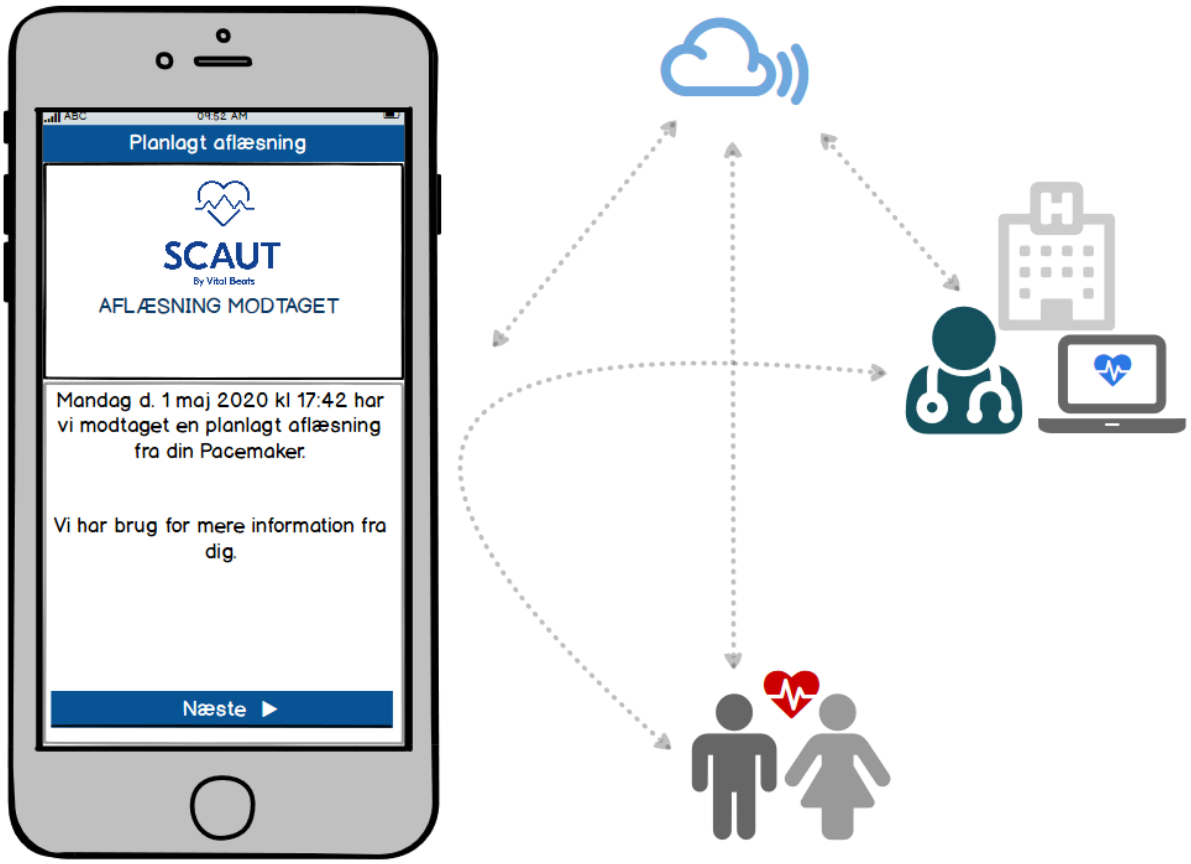
Sarah Dinah Blomquist study number: 20180927
Julie Højris Petersen study number: 20181166

A qualitative innovation of digital healthcare for remote-monitoring pacemaker patients

Julie Højris Petersen & Sarah Dina Blomquist

Master thesis, June 2020



Techno-Anthropology

Aalborg university, Copenhagen

Sarah Dinah Blomquist study number: 20180927
Julie Højris Petersen study number: 20181166

Aalborg University Copenhagen A.C Meyers Vænge 15, 2450 København SV

Master in Techno-Anthropology

Semester: 10, master thesis

Project period: 20200201 to 20200604

Hand-in date: 20200601

ECTS: 30

Supervisor: Søren Nors Nielsen

Collaboration Company: Vital Beats

Number of normal pages: 81,3

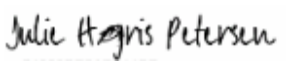
Characters with space: 195.072

Number of pages: 128

Project group

Julie Højris Petersen **Student number:** 20181166

Signature:



Sarah Dina Blomquist **Student number:** 20180937

Signature:

Resumé

Baggrund: Generelt bevæger sundhedssektoren sig hen mod en mere digitaliseret sektor, hvor nye teknologier vil ændre den måde vi behandler og udreder patienter på. Den teknologiske udvikling vil b.la. resultere i, at forsøge og behandle patienter uden at være fysisk til stede. Det vides, at specielt pacemaker patienter lever i frygt med mange bekymringer, grundet deres hjerteproblemer. Dette projekt følger en kvalitativ innovationsproces af en digital kommunikations platform, kaldet SCAUT, der skal være kilden til en bedre behandling af pacemaker patienter, med en hurtigere og lettere tilgængelig behandling. SCAUT platformen er udviklet af scale-up firmaet, Vital Beats, der benytter sig af bruger-orienteret design metoder til udvikling af SCAUT platformen i samarbejdede med klinikere og pacemaker patienter. Dette projekt undersøger mere specifikt hvordan innovations processen bliver til og udfolder sig ved implementering og justering af SCAUT platformen til nye pacemaker patienter.

Teori: Indsigter, resultater og refleksioner vil blive belyst af et teoretisk fundament. Mere specifikt, vil Aktør-netværks teori kaste lys over translationer og aktører i innovationsprocessen. Kritisk teori af teknologi vil afdække et samfundsmæssigt perspektiv samt en diskussion om teknologien i sig selv, i forhold til pacemakerpatienterne og klinikerne.

Metode: Fra februar 2020 til maj 2020, har det metodiske arbejde udfoldet sig, i samarbejde med firmaet Vital Beats og pacemakerklinikken på Rigshospitalet. Projektets fokus er inddragelse af klinikere og patienter og derfor bliver der benyttet deltagende design i form af fem workshops med pacemakerpatienter. Workshopsne er udformet på baggrund af prototyper af SCAUT platformen. For at kunne personalisere SCAUT platformen til patienternes behov, er der udviklet tre Persona profiler der spænder bredt over pacemaker patientgruppen. Der er ydermere blevet udformet semistrukturerede interviews med en talsperson fra Rigshospitalet (en kliniker) og en talsperson fra Vital Beats (udvikler og teknologisk antropolog). Det ene interview har fundet sted i projektets spæde start, imens det andet er et opfølgende interview.

Resultater: For at tilpasse SCAUT platformen til et bredt spektrum af patienter, er der udviklet tre Personas typer, som hver især har været i fokus i forhold til deres behov. Personas profilerne er udviklet på baggrund af et tidligere projekt, udviklet i samarbejde med Vital Beats. Sammen med Vital Beats, klinikere, og specielt pacemakerpatienter er der udviklet kerne elementer til SCAUT platformen.

Konklusion: Brug af deltagende design har bidraget til en mere personlig og passende behandling. Når forskellige aktører inviteres, åbnes der op for forskellige interesser, der skaber et bredere perspektiv. De forskellige perspektiver, gør at "Matters of Concern" kan blive opfyldt. Innovationen opstår ikke flydende, men er ofte en rodet proces, med mange netværker og forhandlinger mellem aktører. Innovationen er præget af de værdier og rationaler der ligger til grund for teknologien.

Abstract

Background: Healthcare, in general, becomes more and more digital which changes the practice of how the treatment of patients occurs. This study is a qualitative innovation study of a digital communication platform named SCAUT. Pacemaker patients are everyday living with anxiety and concerns about their pacemaker and health. Vital Beats is a company, that uses user-centered design, to create the SCAUT platform that mediates between the clinicians at the pacemaker clinic and the pacemaker patients. This project investigates the innovation process of the SCAUT platform by making participatory design and workshops, in collaboration with patients and clinicians. This might adjust the platform to the patients' and clinicians' needs and how the SCAUT platform comes together when involving both patients and clinicians in the design process.

Theory: The theoretical framework is conducted by using key concepts from Actor-network theory and Critical theory of technology, to illuminate the innovation process and as a critical reflection.

Methods: The methodological framework was carried out from February 2020 to May 2020, in collaboration with the company Vital Beats and the pacemaker clinic at Rigshospitalet. This project is practicing participatory design to innovate the technological platform SCAUT. Participatory design, in this case, exists of mockup-illustrations of the SCAUT mobile application. The mockups are executed as individual workshops together with five pacemaker patients by using skype. Personas are carried out as a user-centered design method, in order to create a personalized platform, and by that aim to reach a broad range of pacemaker patients. Semi-structured interviews are performed, by having a spokesperson from the pacemaker clinic at Rigshospitalet (clinician) and a spokesperson from Vital Beats (business developer and anthropologist). The two interviews are conducted before and after the workshops with pacemaker patients.

Results: The results exist of three possible personas profiles, that incorporate a broad range of pacemaker patients, furthermore the executed mockups resulted in three questionnaires, that have been the core of the SCAUT platform prototypes, which are carried out together with pacemaker patients.

Conclusion

Engaging with patients and clinicians have contributed to a more personalized and suitable care. When inviting different actors and therefore different interests, the premises of Matters of Concern get closer to be fulfilled. The process of innovation is not fluid but a messy process, that involves numerous negotiations among actors. The innovations occur at many different levels and at every time behind the scenes. How the process and the technology get developed, depends on the values, intentions, and rationalities that are embedded in the technology.

Keywords: Pacemaker patients, Remote-monitoring, Digital-health, Telehealth, Telemedicine, Participatory design, digital communication, Actor-network theory, Critical theory of technology, SCAUT, mobile application.

Acknowledgment

First, a big thanks to our supervisor Søren Nors Nielsen, who has contributed to, and supported us in this master thesis project. It has been a large advance to have his inputs and reflections through the development of the project.

Secondly, a great thanks to all the employees at Vital Beats and their contributions and facilitation of contacts between patients and Rigshospitalet. Without you, this would not have been durable. Furthermore, particularly, a special thanks to Anders Vestergaard from Vital Beats, whom we have been in close collaboration with through this project.

Lastly, a grateful thanks to all the pacemaker patients, who have contributed with insight. Thanks, for sharing your private thoughts and letting us into your life/world. without the patients' and clinicians' inputs through this project, it would not have been possible, to create a participatory platform.

Preface

This master thesis project is made by two students studying techno-anthropology at Aalborg University, Copenhagen. This project has been developed in cooperation with the scaleup company, Vital Beats. The purpose has been to implement a specific group of pacemaker patients on the healthcare application platform SCAUT. The methodological framework was created based on the fundament of participatory design, personas, and semistructured interviews. The participatory design was carried out by doing digital paper mockups with pacemaker patients. Personas were created based on a previous study of pacemaker patients and aims to categorize different types of pacemaker patients. The semistructured interviews have been carried out with the purpose of getting and sharing knowledge between us and clinicians at Rigshospitalet. All the empirical data has been analyzed through a theoretical framework. The theoretical fundament draws on concepts from Critical

Theory of Technology and Actor-network theory. Postphenomenology functions as an implicit background theory, that we have chosen not to use explicit but are aware of. The combination of methodological and theoretical frameworks gives the opportunity to create valuable decision trees for pacemaker patients and clinicians. The discussion draws on Bruno Latours Matters of Concern. The project is presented and defended in an oral exam.

Table of Content

1.0 Abbreviations

Word	Abbreviation
Participatory design	PD
Information and communication system	ICT
Cardiac resynchronization therapy-pacemaker	CRT-P
Cardiac resynchronization therapy defibrillator	CRT-D
Implantable pulse generator	IPG
Implantable cardiac defibrillator	ICD
Actor-network theory	ANT
Critical Theory of Technology	CTT
Science and technology studies	STS
Healthcare information technologies	HIT

2.0 Motivation

This project intends to investigate how the process of participatory design (PD) can affect the creation of tele healthcare according to remote-monitoring pacemaker patients. We have experienced a general increasing tendency in remote treatment of patients. We expect the tendency to be a stronger and integrated part of the healthcare sector. The development of new technologies often creates challenges, frustrations, inequity, and misunderstandings. From our point of view, we think, that when given more power to the patients and valuable communication to the clinic, the patients' life/world picture will be enriched, which we have experienced on behalf of earlier projects. We hope that cooperation between clinicians and pacemaker patients can create a stronger fundament for the best possible treatment. The development of technologies in the healthcare sector is of huge interest to us on different levels. We both have a personal interest in studying healthcare technologies especially the ethical aspects according to patients. We aim to ensure that healthcare technologies should be beneficial to the patients and not only beneficial for the healthcare sector's economy. If technology, on the other hand, oppresses, mislead and weakens the patients, then we want to enlighten the transparency of these aspects. Our previous educational and professional backgrounds as a-biomedical laboratory scientist and laboratory technological scientist have given us insights into working with patients and at the same time have interaction with new technologies. Our previous educations have created a fundament there is needed in order to understand the scientific and technological aspects of this project. Techno-Anthropology gives the opportunity to create research through fieldwork and make room for patients to tell their stories. The collaboration between us and the patients/clinicians cannot be underestimated and throughout the project, it has been our aim to value both patients and clinicians in order to create a meaningful and actionable platform for all parts involved. The patients are most likely suffering from a chronic disease that they have to engage with every day, which makes them experts on their life perspective. It is our perception that the clinicians have a practical and scientific focus that sometimes clashes with the patient's view. We as intermediators have the task to transfer knowledge and translate it through theoretical glasses to investigate the different aspects of the interaction with new technology. We know

from our previous study that there is a need for more and better communication between patients and clinicians. With this project, we aim to enhance and emancipate the process for both patients and clinicians according to the implementation of pacemaker patients on the SCAUT platform by engaging with the patients through PD.

3.0 Introduction

This project intends to onboard a specific group of pacemaker patients on a telemonitoring communication platform more precisely a mobile application that can communicate between pacemaker patients and clinicians at the hospitals. The aim is to unfold this onboarding process by engaging with patients in the creation of an actionable, feasible, equal and meaningful telecommunication system.

Worldwide almost 30 percent of deaths can be related to cardiovascular diseases and in some of the vital cases, the patients necessitate an implantable cardiac device in order to survive (López-Villegas et al. 2016, p.125). Three million people around the world are living with a pacemaker and 600.000 new implementations follow each year. Since the first implementation of a pacemaker device back in 1958, the number of devices has increased each year and will continue to do so (Ibid). Even though the majority of people living with a pacemaker are over 60 years old when they get their first one, people at any age are having pacemakers (Wood and Ellenbogen 2002, p. 2136). Having a pacemaker is often related to a chronic condition, that affects a person's world/life perspective on many different levels. Telemonitoring is one of the key elements that the healthcare community focuses on in order to improve life quality and reduce, among many other parameters, fear, insecurity, and powerlessness (Ghojazadeh et al. 2015, p. 284).

The phrase telemonitoring or telemedicine was coined in the 1970s and suggests, more specific, healing from a distance. The concept of telemedicine aims to provide the patients with clinical support, overcome geographical barriers in terms of location, involving the use of different ICT (information and communication system)

devices and it strives to improve healthcare as the main goal (World Health Organization 2009, p. 9). The world health organization has created and adopted a general broad description of telemedicine, that captures many of the perspectives in this project.

"The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities" (3) (World Health Organization 2009, p. 8).

This project intends to focus on the broad description of telemedicine more precise telemonitoring. Telemonitoring makes use of an electronic device, in this case, a mobile application to send transmission of the pacemaker patients' heart rhythm doing their daily activities. Telemonitoring creates an opportunity to measure vital events if they occur, and it operates as a safety net for the patients (López-Villegas et al. 2016, p. 125). The idea of telemonitoring originates from the 1970s, where the monitoring made it possible to perceive knowledge about battery lifetime, the technical function of the device, and technical failures. The healthcare organizations, through that, got access to a large amount of new data, that they could use for treatment over time and to increase efficiency at the hospitals (Ibid). Quantitative studies based on implanted pacemakers shows that telemonitoring can lower cost compared to conventional monitoring and reduce hospitalization of patients (Ibid).

When searching through the literature within that specific area, it occurs that there is an interest in patient engagement according to telemonitoring. Among many others, the article, *The digitally engaged patient*, (Lupton 2013, pp. 257-259) investigates the aspects of patient involvement of self-monitoring health devices.

"digitally engaged patient suggest that 'empowerment' may be achieved by using sophisticated digital technologies for self-monitoring and self-care. These discourses suggest that control over one's recalcitrant body and its ills can be better achieved via technological means" (Lupton 2013, p. 260)

3.1 Background

3.1.1 Historical overview

In 2001, remote monitoring of patients with cardiac devices were introduced, now it is an integrated part of care. the asynchronous way of communication between patients and clinicians created the opportunity to improve the workflows and create a better patient experience (Andersen and Moll 2017, p. 2).

The creation of cardiac artificial mechanism began in the 1930s, where Albert Human, (Mulpuru et al. 2017) created the first pacemaker type, see figure 1 (Ibid). Back then the pacemaker existed of a generator transmitting direct current electrical impulses through the right atrium by using a needle. At that time Albert Human experienced a lot of critical skepticism due to the belief that he had created an immortality machine that interfered with the idea of “Playing God” (Mulpuru et al. 2017, p. 189). He, therefore, never found any manufacturers that would support his product. Peoples’ perception changed after world war two and the invention of alternating current, was a genius fundament of invention of the battery. Now the battery made the pacemaker “wearable”. In 1957 the university of Minnesota was performing a large number of open-heart surgeries, one day the power was breaking down for three hours, which caused the tragedy of the death of a child (Ibid). The next day the doctor asked the engineering team to create a battery device so that the tragedy would not happen again. The engineering team added a two-transistor circuit so that it could pace the heart doing the surgery. This was the beginning of the company, Medtronic, which still today is one of the leading pacemaker companies (Ibid).

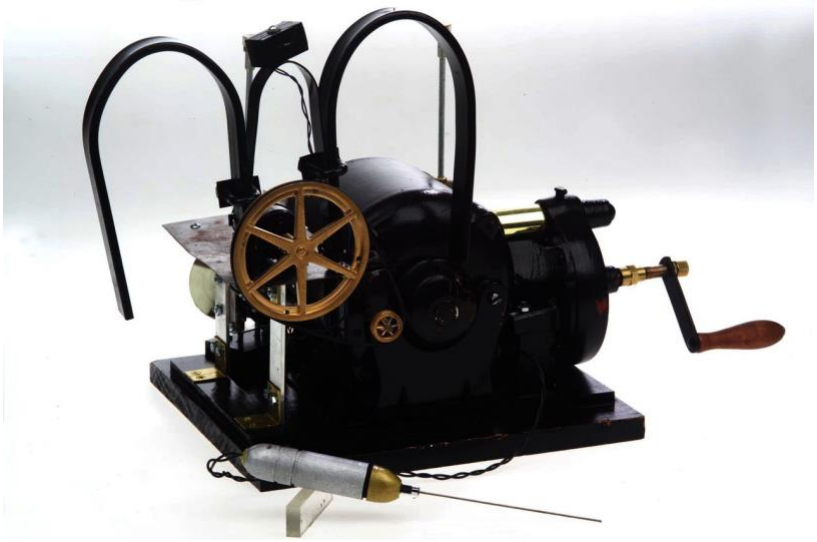


Figure 1 The picture illustrates the first developed pacemaker, created by Albert Human in the 1930s

In 1960 Rune Elmqvist and Ake Senning (Mulpuru et al. 2017, p. 190) implanted the first successful implantable pacemaker. From 1960 to now, the pacemaker has been transformed many times according to size, multi chambers, rate response, battery lifetime, pulse generation, number of leads and internet remote monitoring. Through the years the principle has been unchanged, but future research shows progress in the development of a battery less pacemaker.

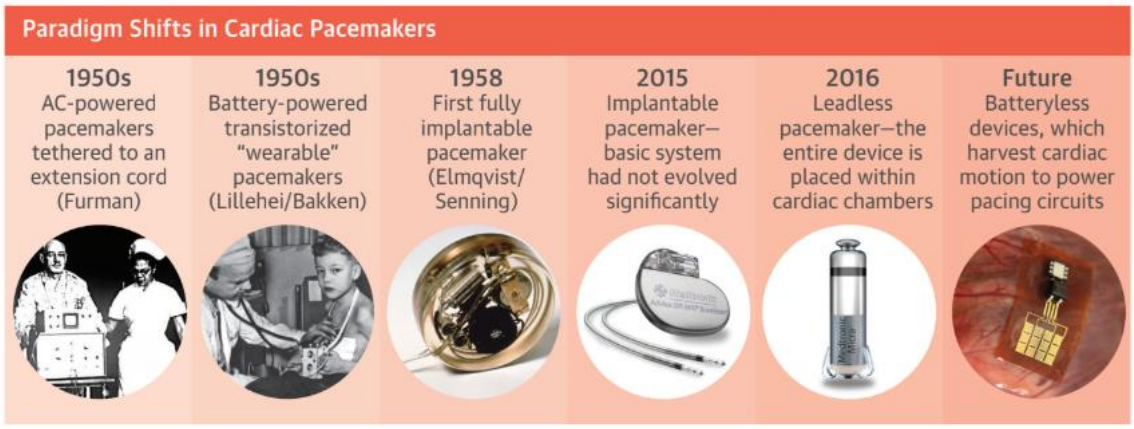


Figure 2 The picture illustrates the historical path of the development of pacemakers, from the 1950s and to the future.

3.1.2 Technological understanding

The majority reason for having a pacemaker is to treat a slow heart rhythm called bradycardia. For most people, the heart beats, between 50-70 times each minute. The heart rhythm can increase under specific circumstances e.g. exercise and stress. If the heartbeat is too slow, then the body cannot create enough blood flow through the body which can result in dizziness, fainting, exercise intolerance, lack of-energy, and breath. In worse cases according to slow heart rhythm, it can be fatal. Normally the heart controls its own rhythm through electrical impulses of what is called the sinus node. In many cases, people are having a pacemaker, because the sinus node becomes too slow (Wood and Ellenbogen 2002, pp. 2135-2137). The other most common reason for having a pacemaker is a failure in the electrical impulses, sending signals through the heart chambers. The failure makes it impossible for the heart chambers to pick up the electrical signals, this causes that the heart will beat too slow and generate what is called a heart block. The pacemaker works by delivering signals to the heart, so that it can pick up an artificial rhythm, that causes it to beat at a proper pace. The pacemaker itself exists of one or two lead/leads, that are connected to the heart, a battery, and a computer that delivers electrical signals through the leads to the heart and makes it beat. Every five to eight year the pacemaker needs to be replaced (Wood and Ellenbogen 2002, p. 2136). There are different ways a pacemaker can pace, and that is represented by a four/five-letter long-chain more specific; A(atrium) V(ventricle) and D(dual/both), the combination of letter determines how the pacing should happen (Mulpuru et al. 2017, pp. 193-194). More specifically, there are three different pacing techniques, first: the single chamber has one wire connected to the right atrium or ventricle, second, the dual-chamber attaches to both and third, the biventricular-chamber has three wires in total that connects to the right side of the atrium and left/right ventricle (pacing synchronically on the chambers). These device types are furthermore divided into different kinds of pacemakers: cardiac resynchronization therapy-pacemaker (CRT-P), cardiac resynchronization therapy defibrillator (CRT-D), implantable cardiac defibrillator (ICD), and implantable pulse generator (IPG), (Medtronic)

3.1.3 The core of the project background

In this project, the focus is on IPG and CRT-P patients. IPG is often referred to by patients, laypeople, and experts as the ‘’regular’’ pacemaker. This kind of pacemaker controls the heart rhythm by electrical impulses. An IPG can have one or two wires connected to the heart. The CRT-P device differentiates from an IPG because it uses three wires to perform biventricular pacing. Furthermore CRT-P patients, often, have a worse or severe condition than IPG patients, and they are often suffering from heart failure, wherein most cases IPG patients are not that affected in their everyday life (“Medical Technology, Services, and Solutions Global Leader | Medtronic”). The figure 3 (“Pacemaker – Google”) illustrates an implanted pacemaker.

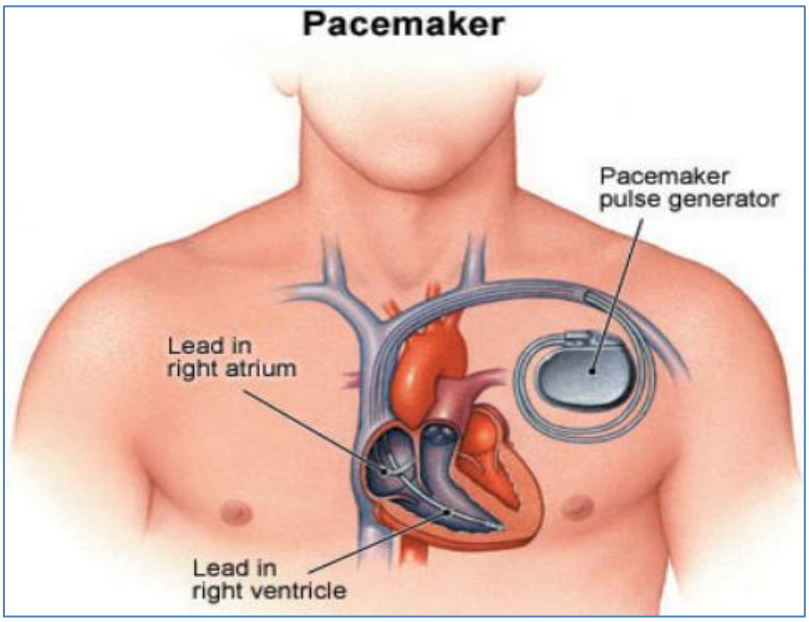


Figure 3 The figure illustrates an implanted pacemaker, and how it is connected to the heart.

Back in 2001 remote monitoring was proposed, according to cardiac implantable devices, especially the group of people living with a defibrillator. Today it is standard care, around the world, to monitor pacemaker patients. Many patients are equipped with a home monitoring box, that can record a transmission from the heart and send it to the hospitals (Andersen and Moll 2017, p. 2). When searching in the literature it occurs that the topic of, healing from a distance, is classified by many different names, and it seems like that the final definition of the topic is not here yet.

Therefore, this project moves between various definitions such as telehealth, telecare, telemedicine, telemonitoring, eHealth, and mHealth.

Earlier research shows that remote monitoring of pacemaker patients have a positive influence on the patients' health in general (Catalan-Matamoros et al. 2019, pp. 1-2). Furthermore, other projects show that communication between pacemaker patients and clinicians, by phone calls, often concerns technical problems according to home monitoring and their transmission (Tariq Osman Andersen et al. 2019, p. 383). If it is possible to make an asynchronous platform of communication, then it would be possible to optimize the time for clinicians and patients. On the opposite side of the positivity, there are of course difficulties to keep in mind according to the patients' autonomy, data sharing, legal rights, system design, and knowledge (Rashid 1995, p. 115).

Since 2008, Jonas Moll and Tariq O. Andersen, the founders of Vital Beats, have been working together with patients on remote monitoring of pacemaker patients. They aim to increase the patient experience and to reduce the workload at the hospitals. They have done that by inventing a remote communication platform called SCAUT. This project has been unfolded within the development/adjustment of the SCAUT platform. In the history of the pacemaker, SCAUT places its relevance in the growth of telemonitoring according to building a better life/world for pacemaker patients.

3.1.4 Interdisciplinary corporation/communication in tele healthcare

This project is created within the MedTech company named Vital Beats. Vital Beats is a scale-up company that unfolded through a Ph.D. project and exists today of 13 employees including us. The company works within the field of predictive and preventive personalized telehealth and care. The company has an interdisciplinary profile, that contains employees with various backgrounds as e.g. anthropology, software engineering, data science, and graphical design ("Vital Beats I Enabling Preventive and Personalized Healthcare"). The various competencies within the company enable this project with several perspectives and reflections, that would not

have appeared if it was not for the interdisciplinarity of the company. Another important aspect of working within a scale-up company is the fact that everyone have to contribute to the company with competencies out of their professional area. In order to make the wheels go around everything from funding, researching, and office cleaning has to be done.

In current writing, Vital Beats works on different projects such as making an algorithm that can predict a heart attack before it occurs and creating better remote-monitoring communication between pacemaker patients and clinicians. One of the key projects that Vital Beats have created is the SCAUT platform. The platform is illustrated as a mobile application, that is used as a remote-monitoring system to communicate asynchronous between pacemaker patients and clinicians. The uniqueness about their way of working is that they use anthropological and ethnographic methods e.g. PD in order to create better healthcare. Vital Beats stages that ethnography is of huge importance in order to understand the patients' and clinicians' work and everyday life (Ibid).

Many actors are involved in the corporation with Vital Beats, but it is important to understand the different groups, otherwise the process can seem a little fuzzy. There are four main groups within this project: there are the pacemaker patients, Rigshospitalet, Vital Beats, and Medtronic. We as master students aim to stage ourselves as an insider with an outside perspective, meaning that we are hired by Vital Beats, but are trying to be open-minded towards the world.

Vital Beats cooperates with Rigshospitalet on creating better communication between the clinicians at the hospital and the pacemaker patients. A clinician is an overall designation of the people who are working with the technical aspect of pacemakers and pacemaker patients. They are often nurses, doctors, cardiologists, and bioanalytics. Vital Beats uses the clinicians for workshops to create a better product and after shaping of the product, they keep on working with clinicians in order to train them, help them with concerns, maintenance and development of new or existing projects. Patients are the ones who are the experts on their everyday life with a pacemaker and all that follows, which is why the patients are essential to the development. Vital Beats performs participatory activities together with the patients

such as interacting, creating mockups, and lastly interviews. Vital Beats helps afterward with the technical aspect of the software. The last *actor* is the company Medtronic, there are the ones creating the pacemaker device ("Global Leder Inden for Medicinsk Teknologi, Tjenester Og Løsninger | Medtronic"). There are other suppliers on the market creating pacemaker devices, but Vital Beats are at the moment only working with Medtronic. Medtronic also has all information about the pacemaker patients, so when getting in contact with pacemaker patients, it goes through the databases of Medtronic. Below is an illustration of the cooperation between the different *actors* see figure 4.

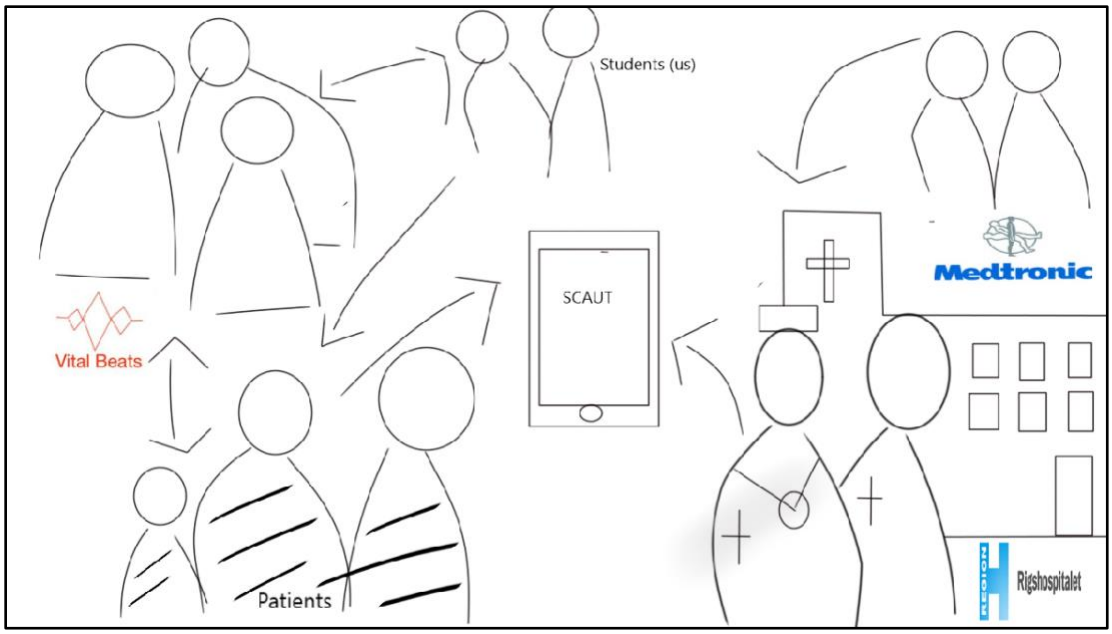


Figure 4 The picture illustrates the five main groups of actors (Vital Beats, Patients, Clinicians, Medtronic and us) and how they are connected to the technology, but also each other in a work practice around the SCAUT platform.

3.2 Scope area

This project works with the implementation of IPG and CRT-P patients on the SCAUT platform. ICD patients have been onboarded on the platform as the first ones, and the patients and clinicians are now using it in their everyday life/work. The SCAUT platform occurs for the patients as a mobile application, that is connected to a computer system, which the clinicians are using. Below is an illustration of today's

communication between ICD patients and clinicians at Rigshospitalet, see figure 5 . In general, the platform exists of functions as e.g. appointment reminders, medical records, health information, device data, patient-generated data and data from the clinic. This project focuses on the production of decision trees in the form of questionnaires. A decision tree is more specific a modeling path that is used to detect outcomes and consequences. An example could be a pacemaker patient having a problem within the category “technical issues”, then a questionnaire survey will guide the patients through questions of technical issues, after answering the questions the clinicians will hopefully have a better indication of what the patient is concerned about or need help with. This project aims to adjust the decision trees and come up with new ones, which makes the platform more personalized for IPG and CRT-P patients.

The decision trees will be created with inspiration from the designer method Personas (Chang, Lim, and Stolterman 2008). Last semester we created a project that investigated if there was a need for IPG and CRT-P patients to be onboarded on the SCAUT platform, see appendix 1. The decision trees will be created by using PD, more precise paper mockups together with patients. This constitutes a unique opportunity to develop a product suitable according to the patients’ needs. The decision trees are supported by interviews with a clinician at Rigshospitalet and an employee from Vital Beats. Based on all the empirical data, a prototype will be developed to be sent into production.

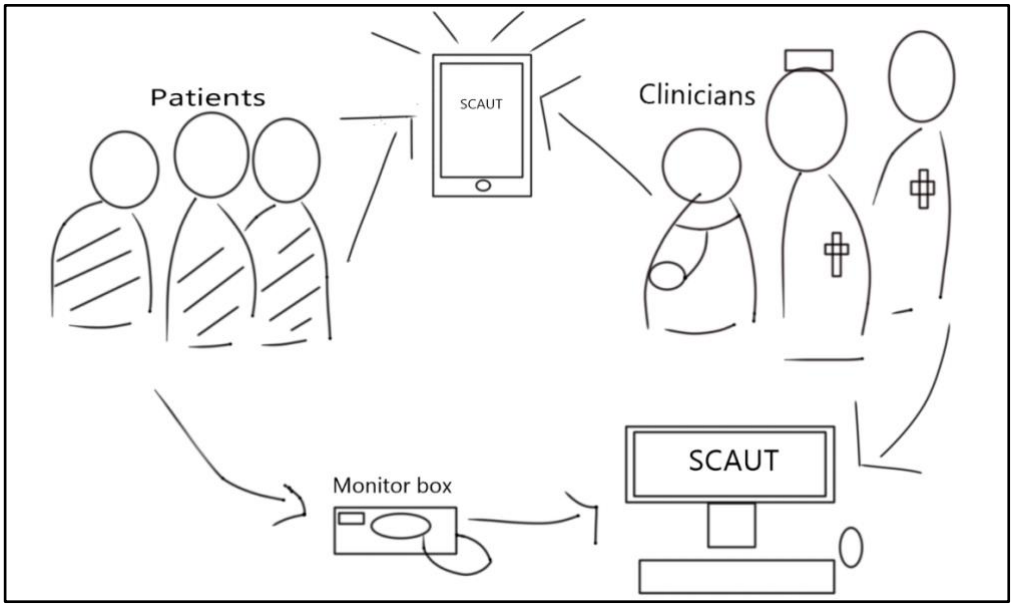


Figure 5 The figure shows how the current communication path is between clinicians and ICD patients, through the SCAUT platform. Patients are sending transmissions from home, and the clinicians are analyzing the data, before they respond.

To support and frame the project, the aim is to investigate the process of adjusting the platform together with patients by using theoretical lenses of Actor-network theory (ANT) and Critical Theory of Technology (CTT). Key concepts of both theories will be used to introduce, understand, enlightening and analyze the technologies function in a social context. Furthermore, the ANT builds the fundament to explain and map the process and the *translations* that occurs. Both theories constitute a meta-perspective within the field. It is important to stage that this project concerns people, which is why post phenomenology is applied as a background theory, to create the micro perspective that is embedded. To navigate within the existing field of remote monitoring, a literature search followed by a literature review supports our findings and views the topic into a scientific and societal context of relevance. This project may hopefully inspire other work processes to the development of telemedicine with the use of PD.

By keeping the introduction and problem area in mind, this leads us to the research question. The question will guide this project through its processes. The initial thought is, that we want to investigate how PD forms the innovation and development of the SCAUT platform. We have furthermore drawn upon the theoretical framework in relation to the research question and the political aspect of it.

3.3 Research question

In what way can participatory design and different networks contribute to the development of telehealth concerned with communication? And is it utopia to think that the new innovative technology can emancipate, the user's life?

Sub questions:

1. *How is the SCAUT platform facilitated and in what way might key actors contribute to better healthcare for pacemaker patients and can the platform then create more feasibility for the users?*

2. *How are political aspects involved in the concerns of innovative tele healthcare technology and will soft values be excluded in the developing process?*

3. *Is it possible to find a balance between innovative technology development and personalized healthcare where everyone involved contributes to an outcome where matters of concern get fulfilled?*

4.0 Theory

In the following sections, you will be introduced to the theoretical framework. First an introduction to key concepts within ANT, that will contribute to illuminate the *networks* and *actors* in this project, the different processes, and how they come to be established. Second, you will be given an introduction to relevant concepts of CTT, that creates societal and critical perspectives on the innovation process from a macro perspective. The aim is to apply a structuralist perspective on how an innovation unfolds with the use of PD, but by applying perspectives of rationalities, values, and ethics.

4.1 Actor-network theory

In the following section, ANT will be introduced and the key theory that will be used in the project will be elaborated on. Shortly described ANT has been used in a techno-scientific manner since the 1980s. ANT is following an ontological path that focuses on *actors*, *networks,* and it follows the process of *translations* (Elgaard Jensen 2003, pp. 5-7). The main founders and contributors to ANT are Bruno Latour, Michel Callon and John Law ("Actor-Network Theory in Education - Tara Fenwick, Richard Edwards - Google Bøger". p. 2). Bruno Latour describes

"ANT is an approach that enables us to trace the ways that things come together, act and become taken for granted, or black-boxed" ("Actor-Network Theory in Education - Tara Fenwick, Richard Edwards - Google Bøger", p.4).

In this section, the focus is to apply the relevant parts of the theory that can contribute to answer the research question ''*In what way can participatory design and different networks contribute to the development of telehealth concerned with communication? And is it utopia to think that the new innovative technology can emancipate, the user's life?".* Therefore, you will be introduced to read about Bruno Latour's *Matters of Concern* and the *triple AIM* which are focusing on healthcare systems in general. Then the *actors*- and *spokesperson* in the *network*. Lastly, *translation* processes in the *networks* and the *obligatory passage point*. These

specific areas will provide broad but specific knowledge that can contribute to analyzing the fieldwork and to the empirical knowledge that has been gathered through this project. This enable us to explain the process of *actors* within the innovation of the SCAUT platform. The *actors* establish the *networks* together through a *controversy translation* will occur, by going through the *obligatory passage point*. This will build a *black box*, that can be opened or reopened according to knowledge.

4.2 Matters of Concern and the triple AIM

Techno-Anthropology has the opportunity to contribute to the Danish healthcare system (Sunhedsstyrelsen) by using appropriate methodologies and approaches there can be helpful in solving technology and human, problems, (Botin, Berthelsen, and Nøhr 2015, p. 3). Some of the forces behind a techno-anthropological solution can be the *triple AIM* and Bruno Latour's *Matters of Concern*. The *triple AIM* is driven by technologies and is therefore essential when solving problems with technologies involved (Ibid). According to The Institute for Healthcare improvement, it is important to have a healthcare system consisting of linked goals, that makes it possible to achieve safe healthcare in society, these goals are named the *triple AIM* (Botin, Berthelsen, and Nøhr 2015, p. 4). Figure 6 shows how the triple AIM looks on a societal, institutional and individual level (Ibid).

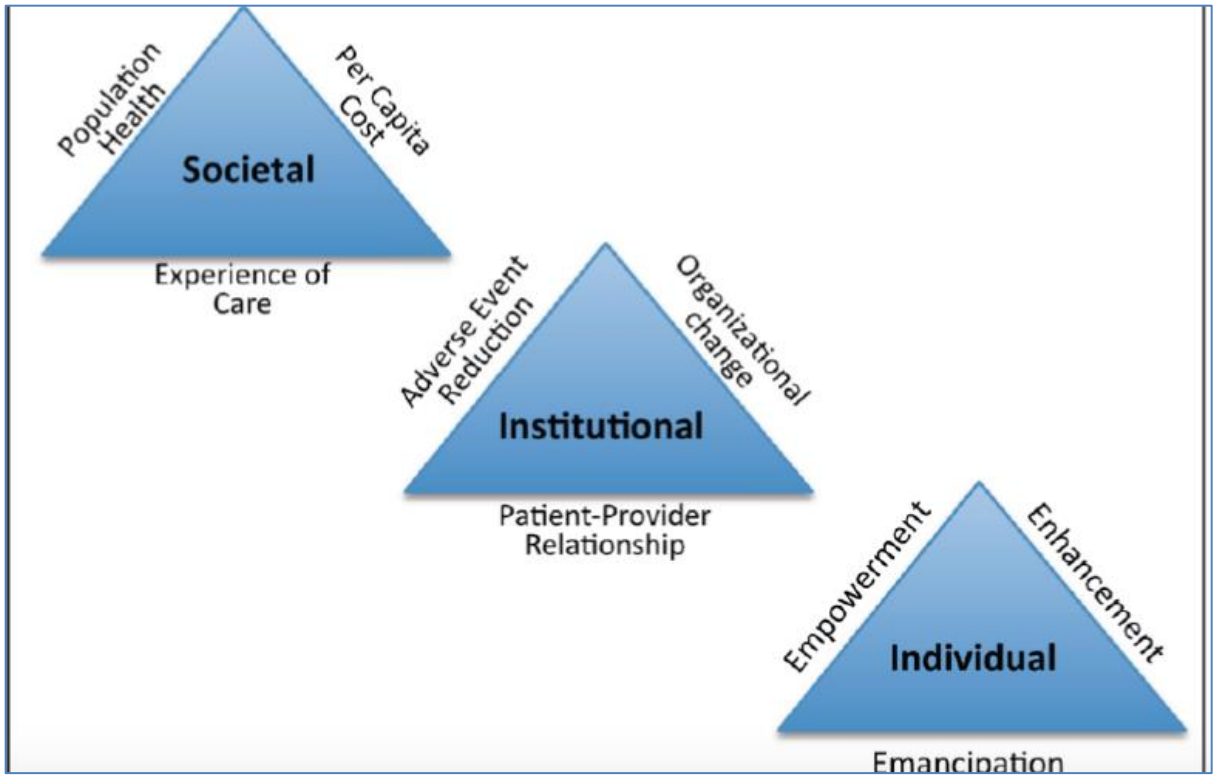


Figure 6, The figure illustrates the triple AIM. Which exists of the individual, institutional, and societal level. On each level, there are different values, challenges and perspectives.

The *triple AIM's* three-dimensional level-figure wants to describe that to reach the goals for a fulfilling healthcare system, it is needed to; improve the patient experience in relation to care, improving in the health of populations and lastly lowering the cost of healthcare (Botin, Berthelsen, and Nøhr 2015). The reality can be messy, unstable and ontological challenging. Reality is situations that will appear when making e.g. healthcare solutions. Technologies are multistable, which means that technology can have many functions. Therefore, multiple perspectives are needed to reach value-based goals in the healthcare system. This is what the *triple AIM* does by solving problems and concerns on three levels (Botin, Berthelsen, and Nøhr 2015, pp. 10-11). Along with the *triple AIM*, Bruno Latour's *Matters of Concern* are elaborating on how to achieve meaningful solutions in e.g. the healthcare system. Bruno Latour's *Matters of Concern* consist of six C's, where three of them concern humanities and the three other sciences. In table 1 below, the six C's are presented (Ibid).

Table 1. The table illustrates Bruno Latour's concept of Matters of concern. There are two groups of values, matters of fairy and matters of fact. Matters of fairy refers to care, creativity and comfort. Matters of facts refers to, cure, construction and cost.

Matters of fairy	*Matters of fact*
Care	Cure
Creativity	Construction
Comfort	Cost

Table 1 is a description of what the six C's consist of and these concerns should be included in the healthcare system, to reach meaningful solutions for both humanities and sciences. Bruno Latour's *Matters of Concern*, matters of fact/fairy, are hybrids to each other, which need to be there when developing methods for healthcare. The ethics (fairy) and the results (facts) are both important parts of the developing process. According to Bruno Latour, he grasps these concerns as a scaffold that is needed to maintain ''fragile habitations'' who are the individuals that need nutrition and comfort e.g. patients and relatives. If the scaffold is stable and strong, the patients, relatives, and caregivers will be emancipated, supported and enhanced (Botin, Berthelsen, and Nøhr 2015, p. 10).

Sub-conclusion

To be able to reach a strong and meaningful healthcare system, (Sunhedsstyrelsen), it is important to consider the *triple AIM* and Bruno Latour's *Matters of Concern* when developing new systems. It is relevant to be aware and incorporate the three levels, in the healthcare systems: societal, institutional and individual. Furthermore, the hybrid of *Matters of Concern* is important to reach in order to have a meaningful and emancipating healthcare system for humanities and sciences.

4.3 Actors in the network

In this section, the concept *actor* will be introduced. An *actor* has many roles, positions, and agendas and they form the *network* as much as they are the *network* itself. It is believed, that by exploring the *actors*, in this research project, it will be possible to explain the construction of the *network* that is embedded in the project. The following pages will elaborate on what constitutes an *actor*, the position and value and how they can contribute to the *network*. Bruno Latour describes (Latour 2011, p. 800) .

> *"An actor is nothing but a network, except that a network is nothing but actors—that resides the main originality of this theory."* (Latour 2011, p. 800)

An *actor*, in ANT, is a semiotic phrase, which means that an *actor* is not necessarily a person. This leads to the belief that an *actor* is an *actor* according to its actions in the heterogeneous *network* (Latour 1990, p. 125). An *actor* can be everything from a- monitor box, doctor, patient, computer to a- strategy or thought. The open definition of an *actor* can cause confusion because most other theories use a human figure as an *actor*, which is why ANT often uses the word *actant* instead. As mentioned, the *actors* are defined based on their actions in the *network*. It is the *actors* that form the *network*, and therefore the *actors* are the *network*. In other words, ANT claims that no object has an essence given by itself. An object is completely defined by its relationships to other objects in the *network* (Elgaard Jensen 2003, p. 6).

To be an actor requires some sort of stable position in the *network* that appears as a *black box*. It is though important to keep in mind, that there is no definitive stable position in the *network*, and the *actors* will change depending on which perspective that is perceived. The effect of an *actor* occurs when a specific "place" speaks or acts on behalf of another place in the *network* (Elgaard Jensen 2003, pp. 7-8). If something becomes unreliable in the *network*, it will be unstable. The existing or new *actors* will negotiate and create new alliances that will form new *black boxes*. This means that *networks* re-form, collapses, and change in different configurations

(Tatnall and Gilding 1999, p. 958). It is important to stage that there behind an *actor* exists, other *actors*, and this often occurs when the *black box* has been opened. A *black box* can be explained as an abstract notion of settled, successful and unquestioned science. The box is created when multiple *actors* go through *translations* and actions. The box contains systems of alliances, agendas, and agencies. Sometimes it manages to reopen the box, which often happens through a controversy (Ibid).

Multiple *networks* and *actors* can exist in one *network/actor*, it is often simplified as one *actor* and one *network*, to limit the confusion (Tatnall and Gilding 1999, p. 959). To be clear this could e.g. be Rigshospitalet which is an *actor/network*, but it also exists of multiple *actors* and *networks*. On another level an *actor* could be a *spokesperson* talking on behalf of the *network*, the *spokesperson* could both be talking on behalf of other humans or things (Lauritsen, Jesnen, and Olesen 2007, pp. 75-76). Another type of *actor* is the micro and macro *actor*, which supports to distinguish between people(micro) and institutions(macro), both *actors* are equal and it is through the *translations* that the power relations will occur (Lauritsen, Jesnen, and Olesen 2007, pp. 79-80).

In order to treat both non-human and human, ANT addresses three core principles: *generalized symmetry*, *free association*, and *agnosticism* (Tatnall and Gilding 1999, p. 958)*. General symmetry* explains the viewpoints of different conflicts in the *network*, by using a neutral and sometimes abstract viewpoint that both humans and non-humans understands. *Free association* refers to the fact that there is no prior distinction between social and technological. Finally, *agnosticism* is referring to the fact there is impartiality according to whether you are human or non-human (Ibid).

Bruno Latour uses his well-known example of guns, to support his theory about human and non-human *actors*. He is staging a scene, where he is discussing the two statements ‘’guns kill people’’ and “guns don’t kill people, people kill people”. He reflects upon whether a man would kill without a gun, but also that a gun cannot kill without a man. He is concluding in broad terms, that you cannot distinguish between *actors* and that it is difficult to master technologies because they are not neutral (Kaplan 2009, p. 157).

Sub-conclusion

Actors can be various objects or humans, but common for all are that they establish the *network*. An *actor* is defined based on its actions. *Actors* can negotiate and establish the *network*, but the *network* is never *black boxed*. A *network* exists of many different *actors* and *networks*. *Actors* build on three core principles *general symmetry, agnostic,* and *free association*.

4.4 Translations

This section is focusing on the theoretical aspects of *translations*. *Translations* are considered to be a key concept in this project because it can be an assistant to explain the processes that occur between *actors*. Furthermore, it is believed that *translations* can explain the connections, advantages, and disadvantages of the *network*. The concept of *translations* will be used both as a theoretical belief, that will be applied to analyze the empirical data but also as a tool, that can identify specific events, how things come to be a unit, form links, and the *obligatory passage point*. John Law is together with Bruno Latour and Michel Callon one of the key founders of ANT and he describes *translations* to be in a compromised version (Law 1992, p. 386).

“In short, it is to explore the process that is often called translation which generates ordering effects such as devices, agents, institutions, or organizations. So "translation" is a verb which implies transformation and the possibility of equivalence, the possibility that one thing (for example an actor) may stand for another (for instance a network).” (Law 1992, p. 386)

The ontological point of view, according to ANT, is that it is examining the world as consisting of *networks*. The *network* can consist of multiple different human and non-human *actors/actants*. The *actors/actants* can involve artifacts, concepts, ideas, humans, animals, and things (Cresswell, Worth, and Sheikh 2010, p. 2). *Actors* are

established based on the relation in the *network* and in order to explain the *translations* the *actors* must be selected. The interpretation of ANT is that the *network* is heterogeneous consisting of cognitive activities. Even though ANT is a theory with a macro perspective, the perspective can change into a micro viewpoint when uncovering *translations* (Cresswell, Worth, and Sheikh 2010, p. 12). Bruno Latour explains the concept of *translations* by dividing it into three different modes. The first one is, that a stage of mess will transform to the so-called *ordering*, this could be a *translation* of a language to reach a common agreement among *actors*. The second one is, that for a *translation* to occur the *actor* must go through an *obligatory passage point*, and it is in that specific event that the common agreement is reached. An *obligatory passage point* refers to the place, the *actors* must go through to reach a common understanding. Often a *spokesperson* is the one leading the *actors* through *the obligatory passage point*. The third point is that a *translation* has a linguistic purpose, where something is translated to become something else (Lauritsen, Jesnen, and Olesen 2007, p. 77). This could be the symptoms of a patient that is transformed into EKG levels and then into e.g. S, T and R heart peaks for the clinicians to analyze (Sand 2008, pp. 277-278). In other words, *translation* is a process that creates *ordering* and *uniqueness* through links. When a *translation* of *actors* occurs in order to be a performing part of the *network*, it can happen with different behaviors such as intentions, morals, consciousness, and subjectivity, which are called an *actor* with an agency (Cresswell, Worth, and Sheikh 2010, p. 10). The mobilization of the *network* is reached when *translations* are starting to occur at different domains and locations. It is important to stage that *translations* occur all the time in the *network* and that numerous of *translations* build stronger *networks/actors*. When a *translation* has occurred the *actors* now perform knowledge or play a certain role in the *network*. In order to identify and investigate a *translation*, it can be divided into four main steps. First, defining the problem, in this case it could be miscommunication between patients and clinicians. Second, interessement where *actors* accept a common solution. Third, enrollment where people are getting roles and agendas. Fourth and last, mobilization where *actors* are engaging to fulfill roles and create links in the *network* (Greenhalgh and Stones 2010, p. 1287).

Earlier research made by Bruno Latour and others has shown (Latour 1999) that translational processes have been investigated to explain life science, through

practical events, by investigating how the *network* comes together through *actors* that change “position/function”. The figure 7, below describes in a schematic way, what happens through *translations*. The goal is to reach a stage of amplification because then you have reached a fact *black box*. The fact is reached when multiple *translations* have occurred. When the circulations of *translations* occur something will be lost and something will be gained/regained (Latour 1999, pp. 70-71).

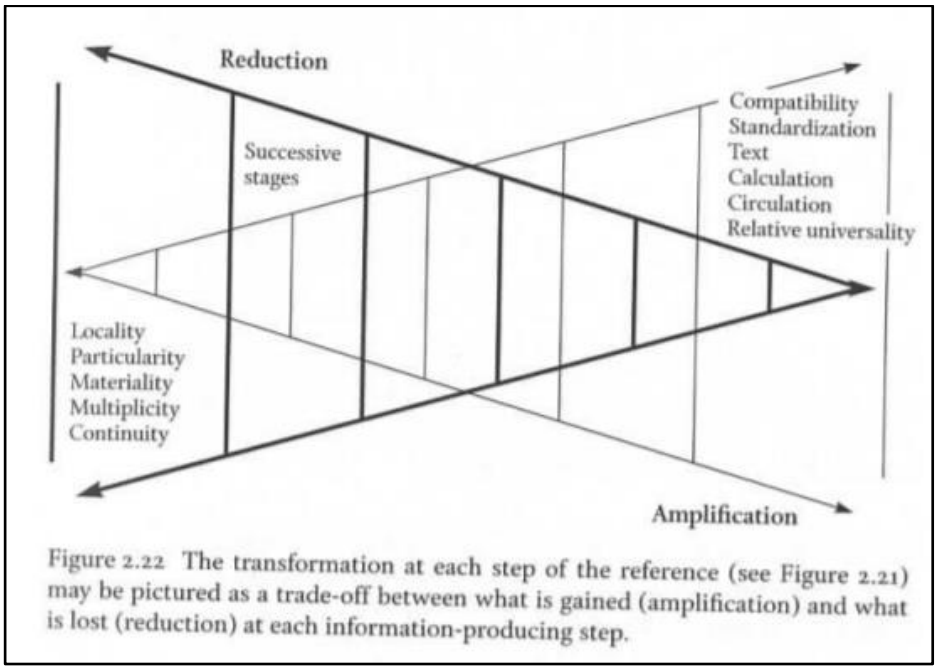


Figure 2.22 The transformation at each step of the reference (see Figure 2.21) may be pictured as a trade-off between what is gained (amplification) and what is lost (reduction) at each information-producing step.

Figure 7. The figure is developed by Bruno Latour, and it illustrates that when having a translation process, something will be lost(reduced) and something will be gained/regained(amplification).

Sub-conclusion

Translations can be described by the mentioned three concepts ordering, *obligatory passage point* and linguistic purpose. *Translations* appears in the *network* all the time and when a *translation* occurs a more mobilized *network* is established. numerous of *translations* can create a stronger *network*, that eventually could become a *black box*. In the *translation* processes, something will be lost, and something will be gained/re-gained.

Summing up on thoughts

Even though ANT creates a dynamic and a rational addition to a problematization, the theory also has its limitations. The researchers' story can be manipulated by the native's voice, and it that way the story can be more or less one-sided. Since there are no preexisting interpretation of *actors*, the existing layers of power, inequality and ethics are not taking into account. Therefore, ANT say little about the exclusion of social groups. Since there are no distinguishing between *actors* and technology, the agency and agendas of humans will lost and reduced (Greenhalgh and Stones 2010, pp. 1287-1288). It has been established what constitutes an *actor*, how *actors* create *networks*. That *networks* are three dimensional on an individual, institutional, and societal level. There are many perspectives according to the soft values in *matters of fairy* and the hard values in *matters of facts*, that needs to be taking into consideration when innovation new technologies. In the discussion, it will be investigated and discussed how matters facts and fairy operates on the three different levels, according to the innovation of the SCAUT platform. It is the *actors* that form *networks* and questions *black boxes*, often through a controversy. The creation and opening of a *black box* occur through *translations* and for a *translation* to occur, *actors* must pass the *obligatory passage point*. In the analysis, it is aimed to define the *actors* and the *network*. Investigate if there are any controversies among the *actors* and how *translations* are formed in the innovation process.

4.5 Critical Theory of Technology

For almost 100 years, critical theory has evolved, with different approaches depending on the societal context. It started with the Frankfurt School in the 1920s, which was an extension of the Marxist approach. The thoughts of Max Horkheimer and Theodor Adorno from the 1920s, who were inspired by the Marxist approach, Hegel's philosophy and psychoanalysis, started the Frankfurt school (Sørensen). In the 1960s Herbert M. criticized the industrial and capitalistic society. In the same period, Jürgen Habermarch as the younger generation of the Frankfurt school developed his thoughts on society according to politics and economy in connection to morality and solidarity. Many others have given their contribution to the theory over the years (Ibid).

CTT draws on general thoughts of science and technology studies (STS). The theory has emerged from the principals and concepts of Critical Theory and its interpretation of the modern society/industrial society. Andrew Feenberg started CTT in the 1990s where he, in general, was inspired by the movement before, in and after the Frankfurt school.

In broad terms, CTT aims to democratize instead of centralizing, in order to receive more social justice and equity. The objective is that a product is always developed in a social context, and therefore it is never value neutral. The technology is shaped by the values we dedicate in the innovation (Feenberg 2002).

In order to frame our empirical work, we have drawn on inspiration from Andrew Feenberg's work on CTT. In the following sections, you will be introduced to key concepts from Andrew Feenberg's work, its relevance for this project and its context. It has been chosen to focus on three meta-objects from the book, transforming technologies, (Feenberg 2002), more specific the *technical code*, the dilemma of development and communicative rationalities and boundaries.

4.6 Technical Code(s) (double aspect)

This section describes some of the key elements according to the term *technical code*, which is an embedded part of CTT. The term was coined by Andrew Feenberg in the 1990s. The purpose of this section is to introduce some key perspectives, that will be applied to frame the analysis. In general, the *technical code* describes the assumptions of cultural and social implications, that are embedded in the invention of new technology (Flanagin, Farinola, and Metzger 2000, p. 411). In Andrew Feenberg's own words, he describes the *technical code* to be.

"The intersection between ideology and technique where the two come together to control human beings and resources in conformity with what I will call "technical codes" Critical theory shows how these codes invisibly sediment values and interest

in rules and procedures, devices and artifacts that routinize the pursuit of power and advantage by a dominant hegemony." (Feenberg 2002, p. 15)

Technical codes can be applied to explore the underlying assumptions that are built into the technology, in this case, the SCAUT platform. The *technical code* takes place from the coherent solutions that are built into the technology in order for it to have a specific function, that will have underlying consequences. An example could be Robert Moses (Flanagin, Farinola, and Metzger 2000, p. 412) who was a founder of some public buildings, he designed parkway bridges lower than usual, so it enabled the city bus to travel under the bridge to Long Island. He, therefore, embedded a social class bias into the technology, because it prevented the lower class to travel to Long Island (Ibid). CTT operates with two different biases the *formal* and *substantive* bias. In the analysis it will be framed how the SCAUT platform might exclude specific groups of patients. There are different types of codes imbedded in technology. Andrew Feenberg describes among others the ethical and the economic code (Feenberg 2002, pp. 21-21, 76-78). The technical code combines both elements, in the choices that are made when inventing new technology to perceive *operational autonomy*. *Operational autonomy* is the capitalist *technical code* meaning obtaining power over the production and the power to make independent decisions. The technology is not completely neutral, even though one might think there is a generic interest, but instead, it is a contestable hegemony. The *technical code* includes both the social and the technical aspects into what is called a *sociogram* and a *technogram*. Technology will be developed into a social context but consist of technical elements. As Andrew Feenberg describes it (Feenberg 2002, p. 78).

"Technologies, as developed oped ensembles of technical elements, are thus greater than the sum of their parts. They meet social criteria of purpose in the very selection and arrangement of elements from which are built up." (Feenberg 2002, p. 78)

In Andrew Feenberg's book Transforming Technology (Feenberg 2002, 74-75) he also refers to the *technical code* as the *double aspect*. He suggests this concept based on Herbert Marcuse and Michel F.'s work, in order to have an approach to

study technology. Andrew Feenberg divides the concept into science/ideology and knowledge/power because the *double aspect* manages to incorporate cognitive and hegemonic functions. Earlier the world was based on traditions and religion, where today's world is based on hegemonic beliefs. This is where knowledge becomes a tool of power, where one another complement each other, (Ibid). The SCAUT platform consist of mono disciplinary knowledge, and multiple power structures are embedded in section 8.0, analysis. In order to simplify the complexity of the technical code, an illustration has been developed figure 8.

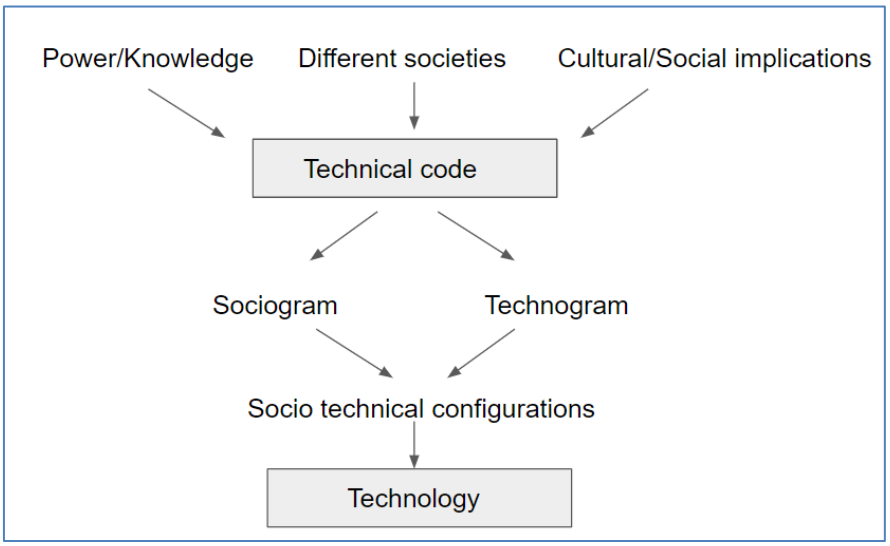


Figure 8. The figure is developed based on Andrew Feenberg's thoughts on the technical code. There are different substances in technical code (power/knowledge, societies, cultural/social). All these elements go into the technical code. Some of the elements will.

Sub-conclusion

The *technical code* is everywhere, and it explores underlying matters in the development of technology, this could be e.g. economy and ethics. It can be beneficial to undercover priorities and choices that are embedded in the technology. There is both a societal and technical aspect divided into a *technogram* and a *sociogram*. *Operational autonomy* is the capitalistic belief of technology. In the analysis it will be investigated how and which *technical codes* that affects the SCAUT platform.

4.7 Technological mediated communication

According to CTT, technologies can be developed in a way, where *the ordinary human being* can get a sense of what it feels like to be an engineer because now computers have different applications that can be helpful programs for engineering work, as e.g. Microsoft programs. Though the critical view of these innovative computer technologies, is that you can use these *fantasy* programs to build perfect bridges, buildings, and cars, it is necessarily not how it will be in real life (Feenberg 2002, p. 98). This can be translated right into healthcare systems and applications, where engineers can build applications with a lot of features, but the users do not know how to use it, because reality is different. In other words, technologies as computers and engineer programs can contribute to a *technical code* where there are specific rules and automation in which innovation gets controlled by (Feenberg 2002, pp. 98-99).

> *''[...] the rules and procedures on the basis of which standard design decisions are made. It is this technical code that defines the computer as a system of control, an automation.''* (Feenberg 2002, pp. 98-99)

Furthermore, Andrew Feenberg elaborates on how computers, are much more than tools and programs for ideas and innovation, it is also a whole new platform for socialization and communication (Feenberg 2002, p. 99), e.g. the SCAUT platform, which can contribute to that most of the contact between the patient and the clinic will be through a mobile application. The computer as a communicative tool becomes the perfect tool for a parallel world, where people can define themselves in a- virtual and real world. In the real world, ones will define themselves around people there are geographically close to them, but in a virtual world, the geography is not an obstruction for communication and contact anymore, which also makes tele healthcare possible (Ibid).

In relation to how technologies get developed through computer programs, the way of designing needs, creates a paradigm shift where rationalistic traditions changes. This way of developing technologies needs rational mapping with a focus on the user

(Feenberg 2002, p. 105). These *alternative rationalities* will involve more implementation instead of planning and control (Feenberg 2002, 106). The way of designing will have to be more self-reflective and based on learning in relation to how to use tools and by that be able to modify them (Ibid), as e.g. by doing PD. With artificial intelligence, computer innovation, and computers as a communicative tool, people get dragged into a possible *human-machine relationship* where the illusion will be that it is a partnership. It is important to be aware that computers do not have a mind and cannot become a real *relationship* (Ibid).

''These aids make possible a new form of human-machine interaction that gives the illusion of partnership. But however ''intelligent'' it may appear to be, the computer is not a mind but ''a structured dynamic communication medium that is qualitatively different from earlier media such as print and telephones." (Feenberg 2002, p. 106)

Andrew Feenberg makes another statement that supports the point in making tele healthcare. Andrew Feenberg proposes that the computer and its availability contribute to be a communication tool and an environment for sharing daily life stuff, concerns, etc. (Feenberg 2002, p. 106). On the other hand, it is important to be aware of what computers do. The computer is not a real picture of '' man'', but it is a platform which enables us to act and be in a certain way through that (Ibid).

''In this conception, computers are not ''images of man'' but domains in which we act and which shapes us in return." (Feenberg 2002, pp. 106-107)

Going back to the design of computers, it is significant and amazing what design can do. Engineers do not design in the matter of *what can we build* but *how can we design ways of being* (Feenberg 2002, pp. 106-107). The design has become more a discourse of what we can be and do, and this is what Terry Winograd and Fernando Flores call *ontological designing*. This *ontological designing* also has a political agenda according to Andrew Feenberg (Ibid). Terry Winograd and Fernando Flores describe in the book *"understanding computers and cognition: A new foundation for design*" how the *rationalistic* way of thinking is in the past. The focus should be on how the computer is integrated and used within society in a social context (Winograd and Flore 1986).

Sub-conclusion

To sum up, on Andrew Feenberg's words, it is necessary to be aware of what possibilities computer technologies offers and be critical to how and in which way it gets designed. The focus on the user has to be center of attention, when designing technologies and at the same time, the technologies must not be a complete substitute for the human. It is important to separate computer and *man*, even though ones can shape oneself through and with technologies.

4.8 Dialectics of technology, the dilemma of development

In the following section, you will be reading Andrew Feenberg's thoughts on the development of technology with a societal/political perspective based on the book Transforming Technology (Feenberg 2002). He analyzes the development through CTT and introduces key concepts on how society affects technology. This is of interest because it is believed that tele healthcare, will be an integrated part of society and therefore social/political changes will occur, which is important to uncover. The SCAUT platform is built into a societal context, and therefore it could be formed by society. Based on Karl Marx's earlier work, Andrew Feenberg furthermore argues that the development of technology can be divided into three transition processes, more specific socialization, democratization, and innovation. These concepts will be described later in this section. In Andrew Feenberg's own words concerning this chapter, he explains (Ibid).

''Instead of pursuing the usual political argument for socialism, I have attempted to identify possible starting points for such a process. The result is not a utopian description of a perfect society, but rather an integrated series of democratic reforms affecting politics, economics, culture and ultimately the technology of modern society." (Feenberg 2002, p. 137)

The dilemma of development concerns the contradictions of the political theory of democracy. Andrew Feenberg describes that modern society involves two demands,

that are complementary, the egalitarianism and efficiency of society. He furthermore argues, that the dilemma of development is due to the capitalistic world, in which socialism will change to a new kind of industrial society (Feenberg 2002, p. 134). The dilemma of the development is structural constraints in the ethnocentricity of society, the constraints are often referred to as *economical* and *technical* (Feenberg 2002, p. 137). CTT pinpoints that modern society is based on the deterministic assumption, which is that technology has its own autonomous development. Determinism is based on two different facts. The first one is that there is a fixed way of developing technologies, which is the same for all societies, even though politics and culture in different societies might affect autonomous logic. The other one being, that at each stage the social organizations must adopt technological processes, which can execute the necessity of the technology (Feenberg 2002, p. 138-139). Another perspective of the development of technology is that an *ideological* solution will have an economical cost where economic efficiency will have a *social cost* (Feenberg 2002, pp. 138-140). Andrew Feenberg stages that societies must be adapting to the development of technology. Technology can emerge new discoveries, cultures, and values as technology changes. CTT believes that the development of technologies creates a social struggle and the approach is to move from a *determined* position to a *non-deterministic* position. The *non-deterministic* approach suggests that technology can go in divergent directions depending on the hegemony and that technological changes according to its condition, as much as the technology also influences its surroundings. Therefore all technical objects are also social objects (Feenberg 2002, p. 143). Andrew Feenberg identifies transitional processes as described above. These processes are phenomenon's that go from one place to another, more specific from a capitalistic society to a socialistic society. In other words, Andrew Feenberg describes the transition to be.

''The transition to socialism can be identified by the presence of phenomena that, taken separately, appear economically irrational or administratively ineffective from the standpoint of capitalist technological rationality, but that together initiate a process of civilization change.'' (Feenberg 2002, p. 148)

In progress, transitions can be used to identify logic in technological development and come up with proposals for change in the process. The concepts of three transition processes is described below (Feenberg 2002, p. 148).

1. Socialization: Socialization can be divided into three steps. First, there will be planning in the cultural and industrial society and productivity on a large-scale. Next, there will be the product itself. In the end, there will eventually be the disappearance again from the market.

2. Democratization: Democratization happens through economic, political and social characteristics of inequalities of society.

3. Innovation: The progress of technology that creates patterns for innovation, in the division of manual and mental characteristics of capitalism. It depends on institutional changes to occur (Ibid).

The social impact towards technology will and is growing constantly and in order to understand the social changes, it is necessary to understand society. In Andrew Feenberg's own words, a developed society is a society with limited major decisions to be made outside of the economic and technical society (Feenberg 2002, p. 136).

Sub-conclusion

The dialectics of development reflects upon the technological innovation according to different societal contexts. Technology is always developed in a societal, political, technological and economical context. The innovation can be analyzed through these transition points, socialization, democratization, and innovation. Technology is formed by society, but the technology itself will also form society. The SCAUT platform is innovated in a context with many different actors, whom acts are based on their position in the network. These actions might form the platform, which will be investigated in the section 8.0 analysis.

4.9 Technological boundaries

In this section, the technological boundaries and rationalities are introduced with a focus on how boundaries can be moral and political. Rationalities consist of collective mindsets with a world that is *one-dimensional*. Andrew Feenberg describes how technologies have more power than ideologies, how they cannot change unless they get redesigned, and how technological development demands a critical consciousness (Feenberg 2002).

When developing technologies, questions about how these *technologies* can lead to a dystopian future, can be raised. When they do that, these possible dystopic technologies get often reformed by placing boundaries around, and it does not get transformed (Feenberg 2002, p. 8). An example of how technologies, has become a question about moral and politics, is when technologies can control lives (Ibid).

''In all these cases critics urges us to reject certain technologies, and then ask us to accept the price of preserving traditional or natural ways. This agenda has given rise to both moral and political solutions to the problem of modern technology.''
(Feenberg 2002, p. 8)

According to Andrew Feenberg, technology is powerful and develops political agendas. He proposes that technology is so powerful that it can overrule any ideological commitment and therefore technology can also be dangerous. The technology can persuasive humans and give an idea of more than well-being, and he supports his statements with how technologies made the soviet union crash (Feenberg 2002, pp. 11-12). What Andrew Feenberg wants to pinpoint, is that technologies have moral and political boundaries around it, which make the technology change its purpose according to which kind of boundaries there are around it, but these boundaries cannot change the technology's original form.

''[...] history seems to show that it is impossible to create a fundamentally different form of modern civilization using the same technology as the West.'' (Feenberg 2002, p. 13)

According to Andrew Feenberg, we must redesign some technologies if we want them to adapt to the needs of freedom (Feenberg 2002, p. 13). Therefore, it is important to notice that technology is not neutral, and that technological rationality equals political rationality. By that he suggests, that every technology has a *technical code* there is embedded in its purpose and way of using it (Feenberg 2002, p. 15).

4.10 Technological rationalities

CTT is suspicious in relation to technology and what possibilities it can make. The reason for that is, that technology is just like justice, it is socially blind, (Feenberg 2002, p. 66). Technological rationality is built upon a base where it is beneficial for the *elite* to control society or *things* in society as e.g. hospitals (Ibid). The concept of technological rationality is that the workers/users have to be separated from the means of production, which contributes to that, private capitalist enterprises stay in control, especially because technology is socially dominated. The instances for social domination as technological rationality is to find in e.g. the design of technology.

> *''Technological rationality is indelibly marked by the presupposition that production goes hand in hand with social domination. The trace of this presupposition can be found in economic thought, managerial methods, and the very design of technology.''*
>
> (Feenberg 2002, p. 66)

Andrew Feenberg elaborates on *One-dimensional man*, written by Herbert Marcuse, (Marcuse), and clarifies that the world is *one-dimensional*. Because there is no room for a critical consciousness in relation to how methods and techniques get used in the production of technology, the rule with an exception does not exist anymore (Feenberg 2002, p. 67).

Sub-conclusion

To sum up, technological- boundaries and rationalities contribute to technology development without reconstruction and reformation. The technology will be difficult to rebuild and reform because the world is *one-dimensional* in relation to have a critical consciousness. Society has a collective mindset, built on the base of ‘’the right procedures and the right techniques’’ and this mindset is decided by power and politics.

5.0 Methodological approach

The following sections intend to clarify the methodological framework, which is the fundament and data of this project. The empirical course of action will be described in chronological order. Before the methodological work, the setting/stage according to obstacles and limitations will be described to create an understanding of the project. This project operates within the area of PD, by using prototypes in the form of mockups. The mockups are the foundation of five workshops conducted together with pacemaker patients. In order to generate knowledge for the creation of mockups the interviews, literature, and personas have been a “pre methodology”. The methodological work has been taking place between February-May 2020. In order to get an understanding of this methodological “network” exist see figure 9. The figure is inspired by the book, *What is Techno-Anthropology* (Børsen and Botin 2016, p 50). It illustrates how technology (the SCAUT platform) is the center of attention, and the different stakeholders affecting and interacting with the technology.

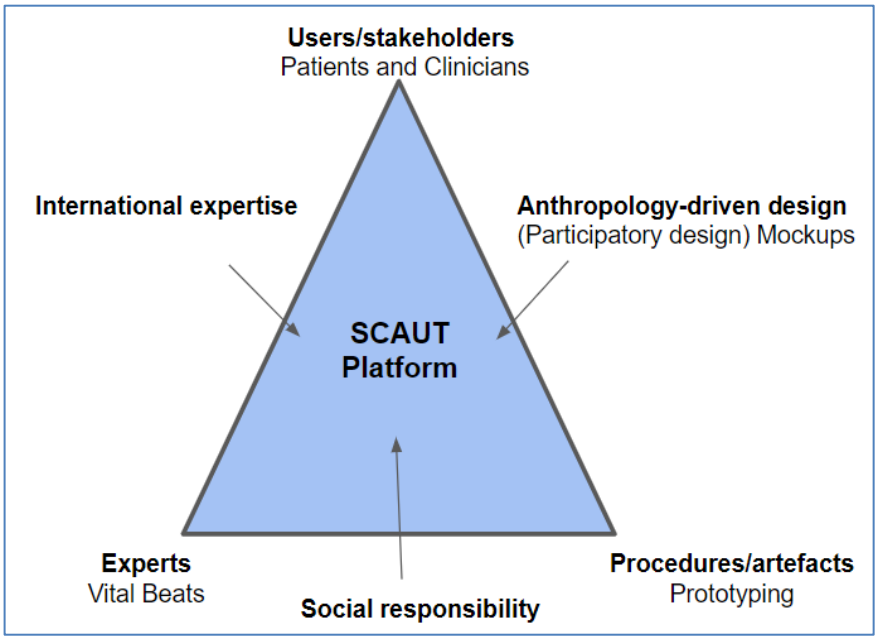


Figure 9. The figure the illustrates how different users/stakeholders, methods, experts, procedures and values are all placed and embedded in the technology (The SCAUT platform).

5.1 Limitations

This project is unfolded within Vital Beats, and we, therefore, needed to meet their expectations and requirements. During the project, the empirical work changed, due to the Novel Coronavirus (“Ny Coronavirus, COVID-19 - Danish Health Authority”) . The original plan was to make the workshops with patients in their homes. We instead changed the workshops to be digital. The patients were given the same material, but the workshops took place in the virtual media, skype. The changes staged an unknown situation for the research since we were inexperienced, unprepared and the amount of literature was limited doing digital workshops. This placed the project in a situation where we needed “digitally skilled” patients to engage in the workshops. Because this project concerns development of a digital platform, that needs to reach a broad group of patients, this situation was not beneficial. Primarily the older generation of people was difficult to reach, and therefore much of the empirical data has been collected based on the younger generation. Despite the workshops, the situation also limited the opportunity to be in close collaboration with Rigshospitalet. The group of patients that participated in the workshops all have a monitor box, live at Zealand, have a Medtronic device and are

connected to Rigshospitalet. The significant changes in the methodological framework created, framed new and unknown reflections and perspectives, that will be addressed in the discussion.

5.2 Flow process

In this section, you will be introduced to how the fieldwork has been conducted. In order to describe this, it will be explained in a flow diagram, which will be elaborated afterward. The flow diagram is explained in a systematic manner. Before the specification of the following points, the flow diagram illustrates, step by step, from beginning to end. This creates an indication of how the project has come together and how our knowledge have evolved throughout the project. It has been one of our key points, to create this project systematically, so that we could gain “reliable” data.

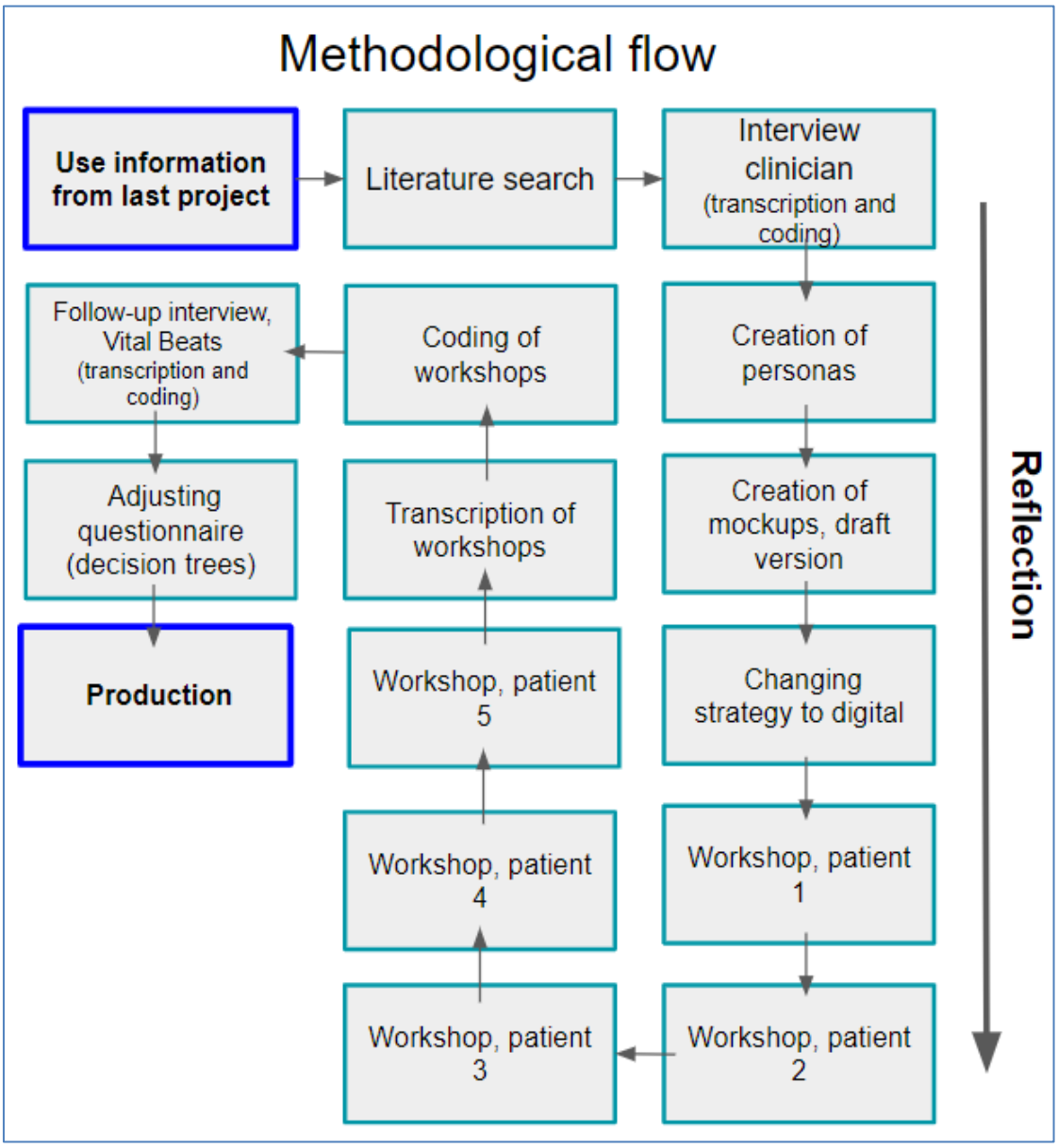


Figure 10. The flow diagram illustrates the methodological process step by step, in a chronological order. Starting from where we left of in the last project until the final adjustments of the platform.

5.3 Literature search

A literature search was carried out at the beginning of the project, to explore the field of telemedicine and to uncover existing methods and theories. This project uses literature as a foundation, but in broad terms, this project is a qualitative study and not a literature study. The ontological point of view has been sustained and supported by scientific articles and books within the area of ANT and CTT. It has been of key interest to conduct a systematic search for literature, in order to investigate and uncover the field. This project incorporates different scientific views of social- and life science, the combination creates a unique project opportunity. In order to explore this, a literature review has been formed, see section 6.0. When searching for literature it quickly appeared, that there have been many different perspectives to take into consideration when developing tele healthcare, therefore it has been chosen to focus on the concepts of *matters of fact/matters of fairy*, more specific the six C´s (Botin, Berthelsen, and Nøhr 2015). All literature was gathered by using the scientific databases SCOPUS, Web Of Science, PubMed, and Google Scholar. The search was performed by using different inclusion and exclusion criteria e.g. the number of articles, search words, publishing years, citations and authors, to achieve the core literature. In order to obtain a systematic search, a literature search sheet has been carried out see appendix 2.

5.4 Interviews

We started out by doing a semi-structured interview, with a clinician at Rigshospitalet, inspired by (Brinkman and Kvale 2008). The reason for conducting a semi-structured interview is because it will create a situation where we are able to narrow down key points to talk about, but at the same time it creates an opportunity for the informant to contribute and elaborate on his/hers point of views (Rabionet 2011, p. 563). There are some specific topics that we need to undercover so that we can form the mockups, but at the same time, we also want the clinician to tell her/his story. Furthermore, the mobile application is a work-tool for the clinicians, and therefore their thoughts are “almost” just as important as the patients. The process of a semi-structured interview can be narrowed down to four overall steps: interview

guide, interviewing, transcription and coding. First, creating an ethical interview guide with key questions, see appendix 3. The interview is created at the beginning of the project, to create a fundament/knowledge for the mockups. Next, the interview was hosted at Rigshospitalet in a small office. Clinicians are busy workers, and therefore there is a risk, that the informant must go back and forth doing the interview. It also creates some restrictions according to time. It has been decided to record the interview by using a mobile phone in order to be present doing the interview. It is important to stage that this interview was conducted before Novel Coronavirus came to Denmark, and we were, therefore, able to do the interview at Rigshospitalet. The transcription has been executed by dividing the interview into two parts, and then it has been transcribed see appendix 5. The interview is transcribed almost word by word with a “refined language” and by using meaning condensation in some sections (Brinkman and Kvale 2008, pp. 199-210). Lastly, the coding is performed in plenum with inspiration from meaning condensation/coding (Brinkman and Kvale 2008, pp. 225-229). A scheme of categories and themes has been used as a coding template, and then the transcribed interview has been distributed to different categories. The template also exists of a- positive and negative side, see appendix 23. In the section analysis, the findings will be reported and analyzed.

After the mockup workshops with patients, a follow-up interview, with an employee from Vital Beats, has been created, with the same procedure as described above. The interview is created based on all the patient-generated knowledge and reflections we got from the mockups. The transcribed and coded interview is shown in appendix 6 and 24. We wanted to conduct the follow-up interview with the same clinician at Rigshospitalet, this was not possible, and we instead interviewed an employee from Vital Beats who is normally in close collaboration with the clinicians at Rigshospitalet.

5.5 Personas

It has been chosen to use personas as a part of our methodology, to be able to make strong profiles there will help us improve our work with a more personalized mobile application. With inspiration from the artic*le ''User profiles and personas in the design and development''* (LeRouge et al. 2013), we believe that a user-centered design technic as personas will contribute to a structured way of describing different types of users, and not only get the demographics but also dig into how they feel and think (LeRouge et al. 2013, pp. 253-254). It is important when developing personas to take into consideration how many personas are needed? what is the market size? and most importantly use existing knowledge and data. It is recommended to use 3-6 personas according to how big and broad the market is (Pruitt and Grudin 2003, p. 5).

We have been using six interviews from an earlier research project we made in cooperation with Vital Beats and Aalborg University Copenhagen, see appendix 1. The earlier project was created to investigate pacemaker patients, specifically, IPG and CRT-P, need for using the SCAUT platform. The interviews we executed in that project, gave us a lot of insight into the end users/patients' lifeworld, and we also had a broad spectrum of patients from children to elderly, with different backgrounds and they lived geographically in different parts of Zealand. We think that the interviewed patients, seen from a qualitative perspective, will cover the demographics of pacemaker patients connected to Rigshospitalet. Therefore, we have chosen to use their profiles to make the user-centered design personas, which will support us to make more specialized surveys in the SCAUT platform, there will be feasible for the IPG and CRT-P patients. We have decided to make and use three personas. The six interviews from our earlier project, see appendix 1, provided us with three clear personas among the patients. There might be even more different personas to develop in the CRT-P and IPG patient groups, but we have carried out three characteristic personas based on the six interviews. The method and criteria we used is described in figure 11 and 12.

How the personas got carried out and what they will contribute to the prototyping see figure 11.

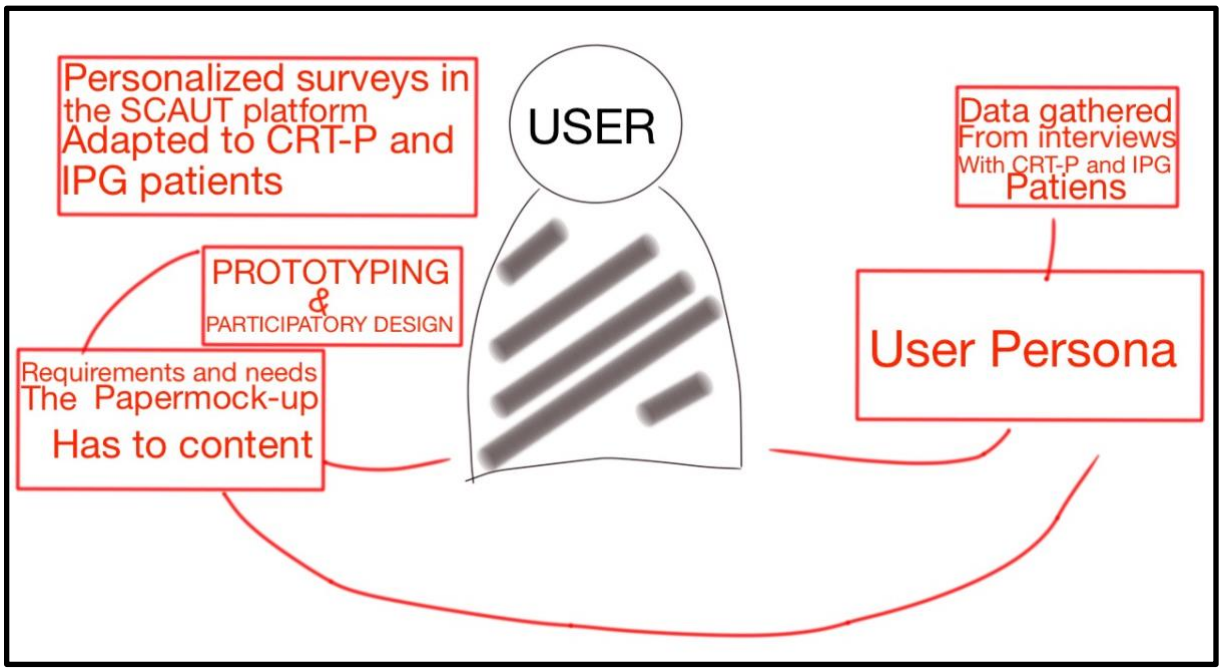


Figure 11. The figure illustrates the users/personas in the middle. Around the user, are different perspectives, information, and thoughts that go into the creation of a persona type.

Model for how to develop a persona, by using interviews see figure 12.

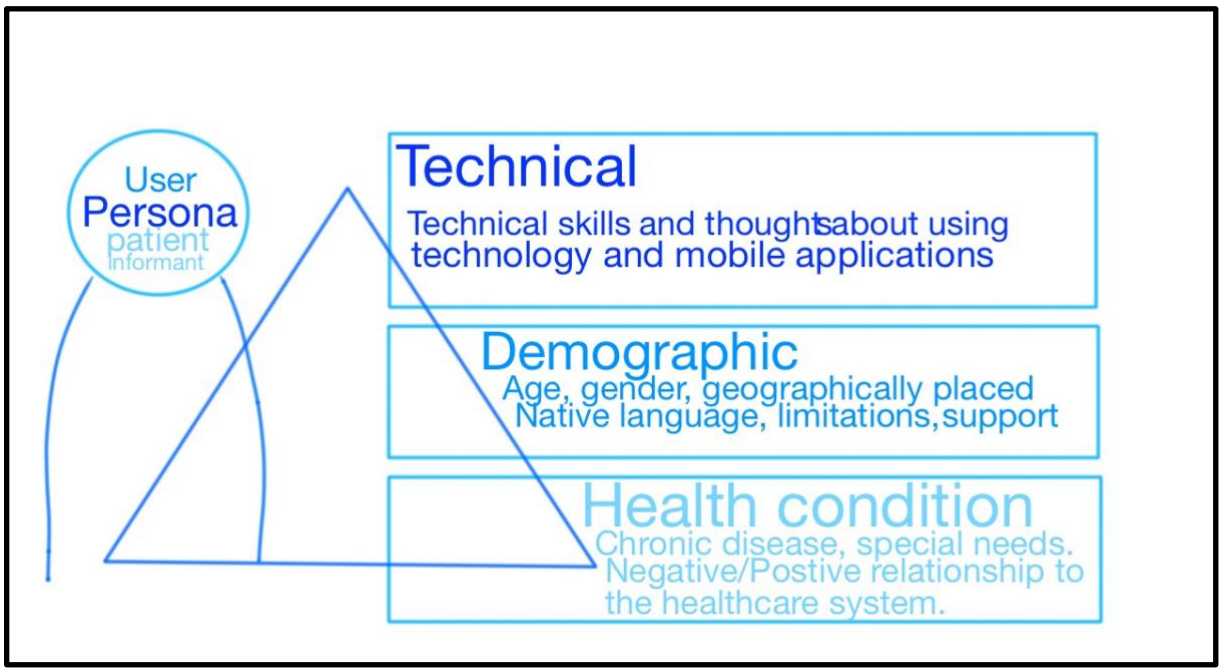


Figure 12. The figure illustrates the focusing points in the invention of a persona in this project. The main perspectives are technical, demographic and the health condition of the user.

5.6 Participatory Design

Participatory design origins from Scandinavia in the 1970s. The design approach was created to empower workers and foster democracy at workplaces (Matias Jose 2010, p. 164).This section deals with PD in relation to paper-mockups and decision trees. The focus will be, the methodological path of the design process. PD is practiced in this project as a research approach to develop technology and turn it into a real-world solution. The patient, therefore, becomes an active subject in the research (Clemensen et al. 2007, p. 122-124).

> *"Participatory design draws on various research methods (such as ethnographic observations, interviews, analysis of artifacts, and sometimes protocol analysis), these methods are always used to iteratively construct the emerging design,[...]."*
> (Matias Jose 2010, p. 164)

By doing PD we aim to develop a product in the interest of both patients and clinicians. We aim furthermore to provide the patients with a substance say in the development because they are experts on their life/world. There is both a moral and a pragmatic proposition. The moral one being that the patients have a right to be included and the pragmatic being that they might be more likely to support, ask questions and give new expert preferences if they are included. The pragmatic view believes that expert views from patients will increase the success of the outcome (Carroll and Rosson 2007, p. 243). There are many different ways PD can be managed, with different tools. This project is focusing specifically on mockups, to be able to generate knowledge and understand the patients' needs (Sanders, Brandt, and Binder 2010, pp. 2-3). The process of PD can be narrowed down to four steps: plan, action, observe and reflect, as shown in figure 13 (Clemensen et al. 2007, p. 124).

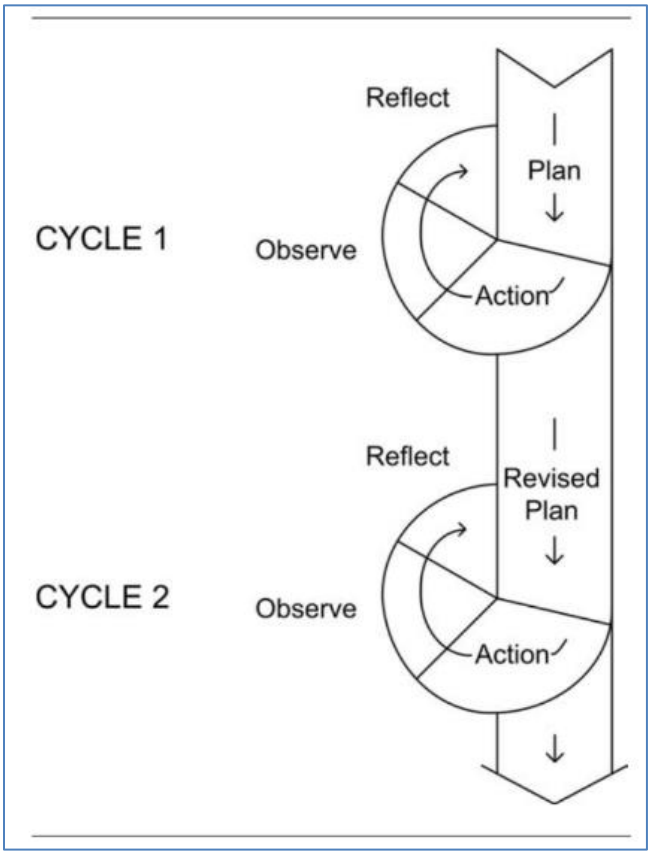


Figure 13. The figure illustrates, in a broad perspective, how the process of PD has unfolded. The loops of the figure illustrate that it starts with planning, then the action of PD, next observations of it, and in the end reflections.

5.7 Mockups

In this section, our choice of PD will be introduced, more specifically how we have conducted paper mockups.

"Mockups have become a very popular artifact to capture requirements in agile methods [...]. Agile methods are appealing for Web applications because they help to provide quick feedback to customers, following short development iterations and involving them in the development endeavor." (Rivero et al. 2010, p. 13)

As the path describes, see figure 13, how we started out by planning the mockups. Based on different parameters, more specific knowledge from Vital Beats, an existing application for ICD patients, last semester project, literature, personas, the prototype and mockups have been created. The figure 14 illustrates the contributions for the mockups.

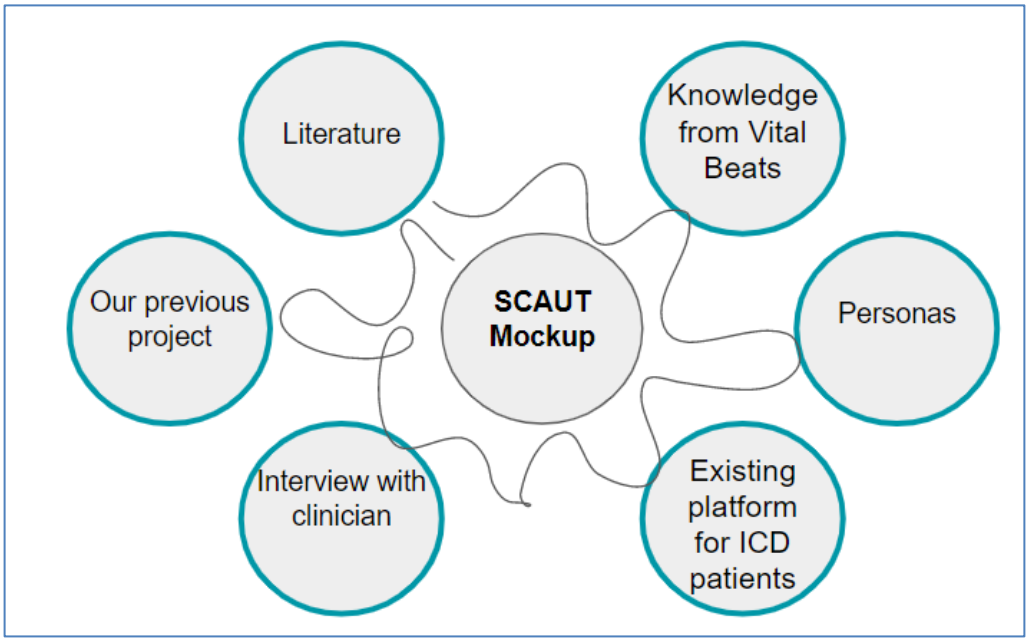


Figure 14. The figure illustrates all the different components that go into the creation of the three mockups. The mockups are carried out, based on literature, knowledge, personas, existing patients, interviews and previous project.

The material contributes to the development of three different decision trees and mockups. The mockups can be divided into three overall themes: scheduled EKG transmission, manual EKG transmission, and pacemaker ambulatory appointment. The first two themes are well known for the already onboarded ICD patients, but the last theme is fully self-developed, due to the patient insights from the last semester project, see appendix 1.

Mockup 1: Concerns the patient, if they have to do a scheduled transmission from their box at home. When the EKG is transmitted, they will be given the opportunity to elaborate on the transmission.

Mockup 2: Concerns the patient if they want to record an EKG transmission from their box at home. When the EKG is transmitted, they can elaborate on why they have sent it.

Mockup 3: When having a scheduled appointment at the hospital, the mockup illustrates that it is possible to change and ask questions about the appointment.

The mockups are illustrated as mobile phones, that are created by using a free computer program called Balsamiq mockup (“Balsamiq Cloud”) . The mockups are shown in Appendix 7, 8, and 9. In the end, the pictures of the mobile phones are questionnaires for the patient to answer, each answer will lead to the next in a so-called decision tree (Quinlan 1986).

After the creation, the mockups have been discussed together with Vital Beats, and they are furthermore applied for a test trial at Vital Beats, on a coworker. Afterward, the patients were contacted by phone. It is of key interest to have a broad spectrum of patients with e.g. different gender, age, and geographical locations, in order to design a product for a broad range of people. In practice, the mockups have been carried out by using skype, with five different patients see table 2.

Table 2. The table illustrates the specifics of the patients who participated in the mockup session. Which existed of three females and two males, with different device types, ages, and locations.

Patient	Device type	Age	Location
Female	IPG	18	south Zealand
Female	IPG	16	Copenhagen
Female	IPG	65	West Zealand
Male	IPG	26	West Zealand
Male	CRT-P	13	South Zealand

The mockups were hosted separately, with one patient at the time. In action, the mockups were performed by having one of us interacting with the patient and the other one tacking field notes. By having the recordings, it was possible to have a focus on the ongoing interaction with the patient. The recordings were afterward transcribed and coded by using meaning condensation (Brinkman and Kvale 2008, pp. 225-229). The meaning condensation is the fundament for the analysis and all relevant citations are placed in a scheme and then the meaning of each citation has been extracted. The key function of all the collected data from the patients makes it possible to personalize the platform. Below is shown a picture of a mockup situation see figure 15.

Figure 15. The picture is captured during the first workshop with patients (Vital Beats's office). The picture illustrates, in action, the designer interacting with the patient through the computer.

Future work/ Post prototyping

After the mockups and the data analysis, the prototypes have been discussed together with Vital Beats. Next, the prototypes were adjusted with all the new inputs in the program Balsamiq mockup (“Balsamiq Cloud”) . The final prototypes are going to be sent to the software developers, for them to transform it into a mobile application.

6.0 Literature review

The following section consists of the literature review, with the main focus on PD and prototyping, because that is our main focus in this project. In the field of pacemakers, there is poor amount of literature that describes the research we are doing in this project with digital PD and prototyping with pacemaker patients. Therefore, the literature review is developed into four themes, that describe, chronologically, how eHealth, self-care technology, and knowledge generated by ‘’laypeople’’, are familiar with the way of making PD and prototyping. To be able to answer the research question in this project, ‘’*In what way can participatory design and different networks contribute to the development of telehealth concerned with communication? And is it utopia to think that the new innovative technology can emancipate, the user's life?",* the literature review breaks into topics that are interesting according to the research question. We assume that not that much research has been made yet because mobile applications and telehealth are relatively new technologies. Areas still need to be explored and investigated. It is known, that there are several articles and research studies there have been developed about remote monitoring pacemaker patients, especially within the company Vital Beats, e.g. *''Unpacking telemonitoring work''* (Tariq Osman Andersen et al. 2019), ‘’*SCAUT: Using patient-generated data to improve remote monitoring of cardiac device patients''* (Tariq O. Andersen and Moll 2017) and *''Aligning Concerns in Telecare''* (Tariq Osman Andersen et al. 2018). That research is some sort of a preface of how to involve patients in developing digital health. This research, in relation to how telemedicine and remote care works, has shown that patients often are dissatisfied with the current care and communication tools at the hospitals (Tariq Osman Andersen et al. 2018). Therefore, we think that it is important to involve the patients and clinicians in the design process of a product because they are going to be the end-users. The four themes: Patient generated knowledge, self-care technology, PD and prototyping, and lastly equality in health will be framed to cover the field, this research project is investigating.

6.1 Patient generated knowledge

In 2014, the article *''Knowing Patients: Turning Patient Knowledge into Science''* (Pols 2014), written by Jeanette Pols (Ibid), asks the question ''how is it possible to turn patient knowledge into science'' and tries to answer that. She describes how laypeople back in 1995-96 participated in generating knowledge in relation to the development of medicine that could cure AIDS and different other studies back in time where lay people have contributed to generate science. This research is a kind of preface, to how we are investigating this project. The AIDS case brings in laypeople's' knowledge so that they can contribute to scientific research in the field.

> *''Epstein's (1995, 1996) classic study into the participation of people suffering from AIDS also shows how these activists gained credibility as partners in the early AIDS studies. Callon and Rabeharisoa's (2002, 2003, 2008) extensive research into concerned groups [...].''* (Pols 2014, p. 74)

Jeanette pols uses ethnographic methods to show how patients can generate knowledge, that can become science (Pols 2014, p. 75). She is using some of the same methods we also are using, to generate knowledge about pacemaker patients' needs. An important point in this article is that ''if you give voice you can make voice'' (Ibid). Again, the surrounding theme in this article is to describe and show how patients' voices can be important for science, that development of science can happen and collaboration with different ''experts'' is possible (Pols 2014, p. 77) .
We have gathered inspiration from this article, to make a framework where we are able to give the users a voice, because it through the years has shown remarkable results.

> *''[...] knowledge—it could be beliefs, or errors. The ''exotic'' position of patient experience neglects the notion that ''giving voice'' is always also a practice of ''making a voice,'' where a particular story is coshaped by the conditions in which it is told.7 Telling stories and making them heard is always a practical accomplishment. Ethnography frames patients differently than biomedicine does.''* (Pols 2014, p. 77)

Jeanette Pols also investigates how a webcam can be supporting for transfer and translate knowledge, which might be know-how for the patients but can be valuable for the scientists and clinicians. These *translation* processes are important for understanding the patient's know-how (Pols 2014, p. 87). Through our project, we intend to investigate the *translation* processes that occur, when we analyze the fieldwork and knowledge that is gathered. Through the project, Jeanette pol's concludes how important it is to change methods in the way where the patients' needs are handled, are planted in the back of our heads to make sure that the project will be beneficial for them (Pols 2014, p. 90).

6.2 Self-care technology

To understand how self-care technology can improve the healthcare system and be supportive for the patients, we draw upon the article, ‘*’The agency of patients and carers in medical care and self-care technologies for interacting with doctors”* (Nunes, Andersen, and Fitzpatrick 2019). Patients with chronic disease, Parkinson, are doing self-care most of the time, which also are experienced with pacemaker patients, see appendix 1, because they only are going to the hospital for control and possible adjustments. Now this research project, from 2017, tries to investigate how the patients interact with self-care technologies and communicate with doctors and clinicians.

Parkinson patients normally want to have an influence on their treatments, because they have different needs. Therefore, self-care technology where patients, doctors, and clinicians interact and decide together, can be both beneficial for the patient and the doctors, etc.

> ‘’*Self-care technologies for interacting with doctors are defined here as tools that support data exchange or collaborative interactions between patients, carers, and doctors.”* (Nunes, Andersen, and Fitzpatrick 2019, p. 2)

There are many similarities between the Parkinson patients and the pacemaker patients we are investigating, therefore this article has some research and results, there might be beneficial for our project and can contribute to support the argument about why self-care technology can be beneficial for these kinds of patients.

The research, in the article, got carried out by doing ethnographic methods, like observations, face-to-face interviews but also by doing digital ethnographic fieldwork. The online fieldwork focused on a platform called 'Ask the doctor', where Parkinson patients were able to ask questions about their disease. In our project, we use the same approach as this article, to gather information and data, because it is a way to get personal and true insights.

> *''For this study, we focused on the 'Ask The Doctor' section where patients and carers could ask questions about their particular case to a handful of specialised volunteering neurologists from the association. A total of 800 posts from the online community were read using a standard web browser, and when relating with data that appeared relevant, copied and coded in ScrivenerTM (n = 332).''* (Nunes, Andersen, and Fitzpatrick 2019, p. 4)

This kind of research can contribute to understanding the patient's and clinician's agency they have and practice if self-care technologies become incorporated in the healthcare system (Nunes, Andersen, and Fitzpatrick 2019, p. 11). The article still points on some issues in relation to decision making and self-care-technologies. There are expressions you are not able to achieve on digital media, where you simply need the face-to-face interaction, but alternatives might help to achieve that (Nunes, Andersen, and Fitzpatrick 2019, p. 16).

6.3 Participatory design and prototyping

When reading the articles *''from research prototypes to a marketable E-health system''* (T. Andersen et al. 2015) *and ''From prototype to product''*(Tariq O.

Andersen et al. 2017) we found that the focus on, how it is possible to make prototypes into production, is suitable literature for the project.

The first article *''from research prototypes to a marketable E-health system''* (T. Andersen et al. 2015) from 2015, is developed by the founders of Vital Beats, which shows that this research is a cornerstone to research made in Vital Beats after 2015, including the research we are doing. The research focused mostly on getting from prototype to product, and which stakeholders and what requirements it involves.

''*To be able to bring an e-health system (all the way) to the market, means that we have to ensure the system will meet regulatory requirements. Rather than postponing $ this, we recommend engaging with the regulatory issues early in the process. Even though the system is solely software-based, it is considered a 'medical device' in regulatory terms [13] and will have to pass regulatory assessment and approval by the relevant authorities (e.g. FDA for the US market and EU MDD for the European).*'' (T. Andersen et al. 2015, p 5)

On the other hand, the article also reflects on how important their fieldwork and mockups have been for reaching the opportunity to be able to make a product. They mix their methods with regulatory requirements so that it also becomes a part of the design process and in that way, it will become a resource for the project (T. Andersen et al. 2015, p. 5).

The other article, ''From prototype to product'' (Tariq O. Andersen et al. 2017) from 2017 is also developed in the company Vital Beats, just a few years later. This research project focus on four aspects where they enlighten the challenges of them (Tariq O. Andersen et al. 2017, p. 1). Again, this kind of research is a cornerstone of what we are investigating in this project and therefore the literature is helpful for us in order to get base information.

''(a) aligning the different concerns of patients and clinicians, (b) designing according to clinical accountability, (c) ensuring commercial interest, and (d) dealing with regulatory constraints when prototyping safety critical health Information Technology.'' (Tariq O. Andersen et al. 2017, p. 1)

The article explains how other large companies like, 'Coloplast' use PD to reach a better end product for the users (Tariq O. Andersen et al. 2017, p. 1). Vital Beats themselves have worked on a PD method that can work both in a commercial setting but also be able to transform a prototype into a usable product (Tariq O. Andersen et al. 2017, p. 2). Furthermore, it explains how important this research is in relation to create better communication between the clinicians and patients through the SCAUT platform (Ibid). One of the ways to create that is to make the PD with the patients and in that way create a platform that adapts to the ones who are using it. They did that by making mockups on a prototype mobile application, where the patients then could try it out and answer different questions (Ibid). This article has given inspiration to the project according to their use of the method and the way to involve patients.

6.4 Equality in health

The article ''*Equality challenges in the use of eHealth''*, (Petersen and Bertelsen 2017) from 2017 elaborate on how eHealth technologies are designed to give hospital workers more time and how it also lowers cost in the hospitals and health services. More and more patients and citizen begin to use these healthcare information technologies (HIT), where they interact less with the staff face-to-face (Petersen and Bertelsen 2017, p. 793). This tendency is increasing and therefore, our project is most likely to be of huge relevance at the moment. Furthermore, the hospitals and healthcare systems get more involved with eHealth, and therefore equality and ethical questions are important to consider when developing technology to be used in the healthcare sector (Ibid).

It can be a challenge for the hospital to keep on track of all these health data generated by the patients through a mobile application and the doctors and nurses also need to take these data into consideration in relation to their treatment of the patients (Petersen and Bertelsen 2017, p. 794)

''This availability of data put pressure on the health professionals to include these technologies in their treatment'' (Petersen and Bertelsen 2017, p. 794)

The question is whether or not HIT is increasing or decreasing inequality in the healthcare system? (Petersen and Bertelsen 2017, p. 794)

> *''The World Health Organisation (WHO) defines health inequalities as "avoidable inequalities in health between groups of people within countries and between countries" and describes health inequality as significantly influenced by social determinants [15].''* (Petersen and Bertelsen 2017, p. 794)

In this article, they investigated data from different healthcare applications and e.g. sundhed.dk ("Sundhed.Dk - Den Offentlige Sundhedsportal"), to understand if HIT creates inequality in the healthcare system (Petersen and Bertelsen 2017, p. 794) . They got their results through quantitative methods by using surveys. These surveys indicated if citizens with a limited or no education were more likely not to use a health application (Ibid). The surveys showed that there were significant differences between citizens with a limited education compared to citizens with high education (Ibid). It is suggested that HIT innovation, should be focusing on the inequality in society and that the ones who are socioeconomically disadvantaged and limited educated are most likely to not use these applications, and therefore they do not get as good treatment as citizens with a higher educational level and a good economic status (Petersen and Bertelsen 2017, p. 795).

Summary

To sum up it has been explained through these four aspects of telehealth, patient-generated knowledge, self-care technology, PD and prototyping, and lastly equality in health, why this field is of importance and has a big relevance. The literature elaborates on how important it is to bring all *actors* involved in the developing process, and ethical considerations. It began with observation and understanding the knowledge laypeople have, and it has turned into PD where end-users give and come up with inputs to the design of a product.

7.0 Results

In the following section, the results will be introduced. First the results of personas, which were used as an inspiration and foundation at the beginning of the project, in order to personalize the SCAUT platform. The second part of the results are the mockups. The mockups are shown as an illustration of a mockup SCAUT mobile application, both before and after the workshops with patients. Illustrations of the decision trees are also represented, to produce an indication of the questionnaire path, when going from one question to another.

7.1 The results of personas

In the following section, the three personas developed from the interviews, made in a former project as described in the methodology section 5.0, are shown below. These three different personas describe possible end-users' characteristics and will be a fictive type of user on the SCAUT platform.

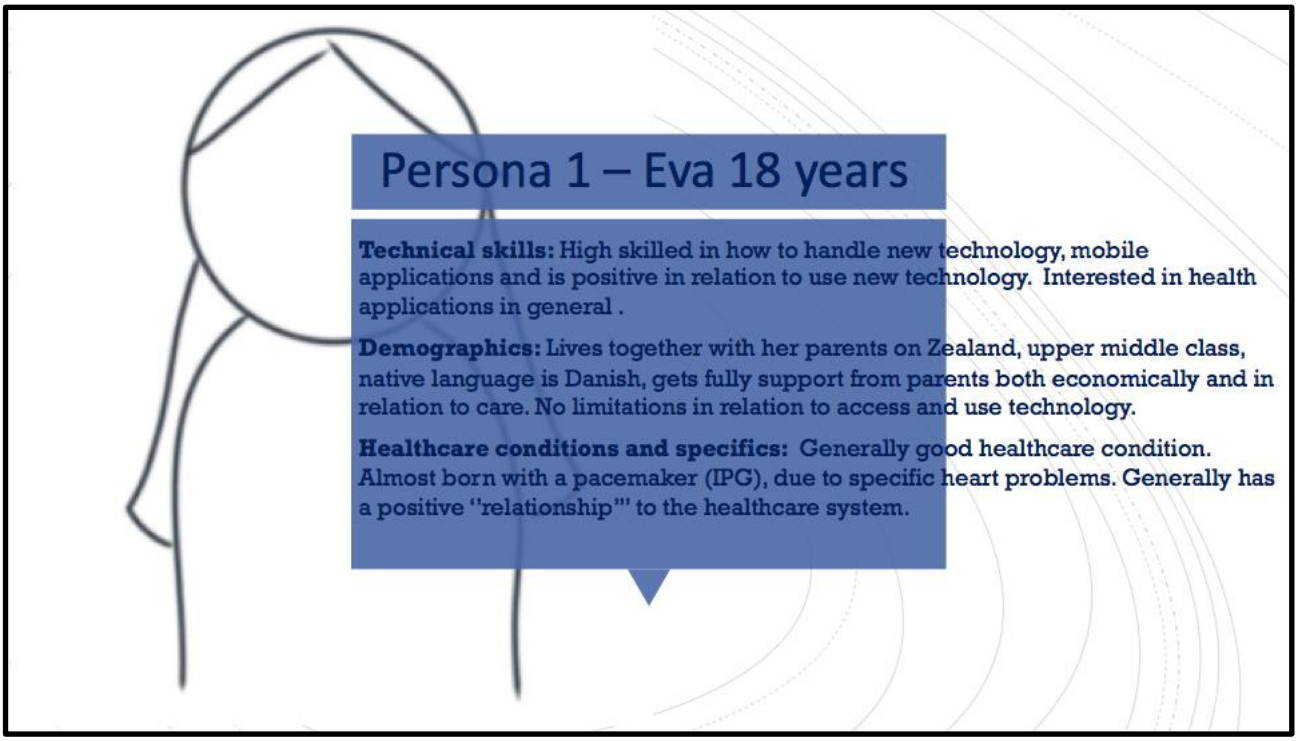


Figure 16. The figure illustrates the specifics of persona 1 Eva. She represents the younger group and technical skilled, she is, in general, resourceful and have good health.

Figure 16 above is a result of a persona, carried out from the interviews in the former project, see appendix 1. She is developed on behalf of the young group of pacemaker patients which and has the general characteristics of a young user, experienced from the interviews with three patients between 15-25 years, see appendix 1. Eva is an example of a ‘’perfect’’ end-user for the SCAUT platform because she is technologically good skilled, easy to convince and communicate with and has no bad experiences at the hospital.

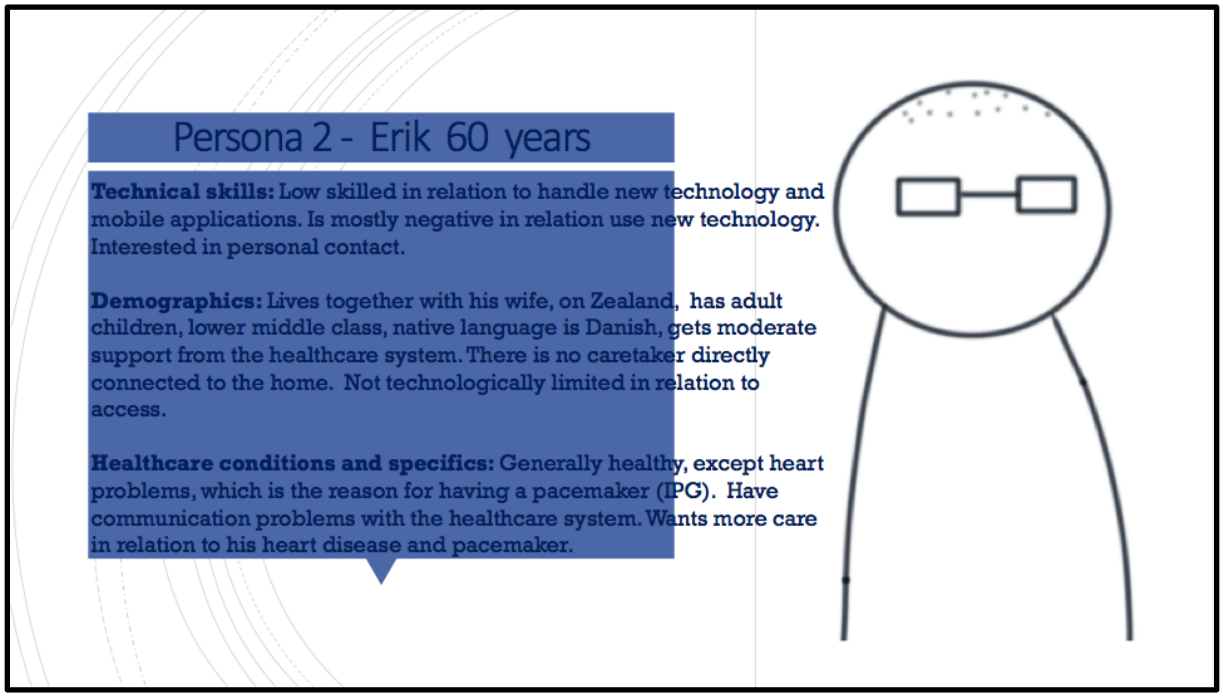


Figure 17. The figure illustrates the specifics of persona 2, Eric. He represents the elderly group. He is less technical skilled, middle class and have a not critical health condition.

Figure 17 above shows a result of the persona Erik who is made on behalf of two patients in the age group between 50-65 years. He represents the more skeptic type of user, with less patience in relation to the hospital, because of bad experiences. He also is technologically bad/low skilled in relation to mobile applications and is not experienced in that area.

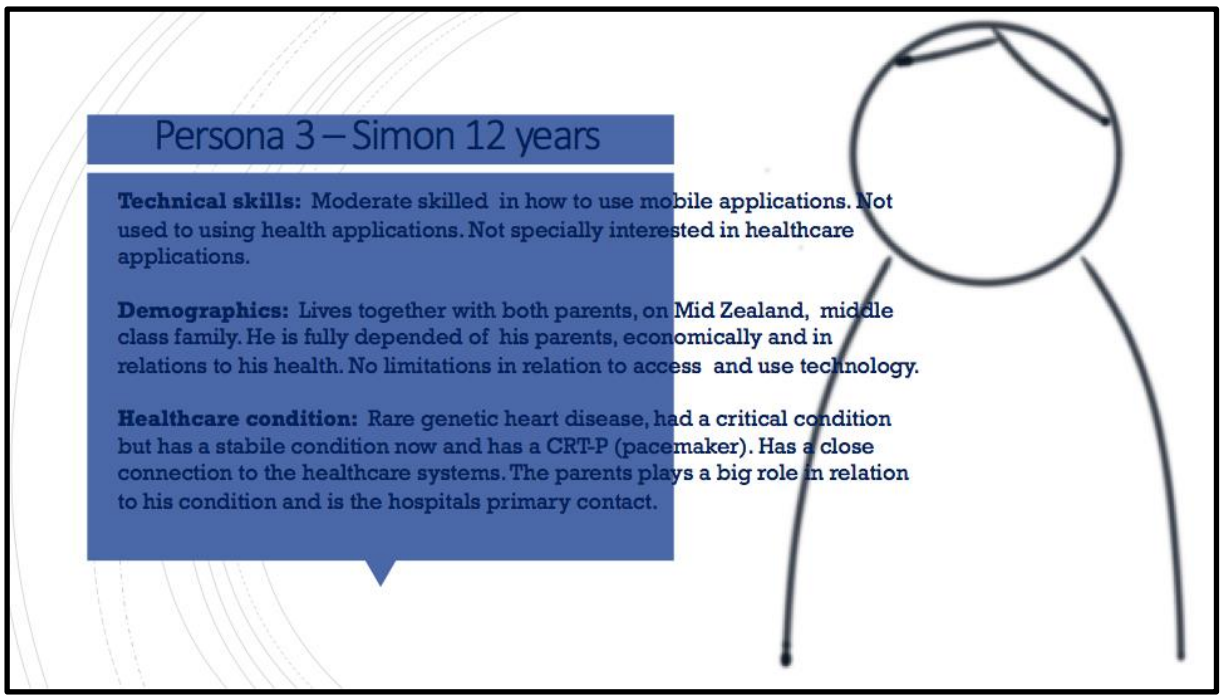


Figure 18. The figure illustrates the specifics of persona 3, Simon. He represents the youngest group who is growing up with technology. He communicates through his parents and have a stable but critical condition.

Figure 18 above shows the last and youngest persona. Simon is 12 years old and developed on behalf of children with a pacemaker and the interviewed patient in the former project, see appendix 1. He is not especially interested in the SCAUT platform, due to his age, but knows how to handle mobile applications. It can be useful for him later, but for now, the SCAUT platform is more in his parents' interest. He is a CRT-P patient and therefore, he might need more attention in relation to his condition than IPG patients need. Therefore, the application can be beneficial for his parents and it might help them worry less.

7.2 Results of Mockups and decision trees

The following section shows the results of decision trees and a selection of the mockup SCAUT mobile application. The illustrated results are from the three mockups. Since the mockups include a large amount of data, only a selection is represented in the result section the rest in the appendix 10, 11 and 12. In order to provide an indication of the changes made from before and after the workshops, there will be both results from before and after the workshops with patients. Since this SCAUT platform is created for Danish pacemaker patients, the mobile application screens are in Danish.

7.2.1 Mockup number one, scheduled transmission with the hospital

The figure 19 below is an illustration of our completion of decision tree one, which concerns if the patient has a planned transmission. Mockup number one is carried out together with the pacemaker patients. The decision tree, shows, in the first three screens, what kind of answers the patient will get if they have no questions in relation to their transmission. If the patients have a question in relation to their transmission the survey will be as the last three screens show. To look further into the decision trees and separate screens see appendix 10.
Figure 20, is an example of the results of our mockups, made for decision tree one, before and after, having workshops with patients. The screen to the left shows which kind of question we would ask in the survey before having inputs from patients, but only from a clinician and Vital Beats. The screen to the right shows how the question looks like after having workshops with the patients. It is adapted to the patients' needs in e.g. relation to possible misunderstandings, there was observed in the screen to the left. The screen to the right has been changed with a more specific text so that patients know that "relevant changes" are only referring to the pacemaker.
To look closer into the mockups, see appendix 10.

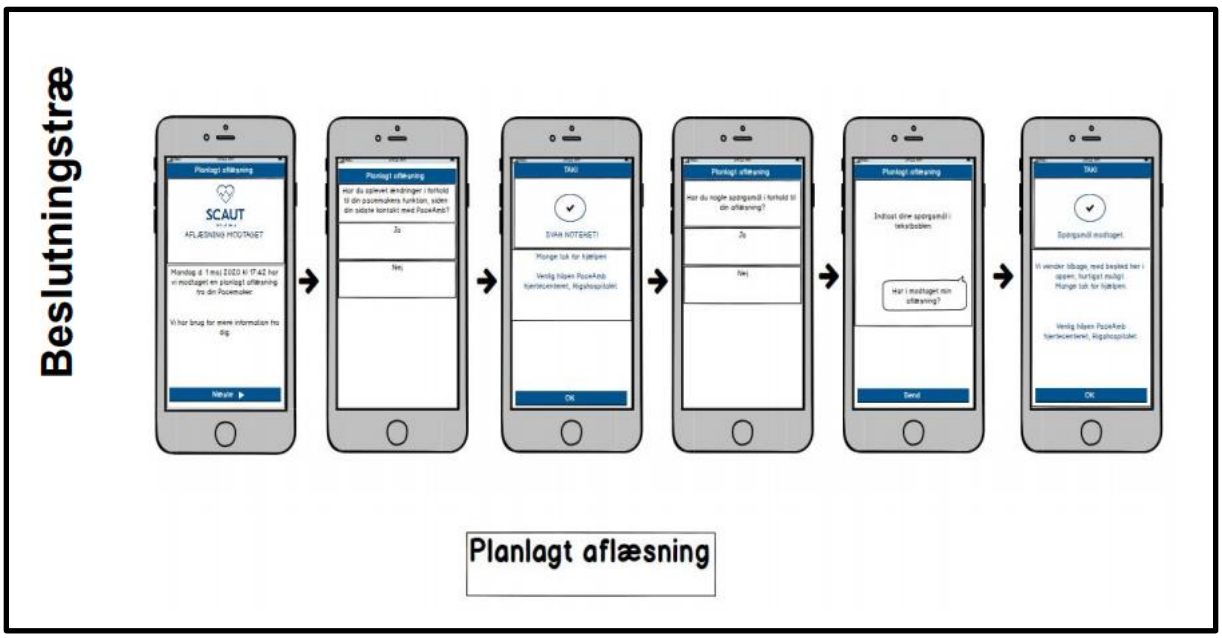


Figure 19. The figure illustrates the decision tree from mockup one, scheduled transmission with the hospital. The decision tree starts with getting a reply from the clinic, and the path of questions that follows.

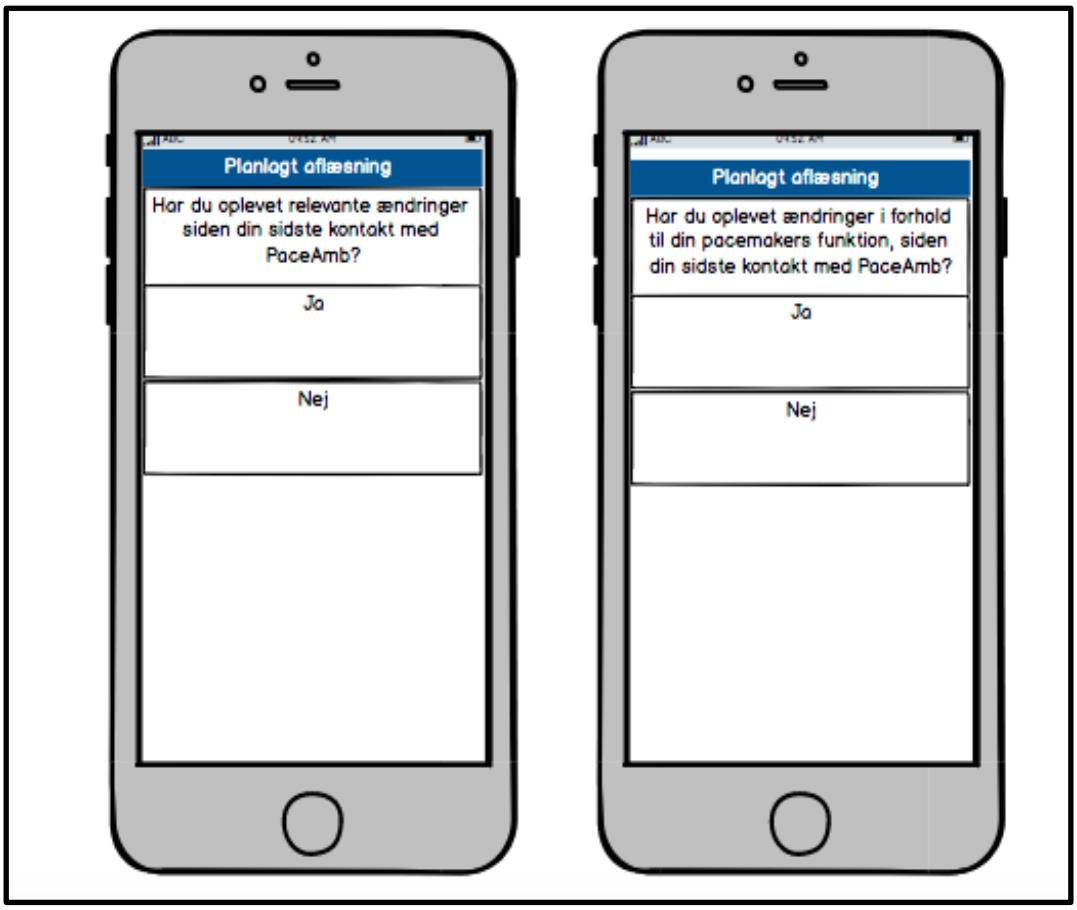


Figure 20. The figure is an illustration of before (left) and after (right) of how a screen has been changed after during PD with patients. In the screen to the right, the text has been changed.

7.2.2 Mockup number two, manual transmission

Decision tree number two, figure 21, below shows a result of how the surveys can lead to different ways and answers in the application. The decision tree number two concerns, if the patient has made a transmission from their pacemaker without a scheduled appointment. Figure 21 shows that the survey can go in four different directions according to symptoms, technical problems, etc. see appendix 11.

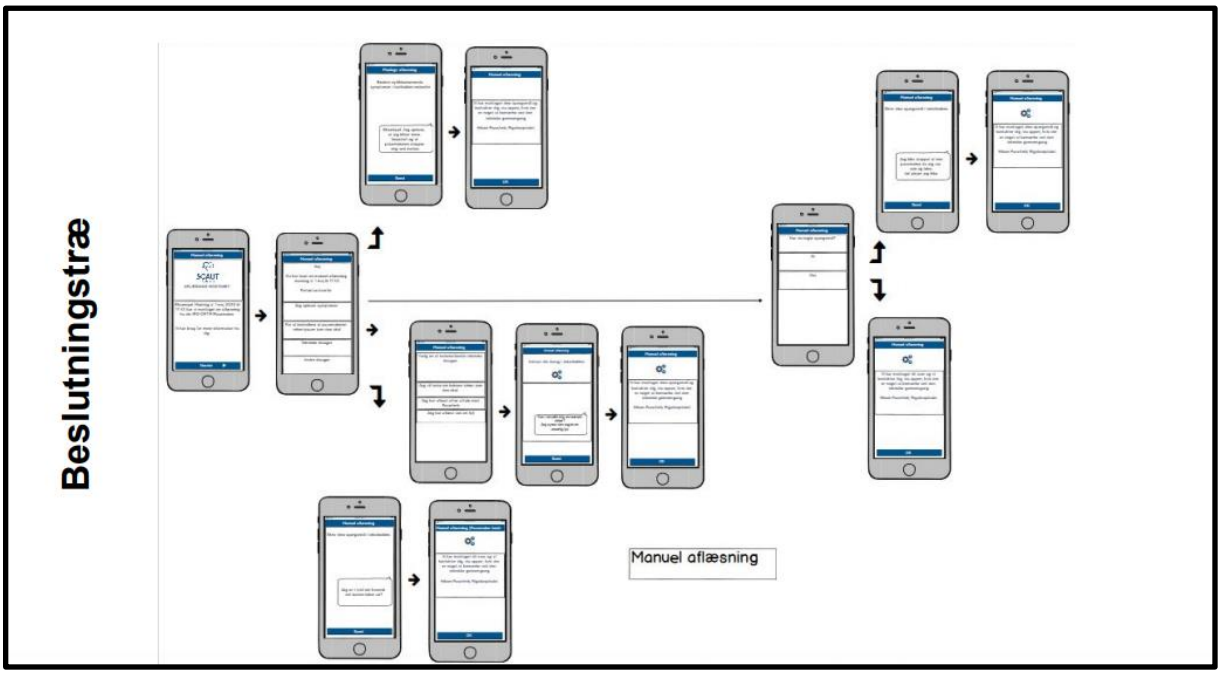


Figure 21. The figure illustrates the decision tree from mockup 2 (manual transmission with hospital). The decision tree starts with getting a reply from the clinic and then the path of questions that follows, in different directions.

Figure 22 show an example of a screen with questions in decision tree number two. The screen to the left is made before workshops with the patients, and the screen to right is created afterward. This is an example of, how the workshops and PD with patients contributed to essential changes in the surveys. The two most significant changes are that two categories have been deleted from before to after the workshop. The first category one the screen being “andre årsager” which can lead to confusion among patients. The second category being “Jeg har hørt en alarm”, which has been deleted because IPG and CRT-P patients do not have an alarm. See appendix 11, for the rest of the mockups, in the mockup number two.

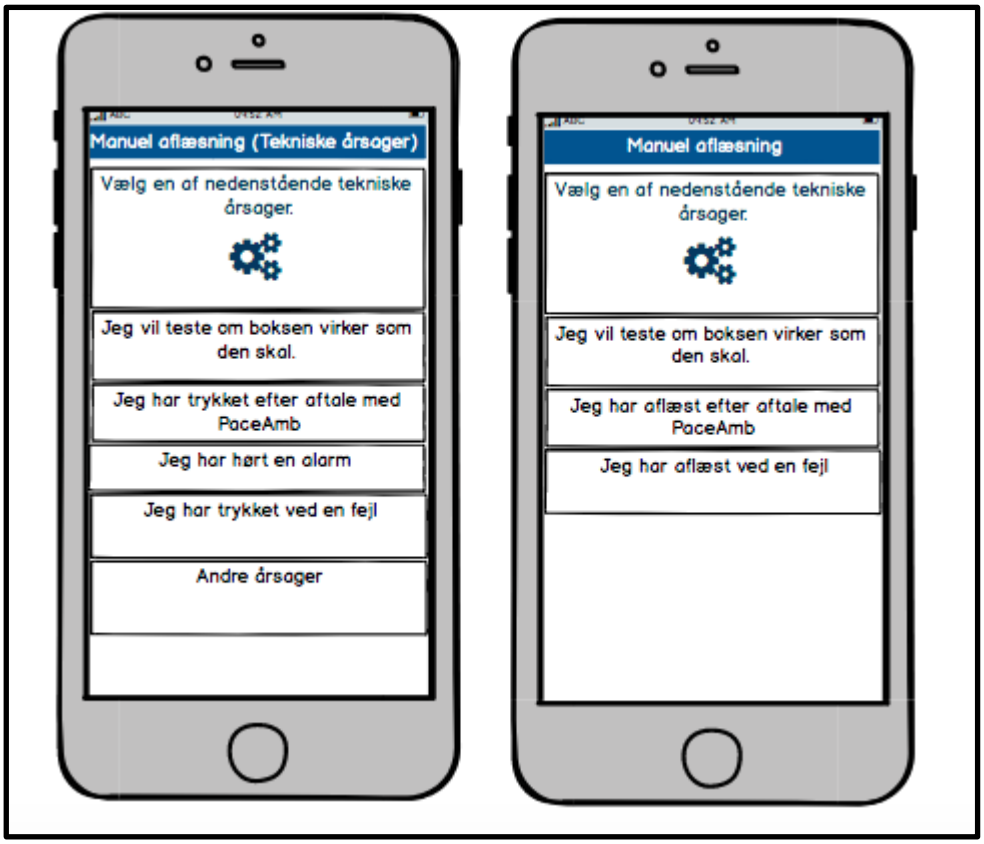


Figure 22. The figure is an illustration of before (left) and after (right), of how the screen has been changed after during PD with patients. In the screen to the right two categories have been deleted.

7.2.3 Mockup number three, scheduled appointment

Figure 23 below, shows the completion of decisions tree number three, carried out on behalf of mockup number three. The decision tree concerns if the patient has a scheduled appointment, they want to confirm, change, or if they have a question in relation to their appointment. The decision tree has three different directions, according to what the patient answer in the survey. See appendix 12, for more details.

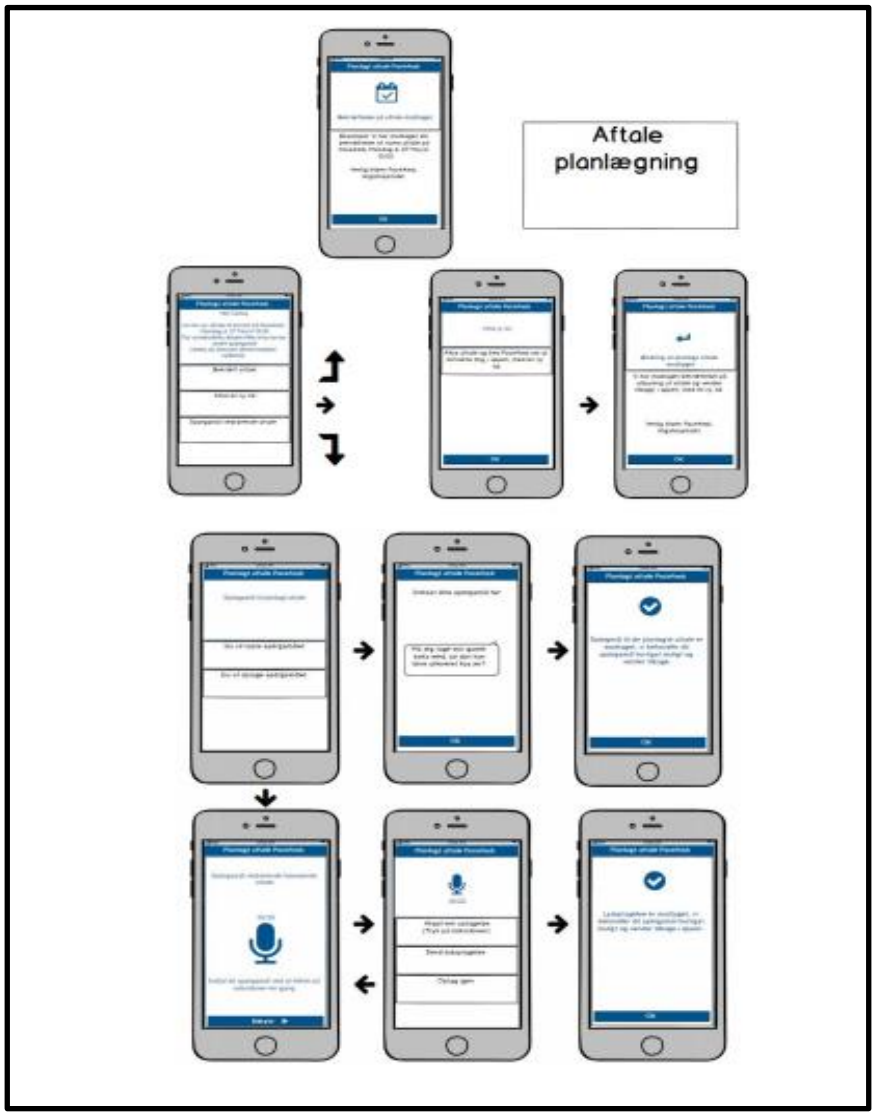


Figure 23. The figure illustrates the decision tree from mockup two (scheduled appointment). The decision tree starts with getting a reply from the clinic about the appointment, and then the path of questions that follows in different directions.

Figure 24 below is a result similar to the former figures, in mockup one and two, where the screen to left shows the prototype before the workshops with patients and the screen to the right shows the prototype after the workshops have been carried out. The screen to the right is adapted to the patients' needs and has some additions in relation to prevent possible misunderstandings. There are two significant changes to the mobile application, the first one being that it has been specified how to click on the microphone and record sound. The second one being, that the button "næste" has been added. See appendix 12 for the rest of the mockups, in mockup number three.

Figure 24. The figure is an illustration of before (right) and after (left) of how the screen has been changed after during PD with patients. On the screen to the right a next button has been added and the microphone text is more specific.

8.0 Analysis

This section will focus on the analysis of empirical data, more specific the five mockup workshops conducted with patients, the interview with a clinician, and the interview with an employee from Vital Beats. The empirical data will be analyzed through the theoretical lenses of CTT and ANT. The concepts framed in the theoretical section will be the foundation of this analysis. It is aimed to enlighten and explain the innovation processes of the SCAUT platform through theoretical perspectives and illuminate the socio-technical configurations. Furthermore, the empirical findings will be compared to relevant literature in relation to the problem statement.

8.1 Mediating actors in the SCAUT network

Bruno Latour argues that *actors* can be non-human and human and that a *network* cannot exist without *actors* nor can actors exist without a *network* (Latour 1990, p. 125). The focus of this section of the analysis is to elaborate on and analyze how Vital Beats and the SCAUT platform, consist of different *networks* that involve *black boxes* that will be opened up. It will also be illuminated how *networks*, consists of strong *actors* and *networks*, there can be a limitation for the SCAUT platform's visions and thoughts about soft values and innovation.

According to ANT the term *actant* is no longer a phrase, but the *actor*, instead, will be in the *network* both as human and non-human. The *actors* are based on their actions, and the *actor* will be defined according to its relationship in the *network*. In this research project, it is possible to identify, three *networks* of interest, from our point of view.

The first *network* of interest is The SCAUT platform. The SCAUT platform is roughly said the center of attention as an *actor*, in its own *network*, though it is a *black boxed actor,* that only a few upcoming users know about. The only *actors* in ''the SCAUT platform network'', who knows about its function and existence, are the ones we have interviewed, who have become the main *actors* in the *network* of patients

because they represented a group and talk on behalf of that group. To open up the SCAUT platform's *black box*, we made a workshop with the patients, in form of PD, where they got the opportunity to ask questions about the SCAUT platform, its relevance, function, and design.

''Interviewer: Is it possible to say that those patients who are the ones there have contributed to developing the SCAUT platform, represents the whole group of patients?''
''Informant Vital beats: You can say that we have around 500 patients onboarded and have many different patients in relation to age and gender [...].'' (Informant Vital Beats, coded interview, pp.4-5)

''Design vice, the headline has to be smaller than the text box. The headline has to be much smaller. If it was me, I would write, '' describe symptoms'' or write ''write symptoms here'' and then have a textbox beneath.'' (Patient five's dad, coded mockup five, p.3)

The SCAUT platform's *black box* gets opened up, when its function and design become possible to remake and redesign, with *actors* in the *network*. Furthermore, the SCAUT platform has *actors* as Vital Beats, and clinicians, and in it is the *network*. Vital Beat's role in this *network* is that the company is the *network's* founder, and therefore knows it. It is possible for Vital Beats to change its purpose and role in the network. The clinicians' function in this network, is a bit similar to the patients. A few clinicians represent the rest of the pacemaker clinic's thoughts about the SCAUT platform and are also the main users of the SCAUT platform. The figure below illustrates ''the SCAUT platform network'', and the *actors* involved. Medtronic who is suppliers of pacemakers and Rigshospitalet is defined as macro *actors* (Lauritsen, Jesnen, and Olesen 2007, pp. 79-80) and are also a distant part of the network, more indirectly in relation to funding and access. See figure 25, an illustration of the SCAUT platform *network.*

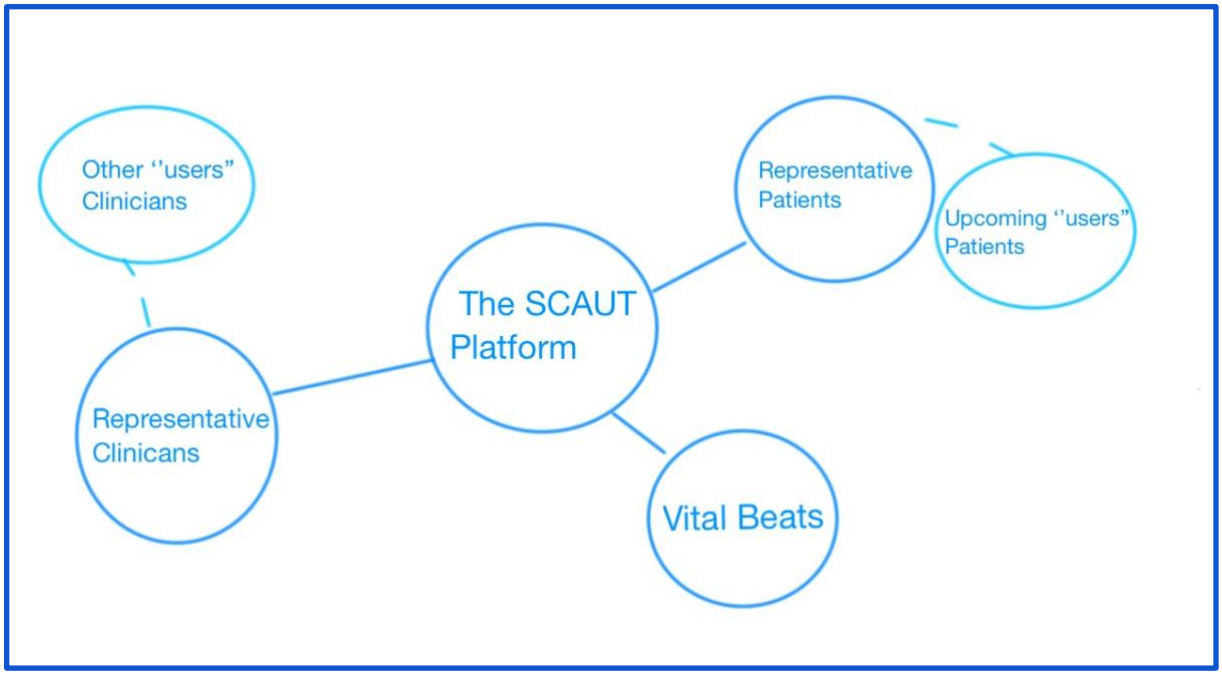


Figure 25. The figure illustrates the network according to the SCAUT platform. The SCAUT platform are placed in the middle, and the actors around it.

Another important *network* in this research, are the patients. The patients are from the project's point of view, the most important *actors* in the *network*. They are the ones there are able to negotiate and create new *black boxes* in the *network*. Through the project, we found that, when talking with patients, the children often have a parent behind them who also wants to contribute to the workshops and design and function of the SCAUT platform. The parent is a *black box*, which is getting opened and has an underlying function in the *network*. In the quote below, it is described how the patient's father wants to get involved in the workshop and also have something to contribute to.

''Patient five: ''This is fine''.

Patient five's dad: ''Is that getting send at that moment, or is it when you push the ok button?'' (Patient five and patients five's dad, coded mockup five, p. 1)

It is discovered that the parents often want to contribute or be involved in their child's life with a pacemaker. This is fully understandable because, we assume that the parents are the ones who are in contact with the pacemaker clinic, making appointments, and other practical things. The figure 26 below shows a network,

where the patient is the center of attention, and how the actors around also are involved with each other without the patient.

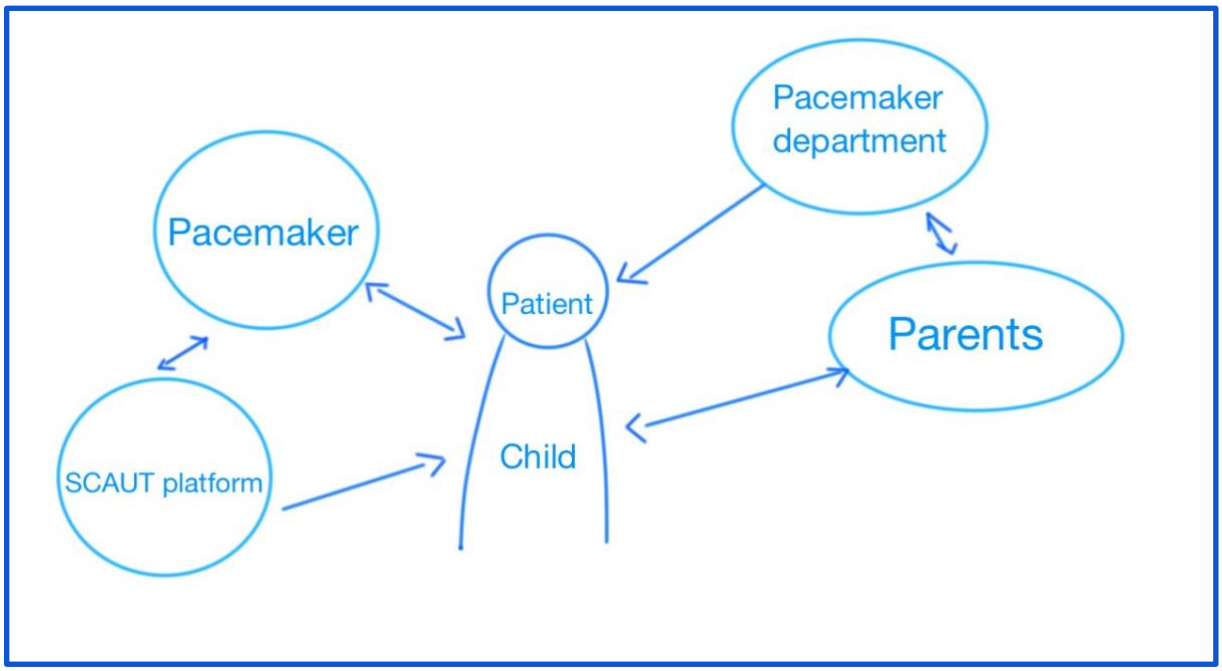


Figure 26. The figure illustrates how the actor (a child) is placed in the network and that the actors are surrounding him.

A *network*, which is more invisible in this project, but of huge importance, is the *network* of the system there make important decisions of whether or not the SCAUT platform will be used, is a good solution and can save money. A *network* will consist of many *networks*, and multiple *actors*, therefore the *networks* there are shown in the sections, are only parts of other *networks* and *actors*. *Networks* often consist of a *spokesperson* there will talk on behalf of the *network*. In figure 27 below we have defined the *spokesperson* in the *network* which also defines that he/she has a strong argument in that particular group of *actors* in the *network* (Lauritsen, Jesnen, and Olesen 2007, pp. 75-56).

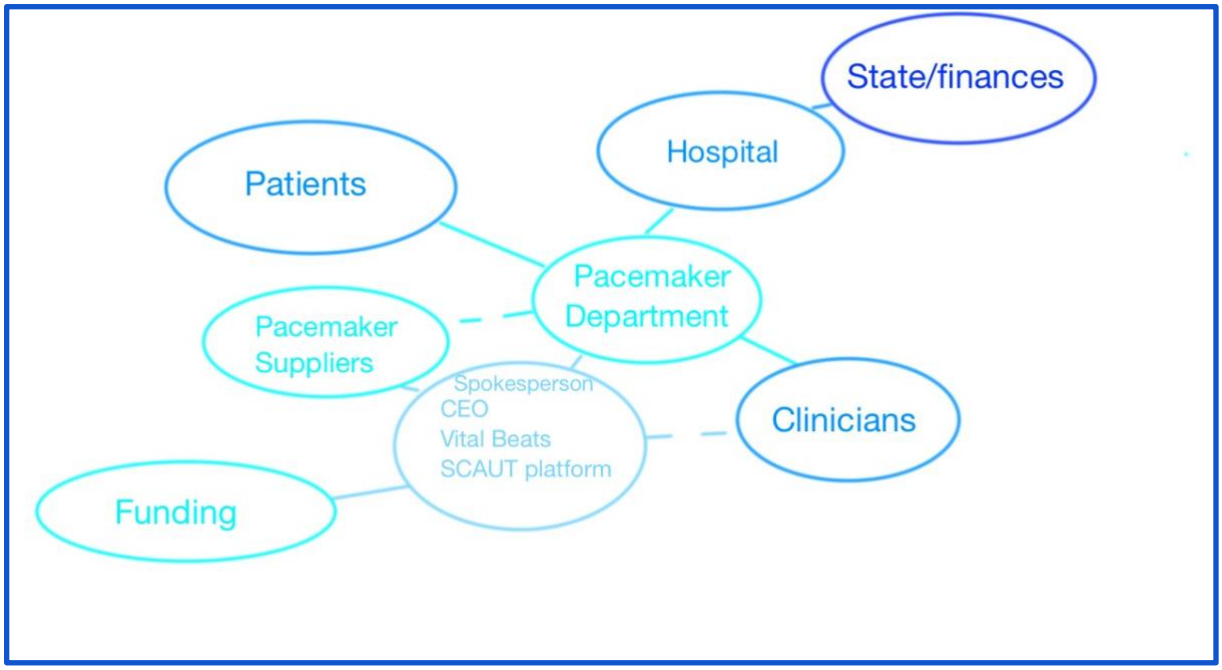


Figure 27. The figure illustrates the different views based on the decisionmakers, that goes into the SCAUT platform.

Figure 27 describes a *network*, where ‘’all’’ decisionmakers are present. It might be possible to identify more *actors* in that *network*, several other *networks* too, but in this project, our main focus only involves the *actors* mentioned in figure 27. The *network* also shows that the CEO at Vital Beats functions as a *spokesperson* who is able to talk on behalf of the company and has contact with every *actor* in the *network* more or less. The *network* shows that it can be difficult to include soft values, as e.g. the patients’ needs even though political aspects, funding, and economics play a big role in how to realize and develop technology in a way where the soft values are of huge importance and money and efficiency are not the first priorities.

Sub-conclusion

The three *networks* in figure 25, 26, and 27 is an example of the most important *networks* identified in the project, seen from our point of view. These *networks* are the ones contributing to how the SCAUT platform gets developed, changed, and designed. In every *network*, the patients appear, which shows that they are important *actors* who are important to include in decisions so that *black boxes* can be opened and remade if they contribute to unstable or unreliable results.

8.2 Translations of mobilizing innovation

In this section, the empirical data through the ontological perspective of ANT, more specifically the concept of *translations*, will be analyzed. It is believed that *translation* processes can enlighten the innovation of the SCAUT platform. ANT believes that *translations* occur through relations among *actors*.

> *"social structures and human agency are recursively linked and co-evolve. ANT studies the relationships that link people and technologies in dynamic networks."*
> (Greenhalgh and Stones 2010, p. 1285)

The focus of this analysis will mainly be between the involved parts in this project, Vital Beats, clinicians, and patients. Even though, ANT operates on a macro and micro level, the view of this analysis operates mostly on a micro-level. Where the focus relies on specific *actors*, who more or less represent the whole *network*. ANT is criticized because the narrative's point of view becomes too strong, and the selection of data material becomes one-sided (Greenhalgh and Stones 2010, pp. 1287-1288). Our assumption is that ANT operates on a wide spectrum, and it is therefore difficult to decide what to include and what exclude in the analysis, without becoming too subjective. It is, therefore, decided to create specific points of impact to frame the analysis. This analysis will build on the four steps of *translations*. More specifically, defining the problem, interessement, enrollment, and mobilization (Ibid), It has been observed through our time at Vital Beats and their collaboration with patients and clinicians, that there are many *translation* processes across different *actors*, and especially according to communication. Based on our empirical data and previous study, it has been decided to focus on the following observed *translations* of impact. First, misunderstandings according to communication between the patient and clinician. Second, the power relations of *translations* among *actors*. Lastly, the *translation* of innovation in relation to the SCAUT platform.

8.2.1 Defining the problem

For a *translation* to occur, there has to be a controversy and therefore an *actor/actor* of power, pinpoints what needs to be explored.

"problematization one (or more) initiating actor(s), also known as a focal actor, defines and constructs a problem and articulates the manner in which it affects its interests. The focal actor also identifies other actors whose interests are consistent with its own(...)" (Troshani and Wickramasinghe 2014, p. 2997)

As mentioned in the quote above the *actors* needs to find a common agreement/alignment to the problem. The focal *actor* is an *actor* of power. It could be assumed that Vital Beats are the ones, in this case, who addressed the problem first. They investigated that there was a possible need for more and better communication between patients and clinicians. The patients during the workshops were asked if they had a last comment on the mobile application. There was a common agreement about, that there especially, were practical needs according to getting a reminder when there is an appointment at the pacemaker clinic.

''Just that you could gather one's hospital visit together inside the app and that it would be possible to have phone numbers, on different departments inside that app. And a reminder with the hospital appointment." (patient one, coded mockup one, p.8)

''It would be nice to have a reminder when you have an appointment or have to send a transmission." (patient two, coded mockup one, p. 4)

In this situation, Vital Beats have the opportunity to be the *focal actors*, but it is also their choice whether they want to develop a solution to the problem. The patients might be the ones who have addressed a problem/need, but Vital Beats have the power to accomplish it.

A controversy between clinicians and Vital Beats appeared at the beginning of this project. The current users of the SCAUT platform, have the opportunity to describe

their symptoms in the mobile application. Even though, the clinicians are concerned that this might lead the patients to feel something they do not feel. In other situations, the clinician address, that it might be irrelevant because all patients have symptoms and only a limited amount is about the pacemaker itself. Lastly, the clinician is afraid that the symptoms would create more misunderstandings.

"It is important to decide, what it is you seek with this platform and the symptoms, it fills so much, and it is difficult to take action on, in this type of communication. Because it can be solved very quickly in a conversation when having nuances and the play between two people that can correct misunderstandings." (Clinician, coded interview, p. 3)

After the interview we broaden our insights to Vital Beats and discussed whether or not the new platform should have symptoms as a part of it. It was decided by Vital Beats, that it should be a part of the new SCAUT platform. In the follow-up interview with Vital Beats, the concerns from clinicians was discussed according to symptoms. Vital Beats elaborated on how symptoms might require more time from the clinicians but could be beneficial for the patients.

"I understand their concern, but I believe it is because they do not totally understand. They are making it something it is not. We are saying that the patients should only describe symptoms in relation to their device [...] Some of the clinicians are concerned about not knowing what to do. They are saying, what can we use it for, it is not our work area." (Informant, Vital Beats, coded interview, p. 2-3)

Now three different problems have been defined according to symptoms, misunderstandings and power relations and they are all very much intertwined with each other.

8.2.2 Interessement

In this step of the *translation* process, different *actors* are being engaged to join interest.

"lock-in" other actors as allies or supporters in the actor network. During interessement, the focal actor attempts to convince others that the interests defined during problematization are aligned with its own." (Troshani and Wickramasinghe 2014, p. 2997)

It has been investigated that in this step the ideas of different *actors* get rejected or accepted. Based on the empirical data the process often stops, if an *actor* with limited power tries to make their viewpoints. In the article ''*Actor-Network Theory: A Tool to Support Ethical Analysis of Commercial Genetic Testing"* (Williams-Jones and Graham 2003, pp. 275-276), it is described that it is important to recognize *actors* on different levels. Furthermore, the article also argues that *translation* occurs at every level but is controlled by *actors*.

"Ongoing translation at a variety of levels is a key source of social order, generating institutions, governments, organisations and agents that exist over time […].
It is important, nevertheless, to recognize the influence and contribution of controlling elements and to expose the underlying inequities and power relations behind technology development.
Technology development is inherently a process of translation" (Williams-Jones and Graham 2003, pp. 275-276)

By engaging patients in the project, another *actor* is invited. ANT believes that having more *actors*, create a stronger *network*, therefore, a stronger *translation* and more "ordering". Through PD, the patients were introduced to the mobile application. It is believed that patients are some sort of experts on the pacemaker, and Vital Beats continue to pinpoint that. This is because it is their daily life world, that is being investigated. There will be no platform if it is not beneficial for pacemaker patients. As Vital Beats describes it.

"Without the patients inputs it would be very hard to develop the platform, as we want it to be. One thing I have used most time on, is understanding our users."
(Informant Vital Beats, coded interview, p.5)

A comment from several pacemaker patients was related to an alarm on the monitoring box, which is a great example of what would have happened if it was not for the contribution of “living pacemaker patients’ actors”.

’The next one is, that I have heard an alarm, what is that? is it the pacemaker? what do you mean with alarm?” (Patient one, coded mockup, p.3)

‘’It's very nice sometimes just to test it and sometimes you have appointments too. Did I hear an alarm? I do not know with other pacemakers, but at least I do not have an alarm.” (Patient two, coded mockup one, p.1)

The two above mentioned examples illustrate how *actors* with “less” power are of huge importance. Because as it turned out, pacemaker patients (IPG and CRT-P) do not have an alarm connected to their device. Now it has been established how different *actors* have been involved and created alignment.

8.2.3 Enrollment

Technology affects human and social interactions, but the technology is necessarily not stable(fixed), it can be changed by other *actors* who did not design the product (Williams-Jones and Graham 2003, p. 276). The design can drift, and it is interesting to think that technology can translate according to different *actors*. It could be assumed that as an *actor*, for instance, us, we could establish ourselves as a designer/facilitator. We have some pre assumptions based on our knowledge and data, these “assumptions” will be incorporated in the so-called technical script. Doing the project more actors have been involved, and the SCAUT platform has slowly changed in a direction that could meet different expectations.

“During enrolment focal actors attempt to define and coordinate roles aiming to stabilize and strengthen the emerging network. It involves “multilateral negotiations, trials of strength and tricks that accompany the interessement and enable them [focal actor(s)] to succeed.” (Troshani and Wickramasinghe 2014, 2997)

We as facilitators have negotiated the interessement of the different *actors*. One of the difficult tasks is to align the patients' concerns without creating a work overload for the clinicians. One of the patients elaborates on, how small adjustments in the questionnaires in the SCAUT platform can create more work for the clinicians.

''Patient four: "Well, I think, depending on who it is, there can be a lot of questions, it opens up a lot of work. There may be many questions: can I bring my relatives, can I eat just before I come? there are endless many things, it requires that some answer."

''Interviewer: "Yes it has to be taken seriously and there must be time to respond."

"Patient four: "Yes and it is not certain that these are stupid questions. but if you have to call to ask something, it often becomes more relevant than if you have to write it somewhere. I think this is my experience.'' (patient four, coded mockup four, p. 2)

It has to be staged that the patient in the workshop works as a medical secretary. It has now been staged how *actors* are given different roles, and how their roles are being played through negotiations.

8.2.4 Mobilization

Mobilization is where methods are being applied so that *actors* stay aligned according to their agreement (Troshani and Wickramasinghe 2014, p. 2997).The step of mobilization, is where the *actors* go through the *obligatory passage point* and stabilize the *network* by creating a *black box*. The mobilization can also be described as the citation below.

*"In the healthcare settings, this means that relevant human actors, including patients, clinicians, policy makers, and non-human actors, including diagnostic equipment and software, codes of practice, have become aligned and their network solidified.***"**
(Troshani and Wickramasinghe 2014, p, 2997)

By investigating the *translation* processes in the innovation step, the *black boxes* will also be revealed. When revealing the *black boxes* quickly, it creates an opportunity for the SCAUT platform to not become too "settle". ANT argues that *black boxes* are difficult to open (Troshani and Wickramasinghe 2014, p. 2997). *Black boxes* limit the possibility for creativity, innovation and an open mindset. It is though fair to say, that during this project different groups of *actors*, have their version of what is correct. This belief is a reflection of the *actors'* agenda, which collide with ANT's idea about, that there are no pre-existing roles (Williams-Jones and Graham 2003, p. 278). The *actors* according to ANT, formed by relations to other *actors*, but in this project, the different groups of *actors* are forming a technology without being present to the other groups of *actors* in the innovation process.

The *obligatory passage point* stages a point where *actors* reach a common agreement and reach mobilization. The main *actor* of this project is the SCAUT platform, and by following the platform and its ongoing changes through the view of clinicians, patients, Vital Beats, literature and our previous study the platform has been translated numerous times. Being translated an extensive amount of times, the platforms become stronger (Latour 1999, pp. 70-71). When all the *actors* around the SCAUT platform are agreeing and settle in their roles, then the SCAUT platform will go through the *obligatory passage point*. When the SCAUT platform is fully developed, produced, and introduced, then it will become *black boxed*. This is where through all the *translation*, that you reach amplification, where something become true/a fact (Latour 1999, pp. 70-71). To obtain the best possible platform in the future and keep it fluid, it has to be questioned.

Sub-conclusion

The *translational* processes are fuzzy and sometimes unpredictable. They happen on all levels among different *actors*. In the section above some of the processes have been introduced and the processes of them. It is fair to stage, that there no right or wrong way to integrate a *translation*. The aim has been to enlighten some of the problematizations and to illuminate the innovation process in another light. The narratives point of view becomes quite strong in the decision making of which *translations* to include. The SCAUT platform itself is defined on behalf of our

observed networks the “main” *actor*, and by following the platform the process of innovation can be understood.

8.3 The multiple aspects of the technical code

This section aims to frame the empirical data with a CTT perspective, and more specifically the *technical code*. When developing and innovating new technologies, there are multiple choices and priorities that move into technology. These decisions reflect how technology is constructed and how it will interact in different contexts. Technology is always developed in a social context, with different political and cultural beliefs. In this section, three key concepts within the technical code will be elaborated on according to ethics, economy, and power. Therefore, the technology is never neutral but biased by the values embedded into the technology. The interest of the *technical code*, especially according to the SCAUT platform, occurs because many *actors* influence the innovation process. It is believed that e.g. clinicians, Rigshospitalet, patients, Vital Beats, and Investors have different reasons to be a part of the platform. Therefore, the SCAUT platform is most likely to have many different *technical codes* embedded. This analysis will try to undress the platform, to investigate its essentials.

“A technical code perspective is a powerful analytic tool because it exposes this relation by correlating technical properties with the social values leading to them or facilitated by them.” (Flanagin, Flanagin, and Flanagin 2010, p. 180)

8.3.1 The ethical aspect

How do different ethical elements come into action, when innovating new technology? There is no doubt, that when developing new technology, especially for a social purpose, some groups might benefit more than others from the technology. This analysis intends to enlighten technology from different ethical perspectives, more specific emancipation, autonomy, oppression, vulnerability, and justice. It is

believed that the ethical aspects are often reflected in the values implanted into the technology.

> *"Technological design is an important indicator of technical code [...]. Design features may include the physical form of the artifact (e.g. hardware or physical structure), social and operational procedures that define its use (e.g. software or rules of conduct), and the intersection of these."* (Flanagin, Flanagin, and Flanagin 2010, p. 182)

The SCAUT platform operates based on the concept of *formal bias*. There is one platform applying to all patients. Meaning that everyone has the same rights, even though most pacemaker patients only have one thing in common and that is that they have a pacemaker. Besides that, the patients are very different from one and other. Therefore, some patients might adapt very quickly to the platform which will lead them to some kind of emancipation. They might get emancipated from their disease, because they are more involved, can get answers quickly, get replies on their transmission, and have more fluid communication with the clinic. Other certain groups are more vulnerable, and they might get oppressed by the technology. These groups could e.g. be patients who do not want to have autonomy in relation to their pacemaker device, are technical unskilled, cannot afford a smartphone, or do not have the capacity to engage in their health. In the expert follow-up interview, an employee from Vital Beats was asked about how they make sure to include all groups of patients on the platform.

> *"It is a huge task. But I think we are also thinking a little bit more about the future. Because we are aware that elderly people are not that technically skilled. They are definitely being challenged. We are also looking at the future, how do health-solutions look tomorrow? otherwise, you would not get far enough."* (Informant Vital Beats, coded interview, p.5).

Vital Beats are aware that they might "lose" a core part of their possible users since most people having a pacemaker are elderly. They believe that in the future, people will, in general, be more technically skilled. Since this project has been conducted based on digital methods, it has been difficult to reach the older generations. On the

other hand, are Vital Beats aware of the bottleneck, and are therefore using more resources on that specific group.

''We are in general prioritizing the worries of the elderly more, because it is more difficult for them. The younger generation is used to all different types of design." (Informant Vital Beats, coded interview, p.4)

The clinician also describes in an interview, how misunderstandings can occur especially according to the elderly generation in contact with technology.

"There can be massive misunderstandings according to a lot of technical things(...) You are an older woman or man, where having to connect power and press a button and look at the button, can be very challenging." (Clinician, coded interview, p.2)

The clinician furthermore argues that misunderstandings often can be avoided by having a conversation instead of a written dialog. In the end, having to switch between different types of communication will be more time-consuming.

"When having communication in writing, there are many more misunderstandings, that is 100 percent certain." (Clinician, coded interview, p. 2-3)

In general, the SCAUT platform aims to create more autonomy for the patients, by giving them the right to be more involved in their own "disease life/world". When asking both Rigshospitalet and Vital Beats, what the patients would benefit most from, by having the SCAUT platform, they answered as followed.

"It would definitely be, to be more involved in their own treatment. To have control of anxiety insecurity, before they answer on their transmissions, so they can live a less stressed life, and they do not have to worry about whether or not the pacemaker is working." (Informant Vital Beats, coded interview, pp.1-2)

"Hopefully some sort of security, a connection in a way." (Clinician, coded interview, p.5)

To sum up, there are various ethical *technical codes*. From the designer's perspective, the platform aims to emancipate and create autonomy for patients. When implementing the platform some patients will be oppressed, and they even might benefit more from the current communication.

8.3.2 The economic aspect

A design is functioning based on e.g. economic factors. The capability of the technology itself is based on scientific development and knowledge. Social interests are more complex because they rely on groups of interest and their values. The SCAUT platform involves many economic considerations.

"Economic codes are nowhere recorded in a manual but are implicit in behavior and attitudes, and signify a broader range of values than the permitted and the forbidden." (Feenberg 2002, p. 77)

A very common topic in Vital Beats, whether it is at lunch, in a meeting, or in the office, is funding and investment. Vital Beats depends on funding, and they are often contesting in the field of digital health solutions, to get money and acknowledgment. Their existence depends on investment and expansion of the SCAUT platform to other hospitals. The quote below touches upon how economics plays a succeeding role.

"Technologies are by contrast developed as proprietary and have an economic incentive built into them, which increases the chances that one form will succeed at the expense of another." (Flanagin, Flanagin, and Flanagin 2010, p. 183)

In order for the SCAUT platform to be interesting, it has to lower costs and reduce workload for the clinicians. Vital Beats argues that the SCAUT platform will decrease the workload for clinicians.

"The greatest advantage, if I was a clinician. It would be that I could do the same work better and more efficiently. It would create more time to focus on the patients, who really needs it." (Informant Vital Beats, coded interview, p.1)

When asking clinicians how they find the SCAUT platform beneficial, they are focusing on the patient. They do not address how it might benefit their work. Clinicians might not see the platform as beneficial for them. Even though this study has not been an “economical” study, there is no doubt that money is an important rationality.

8.3.3 The aspect of power

According to Andrew Feenberg, the world has changed from tradition and religion to power and knowledge. Today knowledge has become a tool of power (Feenberg 2002, p. 75). Knowledge and power should be treated as complementary to each other, instead of separating them. It is believed that knowledge can be used as power. Furthermore, those in power also have knowledge. Vital Beats have the power to decide how the SCAUT platform should be formed, the so-called ‘’script of the technology’’. Clinicians have the power to decide how to use the SCAUT platform and how to communicate and help Patients. The technology might change according to who is in charge.

> *“In implementing a new technology, it may be necessary to ‘allow’ it to drift into unexpected situations; if the technology is going to ‘work’, it must be open to change. Innovations configure the user, defining who may use it and how, but they also modify existing social structures and create new ones.”*
> (Williams-Jones and Graham 2003, p. 277)

The quote above describes how technology can take different forms in relation to who there are using it. Vital Beats have decided what the SCAUT platform exist of. During the field work it was uncovered what the patients needed the most, was direct and easy communication with the pacemaker clinic. However, often in relation to practical information about booking appointments, getting reminders before their visit, have a calendar that corroborates with appointments at the pacemaker clinic. We presented the insights that we have gotten from the patient for Vital Beats. When asking Vital Beats specifically, if it would be possible for patients to confirm their appointment, the answer as follows.

”*I think by confirming your time, it can reduce the number of patients not showing up. It is a good small side feature, but it is not the core of our product.”* (Informant Vital Beats, coded interview, p.4)

Vital Beats are trying to give patients power, to be more involved in their health. On the other hand, the patients have needs e.g. according book appointments, have a booking calendar, get reminders. Vital Beats will not give them the power to meet their wishes. The power structures are used reversed. In general, it is important for the patients to have the power to decide their appointments at pacemaker clinic.

“I am going to school, so I would like to have an option which affects my school as little as possible.” (patient two, coded mockup two, p. 3)

A key concept within the *technical code* is *operational autonomy*. It is a concept, that favors the autonomous power to design.

“The technical code combines elements of both types. It is most essentially the rule under which technical choices are made in view of preserving operational autonomy.” (Feenberg 2002, p. 77)

Vital Beats hopes that their “autonomous design” can inspire others, to create new designs and better healthcare. The informant from Vital Beats elaborates.

“If it succeeds in becoming a success nationally and internationally, I hope that others will be inspired to start with a real issue. I think we are going to be a really good case, for the Danish healthcare system, to be a small company without big partners.” (Informant Vital Beats, coded interview, pp.3-4)

Sub-conclusion

There is an extensive amount of *technical codes* embedded into the SCAUT platform, and properly a lot more than there has been uncovered in this analysis. The *technical codes* will appear differently depending on who is having the power.

Furthermore, depending on who is having the power, the technology will form into new shapes.

8.4 Digital mediated health communication

In this section, a critical analysis of digital communication is formed. The section is inspired by a chapter in (Feenberg 2002, pp. 98-108). According to the innovation of the SCAUT platform, there are specifically two different obstacles. The first one being, that software engineers and designers are creating something not usable or nonfunctional. Meaning, that if the designers imagine something they think are of relevance, it might not be relevant for the patients. The SCAUT platform is therefore not usable. In another scenario, the SCAUT platform might be beneficial, but it is developed, only, by software engineers and therefore, the whole design of the platform might not apply to the users. This can create a situation where software developers are building a platform with features, the patients might not know how to use.

> *"Programmers and designers "live" in an environment defined by the computer programs they use, exchange, and discuss online. Computer is a web of communications, a social as well as a technical network. In its application to communication, the computer has an astonishing power to form the medium for a parallel world."* (Feenberg 2002, p. 99)

Vital Beats have from the beginning framed, the perspective, that they are doing user-centered design.

> *"Without the patients inputs it would be very hard to develop the platform, as we want it to be. One thing I have used most time on, is understanding our users."*
> (Informant Vital Beats, coded interview, p.5)

There is an extensive amount of literature about how digitals systems that fails because they do not apply to the users. Furthermore, the technology is also controlled by the different technical codes applied in innovation. Andrew Feenberg describes that a *"computer is a system of control and automation"* (Feenberg 2002,

pp. 98-99). Vital Beats relies very heavily on their model of innovation, where engaging patients and clinicians in the design process might limit the possibility of developing something not usable

"We have a rule saying that the features that we are developing should create meaning for both parts. It is to ensure the best possible treatment." (Informant Vital Beats, coded interview, p.3)

After conducting the workshops with patients, it appeared that there were many adjustments for the mockups to be made. Even though, the first draft of mockups was created based on an existing platform, a previous project (see appendix 1), personas, literature, and inputs from the clinician. The inputs from patients are unique because they describe situations only pacemaker patients have insights in. Patient five's dad elaborates on it in the quote below.

"We do not press the box, we are reading the box." (Patients fives dad, patient five, coded mockup five, p. 2)

The quote above might seem simple, but it can create a lot of confusion and misunderstandings among patients if it is not correct. In a conversation, it might be possible to correct a mistake quickly. However, when having a digital platform, it creates a parallel world, where people can change and define themselves, but it also overcomes geographical obstacles. In the article *''The agency of patients and carers in medical care and self-care technologies for interacting with doctors''* (Nunes, Andersen, and Fitzpatrick 2019) described in the literature review, it is also explained how digital communication can be limited because of the "missing" physical interaction. Patients living far away, and seriously ill patients do not have to travel to Rigshospitalet, which makes this form of communication attractive.

"The participants in regular online discussions find their lives doubled into a "real" and a "virtual" segment. In their everyday world, they relate to people who are geographically close, but in the virtual world, social contracts are chosen without reference to geography, exclusively on the basis of shared interest of work." (Feenberg 2002, p. 99)

Another advantage of the platform is the asynchronous communication form, that constitutes an opportunity to have more fluid communication. Which is a subject that is discussed from time to time in meetings with Vital Beats. Both patients and clinicians can optimize their time and respond when they have time.

"The clinics are given the information they need to be able to make a quick diagnosis and be able to provide treatment immediately." (Informant Vital Beats, coded interview, p.1)

Another interesting observation is how the relationship changes when having a "human-digital" relation. Andrew Feenberg (Feenberg 2002, p. 106), addresses that a relation between human technology is not durable since the technology does not have a mind. The SCAUT platform might not have a mind, but it acts based on human thoughts and actions. However, when the patient and the SCAUT platform "join forces" they take shape and functions as a *hybrid*. A reason for Andrew Feenberg to separate humans and computers is because the computer acts based on rationalistic choices (Ibid). Andrew Feenberg addressed this in 2002, and much has happened to technology since. Because of digital communication, the patient might take new and more distant shapes, both clinicians and Vital Beats are concerned that the patients will take advantage of the situation and ask more questions and make more transmissions. When asking Vital Beats, if it would make sense to let the patients book their own appointments, the informant from Vital Beats elaborated.

"You may panic and need HELP HELP HELP. Patients sometimes as their illness gets worse become master of acting irrationally. Also, I think it would explode completely with time bookings. There would be some individual patients who would take all the time at the clinics." (Informant Vital Beats, coded interview, p.4)

First, this is because the platform creates a social distance. The other aspect is the convenience where it is easier to send a message, than waiting in a phone queue to ask a question. Another concern from Andrew Feenberg is that when having a social platform like the SCAUT platform, the interactions will be limited. This will create a simplified social interaction among clinicians and pacemaker patients, which might

create more distance. The communication in the SCAUT platform is almost a one-way communication, meaning that it is the patients who are reaching out for the clinicians, and then the clinicians are responding. In general, the patients have been concerned, because they needed more response from the clinicians. It has therefore been of key interest from the patients' point of view, to have a more mutual communication.

"You would like to be contacted if there is anything out of the normal [...] and if you have asked a question then you expect an answer from them." (Patient one, coded mockup, p.4)

This creates a situation where the clinicians are only the "responses". If the clinicians were in direct contact, it would open up for other questions and a more two-sided communication. However, it is still noticeable that Vital Beats believe, that Clinicians through the SCAUT platform can be able to optimize their communication while maintaining even better care for patients.

Sub-conclusion

The SCAUT platform can communicatively be beneficial in creating faster and more convenient communication, but the possibility of personal distance, miscommunication, and misuse can occur. The patients might interact in new roles when communicating through SCAUT. The use of user experience creates a forum where the computer is not only rationalistic, but it becomes more personalized and social.

8.5 Socialization, Democratization, and Innovation

In the following section, the dialectics of technology and its development will be analyzed, through three logic transition processes, that can occur when innovating new technology. These thoughts are based on CTT and Andrew Feenberg's thoughts in relation to technology (Feenberg 2002, p. 148). The three transition processes are *socialization, democratization,* and *innovation*.

Socialization: In this project, it occurred that when developing a product, planning of the innovation is the first step that occurs in the process. With Vital Beats, we have been able to conduct a plan in relation to who and how the SCAUT platform will benefit the ‘’society’’ of IPG and CRT-P patients. Afterward, we found out how to develop suitable prototypes, through PD, to get the most adaptable product for the patients. In the future, this leads to product development where the market will be entered, and hopefully, over time, the market is ‘’filled’’ and disappearance of it will happen. The quote below is an example of how Vital Beats want to enter the market and scale-up, and how users have a huge influence in relation to how the market will be entered.

‘’[...]. I think that overall, there has been positive thought about SCAUT, and they understand the meaning of it, in why we want to have more patients onboarded. It is our responsibility, to adapt the system to the users, more than it already is.”
(Informant Vital Beats, coded interview, p.1)

Democratization: the term *democrati*zation, refers to how technology development, needs processes where economic, political, and social characteristics are considered. When developing the SCAUT platform for IPG and CRT-P, these processes are of huge importance. Through the project, it has been uncovered that the patients have a strong opinion in the development process, but there are certain things, which cannot be argued and where Vital Beats cannot meet the expectations. Some of the patients explained that they would like to be able to get a reminder when they have an appointment at the pacemaker clinic.

‘’It is just if it is able to put all the upcoming hospital visits into the application, and a phone number on every department in the app. A reminder with when to transmit and when to meet up at the clinic.” (Patient one, coded mockup one, p. 8)

Vital Beats, over time, want to meet those expectations, the patient has in the quote above. It is difficult because it must be combined with ‘’Sundhedsplatformen’’, so it is regulations there involve the region and other political aspects before there is a chance that it can happen. The informant from Vital Beats explains how it is

complicated, to get a reminder and other kinds of information about visits at the hospital.

''Yes over time, I think we will. But there is the thing, that we have to be in Sundhedsplatformen before that can happen because if the appointment gets changed, it has to be changed manually in Sundhedsplatformen." (Informant Vital Beats, coded interview, p. 4)

It is difficult to meet every expectation even though, it is the vision, but regulations, politics, and economics is a part of innovation and will play a role no matter what, and this is also what was observed through the project.

Innovation: This third concept of transition, is not clear to observe in this constellation, maybe it is because, it is on an institutional level, where we did not have access to investigate that area or it is because the institutional decisions have not been made yet. The term ''innovation'' in the CTT vocabulary, depends on changes on an institutional level, it could, for example, be that the SCAUT platform got a collaboration with data from ''Sundhedsplatformen'', which is one of the visions Vital Beats have, as mentioned above. Indeed, the development of the SCAUT platform for ICD patients has created patterns for the innovation of the platform for IPG and CRT-P patients. It is known, that the way Vital Beats created the SCAUT platform for ICD patients, happened to be successful, and therefore they are using many of the same patterns for innovation of the SCAUT platform for IPG and CRT-patients. It is also shown in the literature in section 6.0 Literature review, that experiences and do's and don'ts from earlier research have been used, copied, developed, and taken up for consideration from the very beginning of e.g. PD and user-oriented design.

Sub-conclusion

Socialization, democratization and *innovation*, are indispensable terms in the development of the SCAUT platform. The terms contribute in different ways to show how the innovation of technology gets affected and can be navigated in different ways, in relation to what focus the company chose to have.

8.6 Dissolving the boundaries around the SCAUT platform

In this section, it is intended to analyze how political and moral boundaries, limits technology, and place boundaries around it. We aim to analyze, how and if Vital Beats enables the opportunity to remake and remove these boundaries, which is what Andrew Feenberg approaches to be the right way to develop the technology (Feenberg 2002, p. 15). Furthermore, the technological rationalities that can occur will be analyzed, to show that possible stakeholders and other powerful positions can control technological innovation and its purpose.

''Technological rationality is indelibly marked by the presupposition that production goes hand in hand with social domination. The trace of this presupposition can be found in economic thought, managerial methods, and the very design of technology.''
(Feenberg 2002, p. 66)

In this project, PD has contributed to that, the technology ''prototype'' we have developed together with experts from Vital Beats actually began with breaking up the boundaries around it. We involved personas, carried out based on the knowledge, we have gotten about the patients, to find out how the prototypes should be designed so it would fit into the patients' needs. Furthermore, an interview with a clinician was conducted to get insights into what clinicians think that the SCAUT platform has to consist of.

'' [...] It can be everything, it can be symptoms, it can be, ''I cannot meet up to my scheduled appointment, now the box is blinking here at home. It can be many things and it is difficult to give a specific answer.'' (Clinician, coded interview, p. 1)

The quote above is an example from our interview with the clinician before, making the prototype. The clinician contributes to give an idea about what the patient needs and does not need. The clinician's starting point is the ICD patients because he is used to working at the SCAUT platform with ICD patients. It was decided to find out what the difference between ICD and IPG/CRT-P patients' needs are, in order to not

make too many misunderstandings. Therefore, we asked about the differences between the patients, which is shown in the quote below.

''Pacemakers with CRT-ties are given to patients with heart failure. There do not exist patients with heart failure there do not have symptoms. It is a definition of heart failure to have symptoms.'' (Clinician, coded interview, p. 4)

To make sure that, we did not only obtain, the experts from Vital Beats and the clinicians', inputs as ''true'' statements, we also made workshops together with patients, to get their insights and in that way reform the prototypes. By reforming the prototype, we got closer to a solution of freedom where the patients' needs are of huge importance.

''The next one is, that I have heard an alarm, what is that? is it the pacemaker? what do you mean with alarm?'' (Patient one, coded mockup, p.3)

The quote above is an example of, how important it has been to involve the patients in the design process. We did not know, that the IPG and CRT-P patients, do not have an alarm connected to their device. It is only ICD patients who have that, and therefore we removed the alarm question from the application, and by that got a more suitable mobile application for IPG and CRT-P patients.

History also mentions that technology can be difficult to change from its original form and that it will exclude e.g. specific people from using it (Feenberg 2002, p. 13). In this case, it is a fact that the SCAUT platform is a mobile application, and therefore a smartphone is needed to be able to use the SCAUT platform. In that way, it is clear, that the SCAUT platform excludes certain patient groups, and therefore it cannot reach pure equality. It is possible to change the technology, in a way where it will fit the patients who are using it, but not the ones there are already excluded, automatically because they do not have a smartphone. In the quote below, the informant from Vital Beats explains how the task, to get the elderly generation onboarded, can be difficult to manage

''It is a big task, but I think that we think more future vice, because of cause there is a big elderly group who is less technical. They will, clearly, find this more difficult. We think into the future, how does a health-care solution look tomorrow? Because if you only think of today, you will never get far enough.'' (Informant Vital Beats, coded interview, p. 5)

One of the many reasons for doing PD with the users is to be able to dissolve technical rationalities, where technology gets *one-dimensional* and society loses its ability to get critical in relation to the innovation of technology. By involving the patients and clinician it created a critical point of view, on the prototype and it enabled the possibility to be more conscious about the patients' and clinicians' needs. In the quotes below, it is shown how the patients and clinicians came up with critical thoughts in relation to the SCAUT platform.

''I mean that you really have to think in relation to which questions you ask and what kind of answers you can get in return when the patients have to describe their symptoms.'' (Clinician, coded interview, p. 3)

''Dad: It is cool, but it should be described how you will return with an answer. Is it via E-mail, phone, Facebook, or which E-mail? [...] and when will I be contacted? So maybe it has to be described, ''within two weeks or a month?'' (Patient five's dad, coded mockup, p.5)

The quotes above show how both the patient and clinician, ask critical questions, in relation to the prototypes, and comes up with new ideas, and thoughts that are fruitful for the development of the end product.

Sub-conclusion

Our results have shown, that PD has contributed to remaking and transforming already existing prototypes. This is beneficial for users and breaks boundaries around the technology that causes oppression of the patients' needs in relation to their communication with the pacemaker clinic. Through PD, the clinician and patient got the opportunity to have a critical consciousness and ability to see the world from

more than one dimension, in this case, it is possible to remake technology and have influence in relation to that.

9.0 Discussion

In this section, the innovation process of the SCAUT platform will be discussed in relation to Bruno Latour's *Matters of concern* (Botin, Berthelsen, and Nøhr 2015). Bruno Latour combines *matters of fact* and *matters of fairy* and addresses them as *matters of concern*, where he introduces the *six C´s.* Each concern will be discussed chronologically more specifically in relation to *cost*, *cure*, *construction*, *care*, *creativity*, and *comfort*. Bruno Latour argues that the six addressed concerns must be fulfilled to some existent in order to create a suitable healthcare technology. Based on the empirical data and analysis, we have applied two more concerns, which we think are time-relevant according to the innovation of new healthcare technologies. The two new concerns are more specifically *consumption* and *consciousness*. The discussion will be compared with relevant literature and reflections from the applied theoretical- empirical and methodological framework will be discussed.

9.1 Matters of fact (1) *Cost*

This section aims to discuss how *matters of fact* affect the innovation of the SCAUT platform according to *cost*. The holistic view of the SCAUT platform is that the platform can create better care and therefore better health at a lower *cost*. This discussion will both be drawing on the innovation process, in general, according to literature and empirical data, but it will also be a critical reflection of this specific innovation process.

Bruno Latour believes that matters of fact can create meaningful and relevant healthcare solutions (Botin, Berthelsen, and Nøhr 2015, p. 10). Techno-Anthropology operates on a socio-technical level, and therefore the belief and combination of both, suit beautifully into our educated ontological faith. It has been observed through this project that innovation happens on different levels. Earlier in the theoretical section

4.0 Theory, it has been introduced, how there is a societal, institutional, and individual level. Depending on which level, it is fair to say that the values of *cost* changes. In general, the patient does not pay much attention to money in the innovation process (individual level). Vital Beats has to earn money (institutional level). The healthcare sector needs to save money in order for a new healthcare technology to be interesting (societal level). Through our observations, it could be argued that values shift among *actors*, and therefore concerns sometimes conflict because they are simply not the same on every level.

During this project, it has been observed that clinicians and Vital Beats are not always aligned in their concerns. Multiple scientific projects on the topic of innovating telehealth advocates that concerns must be aligned for healthcare technologies to work, among other articles *''Aligning Concerns in Telecare: Three Concepts to Guide the Design of Patient-Centred E-Health"* (Tariq Osman Andersen et al. 2018) . The article above suggests, heavily, that a digital platform is only actionable if concerns among *actors* are aligned. Vital Beats advocates that the SCAUT platform will reduce hospitalization, create faster diagnostic, efficiency at the hospitals, less time on communication, a decrease of workload. Furthermore, because the platform is digital, ill patients, do not have to travel to the hospital unless it is necessary. Hence in this ongoing pandemic, the novel coronavirus, it is of huge importance and efficiency that pacemaker patients, can still get care, but at this moment it has to be digital. An employee at Vital Beats explains what the biggest benefit for the clinicians are, in relation to the SCAUT platform, when we ask him directly.

"The clinics are given the information they need to be able to make a quick diagnosis and be able to provide treatment immediately." (Informant Vital Beats, coded interview, p.1)

The clinicians do not have the same objective. In general, the clinicians do not grasp the SCAUT platform, specifically as a benefitting tool according to optimizing and decrease of their workload. The interviewed clinician emphasized that the SCAUT platform is beneficial in relation to patients. On the other hand, the clinician describes his worries about how miscommunication often occurs in writing and not in a conversation, which can lead to a more time-consuming job.

"When having communication in writing, there are many more misunderstandings, that is 100 percent certain." (Clinician, coded interview, p. 2-3)

It is unknown whether or not the clinicians do not think that the platform benefits their work, or if their focus is only on the patients. We introduced the clinicians' perspectives for Vital Beats, and the informant elaborated.

"What you have to keep in mind is that Rigshospitalet has been involved from the start and all the systems child diseases. Therefore, a story has been built, and they have incorporated a system that was not 100% developed." (Informant Vital Beats, coded interview, p.1)

Rigshospitalet has bought the SCAUT platform, and they are paying a fixed amount of money for each onboarded pacemaker patient. It is therefore Vital Beats way to finance the SCAUT platform, by onboard more patients. However, if the platform cannot reduce costs at hospitals, it might be a sympathetic idea according to helping pacemaker patients, but it is not economically functional. It is fair to say, that there are numerous projects these years about optimization of healthcare, by using digital healthcare.

"Another driver for patient-oriented eHealth is a more managerial vision to improve the efficiency of healthcare provision. Organizing shared care solutions around individual patients is expected to help overcome existing communication barriers between institutions and across administrative levels." (Aanestad et al. 2017, p. 20)

It could also be established, based on our empirical work, that many of the technical choices that go into the platform are based on efficiency. For Vital Beats to be attractive for both investors, buyers, and users they have to focus on the economy. The interesting part relies on whether or not the economy is a limiting factor according to create the best possible platform for patients. The easy answer would be yes, we do know that patients suggested that it would improve their life if they could have appointment reminders and schedule their own appointments. It could

also be claimed that one of the main reasons, that this cannot be a reality is because it would increase the work for clinicians. They will most likely have to use more time on bookings, and patients might be more likely to miss and reschedule appointments. Therefore, the patient's suggestions are not economically beneficial hence not durable. The perspective of ANT and the idea of a *controversy* most be *mobilized* for a *translation* to occur and in that way create an *obligatory passage point* that eventually will create a *black box*, is somewhere in the future. For a *translation* to occur, clinicians, patients, and Vital Beats must align their concerns. Instead, with a critical perspective what has happened, is that the SCAUT platform is a *black box*, that needs to be reopened because the *translation* among *actors* never occurred.

To sum up, there are different assumptions on cost depending on the position in the network and its level. The two major divergent tasks are to decrease the workload for clinicians and increase care for the patients, and in the meantime, Vital Beats has to earn money. However, this is only relevant if patients in the meantime get better healthcare.

9.2 Matters of fact (2) *Cure*

In this section, the SCAUT platform will be discussed in relation to whether or not the SCAUT platform improves health for pacemaker patients. Among other factors, in relation to *cure*, the SCAUT platform aims to create deeper involvement of the patient in their own health, optimize the clinicians' work and manage a space where there is a short distance from concern to treatment.

The three mentioned factors above, are observed key elements, that need to be fulfilled to some extent, in order for the platform to be a *cure*. In the article *''Information Infrastructures within European Health Care"* (Aanestad et al. 2017) it is being explained how tele healthcare needs central concepts, in order for it to be a success. The patients necessitate to be able to navigate and take meaningful decisions and the clinicians have to provide healthcare insights.

"New information and communication solutions need to be provided for both patients (enabling them to contribute meaningfully in decision-taking) and providers (providing them better insight on patient circumstances). Such eHealth solutions can support communications, information sharing and distributed data management."
(Aanestad et al. 2017, p. 20)

It can be argued that for the patients to take valuable decisions, they need to be educated properly. The clinicians, on the other hand, need to be able to decode what the patients require and respond positively to their treatment. One of the key findings in the earlier project, see appendix 1, was that it was staged that patients and clinicians have fundamentally different beliefs on treatment. The clinician refers to the biomedical model and the patient to their feelings. This signifies, that if clinicians and patients cannot reach each other, then the SCAUT platform might not be a mediator to *translate* concerns. In the analysis, it is described how clinicians think that if the patients can elaborate on their symptoms, in the SCAUT platform, it might create misunderstandings and workload. Furthermore, the patient can take advantage of the situation and produce numerous questions about symptoms than before. The interviewed clinician argues that all pacemaker patients have symptoms, but the clinicians are only able to help with technical issues.

"I would rather say why should you ask that group? Is it because they need to ask about the calf muscle. Or do they need to know if the technical stuff is in order."
(Clinician, coded interview, p. 1)

However, Vital Beats elaborates that the clinicians do have a responsibility, including if symptoms are out of their treatment area. They might not be able to directly help the patient, but they can meet their concerns.

"One thing, the clinicians are worried about is, that they do not know, what to do with a known symptom. They say ''what are we going to use it for? we can't do anything". I think it can be an easy way to say we can't solve the problem, but they just forget about the patient so much." (Informant Vital Beats, coded interview, p.2)

A reflection can be, that clinicians are experts within their discipline which is the treatment of patients. The patients are experts in their life/world. Then there are Vital Beats with multiple expert roles from software development to anthropology. Vital Beats then uses their knowledge/power to change the clinicians' expertise. Vital Beats thinks that they have a *cure*, that can create a better life/world for pacemaker patients. On the other hand, the clinicians are the ones, who have to take action by using the SCAUT platform. If the clinicians are not prepared to use the platform, as intended, then the technology might drift, and become something else. In a meeting with an associated professor from the University of Copenhagen, who also works part-time at Vital Beats, it was discussed how it is acknowledged that an innovation process has been successful. He addresses that it is successful when the technology itself is no longer discussed; it is a part of the background. He furthermore addresses that this happens by going back and forth in the innovation process and keep on negotiating with *actors*. It can, therefore, be argued that since the SCAUT platform is still up for discussion, it is not a successful *cure* yet. Our role also biases the project to some extent, because we have been doing a specific task for Vital Beats and we have been a part of their everyday work, meetings, and social gatherings. In the meantime, we are the ones doing the innovation process, but based on the requirements from Vital Beats, but we likewise attempted to distance ourselves in order to create a critical view of the process.

Doing this process, we often found ourselves having an epiphany moment, according to how the SCAUT platform can create better healthcare for patients. One day we were told that the SCAUT platform will create personalized medicine and that patients can be treated from a distance so that ill people do not have travel. The next day it was argued that the platform is not personal, because it is the same for all. That the miscommunications occur when healing from a distance and that patients will suffer from not having the personalized communication. It is fair to say that these statements have sometimes been confusing, and in some situations, they became almost political.

To sum up, for the SCAUT platform to be a *cure* it has to align patients' and clinicians' concerns, in order for them to take proper action. Patients and clinicians behave differently, and misunderstandings and miscommunication might occur.

Clinicians also have to be aligned with Vital Beats, in order for them to take action on patients' needs.

9.3 Matters of fact (3) *Construction*

This section explores a critical view of the innovation process in relation to *construction*. By having a focus on limitations and points of impact, in relation to our own reflections on the process in chronological order. It was chosen to use personas, interviews, and mockups as the methodological framework. This project builds heavily on the methodologies, which reflects both the innovation process and the project. Meaning that the innovation process has evolved based on methodological choices.

We started with personas, which was practiced personalizing the SCAUT platform, by pinpointing stereotypes and make sure, that their needs were fulfilled. However, it is essential to designate that there might be other persona types, we possibly have neglected, and patients might, therefore, have been excluded from the design. Furthermore, a significant critic, in general, is that one person does not fit into the stereotype and that the stereotypes become too extreme (Pruitt and Grudin 2003, p. 13). Another factor is that we aimed to create a persona type, who is less technically experienced. Due to the change of workshops from direct interaction to digital interaction, it excluded patients who did not have the skills to participate virtually.

After the personas, we did an interview with a clinician at Rigshospitalet. In the innovation process, the clinician more or less represents the leading *actor* in the healthcare *network*. His reflections might not be representative of the whole *network*. Furthermore, the intention was, that we should have followed up on his arguments, after collecting the data. This was impossible due to the novel coronavirus, and therefore the clinician's perspectives were not challenged as much, as we would have liked. By drawing on participatory design studies we conducted mockups with patients. One of Vital Beats's core rules is that they always involve patients and clinicians in the development of the new projects.

"Without them, you cannot make the product and have the dreams of where the product could go without their knowledge." (Informant Vital Beats, coded interview, p.5)

Even though the process of the project has been well defined, it quickly appeared that innovation does not happen in a straight line. As new knowledge evolves and new actors get involved, it is necessary to contact old *actors* and ask new questions. It can be debated that when doing participatory design, it contains a lot of negotiations. Where we as mediators have negotiated among *actors'* interest. In the article (Bødker, Dindler, and Iversen 2017, p. 269), something similar has been observed, also that *actors* are not only engaging in the design.

"participants are not only engaged in designing technology, but in creating the structures, networks, and agreements that are crucial to creating sustainable outcomes. These concepts challenge traditional PD concepts such as mutual learning, and prompt reflection on what may be considered the object of design." (Bødker, Dindler, and Iversen 2017, p. 269)

We do not think that our methodological frame has created a mutual understanding of the platform, but it has provided innovation with various perspectives.

In the middle of this innovation, it has been decided to change the research strategy from direct workshop to digital workshop. On the positive side, we had the opportunity to conduct a new research method, overcome geographical obstacles, make a design with patients without exposing them for the infection, more accessible design methods, and optimize the consumption of time. Another unexpected factor has been that the patients spend time preparing before the mockups, by looking at the mockups beforehand. In that way, we did not get the patients' immediate response, that we wanted, so we ended up sending the mockups right before we did the workshops. On the more negative side, the digital solution excluded specific groups of people, made the communicative interaction more difficult, created technical challenges and it formed a more distant communication that limited creativity.

It has been observed during this innovation process, that it requires many different *actors* with different disciplines. The process is not fluid but consists of a lot of power, hierarchy, and negotiations. Often the person with the most power or the strongest discipline will succeed. Most of these processes do not occur in the front but are sort of underlying backstage processes.

> *"The concept of back stage orients us to the activities and the processes that tie together particular design activities, such as workshops and meetings, together. These activities specifically target issues such as the alignment of actors and decision-makers, and the underlying development of the technological platforms used(...)."* (Bødker, Dindler, and Iversen 2017, p. 250)

Backstage design is not an explicit part of PD, but it creates an understanding of how the negotiations, relationships, and *networks* emerge. These activities have been going on much longer than this project, which is why many of the activities are predetermined/pre assumed according to actors and *networks*.

To sum up, there are many considerations to be made when constructing a new technology. This innovation process builds heavily on the methodological choices, that in the end have formed how the SCAUT platform come to be. Many of the negotiations that form the product happens behind the scenes, which builds the SCAUT platform from within.

9.4 Matters of fact (4) *Consumption*

The last concern of matters of fact is a self-developed concern, that draws on inspiration from Albert Borgmann (Verbeek 2005, p. 178). More specific this concept is *consumption*. Albert Borgmann addresses *consumption* as a definition of lifestyle, where the goal is to emancipate and enrich people. When thinking about the SCAUT platform, it is in its pure form, a technology that has to provide healthcare for pacemaker patients, and that leads to the production of new technology. When developing a new technology, a new pathway of *consumption* occurs. Often new technologies refer to production rather than *consumption*. (Lancaster 1966, p. 14)

It is believed that since our society is skilled, developed, and wealthy the innovated technologies are often complex. Where in other societies with limited resources and technical skills, the technology is more simple (Lancaster 1966, p. 15). It can, therefore, be argued that technology applies to a society depending on the market. Vital Beats intends to expand the SCAUT platform to other countries, and therefore also other societies.

> *"I strongly believe that we are an integrated part of the practice of pacemaker patients. If expansion national and international success, I hope others will be inspired(...)."* (Informant Vital Beats, coded interview, p.3)

But is it possible to move one platform from one consumer to another? During this project, it has been observed that even in a healthy welfare society like Denmark, people are being excluded from technology due to limited technical, educational, and financial resources. The healthcare system is in broad terms free of charge in Denmark, but when having the SCAUT platform it is required to have a smartphone to get healthcare. Vital Beats, therefore, privatizes public healthcare to some extent. Now it has been established that consumers are different and therefore also the *consumption*. If you have an existing product, the current user must be convinced, that the new product is better (Lancaster 1966, p. 22). Vital Beats have to convince the patients, that a mobile application can replace/assist current communication with the hospital.

Another interesting perspective is the *consumption* of technology in general. This refers to whether or not the SCAUT platform is just another technology, that is being produced and not consumed. Is it just *consumption* and is the SCAUT platform technology a necessity? Whether or not the CRT-P and IPG patients will adapt to the new technology, we do not know yet. In general, there has been a common interest among pacemaker patients according to the SCAUT platform, and they have not questioned the existence of the platform. They all address that they intend to use it, but mostly as a reminding communication system. This leads to the final reflection, according to the relevance of the platform. Based on the workshops with patients, it is assumed that some features will be used more frequently e.g. reminders, phone

numbers, and appointments. The interview with the employee from Vital Beats clarified that many wishes according to the SCAUT platform from patients, are not a part of their core product. This could, in worse case, end up being a situation where Vital Beats have focused on specific parts and the patients on other parts. It could be claimed that there is a disordered alignment of *consumption* and by that concerns, among *actors.*

To sum up, for the SCAUT platform to be a definition of lifestyle, it must emancipate and enrich pacemaker patients. The technology must be adapted to the market, society, and the patients/clinicians who use it. Furthermore, it has to be better than the existing technology, otherwise, the platform will be produced, but it will not be consumed.

9.5 Matters of fairy (1) Care

The following section draws upon Bruno Latour's first C in *matters of fairy*, *care*. It will be discussed how *care* is embedded in the technology and if it can be a substitution or addition for the patients' way to communicate with clinicians. Furthermore, can PD and prototyping contribute to better care for the patients? Lastly, the focus will be to discuss the results from an ethical point of view, supported by the articles *''Aligning concerns in telehealthcare: Three Concepts to Guide the Design of Patient-Centered E-Health''* (Tariq Osman Andersen et al. 2018) and ''*Equality challenges in the Use of ehealth: Selected results from a danish citizens survey.''* (Petersen and Bertelsen 2017)

Vital Beats tries to make the SCAUT platform, as ''carrying'' as possible. As elaborated on in the analysis, it has been discovered that Vital Beats, involves patients as much as possible to make the best outcome for them. The problem is that some patients will be ''lost'' because they do not have the skills to e.g. use a mobile application and therefore, they might not use the application at all. This problem is of huge importance because most of the pacemaker patients are elderly. Though the informant from Vital Beats explained how they will try to take care of the elderly patients.

''It is a big task, but I think that we think more future vice, because of cause there is a big elderly group who is less technical. They will, clearly, find this more difficult. We think into the future, how does a health-care solution look tomorrow? Because if you only think of today, you will never get far enough." (Informant Vital Beats, coded interview, p. 5)

Vital Beats's informant is not quite clear in his answer to how they will take care of the elderly patients, and it is possible because there is no solution yet, and maybe it will not happen for the elderly generation we have right now. Maybe in 20 years, when people who are used to technology gets older, and possibly gets a pacemaker, it might be easier to get them onboarded. For now, what Vital Beats try to do is, to develop the SCAUT platform, in collaboration with both young, middle age and elderly patients, to get a suitable solution for as many patients as possible. This is maybe the closest way to reach everyone's needs for now and in that way try to take care of the patients' different concerns and needs. Through participatory design, it is possible to make more equality for the patients, because the SCAUT platform, gets developed with patients with any kind of socioeconomic background. This is very important, because a study from the article ''*Equality challenges in the Use of ehealth: Selected results from a danish citizens survey."* (Petersen and Bertelsen 2017) has shown, that patients with lower education found it difficult to use health information technologies as e.g. the SCAUT platform. If this kind of technology wants to reach as broad population as possible, methods where people with a different kind of socioeconomic status, can be taken up for consideration. PD with different patients and backgrounds is a good estimate for a method there will be beneficial for as many as possible and in that way, it can decrease the group of ''lost patients''.

Care is also a term used in relation to the ''real'' caregivers who are the clinicians in this case. In this project, it has been tried to involve the clinicians in how to develop the SCAUT platform. It was conducted with the purpose of aligning concerns. It is known from the article *''Aligning concerns in telehealthcare: Three Concepts to Guide the Design of Patient-Centered E-Health"* (Tariq Osman Andersen et al. 2018) that aligning concerns with the different actors involved, is of huge importance otherwise, the technology will not be actionable, feasible, and meaningful (Tariq

Osman Andersen et al. 2018). Therefore, the clinicians got the opportunity to come up with suggestions, concerns, and reflections in relation to the SCAUT platform, before the prototypes for the workshops got carried out. It can be argued whether or not the clinicians' concerns are fully aligned, because they, in general, have negative thoughts about new technology getting implemented. A way Vital Beats takes *care* of the clinicians' is to make them take better *care* of the patients, to have workshops with them, and make them understand how the SCAUT platform will be beneficial for them too.

> *''We work on a version two, so we have not could give the clinicians the feedback, I hoped to. It can have created some sort of mistrust in the system. Some of the clinicians are still nervous in relation to reform a work practice. We talk with the clinicians about it and invite them to us, for a workshop in relation to vision and plans."* (Informant Vital Beats, coded interview, p. 2)

To sum up, clinicians have to give *care* to the patients. The SCAUT platform can be an extended arm, but to do that, Vital Beats has to take *care* of the clinicians and also the patients. It is a circle and *network* of *care* which has to function from every part to be able to succeed.

9.6 Matters of Fairy (2) Creativity

This following section illuminates and discusses how Bruno Latour's second C in *matters of fairy*, happens to appear in this case. The aim is to discuss how prototypes and PD can contribute to that technology that covers human needs in the ethically way. This will be conducted in relation to the article *"from research prototypes to a marketable E-health system"* (T. Andersen et al. 2015) and *''From prototype to* product'' (Tariq O. Andersen et al. 2017).

Creativity in the form of soft values can refer to how companies and designers create their devices and technologies. Vital Beats has decided to be a company that wants to make user involvement and draw upon the users' thoughts and ideas. In this project, the *creativity* of making prototypes also involved users, and their thoughts.

The article *‘’From prototype to* product’’ (Tariq O. Andersen et al. 2017). explains how user involvement can be very beneficial for end products.

‘’Design interventions are a particularly useful way to combine a good understanding of ‘what is’ with collaborative exploration and experimentation with ‘what could be’.’’ (Tariq O. Andersen et al. 2017, p. 98).

It is, as explained above, an exploration and experimentation of ‘what could be’. This project has shown that without the patients, there have been several points that never had been explored e.g. a patient who explained how the design can be misunderstood according to where a text box is placed, on the screen, in the SCAUT application. For the patient it was obvious, and it annoyed her eye that text box was placed wrong. Without the patient, in the creative process, it has possibly never been discovered, and other patients like her could have used the application and be annoyed every time they got a message because the text boxes were placed in a way, where the messenger and receiver’s text boxes where placed incorrectly.

‘’Interviewer: ‘’Yes there would be a small text box.’’
Patient three: ‘’Sure, but I do not know if it should be on the other side? For me, it looks like the message is coming from the hospital.’’
Interviewer: ‘’Okay, so you think that the text box, looks like they are asking you?’’
Patient three: Yes, if it was placed on the right side, then I would think that the message was from me.’’ ‘’ (Patient three, coded mockup three, p.1)

It makes sense to make user involvement, because the patients actually discover things that the designer, maybe, never would have discovered, as in the situation above. As designers, in the project, we also used a method to make the patients think more creative and not being afraid to say their opinion. The method, that was used was to make the prototypes low-fi. Low-fi means that the prototype, on purpose, does not look too hi-fi and fancy in the design, because then it can look completed. Therefore, it was made low-fi to make the patients think and be more creative in how the design of the SCAUT platform should look.

If looking at the costs of using PD in such a process, as this project, it should be that PD, contribute to a messy process where there can be many loose ends, different directions and patterns. As designers, we are some sort of stakeholders and we are wearing many different hats to be able to align concerns in the process of innovation, and this is exactly how Vital Beats also experienced it in the article *''From prototype to* product'' (Tariq O. Andersen et al. 2017)

''This means that we engage the PD process as a messy process of innovation. We proceed not as only researchers and designers but as entrepreneurs, recognising that being pragmatic and aligning users and other stakeholders' interests is core to making PD commercially viable [20].'' (Tariq O. Andersen et al. 2017, p. 98).

Another important point to make is that innovation processes, have many different interests, and it is difficult to stick to soft values when hard values also play a role for soft values to succeed. Design processes are addicted to money and funding, therefore PD also has to show results that are useful and beneficial, seen from financial point of views.

''The commercial interests and commitment of Medtronic hinges on two main dynamics in the project: How good (and fast) we are at developing an mHealth platform that is considered desirable by both patients and clinicians, and how well we succeed in realising the potential of creating new detection and prediction algorithms using patientgenerated data.'' (Tariq O. Andersen et al. 2017, p. 105)

To sum up, *creativity* consists of many different *actors* to be involved and interests to be aware of. Of cause, *creativity* is mostly referring to user involvement and how the patients can be able to show how they want the platform to look like, and they can contribute to a better end product, both for them, and the company.

9.7 Matters of Fairy (3) Comfort

The third, concern in *matters of fairy*, *comfort*, will be discussed in the following section. *Comfort* is a term that can be used in many different situations and with different meanings. In this case, *comfort* refers to how the SCAUT platform can be able to align concerns with both, Vital Beats, patients and clinicians and by that make the innovation process and end product as comfortable as possible, for the ones involved. Different points from the article *''Aligning concerns in telehealthcare: Three Concepts to Guide the Design of Patient-Centered E-Health"* (Tariq Osman Andersen et al. 2018) will also be brought in.

When aligning concerns, it is possible to find out how, what, and who's needs to take care- and be aware of. When patients and clinicians get heard and are able to have a spokesperson there will talk on behalf of the group, it will be easier to, make technology more comfortable for them. If patients and clinicians do not get involved in the innovation of technology that concerns, them, it is possible that the technology will make them uncomfortable and in worse case fail. It is therefore important to make user involvement and listen to needs and experiences. In the article *''Aligning concerns in telehealthcare: Three Concepts to Guide the Design of Patient-Centered E-Health"* (Tariq Osman Andersen et al. 2018) it is explained how the concepts meaningful, actionable and feasible, have to be present when aligning concerns, with users. In our earlier project, see appendix 1, it got used as force to discover, if the SCAUT platform actually could align concerns. Now our way of using PD, prototyping, and fieldwork, has hopefully contributed to that the SCAUT platform will be able to align concerns and be comfortable to use for both, patients and clinicians and at the same time stick to Vital Beats visions and values.

> *''A concern is (1) meaningful if it is relevant and makes sense to both patients and clinicians, (2) actionable if clinicians or patients – at least in principle – are able to take appropriate action to deal with it, and (3) feasible if it is easy and convenient to do so within the organisational and social context. We conclude with a call for a more participatory and iterative approach to the design of patient-centred ehealth services."* (Tariq Osman Andersen et al. 2018, p. 1)

The question is now if the SCAUT platform will be developed from prototype to product, in the spirit of what this research has discovered? It is now up to Vital Beats', data engineers to develop the SCAUT platform in a way, where the results discovered in this project, will be taken up for consideration when developing. We are of the belief, that they will because we have been hired to this investigation and exploration with the purpose of getting closer to a suitable, comfortable, and great solution for IPG and CRT-P patients.

During the mockup process, we also explored that patients want to handle their opportunities differently, e.g. some patients want to use the microphone and record a question where others are more comfortable in texting. We conducted the prototype in that way, to find out whether or not the patients had different needs.

''YES, sure you know which button you have pressed on, so the app could write ''here you have two options'' because you have pressed on the button where you have a question. So, if you do not want to write it, you can speak on the phone and say it, I think that is cool.'' (Patient one, coded mockup one, p. 6).

If Vital Beats, by having different opportunities, can make patients' life more comfortable, then it is worth it in the product making. As in the quote above, the patients explain how it is comfortable for him, that he is able to record a question if he is not in the mood for writing.

To sum up, making a product comfortable for the users requires a lot of insights from both patients and clinicians, which means user involvement. A product can be comfortable for some patients and not for others, therefore it is important to have different options in especially a mobile application and not too many, that unfortunately can create, confusion. It is furthermore important to keep in mind that what is comfortable for patients, might not be comfortable for the clinicians.

9.8 Matters of Fairy (4) Consciousness

In the last and fourth section, the *matter of fairy*, *consciousness*, will be discussed. This fourth concern is self-developed and is an addition to Bruno Latour's six C's, as the *matter of fact*, *consumption* also is. Therefore, it becomes the eight C's where the two additions, from our perspective, will contribute to a more complete *matter of concern* and in that way also contribute to better healthcare if these concerns are present.

Consciousness is, in this case, referring to, how Vital Beats can keep developing technology, that does not lose its *consciousness.* The *consciousness* represents the clinicians and patients because they are the ones who can be critical in relation to how the SCAUT platform is developed. They are the ones that are able to have a critical *consciousness* and are able to ask critical questions. By that, the SCAUT platform and Vital Beats have to follow the exception of the rule and be open in relation to adjustments and changes.

''Patients five's dad: ''It says again that you will return to us, but how will you return? Is there a mailbox in the application?'' (Patient five's dad, coded mockup five, p. 5)

''It makes sense. Questions in relation to appointment can be a bit dangerous.'' (Patient four, coded mockup four, p. 2).

Both of the quotes above show, how the patients ask critical questions to the prototype, mockups. By giving the patients and clinicians the opportunity to have an influence on the innovation process, they will automatically be able to see the world form more than one-dimension. If the SCAUT platform only was innovated by Vital Beats, and the patients had to use it as a communication platform, then it could possibly be *one-dimensional*, and no critical *consciousness* had been able to influence the innovation process.

Vital Beats makes it possible to believe that technological innovation can be a world innovated seen from more than one dimension, and therefore the human

consciousness still exists. This can be conducted by, making user involvement in the form of e.g. PD as in this project. This way of developing technologies might contribute to emancipation of patients and clinicians because they have a voice, there might be heard.

Lastly and to sum up, a critical *consciousness* can contribute to a better technology there might be more feasible for the users. PD is a way to emancipate the patients and clinicians because the SCAUT platform, is developed in collaboration with them, and therefore, also might be more suitable for them.

10.0 Conclusion

This project has explored the innovation process of the SCAUT platform in collaboration with clinicians, pacemaker patients, and the company Vital Beats. By going back to where this project began, we discovered what was considered as important to investigate for an innovation like this. We developed the research question, *In what way can participatory design and different networks contribute to the development of telehealth concerned with communication? And is it utopia to think that the new innovative technology can emancipate, the user's life?* This research question has provided us with the opportunity to investigate how PD can and has contributed to a better way of prototyping, where the *actors* and users, in this case, patients and clinicians, received the opportunity to be creative and contribute to a more suitable and personalized end product. By that, the product (the SCAUT platform) gets closer to fulfill the premise of *Matters of Concern*, *cost*, *cure*, *construction*, *care*, *creativity*, and *comfort.* The two self-developed concerns, *consumption,* and *consciousness* have we as researchers considered as important missing parts in the *Matters of Concern*, because both, takes the term *concern* to a level where *the self* (subjectivity) also gets taken in for consideration. This signifies that the micro perspective, also becomes important when developing technology, for a whole *network,* as e.g. the SCAUT platform. When turning the attention to the question about however technology, as the SCAUT platform, is built up upon utopian thoughts. It has turned out that it gave us some different- and maybe unsolved answers. Vital Beats endeavor to, make a product that can both fulfill the vision of

making an emancipating technology where the users, patients, and clinicians, get their needs covered in a way, that benefits all parts. This is not simple, because the whole *network* is loaded with different economic interests, funding, and deals to be depending on e.g. the requirements of the state in relation to technology, and the healthcare system. It is a never-ending story of how Vital Beats is exiting of *networks* of other *networks*, there will- and eventually have an influence on the end product and therefore, also on the users. Vital Beats determines to innovate in an emancipating manner as much as they think are possible, where the *Matters of Concern*, is almost obtained. By that, they are able to innovate the SCAUT platform, in a collaborative, engaging, and negotiating way, discovered and evaluated from an explicitly CTT and ANT point of view and implicitly from a post-phenomenological perspective. We argue by involving participants in the innovation process, it might be possible to create a more robust and considered technology, that can avoid miscommunication to some extent and provide patients with more suitable healthcare solutions.

11.0 References

"Actor-Network Theory in Education - Tara Fenwick, Richard Edwards - Google Bøger." n.d. Accessed May 16, 2020. https://books.google.dk/books?id=DhfGBQAAQBAJ&dq=Actor-Network+Theory+in+education+online+book&hl=da&lr=.

Andersen, Tariq, Finn Kensing, Lisbeth Kjellberg, and Jonas Moll. 2015. "From Research Prototypes to a Marketable EHealth System." *Studies in Health Technology and Informatics* 218: 40589.

Andersen, Tariq O., Jørgen P. Bansler, Finn Kensing, and Jonas Moll. 2017. "From Prototype to Product: Making Participatory Design of MHealth Commercially Viable." *Studies in Health Technology and Informatics* 233: 95–112. https://doi.org/10.3233/978-1-61499-740-5-95.

Andersen, Tariq O., and Jonas Moll. 2017. "SCAUT: Using Patient-Generated Data to Improve Remote Monitoring of Cardiac Device Patients." *ACM International Conference Proceeding Series*, 444–47. https://doi.org/10.1145/3154862.3154922.

Andersen, Tariq Osman, Jørgen Peter Bansler, Finn Kensing, Jonas Moll, Troels Mønsted, Karen Dam Nielsen, Olav Wendelboe Nielsen, Helen Høgh Petersen, and Jesper Hastrup Svendsen. 2018. *Aligning Concerns in Telecare: Three Concepts to Guide the Design of Patient-Centred E-Health*. *Computer Supported Cooperative Work: CSCW: An International Journal*. Vol. 27. Computer Supported Cooperative Work (CSCW). https://doi.org/10.1007/s10606-018-9309-1.

Andersen, Tariq Osman, Karen Dam Nielsen, J. Moll, and Jesper Hastrup Svendsen. 2019. "Unpacking Telemonitoring Work: Workload and Telephone Calls to Patients in Implanted Cardiac Device Care." *International Journal of Medical Informatics* 129 (September): 381–87. https://doi.org/10.1016/j.ijmedinf.2019.06.021.

"Balsamiq Cloud." n.d. Accessed May 31, 2020. https://balsamiq.cloud/#login?next=%2Fs244a3v%2Fpqmz4bb%2Fr2278.

Botin, Lars, P Berthelsen, and C Nøhr. 2015. *Techno-Anthropology in Health Informatics*. IOS Press. https://ebookcentral.proquest.com/lib/aalborguniv-

ebooks/reader.action?docID=2190956&ppg=17.

Brinkman, Svend, and Steiner Kvale. 2008. *Interview*. 4th ed. copenhagen: Hans Reitzels Forlag.

Bødker, Susanne, Christian Dindler, and Ole Sejer Iversen. 2017. "Tying Knots: Participatory Infrastructuring at Work." *Computer Supported Cooperative Work: CSCW: An International Journal* 26 (1–2): 245–73. https://doi.org/10.1007/s10606-017-9268-y.

Børsen, Tom, and Lars Botin. 2016. *What Is Techno-Anthropology*. Edited by Tom Børsen and Lars Botin. 1st ed. Copenhagen: Forlag.AAU.dk.

Carroll, John M., and Mary Beth Rosson. 2007. "Participatory Design in Community Informatics." *Design Studies* 28 (3): 243–61. https://doi.org/10.1016/j.destud.2007.02.007.

Catalan-Matamoros, Daniel, Antonio Lopez-Villegas, Knut Tore-Lappegard, and Remedios Lopez-Liria. 2019. "Patients' Experiences of Remote Communication after Pacemaker Implant: The NORDLAND Study." *PLoS ONE* 14 (6). https://doi.org/10.1371/journal.pone.0218521.

Chang, Yen Ning, Youn Kyung Lim, and Erik Stolterman. 2008. "Personas: From Theory to Practices." In *ACM International Conference Proceeding Series*, 358:439–42. https://doi.org/10.1145/1463160.1463214.

Clemensen, Jane, Simon B. Larsen, Morten Kyng, and Marit Kirkevold. 2007. "Participatory Design in Health Sciences: Using Cooperative Experimental Methods in Developing Health Services and Computer Technology." *Qualitative Health Research* 17 (1): 122–30. https://doi.org/10.1177/1049732306293664.

Cresswell, Kathrin M., Allison Worth, and Aziz Sheikh. 2010. "Actor-Network Theory and Its Role in Understanding the Implementation of Information Technology Developments in Healthcare." *BMC Medical Informatics and Decision Making* 10 (1): 67. https://doi.org/10.1186/1472-6947-10-67.

Elgaard Jensen, Torben. 2003. "Aktør-Netværksteori – En Sociologi Om Kendsgerninger, Karakker Og Kammuslinger." *Papers in Organization*, no. 48: 1–32. https://doi.org/2282326590.

Feenberg, Andrew. 2002. *Transforming Technology: A Critical Theory Revisited*. https://ebookcentral.proquest.com/lib/aalborguniv-ebooks/reader.action?docID=430829&query=.

Flanagin, Andrew J., Wendy Jo Maynard Farinola, and Miriam J. Metzger. 2000.

"The Technical Code of the Internet/World Wide Web." *Critical Studies in Media Communication*. https://doi.org/10.1080/15295030009388411.

Flanagin, Andrew J., Craig Flanagin, and Jon Flanagin. 2010. "Technical Code and the Social Construction of the Internet." *New Media and Society* 12 (2): 179–96. https://doi.org/10.1177/1461444809341391.

Ghojazadeh, Morteza, Saber Azami-Aghdash, Zahra Sohrab-Navi, and Kasra Kolahdouzan. 2015. "Cardiovascular Patients' Experiences of Living with Pacemaker: Qualitative Study." *ARYA Atherosclerosis* 11 (5): 281–88.

"Global Leder Inden for Medicinsk Teknologi, Tjenester Og Løsninger | Medtronic." n.d. Accessed May 16, 2020. https://www.medtronic.com/dk-da/index.html.

Greenhalgh, Trisha, and Rob Stones. 2010. "Theorising Big IT Programmes in Healthcare: Strong Structuration Theory Meets Actor-Network Theory." *Social Science and Medicine* 70 (9): 1285–94. https://doi.org/10.1016/j.socscimed.2009.12.034.

Kaplan, David M. 2009. *Readings in the Philosophy of Technology*. Lanham : Rowman & Littlefield Publishers.

Lancaster, Kelvin. 1966. "CHANGE AND INNOVATION IN THE TECHNOLOGY OF CONSUMPTION." *The American Economic Review* 56 (1): 14–23.

Latour, Bruno. 1990. "Technology Is Society Made Durable." *The Sociological Review*. https://doi.org/10.1111/j.1467-954x.1990.tb03350.x.

———. 1999. "Circulating References: Sampling the Soil in the Amazon Forest." In *Pandora's Hope: Essays on the Reality of Science Studies*, 24–79. Cambridge: Harvard University Press.

———. 2011. "Networks, Societies, Spheres: Reflections of an Actor-Network Theorist." *International Journal of Communication* 5 (1): 796–810.

Lauritsen, Per, Casper Bruun Jesnen, and Finn Olesen. 2007. *Introduktion Til STS Af Peter Lauritsen m.Fl.* https://hansreitzel.dk/products/introduktion-til-sts-bog-17081-9788741250281.

Law, John. 1992. "Notes on Actor-Network Theory." *Systems Practice* 5 (1992): 379–93.

LeRouge, Cynthia, Jiao Ma, Sweta Sneha, and Kristin Tolle. 2013. "User Profiles and Personas in the Design and Development of Consumer Health Technologies." *International Journal of Medical Informatics* 82 (11): e251–68. https://doi.org/10.1016/j.ijmedinf.2011.03.006.

López-Villegas, Antonio, Daniel Catalán-Matamoros, Carlos Martín-Saborido, Irene Villegas-Tripiana, and Emilio Robles-Musso. 2016. “A Systematic Review of Economic Evaluations of Pacemaker Telemonitoring Systems.” *Revista Española de Cardiología (English Edition)* 69 (2): 125–33. https://doi.org/10.1016/j.rec.2015.06.020.

Lupton, Deborah. 2013. “The Digitally Engaged Patient: Self-Monitoring and Self-Care in the Digital Health Era.” *Social Theory and Health* 11 (3): 256–70. https://doi.org/10.1057/sth.2013.10.

Marcuse, Herbert. n.d. “One-Dimensional Man.”

Matias Jose. 2010. “From Mockups to User Interface Models: An Extensible Model Driven Approach.”

“Medical Technology, Services, and Solutions Global Leader | Medtronic.” n.d. Accessed May 16, 2020. https://www.medtronic.com/us-en/index.html.

Medtronic. n.d. “Medical Technology, Services, and Solutions Global Leader | Medtronic.” Accessed May 16, 2020. https://www.medtronic.com/us-en/index.html.

Mulpuru, Siva K., Malini Madhavan, Christopher J. McLeod, Yong Mei Cha, and Paul A. Friedman. 2017. “Cardiac Pacemakers: Function, Troubleshooting, and Management: Part 1 of a 2-Part Series.” *Journal of the American College of Cardiology*. Elsevier USA. https://doi.org/10.1016/j.jacc.2016.10.061.

Nunes, Francisco, Tariq Andersen, and Geraldine Fitzpatrick. 2019. “The Agency of Patients and Carers in Medical Care and Self-Care Technologies for Interacting with Doctors.” *Health Informatics Journal* 25 (2): 330–49. https://doi.org/10.1177/1460458217712054.

“Ny Coronavirus, COVID-19 - Danish Health Authority.” n.d. Accessed June 1, 2020. https://www.sst.dk/da/corona-eng.

“Pacemaker – Google.” n.d. Accessed May 16, 2020. https://www.google.com/search?q=pacemaker&tbm=isch&ved=2ahUKEwij-5rGkovoAhVGbJoKHT-aA_IQ2-cCegQIABAA&oq=pacemaker&gs_l=img.3..35i39j0l7j0i7i30l2.52404.52978..54063...0.0..0.96.325.4.....0....1..gws-wiz-img.NYuxmGrt4dg&ei=wAhlXqObDMbY6QS_tI6QDw&bih=706&bi.

Petersen, Lone Stub, and Pernille Bertelsen. 2017. “Equality Challenges in the Use of Ehealth: Selected Results from a Danish Citizens Survey.” *Studies in Health*

Technology and Informatics 245: 793–97. https://doi.org/10.3233/978-1-61499-830-3-793.

Pols, Jeannette. 2014. “Knowing Patients: Turning Patient Knowledge into Science.” *Science Technology and Human Values* 39 (1): 73–97. https://doi.org/10.1177/0162243913504306.

Pruitt, John, and Jonathan Grudin. 2003. “Personas: Practice and Theory.” *Proceedings of the 2003 Conference on Designing for User Experiences, DUX ’03*, 1–15. https://doi.org/10.1145/997078.997089.

Quinlan, J. R. 1986. “Induction of Decision Trees.” *Machine Learning* 1 (1): 81–106. https://doi.org/10.1007/bf00116251.

Rabionet, Silvia E. 2011. “How I Learned to Design and Conduct Semi-Structured Interviews: An Ongoing and Continuous Journey.” *Qualitative Report* 16 (2): 563–66.

Rashid, L. 1995. “Challenges to the Implementation of Telemedicine.” *Access* 1 (2): 115–23.

Rivero, José Matías, Gustavo Rossi, Julián Grigera, Juan Burella, Esteban Robles Luna, and Silvia Gordillo. 2010. “From Mockups to User Interface Models: An Extensible Model Driven Approach.” *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* 6385 LNCS: 13–24. https://doi.org/10.1007/978-3-642-16985-4_2.

Sand, Olav. 2008. *Menneskets Anatomi Og Fysiologi*. 2nd ed. Kbh.: Gad.

Sanders, Elizabeth B.N., Eva Brandt, and Thomas Binder. 2010. “A Framework for Organizing the Tools and Techniques of Participatory Design.” *ACM International Conference Proceeding Series*, 195–98. https://doi.org/10.1145/1900441.1900476.

“Sundhed.Dk - Den Offentlige Sundhedsportal.” n.d. Accessed May 16, 2020. https://www.sundhed.dk/.

Sunhedsstyrelsen. n.d. “Sundhedsstyrelsen.” Accessed May 16, 2020. https://www.sst.dk/da/udgivelser/2017/det-danske-sundhedsvaesen.

Sørensen, Asger. n.d. “Kritisk Teori,” 245–88.

Tatnall, A, and A Gilding. 1999. “Actor-Network Theory and Information Systems Research.” *Proceedings of the 10th Australasian Conference on Information Systems*, 955–66. https://doi.org/10.4018/jantti.2009062304.

Troshani, Indrit, and Nilmini Wickramasinghe. 2014. “Tackling Complexity in E-Health with Actor-Network Theory.” *Proceedings of the Annual Hawaii International Conference on System Sciences*, 2994–3003. https://doi.org/10.1109/HICSS.2014.372.

Verbeek, Peter-Paul. 2005. *What Things Do : Philosophical Reflections on Technology, Agency, and Design*. 1. edition. Pensylvania: Pennsylvania State University Press.

“Vital Beats I Enabling Preventive and Personalized Healthcare.” n.d. Accessed May 16, 2020. https://www.vitalbeats.com/.

Williams-Jones, Bryn, and Janice E. Graham. 2003. “Actor-Network Theory: A Tool to Support Ethical Analysis of Commercial Genetic Testing.” *New Genetics and Society* 22 (3): 271–96. https://doi.org/10.1080/1463677032000147225.

Winograd, Terry, and Fernando Flore. 1986. *Understanding Computers and Cognition: A New Foundation for Design*. 2nd ed. Addison-Wesley Professional.

Wood, Mark A., and Kenneth A. Ellenbogen. 2002. “Cardiac Pacemakers from the Patient’s Perspective.” *Circulation*. https://doi.org/10.1161/01.CIR.0000016183.07898.90.

World Health Organization, ed. 2009. *Observatory for EHealth Series in Member States*. *World Health Organization*. WHO Press, World Health Organization. http://www.who.int/goe/publications/goe_telemedicine_2010.pdf.

Aanestad, Margunn, Miria Grisot, Ole Hanseth, and Polyxeni Vassilakopoulou. 2017. *Information Infrastructures within European Health Care*. *Information Infrastructures within European Health Care*. https://doi.org/10.1007/978-3-319-51020-0.