a “wrapper” (which would make it a mobile app) but we have not seen
the need for that and the practice has not requested it. Also, as it is already
“outside” the technological boundaries of the platform ecosystem and is a
different type of technology, it can also be embraced as such and can stay that
way, as a stand-alone technological solution, but still an important element in the
platform ecosystem. These different technological choices within the project have
given me some headaches when trying to write this part of my thesis, but it is truly
important however, also in platformization, that the practice’s needs are facilitated
through each step in the platformization process. Even though technological
platforms are exciting and fresh, it is truly important to work in close
collaboration with the practices of the end-users and focus on facilitating the
multi-sided market to flourish, in the way that fits the purpose of the practice.
Even more important than exciting technological wonders.

The mobile app part of the platform context is built using modular architecture.
The modules have been developed for the purpose of the first app and the
backend includes i) secure login; ii) push notifications (using built-in smartphone
technology); iii) display of items (such as pain and defecation scales); iv) different
sorts of visualizations; v) registration and logging (see Figure 7 below).
The mobile apps developed up until this point is only the cancer rehabilitation app (the mobile app discussed in included paper 4 and 5). The other mobile apps have not been developed yet but could however be developed from the modular architecture over time, while some are further along in the planning stages than others, which are still merely in the conceptual stage.

The third-party developers have developed and use the boundary resources to utilize the platform’s capabilities when developing the mobile app and the backend. In this project, third-party developers were local entrepreneurs who were students not long ago. This group can subsequently use, enrich and develop new boundary resources in the platform, but the third-party developers have not become a crowd yet, as we are still developing the platform ecosystem. The sensitivity of the data stored within the project also provides a threshold when letting new third-party developers in. This was a larger issue before the platform was GDPR ensured and when there were uncertainties about how GDPR would affect patient-generated health data. However, it has now been ensured that it is entirely possible to allow for a growing community of third-party developers that develop and use the boundary resources, and enrich the platform ecosystem with new boundary resources, without access to the data. This has not happened yet, however.

5.2.1 The mobile app

When the patients use the mobile app, they report each time they use the toilet, when they experience pain, or when they take their medication. Thus, when the mobile app is part of the consultation, the data they use is typically gathered during
a two-week period prior to the consultation. The data collected with the mobile app is collected directly in connection to the activity it is recording, making it possible for nurses and patients to recreate a more detailed image of the patient’s problems. Use of the mobile app also demands less work to elicit facts about bowel movements, making the consultation work somewhat different. The data is presented in various diagrams, depending on the type of data (see Figure 8).

This patient registered each bowel movement in the mobile app to keep track of the frequency. The Bristol scale the patient is referring to is a visualization in the mobile app of the data relating to bowel movement consistency. With the mobile app data, the defecation/urination is registered and classified in direct relation to the experience. This removes memory bias. The patients are able to interpret the visualizations of their data and draw their own conclusions.

With data present during the consultations, the nurse’s questioning tactics move from open questions based on the survey’s six-month period and the patient’s recollections to more precise questions with a focus on validating data. While the data visualizations provide a foundation, the nurse must still lead the consultation. However, the data is a way for both parties in the practice (nurses and patients) to participate in the analysis; they focus the discussion on brief descriptions with the purpose of adding enough information so the nurse can validate premade classifications.

The mobile app has been developed in one version but that version has been refined iteratively and deployed to the App store and Google Play several times. The mobile app was developed in parallel for the two major players on the smartphone market, iOS and Android. The feedback from the use of the mobile app has fed into the iterations.
6 Summary of papers

This chapter presents the summary of the five included papers of this thesis. The table below contains the title of each paper and links each paper to the empirical study (see Table 4); P stands for paper. Paper 1 is written from a platform perspective, analysing a whole platform whereas Papers 2 through 5 analyse instances of a platform in terms of digital artifacts built within a platform.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1. Co-creation and Fine-Tuning of Boundary Resources in Small-Scale Platformization</td>
<td>Home Care (Study I)</td>
</tr>
<tr>
<td>P2. From Co-Design to Co-Care: Designing a Collaborative Practice in Care</td>
<td>Home Care (Study I)</td>
</tr>
<tr>
<td>P3. Learning in Home Care: A Digital Artifact as a Designated Boundary Object-in-use</td>
<td>Home Care (Study I)</td>
</tr>
<tr>
<td>P4. Co-Designing a Digital Platform with Boundary Objects: Bringing Together Heterogeneous Users in Healthcare</td>
<td>Cancer rehabilitation (Study II)</td>
</tr>
<tr>
<td>P5. Data Supported Practice for Co-Creation of Value in Healthcare</td>
<td>Cancer rehabilitation (Study II)</td>
</tr>
</tbody>
</table>

Table 4: The five included papers
6.1 Paper 1

**Title:** Co-creation and Fine-Tuning of Boundary Resources in Small-Scale Platformization

**Status:** Published

**Outlet:** IFIP 8.6 2016 conference

**Type of outlet:** Conference proceedings


The aim of this paper was to understand the technological aspects of building a platform and explore platformization. The platform was examined from within the design and development process and the understanding of the platform architecture derived from this paper has been the foundation for designing the digital artifacts that were followed through the co-design, development and use processes in the following papers. The research question was: How can small-scale platformization be understood in terms of the creation of boundary resources and how can the knowledge communication be arranged in such platformization?

The paper analyses the design and development process and the nascent phases of the platform effort. The study is based on a regional business initiative with the goal to establish an arena for mobile commerce and stimulate local industry growth. The aim of the paper was to shed light on the initial phases of platform development (platformization) in a small-scale context. The paper argues for acknowledging small-scale contexts as a part of the platform research. The platform models presented in prior research (more deeply discussed in the paper itself) do not fit the purpose of the platformization processes observed in the small-scale case that the paper builds on. The biggest challenge regarding the models concerns the arm’s-length relationship between the platform owners and third-party developers (distance between the two), which is the key in established, large-scale platforms. Through the empirical case, the paper illustrates that in a small-scale platformization, the relationship needs to be formed differently. The intimacy in the relationship between the platform owners and third-party
developers is the core. From an evolving small-scale platformization perspective, this relationship must be supported by an intimate and co-creative process of knowledge communication, herein called fine-tuning.

The paper shows how the initial phases of platformization are characterized by socio-technical arrangements, co-creation of boundary resources and intimate knowledge communication. The paper contributes to platform research by acknowledging a small-scale context for platform research. The results of the paper show that platform innovation is a complex arrangement of both technical and social boundary resources that need to be critically considered (Gawer, 2009; Ghazawneh and Henfridsson, 2013). Diverse stakeholders are involved and different technical boundary resources become important such as application platforms, cloud services, code bases, programming knowledge, etc. Through the nascent phases in this platformization study, architectural leverage was not easy to master as it turned out to have a number of consequences for the communication of knowledge and skills requirements. There were several vital decisions made by the expert developers involved in the development of the boundary resources (i.e., code modules), which possibly were motivated by their pre-existing set of technical knowledge. In general, these were not bad decisions, the technical platform is a modern, state-of-the-art development suite, but it turned out to be a poor match of requirement and skills for the local third-party developers and the project in its nascent phase.

In a small-scale context, a platform cannot simply be brought in from the outside and placed within the local setting in terms of commodified boundary resources (Ghazawneh and Henfridsson, 2013) and expected to grow; it takes intimacy and nurturing. Seeing code as value as well as seeing knowledge as value is vital. There is a need for fine-tuning knowledge communication to accommodate the intimacy of professionalization and sedimentation. Frameworks, code and developed modules do not have an intrinsic value of their own, especially if there are not skills and competency on how to enhance them. In a small-scale platform context co-creation needs to be a goal, and offshoring or outsourcing may not be a viable alternative. Thus, the platform boundary resources need to be co-created and locally legitimized in order to achieve architectural leverage and make it be cultivated in the local platform ecology. Without this co-creation and communication of knowledge, the code and modules lack value (Boudreau and Lakhani, 2009; De Reuver and Bouwman, 2012). From this, the paper calls for further research regarding fine-tuning of boundary resources for similar small-scale contexts. Research tends to cover platform efforts once they have become successful and by definition are past their nascent phase, and not focus on platformization. However, the first steps in the life of a platform are just as
essential as its later race for global domination and determines whether a platform is able to reach ignition and become a multi-sided market.

6.2 Paper 2

**Title:** From Co-Design to Co-Care: Designing a Collaborative Practice in Care

**Status:** Published

**Outlet:** Systems, Signs & Actions

**Type of outlet:** Journal


Building on the results from the previous papers, Paper 2 digs into a more intimate fine-tuning process where a set of boundary resources (components for a mobile app) are examined from within the co-design process. The aim of the second paper was to develop new insights from collaborative design work on how to facilitate participation and collaboration between two practices, in order to foster the formation of a new prospective on collaborative practice supported by digital artifacts. The research questions that this paper explores are: How can the design process be organized in order to foster the formation of a prospective collaborative care practice? What aspects are important to consider when designing with a boundary practice perspective?

This paper is based on the co-design process within the home care study which involved participants from different practices: caregivers, elderly, and the designer. The paper explores the formation of a boundary practice in a co-design process when designing a mobile application for grocery shopping with the aim of supporting the elderly and the caregivers. The findings indicate that arranging the co-design activities in a certain way, which empowered the elderly and the caregivers, led to the formation of a co-care boundary practice that, in turn, advanced the design process to an in-use process without a significant implementation effort.

When analysing the co-design process, interesting observations were revealed: almost all design activities from study I (the home care) that were significant (that is, design ideas that were realized in the digital artifact) arose and evolved during mixed group activities where the caregivers and the elderly directly discussed their
respective perspectives and negotiated the different ideas with each other. In the separate group activities, only one group’s point of view was brought forward to the designers at the time. Considering the different practices’ common activities as a boundary practice in co-design sessions, meant bridging preconceived understandings and taking the point of departure from the different user groups together and simultaneously. This facilitated both negotiation and sense-making and encouraged the creation of their own boundary practice. The findings indicate that a co-design approach led to the formation of a boundary practice, which in turn advanced the design process into an in-use process. The formation of the boundary practice is illustrated in Figure 9 below. Bridging boundaries through the facilitation of a boundary practice entails that the boundary practice situation is designed to resemble the in-use situation as much as possible.

Figure 9: The three phases in the co-design process and an illustration of how the boundary practice developed and how the designer’s engagement transformed over time

The paper thereby shows how the creation of a boundary practice can evolve provided that the design process is organized in a manner where the different practices take an active part in designing the artifact together on equal grounds, in ways that their respective perspectives and needs are discussed and negotiated in an authentic setting. When designing mobile apps, a co-design approach can bridge boundaries between practices to facilitate a new boundary practice to form through engagement. Creating design with practices and end-users who have different backgrounds and domains of interest raises what we define as boundary issues.

The designer went from being the one who spans intimate boundaries and the role of the designer developed from being a negotiator to ultimately being an advisor. The intimacy needed in the beginning was not necessary when the co-
care boundary practice was in place, leading to an arm’s-length relationship for the designer in the end. The paper discusses co-design in the modern “appified” world in which apps are increasingly easy to build in a rapid manner and contributes an understanding of organizing design processes for such co-design projects. We also call for a serious reconsideration of the information systems (IS) practice lens to include everyday life practices as part of the lens as design processes today often include practices outside the traditional IS organizational setting.

The contribution of this paper is a practice-oriented design approach combining co-design principles with boundary theories formulated as three design considerations concerning: i) co-designing with boundary objects for two different practices; ii) co-designing in an authentic setting for empowerment issues; and iii) attaching the agency of co-design to the boundary practice itself.
The results from the previous paper are taken further through a learning perspective in this paper. The paper examines the role of a boundary object more specifically when heterogeneous end-users are creating a boundary practice and a boundary object together. The aim of this paper is to understand how the role of a digital artifact plays out in home care settings. The research questions explored in this paper are: In what ways do digital artifacts re-shape a home care practice and how does this affect the interaction between caregivers and the elderly and learning opportunities for the caregivers?

A digital artifact, in terms of a mobile app designed within a platform, was tested to see how the quality of home care work practice was enhanced and changed. An action research approach was taken and the paper was written from the study of the context of home care in a Swedish municipality. The data was collected through semi-structured interviews as well as observations that were conducted during home visits. Concepts of learning and boundary objects were used to analyse and distinguish interactions and collaborations with the digital artifact. The results show how the digital artifact is re-shaping a home care practice and how this affects interactions and identifies learning opportunities. The paper also shows that the views on the mHealth artifact as a designated boundary object as well as a boundary object-in-use must co-exist. It focuses on the interactional and organizational values generated from the actual use of the designed mobile application.

From the elderly’s perspective, the boundary object was designated to function as a substitute for their previous way of buying groceries. Through visualization of groceries, nutritional information and an embedded mobile payment function
there were designated values for the elderly. From the caregivers’ perspective, the boundary object was designed to support a more efficient working process. The time earlier spent in the grocery store now goes to the elderly, leading to more quality of caregiving in praxis.

This paper shows in what ways a digital artifact is re-shaping a home care practice and how this affects the interaction between the caregivers and the elderly as well as shedding light on learning opportunities for the caregivers. In this research the designated boundary object became boundary object-in-use during the interaction and during the change process. The boundary object-in-use became a tool for an evolved caring conversation, as it appeared locally useful and incorporated into home care practice. The two views were found complementary to each other as they provided different perspectives in the dynamics of understanding how an artifact was designed and finally came to be used. In the analysis of the empirical findings we identified three process steps towards an evolved caring conversation: 1) the conversation before; 2) the conversation in the beginning; and 3) the evolved conversation. Furthermore, in the home care practice that emerged three types of learning were identified, which are summarized as a) using mobile tablets and apps as a working tool; b) the informal learning where caregivers build their own competence to evolve in conducting a caring conversation; and c) the informal learning where they learn about diet, appetite and nutrition linked to medical conditions.

This paper shows a digital artifact that has improved care for the elderly as well as contributed to formation of a caring conversation between the caregivers and the elderly. This digital artifact was designed to carry out the task where efficiency could be improved, however, it turned out to promote learning and quality of care as well. The experience from this research, the learning aspects and the nourishing, caring conversation can contribute to a flourishing modern home care.
6.4 Paper 4

**Title:** Co-Designing a Digital Platform with Boundary Objects: Bringing Together Heterogeneous Users in Healthcare

**Status:** Under review

**Outlet:** Health & Technology

**Type of outlet:** Journal


Building on the results from the previous papers concerning that a boundary object played a vital role in the design process, the boundary object lens was taken further in this paper. During the design process in study II, boundary objects were used actively to forward the design process. The aim of the paper was to analyse how the boundary objects are engaged in different design phases, both concerning what type of boundary objects as well as how they play a role in the different stages of design. The research question that this paper explores is: How are boundary objects engaged in different design phases?

This paper connects pre-existing lenses from the boundary objects literature through the empirical case of cancer rehabilitation where different kinds of boundary objects have been used throughout the design process. The results are based on design ethnography in a multidisciplinary collaboration with a cancer rehabilitation clinic in West Sweden.

Many insights can be gained from the extensive literature on boundary objects and the lens of boundary objects has both relevance and explanatory power. However, the boundary object literature lacks tools to understand which types of boundary objects are needed throughout the design process (in different design phases) in general and within complex design contexts in particular. The main contribution addresses this gap. The results are illustrated with three snapshots in time, where particular types of boundary objects were used to forward the design process. We do this by unpacking the design process and describing each of the identified boundary objects through empirical accounts.

We suggest that given the dynamic structure of design for heterogeneous users it can be expected that boundary objects are transformed over time and that
different types of boundary objects come into play, during different stages of the design process and using those actively can forward design processes. The use of different boundary objects to further the design process is illustrated in the paper. The boundary objects have taken different forms through the design process and each presentation form has had a specific function to move the design process forward. The findings present different forms of collaboration design artifacts, analysed as boundary objects from three perspectives (Boland & Tenkasi, 1995; Koskinen, 2005; Star, 2010). These three types of boundary objects are identified and connected through existing lenses of i) narratives as boundary objects, ii) metaphorical boundary objects and iii) classical boundary objects.

Figure 10 illustrates the design process and how different boundary objects were called for at specific times to move the collaboration and co-design forward. At first, the boundary objects were stories in the form of narratives. The boundary objects were more elaborated and not summarized. Through the analysis we saw how the narratives (in the form of patient stories) played a central role as initial boundary objects. This is in accordance with Boland and Tenkasi’s (1995) use of narratives as boundary objects. These boundary objects supported the formation of mutual understanding within the multidisciplinary research context where practitioners and researchers collaborated to find common ground on which to build the digital artifacts (Suchman, 1994). The boundary objects were open boundary objects raising questions about some design aspects while also bringing the group closer together during that phase (Ewenstein & Whyte, 2009). As the collaboration was in its nascent phases, the open narrative boundary objects were just what the collaborating practice needed. We argue that actively using boundary objects in complex design situations with heterogeneous users can be one possible way of forwarding platform design, in platformization efforts.
6.5 Paper 5

Title: Data Supported Practice for Co-Creation of Value in Healthcare

Status: Conditionally accepted

Outlet: Computer Supported Cooperative Work

Type of outlet: Journal


Continuing with the results from study II, this paper further examines the context of cancer rehabilitation. The paper takes the point of departure from the pressure on organizations to become data-driven, and we want to shed light on, and understand how data value is achieved. The aim of the paper was to dig deeper into the healthcare practice, where digital artifacts are being integrated into practice and examines how value can be achieved when using digital artifacts as a part of gathering health data in a data supported practice. The research questions that this paper examines is: How can patients, specialist nurses and oncological researchers achieve value from using digital artifacts in a data supported practice? In this paper we thereby unpack how patients, specialist nurses and oncological researchers achieve value within a clinical practice. We argue that it is important to understand data production practices as processes of value creation and that value co-creation takes place in interactions. Additionally, it is essential that these interactions, where value is co-created, are grounded in the knowledge-generating practice. Our findings shed light on the work put into achieving data value between different actors and how increased data work affects the three practices. We describe how technology in the studied practice lower the threshold of interaction and by doing so increase the value co-creation. We identify two different co-creation processes: one knowledge process that structures the practice based on a scientific perspective and one interactional process based on clinical decision making.

The knowledge co-creation process is a knowledge-production process in which scientific assumptions are tested, proven by the researchers, and then translated by the nurses into a clinical practice. The tools and structures for scientific work support the knowledge co-creation process through proven experience and a narrative practice. The scientific survey was developed together with oncology
researchers and nurses and tested with patients. The survey became a configuring factor for the clinical work, and it structures how the consultation is executed. The survey questions, the nurses’ experiences, and the patient dialogues formed the consultation into this narrative practice over an extended time.

By introducing digital tools (portal, app, visualization, and video), additional resources for interactions are created; which we analyse as interactional process based on clinical decision making. Using these resources enhance the interactive co-creation process. However, they do not add value in themselves. We have identified three different types of resources: resources for generating data, resources for interpreting data, and resources for interactions about the data.

Data value, as an effect of being able to interact with and to comprehend data, is crucial. We argue that data may have a value potential that is realized through interactions and through the capability to exploit and comprehend. The interactions and the capability to comprehend stem from two types of co-creation processes. We argue that data value is realized through interaction and comprehension, which in turn rests on a knowledge co-creation process. These two processes, partly embedded in different technological artifacts, are part of a co-creation process. Technology lowers the threshold for interaction between the different actors of the studied practice.

Data without context and proper interpretation has little value; it is in the interaction with the data and in the interaction between the different actors where creative interpretation happens and the data-gathering becomes worthwhile. Through these two types of interactions, the ability to make judgements develops, which is the key to value creation. The different judgements made in relation to the patient’s situation are not based on the data alone but to a large extent on the interactions around the data, such as with the information portal. Thus, value is created as part of an activity; it emerges from data work, and this is in line with Berg and Goorman (1999).

To achieve value within a data-supported practice, our contribution suggests a systemic approach to value creation, where an increase in the number of resources, and a decreased threshold for interaction between these resources, will increase the data’s value potential. Achieving value is a systemic achievement; it is an achievement realised through knowledge, technologies, personnel, patients, and the way work is organized. Value is an achievement of interaction between the actors, data, and the different resources. In this case the interaction utilizes three type of technology resource to achieve data value, resources for data generation, resources for interpretation and resources for social interaction. However, the clinical work and these resources rest on a foundational knowledge
process. A process characterised by scientific work procedures that in turn, structures and provide relevance to the interaction and value co-creation.

### 6.6 Synthesis of papers

The summarized results of the five included papers give an insight-out view on platformization from different aspects of the platformization. The related work on platforms often takes the point of departure from an outside-in view. Furthermore, the related work on platforms often either takes a more technological perspective, or examines them from market logic (i.e. multi-sided markets). However, my research has been from a socio-technical perspective, meaning that the practices where the platforms are being co-designed and going to be used constitutes an important part of the research effort. The contextual attribute of this thesis has thereby been of importance, where the platforms herein are within highly institutional setting which has called for particular constraints and needs, which has concerned the design of all layers of the platforms. In order to design practice-based platforms, an inclusive approach was thereby taken, more specifically a co-design approach.

The co-design method is applied in the design of the boundary objects (Paper 2: Islind & Lundh Snis, 2018; Paper 3: Islind & Lundh Snis, 2017; Paper 4: Islind et al., forthcoming) which led to the creation of a boundary practice (Paper 2: Islind & Lundh Snis, 2018; Paper 3: Islind & Lundh Snis, 2017) revealing learning and value creation aspects when being a part of a design process, and using the digital artifacts in practice (Paper 4: Islind et al., forthcoming; Paper 5: Lindroth et al., forthcoming).

To sum up the findings of the five included papers, paper 1 provides an overview of a platform, paper 2 examines the creation of a boundary practice when designing digital artifacts in platform contexts, paper 3 examines the use and learning aspects of using a platform, from a practice perspective, paper 4 examines the active use of boundary objects in the design process to support a larger platformization effort and paper 5 provides a view on the co-creation of value when transforming to a digitalized, data supported practice.

Consequently, the papers provide insights into different aspects of the platformization process, from the design, development and use. All papers are based on data that is created with practice, where boundary resources and boundary objects are being designed as a part of platformization efforts that support the formation of boundary practices.
The model below illustrates the focus of the five included papers in this thesis (see Figure 11 below).

Figure 11: The structure of the thesis (P in the figure stands for paper)
DISCUSSION

7 Discussion

The purpose of this chapter is to discuss the findings of this thesis with the point of departure in the research focus that sheds light on platformization in general and practice-based platforms in particular. The research questions regarding how platforms can be designed, developed and used in practice in addition to questions of why it is important to include end-users in platform efforts and when end-user involvement is fruitful, will be answered here. After that, concluding remarks about the theoretical and practical implications are presented.

7.1 Drawing the line of platforms

What the platforms that are the subject of previous research have in common, is that they are all established multi-sided markets and most definitely platforms according to any definition. However, researching platformization efforts entails doing research on platforms that are still being designed, developed and used in the nascent phases, before scaling starts, before multi-sided markets have become multi-sided markets, and before the third-party developers are a crowd. During my research this has constantly raised the question of whether the platforms truly are platforms and if so, when do they become platforms. Whether it has to do with if and when the multi-sided market has formed or whether the boundary resources are in place, and whether that affects when the platforms are truly platforms, have therefore been continuous questions over the course of my research.

As stated in the introduction, the term “platform” takes into account that a platform is a piece of software, while it is also an intermediary that connects needs with resources, in many cases, sellers with customers while in other cases, users with service providers. In line with that argument, and in line with the related work laid out in chapter 2, the two platformization efforts studied in this thesis are most definitely becoming platforms. What I would like to suggest, however, based on my research, is that there is a point in focusing on how platforms become platforms, rather than debating whether they are platforms, and if so, when they became platforms. In line with that, I choose to regard the two platforms studied in this thesis as platforms, and the notion of when they became platforms is thereby backgrounded. Instead, the notion of how they were designed and developed to become platforms, and what their initial use has been, has been foregrounded.
The previous platform literature does not problematize or attempt to unpack this particular notion of how platforms come to be. My research thereby focuses on that gap and contributes a conceptualization of the platformization process when bootstrapping practice-based platforms. What that more specifically has entailed is following the boundary resources as they are being co-designed, and as they are used in combination to form mobile apps, which are used in a specific social situation.

The previous research on platforms relies on secondary data to a large extent whereas this thesis is based on primary data. Consequently, the previous platform research is often from an outside-in point of view while this thesis takes an inside-out view on platformization, from within the co-design, development and use processes. This can also be seen as a bottom-up perspective, where the goal is to see how the practice-based platforms organically grow through interactions with practice. This means that the viewpoint is different, but there are also other elements that differ from the previous literature.

There are structural difference in the platforms in this thesis and the platforms in the previous literature. Scaling is one such attribute. The platforms discussed in chapters 1 and 2 have gone through scaling, and are being researched as established platforms. This thesis however contributes a view on platformization in the early phases and these platforms have therefore not gone through scaling. The platforms studied have not yet reached “the point of ignition” and might not be multi-sided markets yet, whereas the established platforms (in previous research) are all multi-sided already (at least two-sided) and “the point of ignition” has long passed. The platforms studied here might never scale to the size of the established platforms, instead they may remain rather small-scale. What I have studied thereby is not the scaling per se, but how to facilitate platformization that can be fruitful for specific practices.

The second structural difference has to do with the notion that the two platforms are designed and developed to become an integrated part of practices, which means that the two platformization efforts are as stated above practice-based platforms. They are both meant to be used within the public sector, but whether they will be used within the private or public sector, or in primary or secondary care, is less important than the notion of them being designed, developed and used in close collaboration with the practices of the end-users. Consequently, designing practice-based platforms can especially benefit from applying an design approach where the end-users’ practices are heavily involved, such as through co-design.

There is also a structural difference between the two platforms, even though both platforms have the notion of being practice-based platforms in common. Both
platforms differ from Apple Pay, which calls for a consideration of the aim of each platform. The platform in study I is a software development platform, and has similarities to what App Store was in its early days. It is however a small, practice-based initiative although it does have technological structures and aim similar to App Store. The platform in study II is a mediator, similar to PatientsLikeMe or Uber, and thereby differs in aim from the platform in study I. Even though there are fundamental architectural differences between the two platforms of App Store and PatientsLikeMe, both are considered platforms in the literature, and similarly, the notion of platforms is applied to the platforms in my studies. Even though they differ in architectural structure, they are both practice-based platforms.

Regarding the platforms as platforms, comes with several analytical advantages. Taking a platform perspective can for instance mean, focusing on the users of the boundary resources, i.e. the third-party developers in platform efforts (Ghazawneh and Henfridsson, 2013; Tiwana et al., 2010; Woodard and Baldwin, 2008), focusing on sorting out market logics or on platform architecture (Baldwin et al., 2009), focusing on platform dynamics (Gawer, 2009; West, 2003) focusing on the economics of platforms (Evans, 2009), focusing on the platform leadership (Evans et al., 2008; Gaver and Cusumano, 2002) or focusing on the role of boundary resources within platforms (Ghazawneh, 2012; Ghazawneh and Henfridsson, 2013).

However, when the aim is to design and develop a platform, and to understand their initial use, taking a platformization perspective has analytical advantages which differ from those listed above. One analytical point of taking a platformization perspective is that there is a possibility of understanding the socio-technical arrangements, which can bridge the gap between the technological and practice knowledge when designing platforms. Another aspect of platformization relates to focusing more on how platforms come to be, when the aim is to design a platform. Thirdly, co-designing practice-based platforms takes into account how such platforms can be designed and developed to facilitate the needs of the specific practices that will use them later on. Yet another analytical point of taking a platformization perspective relates to understanding the complexity and embracing it, rather than focusing on designing one specific service, such as focusing on the design, development and use of one specific mobile app. IS efforts are seldom free from complexity, and understanding how platforms come to be and understanding the socio-technical aspects is important when the platform phenomenon is becoming an increasingly important part of research (cf. Lyytinen et al., 2017).
To illustrate the findings of this thesis, seven platformization principles will be put forward below. These aspects constitute nuances of the analytical points of taking a platformization perspective and are recommendations based on lessons learned from the five years of platformization, from the two studies of platformization presented here. The principles summarize what has been discussed above, and will be further discussed below. The principles are empirically grounded and theoretically analysed and provide different perspectives on co-designing platforms. These principles focus on different aspects of platformization and summarize the implications of this thesis by providing aspects that can be applied when doing research within practice on platformization and are especially applicable when co-designing practice-based platforms.

**Principle 1: Socio-technical view**

The technological aspects, in combination with the social aspects of platformization (applying a socio-technical lens), contribute to an increased understanding of both the technological and social boundary resources. This constitutes a socio-technical view through the layers of the platforms where sometimes the social aspect is in focus, and sometimes the technological aspect. The social and technological aspects can be separated for analytical purposes but in practice, the social and technological aspects are mostly intertwined and dependent on each other.

**Principle 2: End-user engagement**

When designing practice-based platforms, it is important to involve the end-users in the design of all layers of the platform. End-user engagement, especially when designing with practices that have different user goals from the very beginning, results in end-user influence through all layers of the platform.

**Principle 3: Co-design for practice-based platforms**

During platformization, it is important to facilitate collaboration between end-users’ practices as well as the developers or designers. With that goal in mind, co-design is an approach which can facilitate collaboration and also contribute to the formation of a boundary practice in which the platform can be used, after the co-design process has come to an end and the use-phase begins.
Principle 4: Intimacy during platformization

It is less interesting to focus on the relationship between platform owners and third-party developers during platformization and more interesting to focus on the relationship between the practices which are co-designing the platform, i.e., the end-users; both relationships do however need to be based on intimacy during platformization.

Principle 5: From apps to platforms

Shifting the level of analysis from specific services, such as mobile apps, to also understanding the platform itself brings complexity but allows for an increased understanding of the different layers of the platform ecosystem and infrastructure, and comes with advantages that provide a more holistic view needed in the digital landscape of today.

Principle 6: From platforms to platformization

It is less interesting to study *when* the platform becomes a platform and more interesting to focus on understanding the journey of *how* it becomes a platform. In this way, focus shifts from studying platforms to studying platformization. Applying a holistic approach to platformization means taking into account the design, development and use of specific boundary resources of the platforms and how those boundary resources become boundary objects, while also researching the design of boundary practices where the boundary objects are being co-designed and later used.

Principle 7: Engaged research approach

Co-designing platforms from a bottom-up perspective with heavy end-user engagement requires engaged research approaches such as action-oriented or practice-oriented approaches, as platformization often calls for the dual role of being both a designer and a researcher.
7.2 Co-Designing boundary resources

The broader discussion above takes the point of departure from the various focus points within platform research. Specific parts of the platform literature can be especially interesting, and will be discussed here in relation to platformization. In established platforms, the boundary resources are already in place and the focus can turn to tuning (Eaton et al., 2015). However, during platformization the boundary resources are also being designed and the focus is thereby instead on establishing which boundary resources should be developed. This means that the research focus during platformization can be on design and development decisions rather than on tuning.

Ghazawneh and Henfridsson (2013) argue that the understanding of the dynamics of a digital platform should not merely be through the platform itself, but rather through focusing on understanding the boundary resources. As a reminder, boundary resources are “the software tools and regulations that serve as the interface for the arm’s-length relationship between the platform owner and the application developer” (Ghazawneh and Henfridsson, 2013, p. 174). The boundary resources herein are the code blocks discussed and elaborated on in chapter 5, besides the social agreements, also discussed. Some details from the findings will be elaborated on below to illustrate the relations between the social and technological boundary resources, and the influence that the end-users had on which boundary resources were designed and developed as part of the platformization efforts.

The boundary resources that were specifically designed and developed for the purpose of mobile app in study I (home care) were iii) payment integration to three different payment providers that used different payment methods; iv) a visible shopping cart; v) nested categories; vii) search, sorting and selection; ix) uploading of photos and display of photos; and x) display of items. This is in addition to other boundary resources that were identified late in the co-design and coded late in the development process, and then re-used in the other applications, e.g. top choices. The modules and the core of the platform that interact through a standardized interface, in terms of boundary resources such as these, can be seen as building blocks (Tiwana et al., 2010; Woodard and Baldwin, 2008) which were then put together to make a whole in terms of mobile apps.

In the two studies, there was a heavy end-user influence in the design and development of specific modules in the platforms. For instance, in regards to the payment, the caregivers and the elderly were specific about the necessity of a new payment solution due to the dysfunctional way payments had been handled before. All in all, during the platformization three payment solutions were integrated in the platform, whereas for the empirical setting of home care, one
specific payment solution was agreed upon. The other payment solutions were used in other mobile apps (outside the scope of this thesis). As it turned out, after having integrated the payment method in the platform, which most of the elderly and caregivers agreed upon, there were still unforeseen thresholds in regards to the elderly and their debit cards. The largest issue was that a large group of elderly did not have a debit card while another group had a relative responsible for their finances for various reasons, e.g. dementia. This posed unforeseen challenges which supported the integration of alternative payment methods for the following mobile apps. The practice involvement in study I thereby shed light on the payment challenges that could be faced in various mobile app contexts, when moving forward in the project as well. This called for several social boundary resources in terms of contracts that were important for the design, development and use. Social boundary resources can typically be incentives, intellectual property and platform documentation (Gawer, 2009; Ghazawneh and Henfridsson, 2011), such as payment solution contracts, and these resources enabled access to central modules of the platform (Yoo et al., 2010). In study II, for instance there was GDPR (the new EU personal data law), which also can constitute a type of social boundary resource which during platformization became an important discussion point in healthcare, and thereby a part of the platform effort in study II.

In regards to other boundary resources, it was clear early on that the mobile app in study I would require a shopping cart due to the nature of the grocery shopping activity. However, the interaction with the elderly supported the choice of having the shopping cart visible at all times, which is uncommon in most shopping services. The shopping cart became a module in the platform but its constant visibility was an interaction design choice in the interface. This illustrates that the practices had influence through all layers of the platform, by influencing the boundary resources in the platform itself, as well as the interface of the mobile app. While discussing the categories, it was important for the grocery store owner that the categories would represent the way the store was organized. This influenced the nested categories structure in the platform due to the understanding that the store owner and staff needed to pick and pack the products, so it was important that the packing process be as efficient as possible. The presentation of the categories in the GUI, however, was done according to the navigation patterns of the elderly and their caregivers; this points towards the complexity of co-designing with heterogeneous end-users. Most of the modules designed and developed for the purpose of the mobile app were re-used when designing the “backend” mobile app, which was used in the grocery store while packing. This backend app included packing lists that were organized in the same way as the store was organized (grouping vegetables for instance) for efficiency in packing. Grouping of products in the same way as in the store is quite common
but did however require a lot of discussion to come to a conclusion that would fit the purpose of the all parties involved. The pricing of specific products that are usually weighed in the store (such as bananas) also triggered a long discussion between the caregivers and store owner where they negotiated how the prices should be displayed and charged during billing so that the elderly would not be overcharged for the fruit they were buying. These discussions resulted in both social boundary resources (Gawer, 2009) in terms of different types of documentations and technical boundary resources which were coded as modules in the platform (Ghazawneh & Henfridsson, 2011).

There was a need to put focus on the presentation of products and use high-quality photos in the study of home care. The arguments led to the decision to display products as aesthetically as possible, to promote the appetite as well as enrich the experience for the elderly through images. These arguments led to the decision to integrate specific technical boundary resources (cf. Ghazawneh & Henfridsson, 2011) in terms of a specific photo API. This specific API held high-quality product photos and was integrated into the platform. The API was integrated with the product lists (the API got the photos based on the EAN code of each product (i.e., the barcode) and during the use of the mobile app, it was revealed that there were photos missing in the API. This became apparent during the interaction with practice and triggered the programming of a photo upload function alongside a selection process where if the photo was available from the API, it would be presented from there but if not, the photo from the platform would be presented. These decisions allowed for the necessary complementary innovation within the platform context, in line with Gawer & Cusumano (2008) but more practice-oriented than targeted towards facilitating the needs of third-party developers on which Gawer and Cusumano (2008) focus their efforts.

Search, sorting and selection was also a module, i.e., boundary resource. The search function needed to be highly efficient as the elderly were not necessarily used to typing. One senior wondered why the keyboard was organized in such a strange manner (referring to QWERTY) and not in alphabetical order. This was both challenging for the search function, as well as for the overall security in the mobile app. To remember a long password was not optimal for the elderly, nor was having to fill it in due to unfamiliarity with the keyboard structure. It was also not possible to put the burden of remembering all the logins on the caregivers. This, in addition to the discussion of relatives being responsible for the finances of some of the elderly, was a struggle when it came to sensitive payment information. This contributed to the decision of storing the payment card information in a token in each user account. Finally, we crafted a process for the handling of passwords as well (which was a manual process, and did not affect the platform structure).
What this illustrates is that when it comes to platformization when designing and developing practice-based platforms to be used in specific situations, taking a co-design approach gives insights into the needs of the end-users, not merely the needs of the third-party developers. In platformization efforts, and when designing practice-based platforms, the end-users should be the center of gravity. By approaching the design process with co-design, the end-users are able to influence various layers of the platform infrastructure, which also allows for more influence than merely in the mobile app; the end-users influenced the boundary resources of the platform but also the application layer.

This also illustrates the interplay between the social and technical (c.f. Bjerknes and Bratteteig, 1995; Kraft and Bansler, 1994; Kyng, 1994; Leonardi et al., 2012; Leonardi, 2012), both in terms of the social and technical boundary resources which have been unpacked but also in terms of the influence of practice on boundary resources and vice versa. The aim of this part of the discussion has therefore not been to favour either the technical or the social aspects (c.f. Cecez-Kecmanovic et al., 2014; Leonardi et al., 2012; Orlikowski, 2009). Instead, the focus has been to view the interplay where both social and technical aspects need to be adapted (Leonardi and Barley, 2010). More specifically, this is illustrated through the influence that the practices of the end-users have had through co-design of the boundary resources, while also illustrating the influence that the practices have had on the boundary resources.

The platform is the foundation, the boundary resources are one layer in the modular architecture (Yoo, 2010) and in the platformization process, and the boundary resources and platform are dependent on each other. From the boundary resources, the mobile apps can be built, as a part of the application layer (Yoo, 2010). The mobile apps thereby consist of the boundary resources and as such, these two layers are dependent on each other. However, what this thesis adds is that the mobile apps bind the end-users’ practices together, and can even form a boundary practice, and the mobile apps can function as a boundary object; the mobile app and boundary practice are thereby also dependent on each other. The layered modular architecture, discussed by Yoo et al. (2010), is therefore applied and extended with the additional layer of the practice: the practice layer. This becomes a socio-technical view on platformization.

The platformization view includes the design of the modules in the platform and the digital artifacts and also facilitates practice development, aspects which all relate to boundaries, especially when the end-users are heterogeneous. In these two studies, that has meant co-designing i) boundary resources, ii) boundary objects, and iii) boundary practices at the boundaries. When the end-users have inherently different needs during platformization, as in the two studies here,
where the caregivers’ needs differed greatly from the care recipients’ needs and the aim of the platforms was to function as a bridge between those, co-design is an approach where the needs can be facilitated throughout the process.

To illustrate the dependencies between these socio-technical layers of the platform, I want to propose a model based on the overall results of the thesis and connect the platform dependencies between the platform and boundary resources, between the boundary resources and digital artifacts (boundary objects), and the dependencies between the boundary objects and the boundary practice where the boundary objects play a vital role and can facilitate the formation of a boundary practice (see Figure 12).

![Figure 12: Dependencies and influences in platformization](image)

In this model, there is an end-user and practice perspective which is key for designing practice-based platforms. The colour dimension in the model, which goes from white to blue, illustrates the socio-technical dimension of the model where white illustrates the social and blue the technological.

The practices participating in the co-design efforts can influence the boundary resources in the first layer through intimacy in the co-design process, and as such, influence the platform structure. The practices can both influence the formation
DISCUSSION

of the mobile apps and also of the boundary resources that are being designed and developed. The mobile apps, in terms of boundary objects in the model, also influence the participating practices where the mobile apps are an important facilitator in developing the boundary practice.

7.3 Co-Designing boundary objects

Recombining boundary resources into different digital artifacts has been a part of the platformization efforts studied here. The recombination can lead to supporting independent developers engaging in producing new and interesting boundary resource recombinations (Tilson et al., 2012) and these recombinations can be seen as puzzles which, when put together, become specific objects.

From a design perspective, when designing specific boundary resources in platforms which become mobile apps when put together, the design relationship can be discussed at length. The relationship discussed in participatory design and, later on, co-design has traditionally been intimate, where the end-users are co-designers and collaborate closely in such a process. However, as mobile apps are becoming increasingly easy to build and as software development methods allow for increased speed and platforms allow for building apps in a modular way, user participation and end-user involvement does not always fit the agility of the software development. What this thesis shows, is the importance of co-designing with the end-users (cf. Joshi, 2017; Joshi and Bratteteig, 2016; Malmborg et al., 2010; Sanders and Stappers, 2008; Woll, 2017) even when designing platforms.

The co-design approach has influenced the layers of the platforms, not merely the boundary resources, as discussed above, but also the application layer (i.e., the digital artifacts in terms of mobile apps) in several ways. For instance, in study I, the co-design approach allowed for heavy involvement of both the caregivers and the elderly and the digital artifact became a boundary object between the two already during the design process. An object becomes a boundary object when it serves as a device for transformation, translation and negotiation at the professional boundaries (Bartel and Garud, 2003; Bechky, 2003; Boland and Tenkasi, 1995; Carlile, 2002; Carlile, 2004; Levina and Vaast, 2005; Nicolini et al., 2012; Pawlowski and Robey, 2004; Star and Griesemer, 1989), which is what happened here.

Beyond those boundary resources and boundary objects, there are also other resources which are produced as a consequence of platformization. These types of resources are for instance the data which is produced by the patients when using the mobile app in study II. The data is gathered by the patients and used by
them when assessing their symptoms on a daily basis, but also used by the nurses as grounds for clinical decision-making. In that sense, the data produced in the platform can also be seen as a boundary object between the caregivers and the patients in study II as they engage with each other in new ways, due to the increased data in the data-supported practice (Lindroth et al., forthcoming).

What my research shows is that when designing with heterogeneous users from different types of practices, where one is within organizational boundaries and one outside an organizational context, it is beneficial to work strategically with boundary objects, to facilitate a boundary practice to form between heterogeneous end-users that have not used digital artifacts in close collaboration with each other before. In Islind et al. (forthcoming), the different digital artifacts that were designed as a part of the platformization effort were at times open, ill-structured boundary objects, whereas over time, more structured objects were brought in. These were used during the design process to forward the design process. In study II, as that design process was chronologically done afterwards, that design knowledge of the co-design approach as well as the perspective of designing with boundary objects was inherited from study I, and put to the test in study II, where boundary objects were used more actively to forward the co-design process (illustrated in Islind et al., forthcoming).

In both studies, the platforms, or the different versions of the mobile apps, can be seen as boundary objects, depending on the unit of analysis. In Islind & Lundh Snis (2017), the mobile app is regarded as a boundary object and in Islind et al. (2018), the boundary objects were actively used to forward the co-design process. The platforms in both studies served as a link in the communication and negotiation process and facilitated knowledge sharing and co-creation of meaning (Boland and Tenkasi, 1995). As boundary objects allow groups to unite and form a working relationship and are instances that enable groups that do not share consensus, boundaries or professions to consolidate and work together (Fischer, 2001; Kimble et al., 2010; Kimbler, 2010; Star, 2010; Star and Griesemer, 1989; Wenger, 2000), the mobile apps, data and platforms functioned as such. Consequently the platforms can just as well be regarded as boundary objects.

Boundary objects play important roles as shortcuts to communication, as well as playgrounds for knowledge sharing among different communities of practice (Brown and Duguid, 1991; Cook and Brown, 1999; Wenger, 2000). Up to this point, boundary objects have been studied in various contexts as elaborated in chapter 2, e.g. as artifacts within museums (Star and Griesemer, 1989), in terms of engineering drawings (Carlile, 2002; Henderson, 1991), cargo airway bills (King and Foster, 1995), aircraft maintenance requests (Lutters and Ackerman, 2002), human genome mapping (Winter and Butler, 2011) as well as medical patient records (Berg and Bowker, 1997), whereas this thesis contributes by seeing
various aspects of the platforms as boundary objects, depending on the unit of analysis.

Another aspect that changed as the boundary objects progressed and their role was more established within the co-design situations, was the role of the designer. The role of the designer went from being heavily involved in the beginning and more detached over time as the two practices, i.e., the end-users and co-designers, became more dependant on the platforms. Also, no specific implementation was required, the design phase smoothly continued to a use phase and the practices involved designed their own boundary practice, which later became the practice in which they used the platform (Islind & Lundh Snis, 2018).

The platforms, during both design and use, functioned as boundary object between the two end-users’ practices. During the design, the boundary objects were emerging, meaning that they had neither been stabilized nor gained final meaning (Dalsgaard et al., 2014). The platforms as such were still forming. During the initial use, which I have also studied, platforms were still forming. As the platforms were still forming, they could be seen as rather open boundary objects. The distinction made by (Ewenstein and Whyte, 2009) between open and closed boundary objects has grounds in Leigh Star’s (2010) distinctions “between the ‘ill-structured’ use of boundary objects between social worlds and more specific ‘tailored uses’ within those worlds” (Nandhakumar et al., 2013; Star, 2010). During design and development, the platforms were open boundary objects but they did however move towards more closed boundary objects as the platformization process progressed.

The multi-sided platform perspective could also be used in combination with the practice perspective, as the platforms are an intermediary between the practices which are to collaborate as a result of the platform efforts. Here these practices are the caregivers and care recipients, and the platform can be seen as a boundary object, and an enabler of multi-sidedness between the two practices. The use between social worlds, and the use within those worlds is what will be explored further in the next chapter, from the practice lens.

### 7.4 Co-Designing boundary practices

One outcome of this thesis is that the practice lens needs to be adapted to the digital landscape of today, where the users are not only part of an organizational setting but are everyday people, seeing to their everyday needs. As Sorensen (2016) points out in his commentary on the mainframe in the basement, the field of IS stands strong in doing research in organizational settings but might be stuck
doing research in the way it has always been done. In line with his arguments, I want to propose that we widen the practice lens and by doing so, take it forward, as the practice lens might be stuck in the organizational setting.

Co-designing with heterogeneous end-users is complex, and in these two studies there were two practices in both. Both studies had the same element of the practices being of different characteristics as well. Yoo et al. (2010) argue that digital technologies, such as platforms, tend to blur various types of boundaries and that Google, Apple, and other similar platform owners intentionally blur boundaries and thrive off of that. In line with their argument, designing practice-based platforms also means that various types of boundaries are crossed, spanned and blurred. The boundaries between the practices involved have been blurred during the platformization efforts. One practice was a traditional work practice that was a part of a rather regulated, highly institutional structure (i.e., the caregivers), whereas the other practice consisted of elderly in study I and patients in study II, who are outside organizational boundaries, and as such, not traditional work practices. These practices outside the organizational boundaries are however practices where data is being gathered and platforms are being operated, and use is thereby also happening, which makes them equally interesting to study.

Due for example to increased use of smartphones, end-users are more dispersed than ever, which makes the boundaries of the practices of the end-users more blurred and the user types more complex. For instance, there are various types of users as discussed in the introduction to this thesis. There are both “middle-ware” users, in terms of the third-party developers that are the users of the boundary resources, as well as the end-users of the mobile apps or platforms. The end-users are more often on the move and not bound to an organizational setting. As such, they are everyday people, a part of everyday practices such as self-care, which means that their use is more geographically dispersed than before. The increasing amount of data, which is discussed in Lindroth et al. (2018) encourages so-called data-supported practices where the organizational context can be one part of the data-supported practice whereas the everyday use, performed by patients outside of organizational boundaries, can be another part of a data-supported practice. These two practices can also be two sides in a multi-sided market perspective. This indicates that the datafication (recent stream of literature within healthcare) which is a rising part of modern healthcare where the patients bring their own data, supported by healthcare, might call for a wider practice lens within IS where we increasingly research and design for both everyday use and organizational use simultaneously.

The caregivers in my two studies were a part of home care and healthcare, where there is a history of lagging behind when it comes to digitalization. Healthcare in general is known for being a latecomer when it comes to adaptation of new digital
technologies. The patients in study II have been declared healthy as they are cancer free, but still require much care. The same goes for the practice of the elderly, and both care recipient practices cannot be classified as the most attended to end-users when it comes to designing digital solutions to support their everyday life. The elderly in study I are frail older adults with limited experience of using digital artifacts and the patients in study II are extremely busy with managing their symptoms which are, to be honest, taboo in society. Both are end-user groups that tend to be forgotten when it comes to digitalization efforts. One reason might be because we are stuck inside the organizational boundaries when it comes to research on digitalization efforts. Also, as the heterogeneity of the end-users was high there was a challenge of bridging the boundaries between the two different types of practices. Even though the results of my thesis come from home care and healthcare and are tested in those settings, such heterogeneity of end-users can be found in other sectors, both within the private and public sectors.

When practices are collaborating, the ability to span boundaries between the collaborating practices is of importance (Carlile, 2002, 2004). The design and development of a shared boundary object can allow for the different practices (where each practice represents expertise) to develop a shared language between them (Carlile, 2004). What Carlile (2002, 2004) argues for is the well-structured boundary objects in such a process, but what this thesis shows, as in Islind & Lundh Snis (2018) and Islind et al. (forthcoming), is that the boundary objects can facilitate such a boundary practice to form, even when the boundary objects are not that structured. This is in line with what Kellogg et al. (2006) and Majchrezak et al. (2012) argue for, as well as (Boland Jr. et al., 2007; Ewenstein and Whyte, 2007; Ewenstein and Whyte, 2009). What I argue for, based on the findings of this thesis, is that the boundary practice can begin to form with ill-structured boundary objects, regardless of what types of boundary objects come into play during platformization. This means that such a boundary practice can form during the co-design process and during platformization, as long as the collaborating practices are working towards a mutual goal and the practices are heterogeneous and have specific expertise which is represented during the co-design process, such as one practice being caregivers and the other care recipients. The two practices can thereby come together in the co-design process and form a boundary practice, early on in the platformization process.

When it comes to practice-related aspects of the platform literature, an aspect which has been studied is the relationship which focuses on the creation of an arm’s-length relationship between the platform owners and third-party developers. This has not been studied through the practice lens, but the practice lens could have been applied. Even though this relationship is of importance when it comes to maintaining architectural leverage in platform contexts, where
the goal is to create as many mobile apps as possible and facilitate an agile development process, during platformization the relationship needs to be formed differently. When co-designing practice-based platforms, and looking towards the platformization, the relationship cannot be at arm’s-length. This thesis presents different types of relationships than the literature on established platforms has focused on (cf. Ghasnaweh & Henfridsson, 2013), and can thereby not be compared fully. Studying that particular relationship in the nascent phases would have meant studying the platform owners and third-party developers as one unit (or one practice) because in the nascent phases of platformization, the third-party developers are not a crowd yet. It is not until later in the platformization process, when scaling has started and the platform has started to grow on both sides of the two-/multi-sided market that there is an incentive to study the relationship between third-party developers and platform owners. During platformization, the relationship between the third-party developers and platform owners needs to be formed as a tightly coupled relationship, within the same practice, also discussed as intimacy in Islind et al. (2016). In some cases, the third-party developers and the platform owners might even be the same people in the nascent phases whereas when the platform has scaled, making a distinction between the two fits an analytical purpose, but only then.

As a consequence, the focus here has been less on the relationship between platform owners and third-party developers and more on the relationships in the co-design process. The relationship on which I have focused much in this thesis and what I have observed through both 2.5-year platformization studies, is the relationship between the practices involved, and the relationship between the designer and the practices where the platform is being designed, developed and ultimately used. From a design perspective, when designing specific boundary resources in platforms that in a layered modular architecture way become applications when put together (Yoo, 2010), the design relationship can also be discussed at length. The relationship discussed in participatory design and, later on, co-design (elaborated on in Islind & Lundh Snis (2018)) has in the Scandinavian school traditionally been extremely intimate where the end-users are co-designers in such a process. However, as mobile apps are becoming increasingly easy to build and software development platforms allow for increased rapidness when building apps in a modular way, user participation does not always fit the agility of software development. When designing with heterogeneous users (i.e., stakeholders that are different from each other), arm’s-length relationship (cf. Levina & Vaast, 2006) does not fit the purpose of planning the design process. Arm’s-length relationship has not been associated with design processes in general but the notion of it, especially when platforms and mobile apps are being designed in an agile world, is a struggle. During platformization, the relationship between the designers and the practices involved in the co-design process also
DISCUSSION

needs to be intimate, in the spirit of the Scandinavian school. However, that particular relationship can glide towards an arm’s-length over time (as illustrated in Islind & Lundh Snis, 2018).

This thesis illustrates that during platformization, the relationships in the design process need to be tightly coupled. These relationships more specifically take into account that the relationship between the two collaborating practices that are joined together in the co-design process, such as the caregivers and care recipients, needs to be intimate. The relationship between the designer and the collaborating practices of the end-users also needs to be hands-on and intimate, at least during the initial phases of the co-design process (Islind and Lundh Snis, 2018). When platforms have gone through scaling, it is important that boundaries are established between the third-party developers and the platform owners, which can be foregrounded after scaling (cf. Ghaznaweh & Hefridsson, 2013) whereas during platformization, the third-party developers and platform owners can be a part of the same boundary practice where the goal can be blurring the boundaries rather than strengthening them and the relationship needs to be formed intimately (Islind et al., 2016). Consequently, the intimacy in the different types of relationships is the core during platformization. Over time, the intimacy of the practices involved has the potential to form a boundary practice where both practices are represented, and can co-exist with the boundary object and form their own routines (Islind & Lundh Snis, 2018).

It is not viable to try to mimic the arm’s-length relationship that is suitable for established large-scale platform efforts when designing platforms from scratch. During platformization, all relationships need to be delicate and nourishing, the designer needs to be involved to a larger extent in the nascent phases, and the co-design process needs to facilitate close collaboration (Islind & Lundh Snis, 2018). The relationship between the third-party developers and platform owners also needs to be intimate (Islind et al., 2016). For a platform to grow and for a platform ecosystem to flourish, it is important to understand the influence of the practice in-depth, where the platforms are to be used (Islind et al., 2018; Islind & Lundh Snis, 2017; Lindroth et al., forthcoming) to truly design for the heterogeneous end-user practices so that the platform will be suitable for the purpose it is designed for. Such an approach is especially applicable when designing practice-based platforms. The results of this thesis therefore suggest that it is not enough to understand the technological aspects of platforms. The social situation and socio-technical interplay are equally important to shed light on.

Subsequently, the most important relationship during the platformization that should be foregrounded when researching such efforts is the closeness to the end-users (i.e., the user-centeredness of the design process) which is highly important
in the nascent phases of platformization. The Scandinavian school has throughout the years focused on democracy and intimacy in the design process, which I would hereby like to suggest is also needed during platformization when co-designing practice-based platforms, designed and developed with practices that are then to be used for specific purposes, to fit a specific use.

It can be argued that the aim of PatientsLikeMe and Uber was also designed to facilitate a rather specific purpose. They might, as such, be considered practice-based platforms. The purpose of PatientsLikeMe is to facilitate a meeting between people with similar health issues while the purpose of Uber is to facilitate a meeting between a driver and a traveller. These platforms have since been scaled and the ecosystems have grown into large-scale multi-sided markets, so even though a platform is designed for a specific purpose, involving a particular practice, it does not mean that it cannot scale and become large over time. Designing practice-based platforms and exploring platformization does not necessarily negate the scaling. However, it is fundamentally different to design a platform for the purpose of maximal scaling from the start, as in the case of Apple, and to design a platform to fit a specific purpose, i.e., practice-based platforms, such as with the platforms researched in this thesis. For such specific platforms, the co-design approach is appropriate and for such platformization efforts, facilitating the meeting between the end-users early on through co-design, can facilitate a boundary practice to form already during the design phases, and that can be of value.

Lastly, the practices involved in platformization influence the platform development, and the platform influences the practice development as it facilitates a boundary practice to form. This is an iterative, cyclic process (illustrated in Figure 13).

![Figure 13: The practice influences the platform development and the platform development influences the practice development](image)
CONCLUSION & RESEARCH IMPLICATIONS

8 Conclusion & research implications

The potential that digital platforms bring, is as stated in the beginning of this thesis, becoming an increasingly important part of work, everyday life and research. However, understanding what happens during platformization, is limited in prior research. In this thesis, the design and development of two platforms has been researched and the design of the platforms has been validated by studying the use of the platforms within practice as well. This thesis provides new insights regarding co-design of platforms and contributes with conceptualization of the platformization process through a five years longitudinal AR project, based on the design, development and use of two practice-based platforms with heavy end-users engagement. These two platformization efforts are from two studies within care: i) from within home care and ii) from cancer rehabilitation. The contribution of this thesis expands the scope of the platform literature by increasing the understanding of the early phases of how platforms come to be and thereby, contributes to the core platform literature (cf. Baldwin et al., 2009; de Reuver et al., 2017; Eaton et al., 2015; Furstenau and Auschra, 2016; Gawer, 2009; Ghazawneh and Henfridsson, 2013; Yoo, 2013). Moreover, this thesis also contributes to the stream of literature on co-design (cf. Joshi, 2017; Joshi and Bratteteig, 2016; Malmborg et al., 2010; Sanders and Stappers, 2008; Woll, 2017) with a new application area of co-design as an approach.

The contribution is illustrated in the platformization model along with seven platformization principles that can be applied when researching how platforms come to be. Drawing on the existing literature on platforms, this thesis contributes to the previous work in several ways. This thesis introduces practice-based platforms as a research phenomena and platformization as an approach to researching platform efforts. The question of how practice-based platforms can be designed and developed is answered through showing the impact that the end-user’s practices had on the design of all layers of the platform, through the co-design approach, including an influence on the boundary resources that were developed within the platform. End-user involvement is especially important when designing platforms that are to be used within situations that consist of heterogeneous practices. The platforms, also had impact on the practices, which designed new ways of interacting. It is noteworthy, from the results of this thesis, that the platformization processes herein, contributed to the formation of boundary practices, which were supported by the platforms. The learning aspects alongside the value aspects are also shown, which illustrates the influence that the platforms had on the interaction and mediation between the end-users involved. The results also show that intimacy is important during platformization, especially when designing practice-based platforms. Through the co-design approaches in
both empirical studies, the end-users influence the different layers of the platforms is illustrated through: a) design, development and use of specific boundary resources of the platforms; b) to design, development and use of the mobile apps; and c) the design of boundary practices where the boundary objects are being designed, and later used. The results thereby both show the impact of the end-users’ practices (caregivers and care recipients), which are heterogeneous, on the platform design – as well as the impact of the platform on the design of their boundary practice.

8.1 Practical implications

This part of my thesis is written in a more sentimental way. I am truly aware that my research would not have been possible without the heavy engagement of the caregivers and the care recipients (the elderly and the patients). The thesis is written within a research group that specializes in work-integrated learning research. For me, this has meant substantial engagement with the practices involved and I have spent a great amount of time on field work. The work-integrated learning part, has also included a focus on understanding and facilitating change, over time. The research approach of action research, which is often seen as a driver of change, constitutes a large part of my efforts and I also see my engagement with practice, as a responsibility to give back to them, as they have contributed so much to my research.

It is my hope that my research informs the practices by improving aspects of the care for the elderly, as well as the care for patients with complications due to cancer treatments, while also informing aspects of being a caregiver using platforms as a part of everyday work. By being involved with practice, I have learned a lot, but I think my research has also informed the practices involved in different ways.

The results of the included papers might be more applicable within practice, than the overall results of the cover text. The results of the papers have for instance included the formation of a boundary practice through involvement in the co-design process due to a specific way of organizing the co-design process. The co-design process in study I moved from being in unfamiliar settings to being in an authentic setting, in the homes of the elderly, which was beneficial for both the elderly and their caregivers. The digital artifact that was designed and developed improved the care for the elderly as well as contributed to the formation of a caring conversation between the caregivers and the elderly, empowering the elderly and facilitating a change in work routines for the caregivers, towards increased care as a part of their daily tasks. This digital artifact was designed and
developed to carry out a task where efficiency could be improved, however, it turned out to promote learning and quality of care within home care as well. The experience from this research, the learning aspects and the nourishing caring conversation has the potential to contribute to a flourishing modern home care. The results from study II include that designing in a specific way, from forming narratives of patient stories to using more concrete design objects, over time, can forward design processes within complex, highly regulated settings, such as cancer rehabilitation. The results also show the value that is co-created within a data supported practice and how a mutual care practice can evolve through the use of various data sources, such as digital artifacts, where both the patients and caregivers contribute with value, and co-create value together in their interactions. The cancer rehabilitation clinic, the patients and the nurses, have become increasingly digitalized throughout the project which has both been a burden and a blessing. It has at times been difficult, as new routines are being set, whereas it has also increased the quality of the data brought in for validation that is used as a part of the decision-making process in the consultations. These contributions are more of practical character as the results of the papers are truly empirically grounded and gathered alongside the practices, through longitudinal engagement and true willingness to change care to the better.

8.2 Future work & limitations

This thesis presents a longitudinal study of two platformization processes whereas more studies of such character are hereby encouraged to increase the understanding of platformization. Future work could also include testing the platformization model alongside the seven principles, within other settings than care. As identified by Braa et al. (2004), it can be a challenge to facilitate change processes that last over time, which motivates me to continue following study II (the cancer rehabilitation) and continue gathering empirical data, to be able to follow the change process, over an even longer period of time. Following up on the changes, can be one direction of future work, while testing the results in settings other than care can be another possible application area for future work.

The results of this thesis are based on platformization within the public sector whereas studying platformization within the private sector might reveal other insights. The principles are based on the design and development of platforms that have been used within practice, and both platforms have been followed through initial use as well, meaning that their design has been put to a test. However, both platforms are small scale, so that the findings of this thesis are particularly applicable in initial phases of platformization.
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REFERENCES


115


REFERENCES


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Digital platforms are slowly becoming an important part of both research and everyday work. However, little focus has been on platformization (i.e. design, development and use of platforms) and how platforms can be co-designed within practice. This thesis is based on an action research study on co-designing practice-based platforms in care settings through one 2.5 years study within home care and one 2.5 years study within cancer rehabilitation where platforms are being co-designed by caregivers and care recipients to be used within those settings. The main contribution of this thesis is a conceptualization of the platformization process where the key characteristics of designing such platforms with heavy end-user engagement are illustrated.