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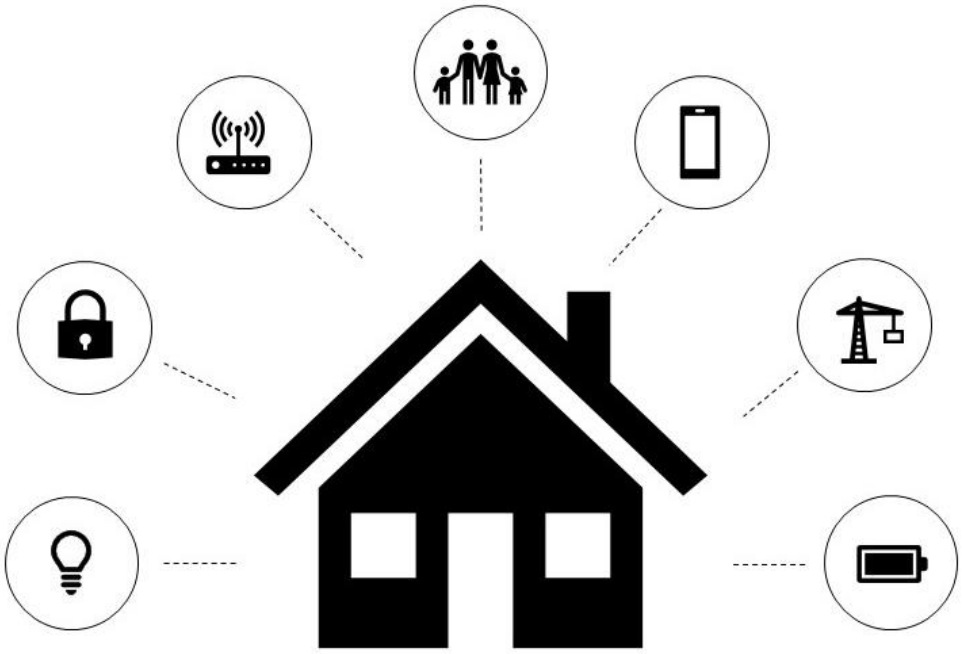

Finding Future Customer Needs for Smart Home Solutions

A Method Developed for the Construction Industry

Master's Thesis in the Quality and Operation Management Programme and Management and Economics of Innovation Programme

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Cover: The smart home
[The illustration conceptualizes the smart home and smart home solutions. Sketch by Lisa Stenseke, 2017.]

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Abstract

The smart home industry is characterized by actors providing a technology-push as opposed to a demand-pull system. For companies to be able to satisfy customers it is essential to know what customers desire and to use appropriate methods for finding their needs. Most research regarding smart homes has had a technological focus while social aspects have been neglected. The aim of this master's thesis is to develop a method for finding future customer needs for smart home solutions that will primarily be used by companies in the construction industry. In order to achieve this aim a method framework proposal was developed through analyzing theories regarding customer needs in combination with research concerning smart home solutions and the market concerning them. This research was complemented by a case study conducted at the department New Homes at the construction company Skanska.

The initial method framework proposal was field tested on five persons in collaboration with Skanska and the test generated in total 273 raw customer needs which after interpretations and categorization became 118 customer needs. Following the field test, a final method framework was created that contained twelve steps in which the three main elements were a demonstration of existing smart home solutions, a contextual inquiry and an in-depth interview. These elements were used in combination with each other in order to obtain future needs which are often unarticulated and excitement needs. The method framework is based on a concept that we have created and applied in a matrix. This concept states that a person’s ability to express unarticulated needs are favorably affected by two factors: a person’s ability to understand technology and how easy a certain technology is to understand. There are no established measurements for these factors and hence to be able to use our concept, we have interpreted these factors into: a person’s age and stage of the technology in the product life cycle.

Due to the results obtained from the field test and the improvements made to the initial method proposal framework, we conclude that our final method is successful in finding future customer needs for smart home solutions. Hence, our final method framework is the solution to our research problem.

Keywords: customer needs, smart homes, method development, combining methods, framework, future

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Lisa Stenseke and Agnes Söderholm

Gothenburg, May 2017

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1 Introduction

The report starts with a background to the master's thesis that leads up to the research problem, aim and research questions. This is followed by a description of how the rest of the master's thesis report is outlined.

1.1 Background

The background aims to provide a context to and support this master's thesis work. It includes a comprehensive presentation of information regarding the smart home market and its slow adoption, general information about customer needs and information regarding smart home solutions within the construction industry.

1.1.1 The Smart Home Market and Its Slow Adoption

The expression “smart house” was first introduced as early as 1984 (Harper, 2003). According to Harper (2003), a house is considered to be smart if it contains interactive technologies. Allameh et al. (2012) have a similar understanding of a smart house, but use the term “smart home” instead of “smart house”. According to Allameh et al. (2012), a home is smart if it contains several advanced technologies as well as interconnected devices. Even though there seems to be some agreement regarding what a smart home is, a unanimous definition of a smart home does not exist today. In this report the definition provided by Aldrich (2003, pp.17) will be used since it includes most aspects of other definitions. Aldrich (2003, pp.17) defines a smart home as “a residence equipped with computing and information technology which anticipates and responds to the needs of the occupants, working to promote their comfort, convenience, security, entertainment, healthcare, education, and communication through the management of technology within the home and connections to the world beyond”. A “smart home solution” is any physical solution that encompasses this definition of a smart home and will be used interchangeably with the term “smart home technology”.

According to Webb (2011) and McKinsey & Company (2016), the development and adoption of smart home solutions have been slower than expected even though both large technology companies and smaller startup companies have created smart home solutions through existing and new, stand-alone, products. There are many suggested reasons for why the smart home market has not developed as fast as predicted, which include: high prices for smart home products (Hedlund, 2015), limited customer demand and long device replacement cycles (Greenough, 2016).

People tend to make changes to their homes at a slow pace, usually when something big happens in their life, for example when they are having children, remodeling or getting married (Ahuja, 2017). During life changing events, in particular when residents upgrade or renovate their homes, move to a new house or buy a new house, residents are most likely to invest in new

smart home technology (iControl Networks, 2015). Greenough (2016) states that smart home solutions have long device replacement cycles and consumers often wait until a device is broken until they replace it with a new device. Hence, people do not buy smart home solutions regularly which is one explanation to the slow adoption.

Another obstacle for the smart home market that stands in the way of mass adoption is technological fragmentation of the smart home market ecosystem, meaning that customers today need several devices, apps and other solutions to be able to operate their smart home (Greenough, 2016, McKinsey & Company 2016). This creates frustration and confusion amongst both early adopters and potential customers who are looking for a full value proposition (Stamford, 2014, McKinsey & Company, 2016, iControl Networks, 2015). Additionally, within changing markets, such as the smart home market (Greenough, 2016, McKinsey & Company, 2016), customers find it difficult to express their needs and therefore uncertainties arise regarding which market opportunities to invest in (Mullins & Sutherland, 1998). Another reason for the slow smart home market adoption is a lack of interest for smart home technologies, caused by a perceived lack of need, and therefore it is necessary to educate customers on how the technologies can solve their unmet needs (Hedlund, 2015).

A global study conducted by Ericsson (2015) revealed that most smart homes are used by single men in single person households. However, the study also shows that the customer category that would benefit most from smart homes are not single men but rather families with young children and in particular women who live in larger households (Ericsson, 2015). In terms of interest of smart homes conducted by iControl Networks (2015) in the U.S. and Canada, 79 percent of millennials, 76 percent of parents and 50 percent of the overall population stated that they were interested in smart home solutions. Thus, the reason for why smart home technologies have not been adopted is not because people are not interested but rather because the existing solutions do not fit their needs.

Most research regarding smart homes has had a technological focus, and social aspects related to smart homes have been neglected (Aldrich, 2003). In order to succeed with smart home technologies, companies have to develop products not for the sake of technological novelty but for the sake of making them usable for customers (Stamford, 2014). Concluding, the smart home industry is characterized by actors providing a technology-push as opposed to a demand-pull system, and this leads to discontent amongst customers (Suryadevara & Mukhopadhyay, 2015). For companies to be able to satisfy customer needs it is essential to know what customers desire and use appropriate methods for finding customer needs.

1.1.2 Customer Needs

Successful products are conceptually generated through understanding how salable, feasible and desirable they are (Bayus, 2008). Bayus (2008) states that it is often companies that decide whether or not a potential product has these essential qualities, with an emphasis on feasibility and salability. Thus, new products are somewhat neglecting the desirability aspect, only to afterwards find out whether or not it is received well with customers (Bayus, 2008). Hence, this

type of product-driven approach often results in unsuccessful products and is therefore unsustainable.

Companies have a lot to gain from testing and learning from customers before product development begins. One of the main benefits of following this sequence is that information regarding customers' actual problems and to which of these problems satisfactory solutions already exist is obtained. If this information exists before product development starts, the risk of creating inadequate solutions decreases and money can potentially be saved. However, the means of how to gather this information influence the quality of the information obtained. (Griffin, 2012)

In a survey conducted by Ulwick and Bettencourt (2008), only 5% of the companies under investigation said that their organization had an agreement regarding what a customer need is. This is surprising since truly successful innovations can be established from a deep understanding of customers' needs (Bayus, 2008). Therefore, it is important to further explore customer needs.

According to Ulwick and Bettencourt (2008), no exact standard definition of customer needs exists. One can make a distinction between a customer need and a want but in this research we will solely use the term need although it encompasses both needs and wants. A need includes both utilitarian and hedonic benefits (Bayus, 2008) such as the benefits 'learn more about a certain comedian and getting a laugh' one could get from watching a documentary about a comedian. In contrast, a want is something that a customer believes will satisfy an acknowledged need, is short-term and temporary, and can be altered based on psychosocial cues (Bayus, 2008). In some practices customer needs refer to product features, product specifications, engineering characteristics and technological performance measures (Bayus, 2008).

1.1.3 Smart Home Solutions Within the Construction Industry

Due to globalization and technological advancements, competition for technical products has increased which has resulted in shorter product life cycles for these products (Chen, Damanpour & Reilly, 2010). In order to achieve an earlier market entrance so the product can enjoy a longer product life (Wheelwright & Clark, 1992), companies have to increase the speed when developing new products (Chen, Damanpour & Reilly, 2010). In contrast, the development time for buildings is long and it usually takes between three to five years from start of designing an average apartment building until the construction is completed. Hence, there is a conflict between the development time for buildings and technical products which implicates the investment decisions regarding smart home solutions for construction companies.

According to Ericsson (2015), smart home technology, such as security and entertainment systems, should not add clutter to the home. Home residents often feel that cables and remotes use too much of the house's space and therefore components and wires should not be visible (Ericsson, 2015). Additionally, Hedlund (2015) states that the future connected home should

have all smart home systems integrated into one solution since cost savings can be obtained and the solutions are easier to use and maintain (Ericsson, 2015). Examples of such systems are security, energy, entertainment and lighting (Ericsson, 2015). To achieve good aesthetic and integration, Ericsson (2015) state that it is more beneficial to plan for it before the house is built instead of upgrading the house later. Thus, construction companies have to decide which smart home solution they want to offer and build-in into the house early in the design process. Since the smart home technology will not be experienced by the customer until the construction of the building is completed, it is important for construction companies to predict what smart home technologies will be desirable in the future.

The physical product life cycle represents the progress of a physical product, from raw material through production, distribution, use and finally disposal (Sundin, 2009). Crowley and Coutaz (2015) state that physical products for smart home technologies should have the same life length as buildings. Because of this, companies that aspire to take part in smart home development, such as construction companies, need to predict what needs the smart home residents will have in the future, since the customers will live with the smart home solutions for a long time.

1.2 Research Aim

This section explains the foundation of the master's thesis work through defining the research problem and presenting how we aim to solve this problem.

1.2.1 Research Problem

There are obvious concerns for construction companies regarding customer needs for smart home solutions due to the slow adoption prevalent in the smart home market. One of their main concerns is that they have been unsuccessful in satisfying customers' needs for smart home solutions. In order to satisfy customers, construction companies have to use a reliable approach for predicting future needs. The problem is that there is no established approach for doing this.

1.2.2 Aim

In order to address the research problem stated above, our aim is to: **develop a resource efficient method for finding future customer needs for smart home solutions.**

A method is defined as "a particular procedure for accomplishing or approaching something, especially a systematic or established one" (Waite and Dictionaries, 2012). The term 'customer' will in this report be defined as the end user of a product, sometimes referred to as a consumer (Bayus, 2008). Hence in this report, the residents using smart home solutions will be referred to as customers. "Future customer needs" will entail the needs that customers will have approximately four years from start of investigation of the needs, since this is the time it takes from the design to the finalization of the construction of a house.

Our method will be an approach that is primarily designed to find future customer needs related to smart home solutions in apartment buildings however it can also be applied for customers that live in other housing buildings. Additionally, the method is primarily intended to be used by construction companies, but could also be used by other companies in the smart home industry. Since the method is intended to be used by companies, it should be resource efficient in terms of time and cost. To test and evaluate our method, we will collaborate with the department New Homes at Skanska AB.

1.2.3 Research Questions

In order to develop a method that is specific for finding customer needs for smart home solutions, we have to investigate what characteristics of smart home solutions will influence our choice of method which leads us to our first research question:

1. *What are the special characteristics of smart home solutions and their market?*

We also have to investigate what current approaches and methods for understanding and finding future customer needs exist and therefore we have to answer the following research question:

2. *What are the approaches for understanding and finding future customer needs?*

Based on the findings from research question one and two, we will develop a method with suitable approaches for finding future customer needs for smart home solutions. This leads us to our third research question:

3. *How can one find future customer needs for smart home solutions in a systematic way?*

1.3 Disposition of the Report

This section provides an overview of the subsequent chapters of the report.

2. Characteristics of Smart Home Solutions and Their Market
This chapter contains information about characteristics of smart home solutions and their market. The research provides necessary information to be able to answer the first research question.

3. Understanding and Finding Customer Needs
This chapter contains information about how one can understand and find customer needs. The research provides necessary information to be able to answer the second research question.

4. *Method Proposal*
Based on an analysis of Chapter 2 and 3 a method framework proposal is presented. The method proposal framework aims to answer research question three and is considered to be the first part of our results.

5. Methodology
Our methodology describes how the master's thesis has been conducted. The methodology is presented after the method proposal since the methodology contains a description of a field test of the method proposal and this part would be difficult to understand without having seen the method proposal.

6. *Evaluation and Modifications of the Method Proposal*
This chapter contains an analysis of the field test of the method proposal. Based on the analysis an evaluation and modification of the method proposal is presented.

7. Conclusions
All research questions are answered in this chapter. It includes our final method framework which is considered to be our final result.

8. Discussion
The conclusions are discussed and through stating its limitations and contributions. Finally, suggestions for future research are made.

2 Characteristics of Smart Home Solutions and Their Market

Theories used to answer research question one will be presented in this chapter.

2.1 Definition, Actors and Categories

Since there is no unanimous definition of a smart home there are also no clear definitions of the smart home market or industry. Therefore, the size of the smart home industry and market is unclear. McKinsey & Company (2016) suggest that the smart home industry consists of actors such as hardware and consumer electronics manufacturers, telecom and cable providers, retail outlets, software and ecosystem actors and service providers.

Because there is a vast number of smart home solutions, there is also a large number of ways to label and categorize them. Hedlund (2015) proposes four main product categories for smart home technologies which are energy, safety, appliances and other. A more specific classification based on function areas is presented by McKinsey & Company (2016) which shows that all parts of the home is subjected to smart home solutions. It includes: home intelligence, entertainment, access control, home comfort, connectivity, energy efficiency, wellness, home safety and daily tasks (McKinsey & Company, 2016).

Additionally, there are classifications that are based on the nature of the solutions themselves. For example Cook (2012) states that the category 'smart home technologies' consists of sensors, monitors, interfaces, devices and appliances that can be interconnected (typically wirelessly) to create an overall solution. Further, Robles and Kim (2010) presents a category of 'controllable appliances and devices' which comprises existing solutions that could become 'smart' such as heating systems, windows, lighting, curtains, fridges, washing machines, TVs and garage doors.

2.2 Product Life Cycle

The life cycle of a product can be divided into four phases: *introduction*, *growth*, *maturity* and *decline*, based on the economic life cycle of the product (Swat, Brünnet & Bähre, 2014). This definition of product life cycle (PLC) is often portrayed as a bell shaped curve (Kotler et al., 2009), see Figure 1.

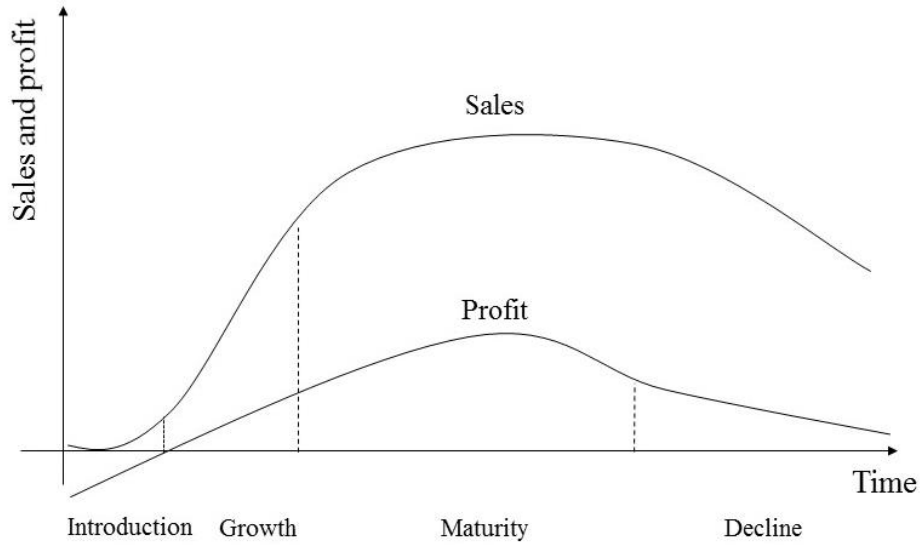

Figure 1: *Illustrates the product life cycle of a product in terms of sales and profit. Adapted from Kotler et al. (2009).*

In the *introduction* phase, the product is introduced to the market and has a slow sales growth rate. The product is not profitable during this phase due to high investment costs related to market introduction. In the *growth* phase the product experiences rapid market acceptance and consequently improvements in profits. During the *maturity* phase the product has reached its peak and acceptance among most customers. The growth of sales is therefore declining. Hence, the profits are stabilized and might even decline due to increased competition. During the final phase, the *decline* phase, both sales and profits are declining. (Kotler et al., 2009)

According to Stamford (2014) the smart home market will not reach the maturity phase until approximately year 2020 to 2025. Thus, the smart home technology is still in the growth phase of the PLC (Greenough, 2016). However, within the smart home market, many different product life cycles exist where each smart home category has its own PLC. According to Hedlund (2015), the majority of the smart home market currently consists of smart home security and smart home energy solutions, while smart applications and other smart home solutions only contains a very small part of the market. Hedlund (2015) estimates that in 2019, the global smart home market will consist about 55 percent of smart home energy solutions, 38 percent of smart home safety solutions and smart appliances and other solutions about 7 percent combined. The information provided by Hedlund (2015) clearly indicates that safety and energy solutions for smart homes are in the forefront of the overall smart home market and will reach the maturity stage first.

Nevertheless, the smart home market is expected to grow but due to the uncertainties regarding the smart home market boundaries and the nature of forecasts, these numbers are considered by the authors of this report to be rather uncertain. In 2015 it was estimated that approximately 10 percent of the U.S. population owned a smart home device (Greenough, 2016). McKinsey & Company (2016) estimate that the compound annual growth rate of number of connected homes

in the U.S. is 31 percent. In addition, Stamford (2014) states that by 2022, a typical family home could hold more than 500 smart home products. Furthermore, Markets and Markets (2016) estimates that the global smart home market will be USD 121.73 Billion by 2022 (where Europe will account for 20 percent of the global market) with a compound annual growth rate of about 14 percent between 2016 and 2022. Finally, Hedlund (2015) estimates that the smart home market grows by approximately 67 percent per year.

2.3 Technology Adoption Life Cycle

The technology adoption life cycle is a framework for classifying consumers based on their reactions to high technology products (Meade & Rabelo, 2004). Consumers are divided into five categories: *innovators*, *early adopters*, *early majority*, *late majority* and *laggards* (Meade & Rabelo, 2004), see Figure 2. Consumers within different categories have different needs and expectations regarding products and react differently to new innovations (Meade & Rabelo, 2004).

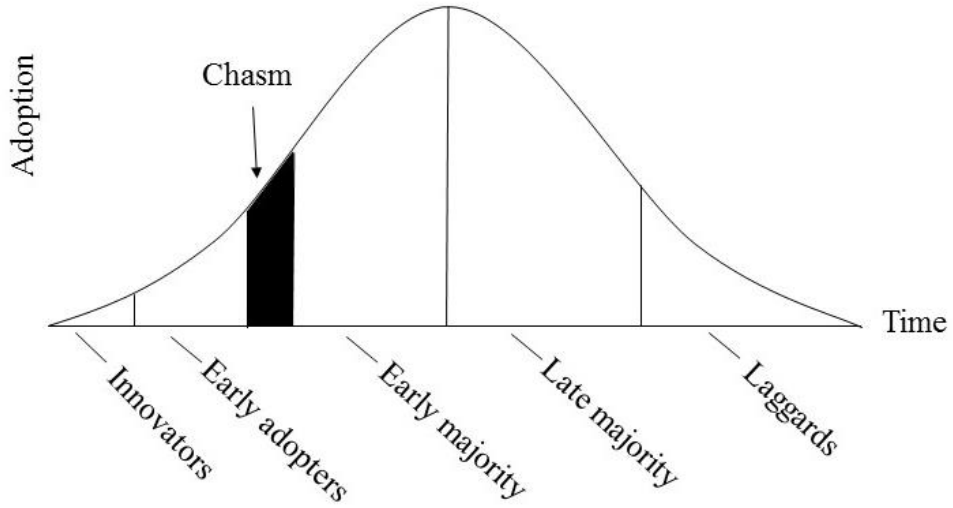

Figure 2: *Illustrates the technology adoption life cycle with its five consumer categories. Adapted from Meade and Rabelo (2004).*

Innovators are technology enthusiasts who are excited about exploring new technology (Hutt & Speh, 2010). They influence how an organization perceives a product and can help promote new innovations. They are more likely to take technology risks and invest in new technology just out of curiosity even in cases where they are not certain where the technology can be applied (Chinchor, Cook & Scholtz, 2012).

Early adopters are visionaries that can help boost the sales of a product during the early stage of the products life cycle (Hutt & Speh, 2010). However, in order for the early adopters to promote the innovation they often demand modifications of the initial product in order for them to see the value of the technology (Hutt & Speh, 2010). In contrast to innovators they are not exploring new technology for technology's sake (Chinchor, Cook & Scholtz, 2012). According

to Chinchor, Cook and Scholtz (2012), early adopters are innovative users that adopts new technologies to satisfy unmet needs that existing products are not fulfilling.

Early majority are pragmatists that seek technology evolution not technology revolution (Hutt & Speh, 2010). They are have no problem with using new technology but are striving for productivity improvements not revolutionary innovations (Chinchor, Cook & Scholtz, 2012).

Late majority are conservatives that are pessimistic regarding a new technology's ability to deliver value (Hutt & Speh, 2010). Consumers within this category are often price sensitive and only invest in new technology to not be left behind (Hutt & Speh, 2010). In order for the late majority to adopt a technology it must be easy to use and the benefits of using the technology must be well proven (Chinchor, Cook & Scholtz, 2012).

Laggards are sceptics who are very critical to high technology products (Hutt & Speh, 2010). According to Chinchor, Cook and Scholtz (2012) laggards avoid technology as long as possible and only adopt new technology when they have to.

According to Hutt and Spech (2010), truly innovative products are often welcomed by innovators and early adopters, but thereafter sales often decline. The gap between early adopters and early majority is often referred to as the "chasm" and the success of a new product relies on the company's ability to move adoption beyond the small amount of early adopters to the larger consumer category early majority (Meade & Rabelo, 2004). Many new products fail because they are not adopted by the early majority consumers (Meade & Rabelo, 2004). In addition to adopting new technologies earlier, innovators and early adopters are more willing to participate in the development of new products and provide feedback that can help a company to improve the product in exchange for getting access to the product earlier (Prasad, 2005).

According to Greenough (2016), the smart home market of U.S seems to be stuck in the chasm, between early adopters and the mass market. Many residents do not understand the value proposition the smart home technology is offering and many issues addressed by the early adopters have to be fixed (McKinsey & Company, 2016). The smart home market has to overcome this chasm before the early majority, late majority and laggards consumers will adopt the smart home technology and mass adoption can be achieved (iControl Networks, 2015).

In addition to the reasons stated in the background, privacy concerns are agreed to be one of the main reasons that hinders the adoption of smart home solutions (Accenture, 2015, Stamford, 2014, Wilson, Hargreaves & Hauxwell-Baldwin, 2017, iControl Networks, 2015, Arabo, 2015). Specifically, (Hedlund, 2015) argues that customers are not concerned of their private data being misused by their smart home solution providers but rather by third parties and other users. Therefore, digital businesses, such as those creating and handling smart home solutions, will to a greater extent than traditional businesses have to regard customer privacy, demand for transparent use of data and the ethical use of new technologies (Accenture, 2015).

2.4 Technology Acceptance Model

Due to uncertainties related to the introduction of a new technology it is often very challenging to encourage people to adopt new technologies (Hashim et al., 2015). Examples of such uncertainties are unavailability of complementary products, lack of technology standards and incompatibility with other technologies (Hashim et al., 2015). Davis (1989) states that what influences a person to accept or reject an information technology is the person's perception of the technology's usefulness and ease of use. Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, pp 320) while perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320).

The technology acceptance model (TAM) is a model used to explain how users accept information technology (Davis, Bagozzi & Warshaw, 1989). In the TAM, a person's attitude toward using a product, intention to use a product and actual adoption behaviour are determined by the product's perceived usefulness and perceived ease of use (Davis, Bagozzi & Warshaw, 1989). An illustration of the TAM is presented in Figure 3.

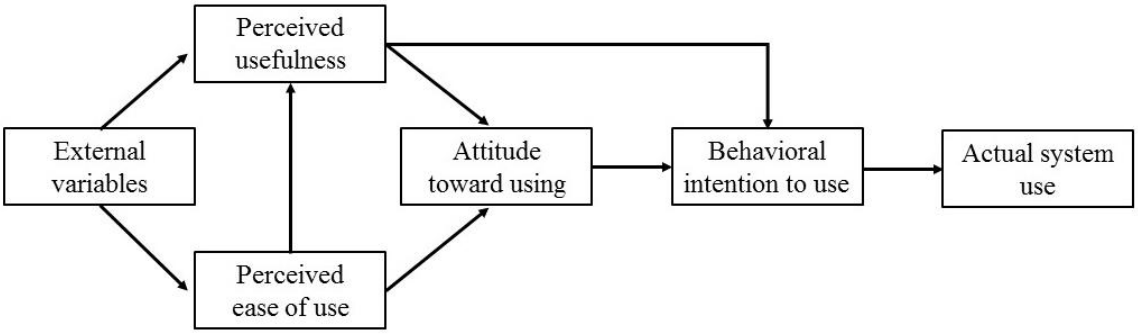

Figure 3: *An illustration of the TAM. Adapted from Davis, Bagozzi and Warshaw (1989).*

The positive outcome obtained through increased usefulness increases the user's attitude as well as the user's intention to use the technology. Perceived ease of use also has a motivating aspect that directly influences the user's attitude. Since ease of use helps increase the performance of a job, perceived ease of use also influences the user's perceived usefulness. (Davis, Bagozzi & Warshaw, 1989)

Thereto, when customers examine whether or not to buy a smart home product, the ease-of-use is more important than technical innovation which means that they are more drawn to more simple technologies (iControl Networks, 2015, Hedlund, 2015). Also, customers who know someone who lives in a smart home are decidedly more probable to be excited about home automation in difference to customers who have never seen the technology actually being used (iControl Networks, 2015).

2.5 Millennials

Millennials, also known as Generation Y, is a generation defined as the people born between 1980 and 2000 (Gurău, 2012) and hence span the ages of 17-37 when this report is written (year 2017). However, Gurău (2012) also states that there is no completely unanimous definition of when the birth date of this generation starts and ends and hence these ages are approximate. Nevertheless, the millennials are considered to be a very attractive market segment since they are expected to spend more and also have more money to spend relative to older generations (Bakewell & Mitchell, 2003, Solomon, 2013).

Moreover, millennials are unique since they have been brought up with digital technology, and are therefore regarded as the first "high-tech generation" (Norum, 2003) and are named "digital natives" (Bess & Bartolini, 2011, Solomon, 2013). In particular, they have grown up in an environment with mobile technology and online social networks (Eastman et al., 2014). Technological products such as video games, laptops and mobile phones, were present not only for the high income segment but also for those with average income and hence most millennials have grown up with technology (Atkinson, 2008, Solomon, 2013). The fact that millennials are so familiar with digital technology has led them to become 2.5 times more likely to be early adopters of new technology (Fromm & Garton, 2013). Further, they have also become the ones who typically operate the household technology and hence make purchase decisions (Fromm & Garton, 2013).

As for the future users of smart home technologies it seems as like the younger generation (age 45 and below) (iControl Networks, 2015) and in particular the millennial generation (Accenture, 2015) will be the majority users of smart homes and those that companies should focus on.

2.6 Elderly

To be able to make a distinction between 'young' and 'old' people one can use the limit of the millennials i.e. 37 years, however what can be considered to be a more 'mature' demographic such as those labeled 'elderly' the age 65 may be used (Oumlil & Williams, 2000). According to Oumlil and Williams (2000), mature customers are typically not viewed of being innovators or early adopters of new technologies but instead late majority or laggards.

Moreover, studies have shown that elderly overall have a positive attitude of smart home solutions such as devices and sensors that would be installed in their own home with a purpose of enhancing their lives (Demiris et al., 2004 & Heinz et al., 2013). In particular, elderly tend to be more likely to adopt new technology if they are able to see the benefits for themselves (Heinz et al., 2013). Additionally, if the technology is able to maintain elderly's quality of life and independence through having a high degree of usefulness and usability, they were eager to adopt new technology since it outweighed feelings of inadequacy (Heinz et al., 2013)

3 Understanding and Finding Customer Needs

In this chapter, theory that will respond to our research question two will be presented.

3.1 Understanding Customer Needs

In order to be able to fully understand the approaches for finding customer needs it is critical to understand the nature of customer needs. There are many different theories that describe customer needs and the ones that we consider to be most suitable for finding future customer needs are presented below.

3.1.1 Different Levels of Needs

According to Bayus (2008), customer needs can be classified in a hierarchy with different levels of needs. Some of the more basic needs that would correspond to the lower levels are that a product or service is safe and useful (Bayus, 2008). A higher level of a customer need could entail that the product or service is bought for a specific purpose to be accepted by others (Bayus, 2008). At an even higher level, a customer need can correspond to a product or service which is purely aesthetically pleasing. Generally, customers do not express their needs in a satisfactory manner and this is especially true for the higher level needs (Sanders, 1992).

3.1.2 The Abstraction of Customer Needs

One way of understanding customer needs is using a FCE-model, which is described by Bayus (2008) and based on Shillito (2001). The FCE-model describes three different levels of customer needs that increase in level of abstraction: *features*, *consequences* and *desired end-states*. *Features* are typically referred by the customer as a product or service along with its particular specifications and are concrete, short-term and easily influenced. Hence, features somewhat describe ‘how’ a certain customer need will be fulfilled. *Consequences* describe ‘what’ the customer will want the outcome to be from owning or using a certain product or service. Thus, consequences are generally described as more emotional such as ‘wearing this dress gives me confidence’. *Desired end-states* are the customer’s fundamental purposes and goals hence they are more long-term than the other needs. Moreover, due to these different levels of abstractions, raw data from customer research studies acts as a basis from which to interpret the ‘actual’ customer needs. (Bayus, 2008)

Further, Ulwick and Bettencourt (2008) claim that in order to understand customer needs one should not focus on a particular product or its features but rather what needs they are fulfilling through its execution. In addition, for the customer need to be valid over time it should not be any form of a solution (Ulwick & Bettencourt, 2008).

3.1.3 Articulated, Unarticulated and Interpreted Customer Needs

According to Bayus (2008), customer needs can also be categorized into articulated, unarticulated and interpreted customer needs. *Interpreted needs* consist of both articulated and unarticulated needs. *Articulated needs* are those that a customer can easily verbalize, if it is assumed that the customer is asked in an applicable way (Bayus, 2008). Hence, these types of needs are usually based on what customers say, and therefore, research methods typically used to extract this information are focus groups (McDonagh-Philip & Bruseberg, 2000), interviews, surveys, emails and product clinics (Urban & Hauser, 1993).

In contrast, *unarticulated needs* are those that a customer is not aware of (Bergman and Klefsjö, 2010) and therefore cannot verbalize in an easy manner (Bayus, 2008). Unarticulated needs can also be needs that are so evident that the customer would not mention them if asked (Bergman & Klefsjö, 2010). Hence, unarticulated needs deal with information concerning what customers do and make, rather than say (Sanders, 1992). Common methods used to find unarticulated needs are those that occur in a customer's natural habitat and are open-ended (Bayus, 2008). The principal methods are participant observation, applied (rapid) ethnography and contextual inquiry (Bayus, 2008).

Furthermore, it should be noted that customers say what they do based on multiple reasons that may not necessarily relate directly to their need (Bayus, 2008). For example, they might say something because they believe that it is what the researchers want to hear, they may not remember certain things or they might find some areas too private (Bayus, 2008).

3.1.4 The Kano Model

The Kano model is a model developed to categorize customer needs and the philosophy behind the model is that different customer needs affect customer satisfaction differently (Shahin & Nekuie, 2011). The Kano model uses non-linear relationships between customer satisfaction and fulfillment of customer needs (Mikulic & Prebezac, 2011), see Figure 4. The Kano model divides customer needs into the three different kinds of needs (Bergman & Klefsjö, 2010, Shahin & Nekuie, 2011, Matzler et al., 1996). However, different authors use different names for the needs. Bergman and Klefsjö (2010) use the names *basic needs, expected needs and excitement needs* while Matzler et al. (1996) and Shahin and Nekuie (2011) define them as *must-be requirements*, *one-dimensional requirements* and *attractive requirements*.

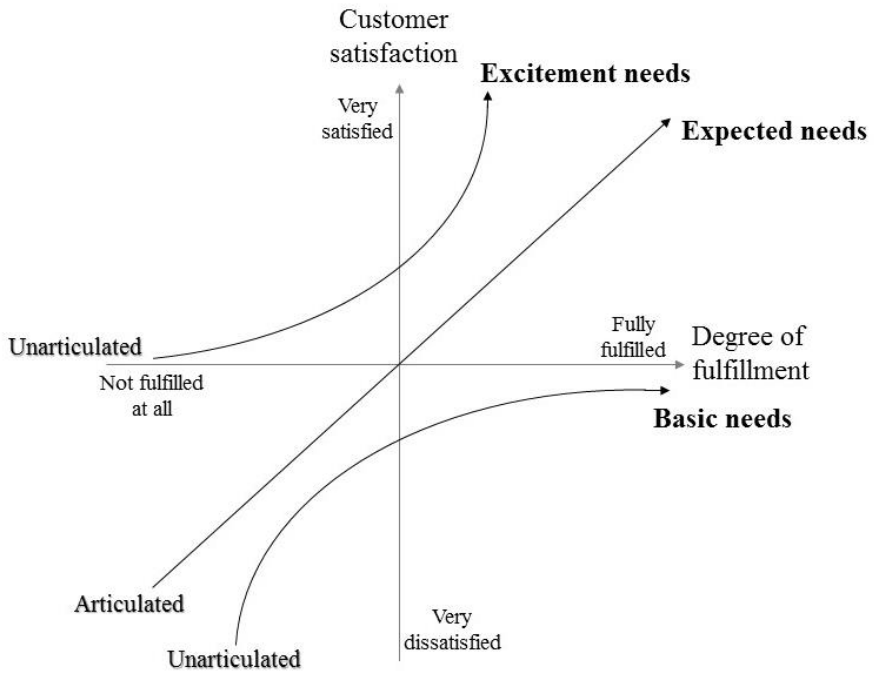

Figure 4: *An illustration of the Kano model. Adapted from Bergman and Klefsjö (2010).*

Basic needs (*must-be requirements*) are needs that are so obvious that the customer would not mention them if asked to name what they require of a product (Bergman & Klefsjö, 2010). Hence, these needs are so basic that the customer takes them for granted (Matzler et al., 1996). Thus, fulfilling basic needs will not create satisfaction (Bergman & Klefsjö, 2010). However, if a product does not fulfill the basic needs the customer would be very dissatisfied (Bergman & Klefsjö, 2010). As the basic needs are seen as a prerequisite, customers would not even be interested in buying the product if the product does not fulfill all basic need (Matzler et al., 1996).

Expected needs (*one-dimensional requirements*) are needs that the customer is aware of and will mention when asked to state the requirements of a product (Bergman & Klefsjö, 2010). These needs are very important to the customer and the customer expects these needs to be fulfilled (Bergman & Klefsjö, 2010). The better the product fulfills the expected needs the more satisfied the customer gets and vice versa (Matzler et al., 1996). The relationship between fulfillment and satisfaction is proportional (Matzler et al, 1996) and is therefore illustrated with a linear correlation (Shahin & Nekuie, 2011). By performing better than competitors regarding the expected needs a company can win customers (Bergman & Klefsjö, 2010).

Excitement needs (*attractive requirements*) are needs that the customer is not yet aware of and can therefore not express (Bergman & Klefsjö, 2010). These needs are the ones that can increase customer satisfaction the most and hence by fulfilling the excitement needs customers will be very satisfied (Matzler et al., 1996). However, not fulfilling these needs will not result in dissatisfied customers (Matzler et al, 1996). According to Bergman and Klefsjö (2010) a

company can gain a significant competitive advantage and win loyal customers by identifying and fulfilling excitement needs.

As previously stated, unarticulated needs are needs that are so evident that the customer would not mention them or needs that the customer is not aware of. Therefore, both basic needs and excitement needs are unarticulated customer needs while expected needs are articulated needs.

Moreover, customer needs and expectations tend to change over time. What at first is classified as an excitement need eventually becomes an expected need until it is defined as a basic need. For example, a color TV were in the 1950s an excitement need, it became an expected need during the 1970s and today it is classified as a basic need. (Bergman & Klefsjö, 2010)

Customer needs can be classified as basic needs, expected needs or excitement needs through a Kano questionnaire (Matzler et al., 1996). In the questionnaire one pair of questions should be formulated for each need where the first question asks how the customer would react if the need is provided while the second question asks how the customer would react if the need is not provided (Matzler et al., 1996).

3.2 Finding Customer Needs

There are many different ways to find customer needs: one can listen to what customers say, one can interpret what customers express and make inferences about what they think, one can watch what customers do, one can observe what customers use, one can uncover what customers know, one can reach toward understanding what customers feel, and one can appreciate what customers dream (Sanders & Dandavate, 1999). In this section, the methods most suitable for finding future customer needs will be presented.

3.2.1 Demonstration

According to Füller and Matzler (2007), customers can only accurately express whether or not a product idea fulfills an unknown need through experiencing that product and its features. By finding customers' unknown needs and integrating them with the core competencies of a company, the company is able to develop new and successful products (Füller & Matzler, 2007).

In general, customers can comfortably provide information on how companies should improve products that already exist but have a harder time to provide specific information on what products should be developed, in particular revolutionary products or radical innovations. Despite this, people will try to provide answers to the questions that are asked of them in order to be helpful, even though there is a high degree of uncertainty to those answers. Due to this, customers tend to fantasize about what the product will do for them or simply tell companies what they think they want to hear. Information derived from such uninformed customers has a

low quality and may even be nonsense. It is very risky to use this information for product development. (Griffin, 2012)

Nonetheless, what customers can provide reliable information on are things that they are personally familiar with and have experience from. If they are experienced in an overall area of customer problems they may also be able to provide subset of needs within this area. Therefore, it is crucial to observe and interact with customers in a context in which they can provide fact based answers regarding the products. The best way of doing this is to test a product concept with customers by presenting a representation of the product, often called demonstration model, and obtain information regarding customers' interest and willingness to pay. This can be done through presenting models, mock-ups, computer-aided design (CAD) drawings, protocepts and/or virtual prototypes. (Griffin, 2012)

Creating virtual product experiences for customers is one way of finding customers' known as well as unknown needs (Füller & Matzler, 2007). Virtual product experiences may utilize internet, virtual reality (VR) and augmented reality (AR) technologies (Dahan & Hauser, 2002). In VR, an entire virtual world is created in which customers are deeply involved with (Füller & Matzler, 2007). AR on the other hand uses the real world as a basis which is complemented with virtual, computer generated, objects that coexist in the same space as the real world (Füller & Matzler, 2007). These means of technologies may also be favorably used in combination with one another, for example internet may be used in combination with VR and AR in order to enable virtual customer integration (Füller & Matzler, 2007).

One benefit of using virtual experiences is that companies are able to present products to customers before they exist which allows them to uncover unknown needs early and thus alter product innovations early on in the product development process (Füller & Matzler, 2007). However it is important to note that at this stage, where customers express needs of a more abstract nature and lack specific product knowledge, it is not desirable to obtain information about specific solutions from customers (Ulwick, 2002). Creating the actual product solution is the job of the R&D department of a company and the value derived from the virtual product experiences is rather to obtain customer feedback (Ulwick, 2002).

Additionally, one benefit of using internet in conjunction with virtual product experiences is that it is an interactive medium that allows for fast and low cost mass communication (Dahan & Hauser, 2002). The main enabler for this means of communication is the fact that most private people, and potential customers, nowadays have broadband connections at home and at work (Dahan & Hauser, 2002). According to Dahan and Srinivasan (2000), virtual prototypes are significantly cheaper to create and test than physical prototypes and therefore, companies are able to afford to investigate a larger number of product ideas. Also, internet based methods for receiving customer feedback on virtual prototypes can be adapted quickly by for example changing questions as a result of initial customer feedback (Dahan & Hauser, 2002). By utilizing internet, it is also easier to gather customer feedback faster, easier and cheaper from customers that are located in various places of the world (Dahan & Hauser, 2002). Dahan and Srinivasan (2000) further claim that using virtual product experience testing through utilizing

internet as a medium produces nearly exactly the same results to using physical prototype testing while being faster and cost less.

Albeit there seemingly are many favorable aspects of using internet and virtual based methods, one has to make sure to also be aware of the disadvantages and hence create designs suitable for these mediums in order for the methods to be effective (Dahan & Hauser, 2002). For example, for customers that provide feedback from their own home or work it may be easier to terminate a survey or interview if their incentives to finish it are not high enough, such as if they feel it is taking up too much of their time (Dahan & Hauser, 2002).

A radical innovation, also known as disruptive innovation, is a product or service that is new to the market or has completely transformed as a result of a new technology or business model (Schirr, 2012). Schirr (2012) argues that customers are not able to understand or imagine a radical innovation and its benefits without using the product or service. Therefore, in order to receive useful feedback it is crucial to get the product into the hands of the intended user (Schirr, 2012). One way of doing this is through a method called rapid prototyping which users provide iterative feedback on a product in development (Thomke, 2003). In rapid prototyping, feedback from users is given on prototypes that are in various stages of the product development (Thomke, 2003). The feedback provided is used to improve the next prototype and also to create new ideas regarding the product (Thomke, 2003).

3.2.2 Applied Ethnography

Ethnography is a type of science which describes human behavior based on observations and fieldwork (Silverstein, Samuel & DeCarlo, 2012). The research method has its origin in cultural anthropology from which it has been adapted (Dell'Era & Landoni, 2014) and can be used by companies to gain insight into their customers' behavior and culture (Schirr, 2012). During the early 20th century, ethnography was mostly used to study cultures in distant and exotic countries (Maginn, 2007). Since then ethnography research has focused more on institutionalized micro social cultures such as police organizations, schools and housing departments (Maginn, 2007). Today, ethnography is one of the most used tools for consumer research because of its ability to acquire a deeper understanding of customers' behavior and what motivates them as well as its ability to address questions that traditional interviews cannot (Beckley, Paredes & Lopetcharat, 2012).

Traditionally, to conduct an ethnography study people had to be observed in person for an extended period of time, usually for more than a year (Beckley, Paredes & Lopetcharat, 2012). However, according to Polukhina (2015), the time of an ethnography research can vary substantially depending on its characteristic, if the study is a long-term ethnography or more of a rapid assessment procedure. Recently, ethnography has been modified to suit the time constraints of today's market and business objectives and therefore the study usually takes between two and three hours (Beckley, Paredes & Lopetcharat, 2012). These shorter ethnography studies are often referred to as applied ethnography (Savage, 2006). According to

Hanington (2003), applied ethnography is usually conducted through short-term observations in order to make the ethnography more manageable and collect more relevant information.

In contrast to traditional ethnography, which collects information and enhances knowledge regarding human societies, applied ethnography could be used to observe and analyze social issues as well as policy structures and processes (Maginn, 2007). According to Dell'Era and Landoni (2014), applied ethnography is the practice of observing people using a product in the context where the product is intended to be used. Consumers are not always aware of how they interact with a product and are therefore not able to express all needs they have regarding the product (Dell'Era & Landoni, 2014). Applied ethnography is a good method to use in order to collect these unarticulated needs through observing the product and the consumer in a natural context and interpret the needs based on the user's attitude and behavior (Dell'Era & Landoni, 2014).

It is the symptoms of unarticulated needs that will be identified through applied ethnography, such symptoms can be fear of using a product, frustration of using the product or not using the product as intended (Dell'Era & Landoni, 2014). Thus, applied ethnography focus on how the customers gets a job done by observing how they use the company's or a competitor's product (Silverstein, Samuel & DeCarlo, 2012). According to Silverstein, Samuel and DeCarlo (2012), applied ethnography can detect jobs that the customer cannot express and is a useful research tool for the early innovation process, especially when no good solution currently exists. Ottum (2012) states that an ethnography study can yield between 20 to 40 raw customer needs.

Before conducting an ethnographic study, some decisions have to be made. First, the researching organization has to decide when to observe the user. To discover hidden unarticulated jobs, people should be studied when using the product. Thereafter, a decision has to be made regarding how to observe the people, if the observed people should be aware of them being observed or not. Moreover, one has to decide who to observe, if the persons being observed should have previous experience of using the product or not. A lot can be learned by watching a person trying to use a product for the first time. The research organization also has to decide where they should observe the people. This depends on what setting the observed product is intended to be used in. However, the point of ethnography is to observe users in their native environment, and not in a lab. Finally, a decision has to be made regarding the length and sample size of the ethnography study. When a study is conducted in order to better understand customer needs it is the quality of the participants that matters, not the quantity of observed people. (Silverstein, Samuel & DeCarlo, 2012)

Before observing the participants, it is important to inform them about the purpose of the study, what information that will be collected and how this information will be used (Silverstein, Samuel & DeCarlo, 2012). During the study, the observer's job is to silently take notes regarding how the participant interact with the product or service (Silverstein, Samuel & DeCarlo, 2012). It can also be helpful to draw sketches or take pictures of a situation occurring during the observation (Aagaard & Matthiesen, 2016). This will help the observer to remember

the situation afterwards, in the same manner as a voice recorder can be used during interviews to remember a conversation (Aagaard & Matthiesen, 2016).

During the observation, it is not enough to simply observe the participant (Griffin, 2012). The researcher has to constantly question why a participant behave in a certain manner (Griffin, 2012). According to Silverstein, Samuel and DeCarlo (2012), questions the researcher can ask itself during the observation is:

- Why does the participant use the product/service, what type of job is he or she trying to get done?
- What expectations does the participant have regarding the product/service?
- Is the participant using the product/service as intended or in an unexpected way?
- How does the participant appear to feel regarding the product/service?

A challenge with collecting information through observations is that the research team has to interpret the actions of the participants and turn these actions into words in order to reliably capture the needs of the customers (Griffin, 2012). Therefore, it is advantageous if a trained ethnographer collects and analyzes the findings from the ethnography study (Silverstein, Samuel & DeCarlo, 2012).

The key to an ethnography study is impartial observations. However, additional insights regarding a customer's unarticulated needs can be provided through interviews. Therefore, the researcher can decide to interview the participant after the observation. During this interview, open-ended questions could be asked. To more easily interpret the participant's responses, the interview can be recorded or videotaped. However, it is important to first ask for the participant's permission. The information collected from the ethnography study, both from observations and interviews, should be sorted in order to find patterns or trends. (Silverstein, Samuel & DeCarlo, 2012)

A disadvantage with applied ethnography is that if the participant is aware that he or she is being observed the participant might alter his or her behavior (Schirr, 2012). However, an advantage with active participation during the observation is that it can increase the researcher's understanding about the situation (Schirr, 2012). According to Sørensen (2009), the researcher has to find and maintain an appropriate balance between observing and participating during the ethnographic study. Another disadvantage of applied ethnography is the risk of losing information. If the observation is not videotaped it can be difficult for the researcher to capture all the details that occur during the observation (Asan & Montague, 2014).

3.2.3 Contextual Inquiry

Contextual inquiry is a user-centered design research method (Dell'Era & Landoni, 2014). The method is derived from contextual design methodology and utilizes contextual interviews (Berndt, Furniss & Blandford, 2015). The method consists of participatory observations were the customer is examined using a product in the product's natural setting (Luojus & Cavén-

Pöysä, 2010). Simultaneously as the customer is being observed, the researcher will talk and ask questions to the customer (Holtzblatt & Beyer, 2015). The researcher will watch the customer use the product and discuss with the customer what is seen (Dell'Era & Landoni, 2014).

According to Beyer and Holtzblatt (1998), people sometimes have difficulties to express how and why they are doing a certain task since they are performing the task out of habit. Everyday tasks usually become habitual and something people do unconsciously (Holtzblatt & Beyer, 2015). By observing people performing a task and simultaneously let them explain how they are doing it, allows people to more easily articulate a work procedure in detail (Beyer & Holtzblatt, 1998). Similarly, observing customers utilizing a product and simultaneously asking questions about the product prevents the customer from talking about the product in generalization and more detailed needs can be discovered (Beyer & Holtzblatt, 1998). In addition, using artifacts can help people to remember something that happened in the past and allow the person to express that, which the person would have forgotten to mention during a regular interview (Holtzblatt & Beyer, 2015).

Contextual inquiry can be used to identify observable needs (Dell'Era & Landoni, 2014). The method delivers new insights into the product's context of use and what challenges the customer experiences when using the product (Luojus & Cavén-Pöysä, 2010). During the contextual interview, the researcher can find what customers do and thereby discover their unarticulated needs (Bayus, 2008). Between 20 to 40 raw customer needs can be discovered during a contextual inquiry (Ottum, 2012).

Normally a contextual interview is structured as a one-on-one interaction and lasts for about two hours (Dell'Era & Landoni, 2014). How to run the interview is based on four principles: *context, partnership, interpretation* and *focus* (Beyer & Holtzblatt, 1998, Holtzblatt & Beyer, 2015). The *context* principle states that the data collection should occur in the context of the user in order to gather concrete data instead of abstract data (Beyer & Holtzblatt, 1998). *Partnership* means that the interviewer should collaborate with the user and let the user lead the interview (Holtzblatt & Beyer, 2015). The interviewer should not bring prepared questions to the interview but rather ask questions based on what is observed (Holtzblatt & Beyer, 2015). The *interpretation* principle entails that the interviewer should share his/her interpretation of the user's emotions, words and actions with the user (Holtzblatt & Beyer, 2015). Based on the response of the user the interviewer can assure that the interpretation is correct, if not it allows the interviewer to correct his/her interpretation (Holtzblatt & Beyer, 2015). The *focus* principle means that the interviewer should steer the conversation with the user toward topics that are meaningful for the investigation and ignore subjects that fall outside of the scope of the investigation (Holtzblatt & Beyer, 2015).

To help guide the interview in the right direction the contextual inquiry should consist of four parts (Beyer & Holtzblatt, 1998). First the interview should start with a *conventional interview* where the interviewer and the customer can get to know each other and the interviewer can inform the customer what he is searching for which will help the customer to share more

relevant information. The interviewer should also ask for permission to record the customer and inform the customer that he or she is encouraged to correct any misunderstandings. Thereafter the interview should consist of a *transition phase* where the interviewer states the basics of the contextual interview, that the interviewer will observe the customer and interrupt when seeing something of interest. Then the *proper contextual interview* can start where the customer starts performing the task and the interviewer watches and interprets. The interviewer should take notes during the contextual interview and not rely solely on the recorder. The final part of the interview is the *wrap-up* where the interviewer summarizes the notes and repeats verbally to the customer what has been identified, giving the customer a last chance to correct or elaborate on the interviewer's interpretations.

3.2.4 In-Depth Interview

According to Griffin and Hauser (1993), 20-30 interviews are often sufficient to capture 90-95 percent of the customer needs. Interviews can be conducted by telephone, e-mail or personal contact (Matzler et al., 1996). Ulwick and Bettencourt (2008), state that to capture customer needs the interview should be conducted in person. In-depth interviews is a type of personal interview that has a semi structured format and uses open-ended questions which allows the interviewer to detect underlying emotions, meanings and thought (Powers & Knapp, 2011). Since the purpose of an in-depth interview is to explore the customers' experience and what meaning the customers make out of that experience most questions asked during an in-depth interview follows the response to an earlier question (Granot, Brashear & Ceasar Motta, 2012). However, according to Carson et al. (2001) the format of an in-depth interview can vary, the interview can have no structure and be more of an informal conversation or it can use direct questions and be more structured.

Common for all in-depth interviews is that they consist of the following three steps: *planning the interview*, *starting the interview* and *managing the interview* (Carson et al., 2001). *Planning the interview* is where the overall objectives of the interview is determined (Carson et al., 2001). The interviewer should also prepare an interview protocol which contains some general open-ended questions related to the overall objectives which will help guide the interviewer through the interview (Carson et al., 2001). During the interview, these open-ended questions do not have to be addresses in the same order as they are written (Carson et al., 2001). The questions must be well thought out and pre-tested before conducting the interview (Raharjo, 2016). In addition, if the interviewer is inexperienced it is advantageous if the interviewer practices by interviewing someone the interviewer does not know very well, preferably a stranger (Silverstein, Samuel & DeCarlo, 2012).

When *starting the interview* one should start by presenting the purpose of the interview and ask for confirmation to record it. Even though the interview is recorded it is important to still take notes during the interview in case the recorder does not work or if background noise drowns the interview. However, not all researchers prefer to record the interviews since it could distract both the researcher and the respondent. The final step is to *manage the interview* which is when the interviewer covers the topics of the interview protocol. During the interview, it is important

to never interrupt an answer, not ask leading questions, use small encouragements like a yes or a smile and always maintain eye contact. (Carson et al., 2001)

Using in-depth interviews is an efficient method for detecting many and detailed customer needs (Griffin, 2012). However, tacit information might not be discovered through this method (Griffin, 2012). An advantage of individual interviews is that they are considered to be more cost efficient compared to focus groups (Griffin & Hauser, 1993) and uncovers deeper customer needs (Schirr, 2012).

3.2.5 Voice-of-customer

The voice of the customer (VOC) originated in the total quality management movement and together with quality function deployment aims to facilitate communication between functional boundaries within a company, such as marketing, R&D and manufacturing (Griffin & Hauser, 1993). The VOC entails identifying, structuring and prioritizing generic and specific customer needs through using certain principles and methods in the R&D, engineering and manufacturing processes of product development (Griffin & Hauser, 1993).

Griffin (2012, p. 224) describes VOC as "a structured, in-depth probing, one-on-one situational interview technique" and claims that using this technique may be more efficient in terms of time and cost for obtaining customer needs compared to other methods such as emulation or observation. The VOC can also be used as an alternative to focus groups and the main difference between these two techniques is the way the questions are asked (Griffin, 2012).

The way questions are asked mainly differ in four major ways. The first difference is that the questions and hence answers should be based on events that have actually occurred in the respondent's life. By asking such questions, customers do not fantasize or speculate about things that they have no knowledge of. The second difference is that questions should be indirect which allows the interviewer to uncover customer needs by guiding the customers through the approaches that they currently use to satisfy a certain need. The third it that the questions should be focused on the functionality, rather than particular products or services and their features, since it may provide unpredictable information about what products or services people actually use to fulfill a function. Finally, the fourth difference is that questions should entail the inclusion of several experiences and their contexts of when customers had a problem. This is important since it can capture both broad and detailed information that may be of relevance to the customer need. (Griffin, 2012)

One benefit of using this interviewing method is that a large amount of use cases can be explored at the same time. By gathering many different use cases, it is possible to obtain information about supplementary use areas, other than what is expected of the functional performance which is being investigated. A question that would follow the VOC principles and that would be good to start the interview with is to ask the customer to describe the most recent time they were in a situation in which the function had to be conducted. It is also preferable if the VOC interviews are conducted by the product development team themselves, rather than

outsourcing it to a market research group since it generates a deeper understanding. However the development team has to be careful to not to distort the words received by the customers or directly translating them into a solution before fully understanding the customer needs. Further, it is important to be aware of the fact that some customers may have a hard time to communicate and express their needs and even though tacit needs are obtained they may be exhaustive after using VOC. (Griffin, 2012)

Swaddling and Zobel (1996) argue that if researchers have conducted customer research in a satisfactory manner, through for example interviews, they should have obtained information about the specifics of a certain customer need. The information should include:

- The essence of the need
- Why the need exists
- Which benefits and features are compulsory and exchangeable
- Which benefits are available to the customer today and which of these are most valuable
- Which factors that may drive a purchase decision

If for example a company wants to investigate the needs regarding washing dishes, they could divide the questions into various categories in order to be able to obtain the information above (Swaddling & Zobel, 1996).

Category 1: Customer attitudes and behaviors
Example questions: How frequently do you do the dishes? What annoys you about doing the dishes?

Category 2: Benefits sought
Example question: What do you want dish washing products to do for you?

Category 3: Product specific questions
Example question: What type of dishes do you wash most?

Category 4: Problems consumers experience
Example question: What food stains are hardest to remove?

Category 5: Solutions currently in use
Example question: How and with which products do you solve the problems you have mentioned?

Category 6: Solution likes and dislikes
Example question: How well do the solutions that you use provide the benefits you want?

Category 7: An ideal solution
Example question: What would an ideal solution to do for you?

3.2.6 Laddering

Laddering is a one-on-one, in-depth interview technique used to better understand consumers' decision making process (Reynolds & Gutman, 1988). The laddering technique is derived from the means-end-theory and uses a series of "Why is this important to you?" questions in order to determine the linkage between attribute, consequence and values (Reynolds & Gutman, 1988). In contrast to Reynolds and Gutman (1988), Phillips and Reynolds (2009) divide consequence into functional consequence and psychosocial consequence.

By continually asking customers why something is important to them the customers are forced to critically think about the connection of a desirable attribute and the value that the attribute creates for the customers personally (Reynolds & Gutman, 1988). The objective of the laddering technique is to through a bottom-up-process obtain the ladder, i.e. the mean-end - chain (Phillips & Reynolds, 2009). The technique starts by eliciting an important attribute and then asking why that attribute is important to the customer to discover the consequence (Phillips & Reynolds, 2009). The personal value of the customers is then obtained by continuing to ask, "why is this important to you?" questions regarding the consequence. Two examples of the laddering technique is illustrated in Figure 5.

Personal value:	Quality of life	Self-esteem
	↑	↑
Psychosocial consequence:	Enjoyment (have more fun)	Accomplishment (mastery)
	↑	↑
Functional consequence	Can play often (easy on feet/legs)	Can get to ball (long rallies)
	↑	↑
Attribute:	Soft surface	Slow surface

Figure 5: *Illustration of two examples of the laddering technique taken from Phillips and Reynolds (2009) were the respondent were asked why he preferred a tennis court of clay compared to a hard surface.*

An attribute or consequence can contain more than one rung, meaning more than one "why is this important to you?" questions might need to be asked in order to obtain a consequence from an attribute or to obtain the personal value from a consequence. According to Phillips and Reynolds (2009), the ladder usually contains four to six rungs. In order to perform the laddering interview technique, the respondents must feel safe to express themselves (Reynolds & Gutman, 1988). Therefore, it is important to state that no right or wrong answer exist (Reynolds & Gutman, 1988).

3.2.7 From Whom to Obtain Customer Needs

Usually, companies tend to perform customer investigations on their already existing customers with whom they have established relationships (Griffin, 2012). However, if firms solely interact with existing customers, who presumably already like their products to some extent, they will miss out on input that may facilitate gaining new customers (Griffin, 2012). Some firms also tend to only conduct investigations on their own employees, however they are biased hence this approach may be more risky than not interacting with any customers at all (Griffin, 2012).

Interacting with experts to obtain customer needs is something that should be avoided since they have more knowledge in a specific field than the typical customer and will thus be biased (Griffin, 2012). However, using lead users or emergent users can be a good idea in order to expand the minds of the developers and gain a better understanding of how concepts may be commercialized (Schirr, 2012). Lead users are users that have certain needs that will become needs for a mainstream market in months or years (Von Hippel, 1986). Emergent users are users that have a special ability of being able to envision how concept ideas can be developed so that they will be adopted by the mainstream market to a large extent (Hoffman, Kopalle & Novak, 2010). According to Schirr (2012), a trait scale for finding emergent users can be used and studies have shown that using emergent users may generate better results than lead users.

Further, segmentation is important when deciding who to obtain needs from since customers within different segments do not have the same preferences regarding products (Ottum, 2012). To conduct segmentation, customers are divided into different "buckets" of similarity (Ottum, 2012). Ottum (2012) states that it is most useful to segment customers according to demographics, which could be age, income, geography, family type, and so on. However, customers could also be segmented according to firmographic, purchases and benefits sought (Ottum, 2012).

3.2.8 Who Should Be Involved

It is important that the development team is as involved as possible when gathering customer needs since it will increase their level of understanding which in turn will generate more accurately developed products. Having the development team members personally involved will also be beneficial since more tacit knowledge from customer investigations will be captured since tacit knowledge is otherwise hard to transfer. Even though the interviewers include a salesperson, there should not occur any selling while investigating customer needs. Nonetheless, it is important for those who have participated in the customer exploration to transfer their gained knowledge to other members of the organization. Therefore, it is necessary for the firm to create a system for this transfer and how to codify what they have learnt. (Griffin, 2012)

3.2.9 Sort Customer Needs

Customer needs are similar in nature and have different degrees of exactitude (Takai & Ishii, 2010). Since they are similar, it is beneficial to reduce a large number of needs into a small set of needs that are representative of all of them (Takai & Ishii, 2010). Because they have different specificity, there are more specific needs that could be considered to be included in a more general need (Takai & Ishii, 2010).

According to Takai and Ishii (2010), using affinity diagrams is a popular grouping method for identifying customer needs for new products. Affinity diagrams could be used for sorting large amount of verbal information such as customer desires (Bergman & Klefsjö, 2010). The sorting should be based on associations rather than logical connection (Bergman & Klefsjö, 2010). The affinity diagram approach starts by placing the identified customer needs on a white sheet of paper (Takai & Ishii, 2010). Thereafter, customer needs that are similar to each other are grouped together (Takai & Ishii, 2010). The grouping continues until all team members are satisfied and agree with the grouping (Takai & Ishii, 2010). When consensus is reached, the group members name each cluster of customer needs after a representative need (Takai & Ishii, 2010).

The affinity diagram method often leads to a strong commitment among team members due to the consensus approach (Takai & Ishii, 2010). However, if the consensus process does not work as intended, there is a risk that the result of the grouping only reflects a few group members' opinion (Takai & Ishii, 2010).

4 Method Proposal

To our knowledge, no method currently exists that is especially designed for finding future customer needs nor is there one that is especially designed for finding customer needs for smart home solutions. From theories regarding how to find customer needs in combination with the information about the nature of smart home solutions and the market for them, we have developed a method framework proposal for finding future customer needs for smart home solutions. We call this our proposal since it will be field tested and modified at a later stage. This chapter intends to answer research question three and consists of an explanation of why the method proposal looks like it does, an analysis of why each part in the method framework proposal is included and the method framework proposal. The method framework is the first part of our results and is regarded as a product that will be used by practitioners.

4.1 The Matrix

In order to understand why the method looks like it does we have developed a matrix that explains the concept behind the method. Primarily, the matrix explains why we will use demonstration in our method and it addresses the selection of products to demonstrate and whom to demonstrate the products to.

4.1.1 The Ability to Express Unarticulated Needs for Technical Solutions

Customers are not always aware of what they desire in the future. Therefore, most future customer needs can be classified as excitement needs (Bergman & Klefsjö, 2010). These needs cannot be expressed by the customer and are thus unarticulated needs (Bergman & Klefsjö, 2010). Our method will therefore focus on finding unarticulated needs for digital technical solutions and we have investigated in what ways people are enabled to express such needs. From the theories presented in Chapter 2 and 3 we have concluded that there are two main factors that affect how easily people can express their unarticulated needs for digital technical solutions. These two factors are:

1. A person’s ability to understand digital technology
2. How easy a certain digital technology is to understand

The reasoning behind these two factors will be further explained and connected to existing theory in section 4.1.2 A Person’s Ability to Understand Technology and 4.1.3 How Easy a Certain Digital Technology is to Understand. From now on digital technology will be referred to as technology. Our conclusion is that the better a person’s ability is to understand technology and the easier the technology is to understand, the easier it will be to derive unarticulated customer needs for technical solutions. We have not been able to conclude which one of these two factors that has the largest impact and therefore our assumption is that they have an equal effect.

Based on the two factors stated above a two-by-two matrix has been developed and is presented in Figure 6. The matrix explains people's ability to express unarticulated needs for technical solutions. The x-axis represents a person's ability to understand technology while the y-axis represents how easy a certain technology is to understand. The matrix has binary scales on both axes since it makes it easier to apply in practice.

		A person's ability to understand digital technology	
		Low	High
How easy a certain digital technology is to understand	Easy	Breeze	Walk in the park
	Difficult	Nightmare	Shooting star

Figure 6: *Matrix that explains people's ability to express unarticulated needs for technical solutions.*

The *walk in the park* means that the likelihood of a person's ability to express unarticulated needs is the highest. The *nightmare* means that the likelihood of a person's ability to express unarticulated needs is the lowest. For the *breeze* and the *shooting* star the likelihood of a person's ability to express unarticulated needs is moderate. The shooting star has more potential to express unarticulated needs compare to the breeze due to reasons explained below.

4.1.2 A Person's Ability to Understand Technology

From our background research, we have not found any established ways of measuring a person's ability to understand technology. Nevertheless, what we have found is that a person's ability to understand technology is greatly connected to the person's overall experience with technology. For example, millennials who, in contrast to older generations, have grown up with a large exposure to digital technology have a better ability to understand this type of technology than older people (Bess & Bartolini, 2011, Solomon, 2013, Fromm & Garton, 2013). Another example are people who have an interest in emergent technology, such as early adopters, are in general more experienced with technology and hence will have a better ability to understand technology (Chinchor, Cook & Scholtz, 2012). There are different ways of determining a person's overall experience with technology (Hoffman, Kopalle & Novak, 2010, Solomon, 2013) but none that is established. We have decided to use age as an indicator for the overall experience with technology since it is evidently an important factor in understanding technology and as well as easy information to derive when conducting customer investigations.

To summarize: *A person's age affects a person's overall experience with technology which affects a person's ability to understand technology*.

4.1.3 How Easy a Certain Digital Technology is to Understand

From our background research, we have not found any established ways of measuring how easy a technology is to understand. However, we have found that how easy a technology is to understand is greatly connected with the degree of experience with that particular technology (Griffin, 2012, Schirr, 2012, Füller & Matzler, 2007). For example, people who have smart home technologies or know people with smart home technologies are more inclined to adopt smart home technologies since they more easily understand the concepts (iControl Networks, 2015). Another example is that people who have been shown a demonstration of a technical solution that they have not seen before, understand its functions and applications better after the demonstration (Griffin, 2012, Schirr, 2012, Füller & Matzler, 2007).

How to measure people's experience with a specific technical solution can vary. For example, the further along the product life cycle (PLC) a product is, the more likely it is that people has had some type of experience with it, whether it be directly or indirectly (Chinchor, Cook & Scholtz, 2012). We have chosen to use the PLC as an indicator of people's experience with a certain technology since it is an easy concept to grasp and it is resource efficient to use.

To summarize: *In what stage of the product life cycle a technical solution is in affects the likelihood of a person's experience with that technical solution which affects how easy that technical solution is to understand.*

4.1.4 Set Values for the Matrix

To make the matrix practical, values have to be set for the axes, see Figure 7. The binary values on the x-axis have been set to 'people below or equal to 37 years of age' and 'people above 37 years of age'. We have decided to use the age 37 as a limit since today in the year of 2017, the oldest millennial (according to our definition of the term) is 37 years. Millennials, in contrast to older generations, have grown up with a large exposure to digital technology have a better ability to understand this type of technology than older people (Bess & Bartolini, 2011, Solomon, 2013, Fromm & Garton, 2013).

We have chosen to use introduction/growth and maturity as values. The introduction and growth stages have been put together since the difference in likelihood that a product has been experienced is smaller for products in the introduction and growth stage than it is for products in the maturity and growth stage (Kotler et al., 2009). The decline stage has not been included since products in this stage of the PLC are too outdated and irrelevant to use for finding future customer needs.

		Age of person	
		People above 37 years	People below or equal to 37 years
Stage of solution in product life cycle	Maturity	Breeze	Walk in the park
	Introduction/ Growth	Nightmare	Shooting star

Figure 7: *Matrix with modified values for the axes*.

How to derive future customer needs for smart home solutions differs depending on which square one is placed in. We have developed a method that is designed to fit the *shooting stars* since we consider this square to be most suitable for finding future customer needs for smart home solutions. This is due to the fact that younger people have a better ability to understand digital technology and can therefore more easily express unarticulated needs. Additionally, future customer needs are favourably derived from products in the early development stages since it is easier to derive future customer needs when the product is less experienced (Silverstein, Samuel & DeCarlo, 2012). Moreover, the need to develop a method for finding future customer needs for smart home solutions is greater for products within the introduction and growth stage of the PLC since most smart home solutions are in these early phases (Greenough, 2016).

A person's overall experience with technology is difficult to change, since it takes a lot of time and effort. However, a person's experience with a specific technical solution can more easily be changed. Therefore, to discover unarticulated needs it is more resource efficient to increase the level of experience of a specific product and not increase a person's overall technological experience. Therefore, our method will be designed to increase the level of experience of a specific product and not increase a person's overall technological experience.

4.2 Parts of the Method Proposal

This section explains which parts that are included in our method and why they are included. The proposed method framework will consist of three main parts: the first part is planning of the investigation, part two is conducting the investigation and part three which is the completion of the investigation. By investigation we refer to all activities in part two which is the part that we have focused on since it is specially designed for finding future customer needs for technical solutions. Part two will be presented first since part one and part three depend on part two. This is because, to be able to prepare an investigation (part one) and finish the investigation (part three) one has to have knowledge about the design of the actual investigation (part two).

4.2.1 Part Two - Conducting the Investigation

Part two of the method will consist of four main steps which are: demonstration of existing products or concepts, a short applied ethnography, a contextual interview and finally an in-depth interview. These parts are intended to complement each other in order to find future customer needs.

Combining Approaches for Finding Customer Needs

We will combine four different qualitative approaches for finding customer needs. Combining different approaches follows the logic of triangulation which is based on the fact that no sole method is immune from explanations from other methods (Patton, 1999). Hence, by combining multiple approaches of data collection, one can obtain various aspects of empirical reality and achieve cross-data validity checks (Patton, 1999). For example, in field work it is advantageous to combine observations and interviews (Patton, 1999). If only one approach was to be used, it is subject to more errors that are specifically connected to that approach (Patton, 1999).

Since future customer needs often are unarticulated needs and especially excitement needs, the approaches used to identify needs in this method proposal are research methods specialized in discovering these excitement needs, such as applied ethnography and contextual inquiry, in contrast to more traditional research methods such as focus groups, surveys and traditional interviews (Bayus, 2008). In addition, Sanders and Dandavate (1999) state that in order to understand and establish empathy with customers, one has to investigate both what people do and what they say. Therefore, it is also important that our proposed method utilizes both observation and interview techniques, whereby our method will contain an in-depth interview in addition to the applied ethnography and contextual inquiry. Moreover demonstration is also included in the method since the participants' experience level has to be increased in order to derive customer needs from the other approaches.

The demonstration should be conducted first since the participants' experience level has to be increased prior to using the other approaches. By participant we refer to people taking part in the investigation. The applied ethnography will be second because it is advantageous to observe people's spontaneous reactions when first interacting with a product. The contextual inquiry is a natural continuation from the applied ethnography since questions asked in the contextual inquiry are derived from observations (Holtzblatt & Beyer, 2015).

The demonstration, applied ethnography and contextual inquiry should be conducted for one product at a time, whereas for the in-depth interview all products/concepts included in the investigation should be discussed simultaneously. This is because, for the first three approaches, the customer should not be overwhelmed and if all products where to be demonstrated before the applied ethnography and contextual inquiry there is a risk that the participant has forgotten how a product functions. For the in-depth interview we believe that we will obtain more customer needs if the participant has knowledge about all products since the participant then is more experienced. In addition, the questions in the in-depth interview

will not focus on the products but the function the products are providing. Therefore, all products have to be demonstrated before the in-depth interview.

The steps mentioned above should be performed individually and not in groups since it is considered to be more cost-efficient to gather customer needs in one-on-one interviews compared to groups (Griffin & Hauser, 1993) and will also help discovering deeper customer needs (Schirr, 2012).

Demonstration

The first part of the investigation is to demonstrate smart home solutions. The demonstration will include both to verbally describe and to physically show how the products work and the concept behind them. The purpose of using demonstration is to increase the experience level of the participant and doing this will increase the likelihood of yielding realistic and reliable answers from customers (Griffin, 2012). Therefore, one should demonstrate and explain a product until the participant fully understands it. This is especially true for disruptive or radical innovations (Schirr, 2012). By demonstrating products, the customers will understand them better and hence be able to provide detailed and fact based answers (Griffin, 2012, Schirr, 2012). Further, by providing an opportunity for customers to experience a product or product concept it enables customers to express an unknown need (Füller & Matzler, 2007).

One can demonstrate a solution by presenting the physical product, or if for some reason the solution is not physically available, one can demonstrate a representation of the solution through models, computer-aided design (CAD) drawings or virtual prototypes (Griffin, 2012). According to Füller and Matzler (2007), a virtual product experience is a way of finding customers' known as well as unknown needs. Moreover, if the smart home solution contains a service element, in addition to the physical product, it may be beneficial to simulate this service in order for the customer to have a more realistic experience. This can be done by providing a more exhaustive verbal explanation or by showing the concept virtually.

Applied Ethnography

The second step of the investigation is to conduct a short applied ethnography. The applied ethnography will help to identify the symptoms of unarticulated needs (Dell'Era & Landoni, 2014). The length of an applied ethnography can vary substantially (Polukhina, 2015). A more complex product is expected to require a longer ethnography. Since many products will be observed and other methods for finding future customer needs will be used as well, the length of the applied ethnography is recommended to not be too long. If the entire investigation takes too much time, there is a risk of losing the interest of the participants and they will lose focus before the in-depth interview part of the investigation starts. Therefore, our applied ethnography will be significantly shorter compared to the traditional applied ethnography.

During the observation, the investigator should not ask any question, only take notes and observe how the participant interacts with the product (Silverstein, Samuel & DeCarlo, 2012).

To help remember a situation, it can be advantageous to draw a sketch of that situation (Aagaard & Matthiesen, 2016). We have chosen to document the applied ethnography using notes and sketches for gathering information while not disturbing the participants. It is especially important to not disturb or require too much private information when dealing with smart home solutions since privacy is a concern of many people (Hedlund, 2015). Therefore, we have decided not to use a video recorder. By not infringing on privacy, we expect to acquire more honest and spontaneous reactions since the participants will be more comfortable. During the observation the investigator should also ask himself/herself the following questions, suggested by Silverstein, Samuel and DeCarlo (2012):

- Why does the participant use the product/service, what type of job is he or she trying to get done?
- What expectations does the participant have regarding the product/service?
- Is the participant using the product/service as intended or in an unexpected way?
- How does the participant appear to feel regarding the product/service?

These questions can help the investigator to translate the actions of the participants into customer needs.

Contextual Inquiry

Contextual inquiry can be used to discover unarticulated customer needs (Bayus, 2008). Therefore, to obtain additional insight into a customer's unarticulated needs our method also consists of a contextual inquiry. Observing the participant using a product and simultaneously asking questions about the product will prevent the participant from talking about the product in generalization and our method can thereby discover more detailed unarticulated needs (Bayus, 2008, Beyer & Holtzblatt, 1998).

When performing the contextual inquiry, the investigator should follow the four principles presented in the background research (page 21) *context, partnership, interpretation* and *focus.* The context principle is important in our case since it gathers concrete data. Because this method is meant to be used by companies that require actionable results, concrete data is preferable to obtain. The partnership principle is important since the interviewer might be biased and may influence the participant. Unarticulated needs are hard to correctly interpret, therefore it is important to use the interpretation principle by repeating the words of the participant and confirm their meaning. Further, the interpretation principle enables the participant to correct or elaborate on the investigator's interpretations. The interpretation principle is important to use when dealing with smart home solutions since they are generally hard to understand, especially those in the early stages of the PLC. The focus principle is necessary due to time and cost constraints that companies have.

To document the responses obtained during the contextual inquiry the investigator should take notes and not audio nor video record the inquiry as recommended by Beyer and Holtzblatt (1998) since the use of a recorder would be impractical if using a simple recording device which

would be most cost and time efficient. This is because the contextual inquiry will take place by the products that has been demonstrated and the products may be installed in various places. Thus, the interviewer would have to record while interacting with the product and participant and maneuver the recorder in between products. One might have to start and pause the recording and carry the recorder between the different locations which could become a disturbance to both the participants and the interviewer and lower the quality of the investigation.

A contextual inquiry normally takes around two hours (Dell'Era & Landoni, 2014). However, we do not recommend such long inquiry for the same reasons as stated for the applied ethnography. Therefore, the contextual inquiry will be significantly shorter compared to a traditional contextual inquiry.

In-Depth Interview

After having demonstrated, observed and conducted contextual inquiry for each product, the method proposal consists of an in-depth interview. During this in-depth interview, a set of prepared open-ended questions will be asked and these questions should focus on the function rather than the features of the products. A traditional interview mostly finds articulated needs (Griffin, 2012), however for our method proposal, we recommend using the voice-of-the-customer technique to prepare the interview questions. By using this method, the in-depth interview can focus more on needs that are difficult to articulate (Griffin, 2012). For guidance regarding how to write questions using the voice-of-the-customer technique, see page 23, and to see example of questions written with the voice-of-the-customer technique, see page 24 and Appendix.

During the interview, it is important to listen carefully to the responses of the participant, to be able to ask supplementary questions. To further focus on unarticulated needs during the interview, one shall use aspects of the laddering technique, meaning to continually ask the respondents why they answered like they did on the previous question (Reynolds & Gutman, 1988). The participants are then forced to critically think about the connection of a desirable attribute and the value that attribute creates (Reynolds & Gutman, 1988). Thus, focus is more on the function rather than the product features which is important when gathering desired end-state needs. The end-state needs are long-term (Bayus, 2008) and are therefore more likely to remain in the future.

To be able to capture everything that has been said during the interview, it is recommended to audio record the interview. Recording is more appropriate during the in-depth interview compared to the applied ethnography since audio recording is less intruding than video recording. It is also more practical because the interview is held at the same spot, unlike the contextual inquiry. Since the purpose of the proposed method is to find unarticulated needs, it can be advantageous to go back and listen to the interview afterwards and try to identify underlying needs that the participant was not fully able to articulate. However, before the interview is recorded one has to ask the participant for permission due to privacy concerns. If permission is not granted, still continue with the in-depth interview and take notes. Even though

a recorder is used, notes should still be taken during the interview in case the recorder does not work as intended or if background noise drowns the responses (Carson et al., 2001). The data from the recording will be used when analyzing the results of the investigation.

4.2.2 Part One - Planning the Investigation

Part one of the method consists of seven steps that have to be conducted prior to the investigation. These steps are influenced by the choice of approaches for finding future customer needs presented in part two and the matrix discussed earlier in this chapter. The steps should be conducted in the order stated below since a later stage is influenced by choices made in an earlier stage. However, the order of step one and step two can be alternated since they are not dependent on each other and can therefore be conducted in the order desired by the company.

Decide Customer Segment

The first step in our method proposal is to decide for which customer segment a company wants to research future customer needs. Segmentation is important since customers within different segments do not have the same preferences regarding products (Ottum, 2012). If people have similar preferences it is more likely that they will have similar needs which may facilitate when acting upon the results from the study. In our method proposal, we will not state how to conduct the segmentation, the company has to decide themselves which type of segmentation that will be most beneficial to them.

If a company wishes to investigate one certain customer segment they have to evaluate this segment in terms of their experience with technology, as suggested by age. If some people in the segment are older than 37 years old and some are younger than 37 years old the company is recommended to conduct the method on those people in the age group that is the largest. This is because the majority will represent that particular segment best. Moreover, the method cannot be conducted on both people over and under 37 years old simultaneously since the method is designed differently for these age groups. If a company wishes to in the best possible way derive future customer needs, they should choose people that have a high overall experience with technology.

Choose Product Category and Products

According to Stamford (2014), in year 2022 a typical family home could hold more than 500 smart home products. Thus, to investigate future customer needs for all products within the smart home market in the same investigation is too resource consuming and the company should therefore only investigate few products at a time. This is also important for the participants to not be overwhelmed by new concepts and due to time constraints for the participants and company. We are suggesting that no more than five products or not fewer than two products are investigated in the same investigation. It is beneficial to demonstrate at least two products since the participants will be able to compare products and concepts which enables them to be

more analytical. Demonstrating more than five products will be overwhelming and may confuse the participants. To generate as many needs as possible for these products, the same products should be demonstrated for all participants.

In order for the investigation to not be too scattered and to investigate products that fulfill similar needs, the company is recommended to investigate products within the same product category. Our proposed method could be used for all different types of product categories within the smart home market. It is up to the company to decide which product category they want to investigate. However, the product category should not be too broad, products within the category should satisfy the same function and have similar characteristics. As the smart home market develops and more smart home solutions are offered, the product categories will contain increasingly more products and hence create more subcategories. Thus, when choosing products that have similar characteristics, one will have to choose a narrower subcategory.

Once the company has decided which product category they want to investigate, they should evaluate were in the PLC that product category is, introduction/growth or maturity. Thereafter, the company has to decide which products within the category they want to examine. Preferably the products will be developed enough for a physical component to be used for demonstration and observation. If products within the same product category are at different stages of the PLC, the company is advised to use the recommended approach for those products that are in majority.

Evaluate Matrix Placement

The next step is to evaluate if our method is most suitable to use for the chosen customer segment and product category by seeing were in the matrix (Figure 7) they are placed. As stated before, the method is developed for the *shooting star*, thus if the selected parameters are placed in the *shooting star* square the company is good to go.

For the *breeze* our proposed method is also suitable to use. Even though participants within this square have low overall technology experience, the product category is mature. Therefore, it is likely that the participants have previously come in contact with these products and have an idea about how they work. However, since these participants have a lower overall technology experience compared to the ones in the *shooting star* it is not as easy for them to answer the questions in the contextual inquiry and the in-depth interview. Therefore, more time has to be allocated for these parts of the investigation.

Moreover, for the *nightmare*, our proposed method can be used, depending on the abstraction of the technology. If the technology within the product category is very difficult to understand, participants with low overall technology experience are not as likely to be able to answer the questions during the in-depth interview. The time used for demonstration has to be longer compared to the *shooting star* and sometimes it is not be enough to demonstrate the products in order to translate the participants into experienced customers. Furthermore, more time has to be allocated for the contextual inquiry and in-depth interview due to the reasons explained for

the *breeze*. The total time for the investigation will hence increase. As mentioned before, there is a risk that people will lose interest and focus if the investigation is too long. Therefore the amount of products used in the investigation for the *nightmare* should be fewer compared to the *shooting star*. We recommend to include less than five products in the investigation for the *nightmare*, depending on the abstraction of the solutions.

Finally, if the selected parameters are placed in the *walk in the park* square, our proposed method could be slightly redundant. Therefore, the company should evaluate if it is enough to use a simpler and more resource-efficient method for finding future customer needs. However, if the company still decides to use our proposed method, all steps (demonstration, applied ethnography, contextual inquiry and in-depth interview) can be shortened. For example, it is probably not necessary to demonstrate the products to the users since they have presumably already experienced them.

Find People to Investigate

The next step of the proposed method is to find people to investigate. In accordance with Griffin (2012), these people should not be the company's own employees, experts within the field or only existing customers. It is beneficial to investigate at least a few persons that have never used the products before since by watching a person trying to use a product for the first time, unexpected ways of the product usage can be revealed (Silverstein, Samuel & DeCarlo, 2012).

According to Griffin and Hauser (1993), 20-30 one-on-one interviews are often sufficient to capture 90-95 percent of customers' needs. The purpose of our method is to find future customer needs, needs that people are not aware of today. Therefore, the purpose of our method is not to find all customer needs, but the method is more focused on finding the excitement customer needs and less designed toward finding expected and basic customer needs. Hence, as long as the excitement needs are found it is more than sufficient to find 90-95 percent of all the customer needs.

Furthermore, since our proposed method uses both applied ethnography and contextual inquiry in addition to in-depth interviews, it is assumed that less than 20-30 people are needed to capture 90-95 percent of the customers' needs. Silverstein, Samuel and DeCarlo (2012) state that to better understand customer needs it is the quality of the participants that matters, not the quantity of observed people. We suggest that for our proposed method it is enough to investigate 10-15 persons. This will also make for a resource efficient method since a typical one-on-one interview costs approximately USD 1000-2000 (Griffin & Hauser, 1993). Since there are many different regulations and approaches for how to reach out to customers for different companies it is up to every company to decide for themselves how they will do this.

Decide Where to Conduct the Investigation

The next step is to decide where the investigation should be conducted. Both applied ethnography and contextual inquiry should be conducted in the user's current native

environment, were the product is intended to be used (Silverstein, Samuel & DeCarlo, 2012, Luojus & Cavén-Pöysä, 2010). However, since the smart home market is not well developed, few people have smart home solutions installed in their homes. In addition, even when the market is developed, our method intends to investigate products in the introduction and growth stage and therefore it is unlikely that they are already installed in people's homes at the point of investigation. Many smart home solutions offered by construction companies are preferably built into the home (Ericsson, 2015), therefore it is difficult to conduct the investigation at people's homes. Moreover it would be time and cost consuming to conduct individual investigations at people's own homes. However, the downside of not conducting the investigation in the participant's native environment is that it is less realistic.

Instead, the investigation should be conducted in an environment as similar as possible to the participants' own homes. For construction companies, a show flat, an apartment used by the construction company where the chosen smart home products are installed, would be most suitable. If that is not possible, another environment such as a lab could be used. The most important aspect is that all products under investigations are installed and work as intended.

For products that are in an early phase of the PLC and still under development, VR and/or AR could be used to let the consumers experience the product (Füller & Matzler, 2007). One benefit of using VR or AR is that companies are able to show products in an early development stage and gather unknown needs early and it can be more cost efficient than using a physical prototype (Füller & Matzler, 2007). However, if the physical product already exists it is unnecessary to develop VR and AR models. Though VR and AR could be performed over internet we still suggest that these techniques are used in person, since the steps after demonstration require in person contact. It is also beneficial to conduct the demonstration in person since it increases the response rate and effort put into the investigation by participants (Dahan & Hauser, 2002).

Preparation of Investigation

To prepare for the investigation, the company should decide who will perform it. It is advantageous if the investigator has previous knowledge regarding how to perform an applied ethnography (Silverstein, Samuel & DeCarlo, 2012). These people can more easily discover customer needs and thus more customer needs can be found. Moreover, the investigation should be performed by the product development team themselves and not be outsourced to a market research group (Griffin, 2012). This is because the captured customer needs will be better understood by the people who has conducted the investigation and it will therefore be easier to act upon the needs during product development.

Once the company has decided who should perform the investigation, the company has to make sure that the investigator/investigators understand and have enough knowledge regarding the products that will be used during the investigation so that they will understand the comments and questions made by the participants. The investigator/investigators have to be able to demonstrate the products to the participants and be able to ask follow-up questions regarding

the product. Using the same people (investigators) for the entire investigation process is resource efficient.

The final part of the preparation is to prepare questions for the in-depth interview. How the questions should be formulated is addressed in section '3.2.1.5 In-Depth Interview'. Preparation of questions for the contextual inquiry is not necessary since questions during this part of the investigation should only be based on what is being observed (Holtzblatt & Beyer, 2015). Once the questions for the in-depth interview have been prepared they should be tested before conducting the investigation to make sure that the questions are easy to understand and interpreted as intended (Raharjo, 2016). Since no demonstration will be conducted prior to testing the questions, the questions should be tested on a person that has previous knowledge about the products included in the investigation, while not being an expert. In addition, if the investigator has no previous experience of interviewing people, he/she should practice his/her interviewing skills by interviewing a stranger (Silverstein, Samuel & DeCarlo, 2012). The test should be conducted in accordance with the instructions of the method.

Introduction to Investigation

Both for applied ethnography, contextual inquiry and in-depth interviews it is important to first inform the participant about the purpose of the investigation and how this information will be used (Carson et al., 2001, Silverstein, Samuel & DeCarlo, 2012). Thereafter the investigator should explain how the investigation will be conducted.

4.2.3 Part Three - Completion of the Investigation

Part three of the investigation consists of two steps. The first step in conducted in conjunction with the investigation while the second step is performed after the investigation.

Finish the Investigation

When the in-depth interview is finished, the participants' part of the investigation to find future customer needs is completed. End the investigation by thanking the participants for their involvement and ask them if there is something they want to add before the investigation is completed.

Summarize the Results

After the investigation, one should compile all customer needs that have been identified during the applied ethnography, contextual inquiry and in-depth interview. Gibbs (2010) states that qualitative data is usually analyzed in text, whether it is field notes from ethnographic work or transcription from interviews. Additionally, Gibbs (2010) argues that most audio recordings are transformed into text before being analyzed since text is an easy form of data to deal with. Therefore, to make sure that all needs during the in-depth interview are identified one should

after the investigation listen to the recordings from the in-depth interviews and write down important points.

As stated by Takai and Ishii (2010), customer needs are often similar to each other and therefore have to be grouped together. This is especially true when multiple customers have been involved. It is likely that the participants have needs that are common for all participants, but have been expressed differently among the participants. To group needs that are similar to each other is important in order to lower the amount of customer needs and facilitate the future work of developing products desired by the customer.

To group the identified customer needs, it is recommended to place the customer needs with similar meaning next to each other (Takai & Ishii, 2010). All the investigators should participate in the grouping activity since it is advantageous with diverse input. If the investigation was conducted by only one investigator, other people in the product development team should participate in the grouping activity. Grouping with multiple people is useful since unarticulated needs are difficult to interpret since they deal with information concerning what customers do and make, rather than say (Sanders, 1992).

As stated by Takai and Ishii (2010), grouping of the needs is completed when everybody agrees upon the grouping. It is unlikely that everybody immediately has the same opinion regarding which customer needs that should be grouped together. Therefore, it should be easy to move a customer need back and forth between different groups. To facilitate the movement of customer needs, one are advised to write all identified customer needs on post-it notes. When consensus is reached among the investigators, they should name each cluster of customer needs after a representative need (Takai and Ishii, 2010).

4.3 Method Framework Proposal

This section presents the method framework proposal which consists of 13 steps. Steps 3 to step 13 should be conducted in the order stated in the framework since a later stage is influenced by choices made in an earlier stage. However, the order of step one and step two can be alternated since these two steps do not influence each other. In the framework actions and recommendations, derived from 4.2 Parts of the method proposal, will be presented for each of the 13 steps. Action should be conducted in the stated order within each step. For some actions, recommendations are given and the relationship between action and recommendation is indicated by a letter. The method framework proposal is presented on the next three pages.

Parts and steps of the method	Actions to take	Recommendations
Part One - Planning the investigation		
1. Decide customer segment	**a.** *Either* choose customer segment and thereafter gather information on their age. **b.** *Or* choose customers that will optimize the results of the study, people that have a high overall experience with technology.	**a.** If some people in the segment are older than 37 years old and some are younger than 37 years old the company is recommended to conduct the method on those people in the age group that is the largest.
2. Choose product category and products	**a.** Choose a narrow product category. **b.** Evaluate the product category's placement in the product life cycle. **c.** Choose no more than five or fewer than two products within the product category.	
3. Determine matrix placement	**a.** Determine matrix* placement based on the chosen customers and product category. **b.** If placed in shooting star, no modifications have to be made. **c.** If placed in breeze, allocate more time for contextual inquiry and in-depth interview. **d.** If placed in nightmare, allocate more time for demonstration, applied ethnography, contextual inquiry and in-depth interview. Also limit the number of products to three products. **e.** If placed in walk in the park, evaluate if this method is redundant. If it is not redundant, shorten all steps (demonstration, applied ethnography, contextual inquiry and in-depth interview).	*The matrix is presented at the end of this framework. **e.** Depending on the familiarity of the product, demonstration may be excluded.
4. Find customers to investigate	**a.** Find 10-15 participants.	**a.** These participants should not be the company's own employees, experts within the field or only existing customers.
5. Decide where to conduct the investigation	**a.** Select an environment as similar as possible to the participants' own homes, for example a show flat.	**a.** For products that are in an early phase of the product life cycle and still under development, virtual reality and/or augmented reality can be used to let the customers experience the product.

6. Prepare the investigation	**a.** Decide who will perform the investigation. **b.** Prepare questions for the in-depth interview. **c.** Test the questions to make sure that they are easy to understand and interpreted as intended.	**a.** The investigator/investigators should understand and have enough knowledge regarding the products that will be used during the investigation. Preferably they should be trained ethnographers and part of the product development team. **b.** The questions should focused on function rather than features and follow the principles of voice-of-the-customer. **c.** Preferably test the questions on a person that has previous knowledge about the products under investigation.
7. Introduction to investigation	**a.** Inform the participants about the purpose of the investigation, how information obtained during the investigation will be used and how the investigation will be conducted.	
Part two - Conducting the investigation		The demonstration, applied ethnography and contextual inquiry, should be performed in sequence for one product at a time whereas for the in-depth interview all products/concepts should be discussed simultaneously.
8. Demonstration	**a.** Verbally describe and physically show how the product works and the concept behind it. Demonstrate and explain the product until the participant fully understands it.	**a.** Demonstrate a solution by presenting the physical product, or if the solution is not physically available, demonstrate a representation of the solution.
9. Applied ethnography	**a.** Do not ask any question, only take notes and observe how the participant interacts with the product. Also draw a sketch of that situation. **b.** During the observation the investigator should ask himself/herself the following questions: - Why does the participant use the product/service, what type of job is he or she trying to get done? - What expectations does the participant have regarding the product/service? - Is the participant using the product/service as intended or in an unexpected way? - How does the participant appear to feel regarding the product/service?	

<table>
<tr><td>10. Contextual inquiry</td><td>a. Follow the four principles of contextual inquiry: context, partnership, interpretation and focus.
b. Take notes during the contextual inquiry.</td><td></td></tr>
<tr><td>11. In-depth interview</td><td>a. Ask for permission to record the interview. If permission is granted, record.
b. Take notes during the interview.
c. Ask the prepared open-ended questions regarding the products that have been demonstrated.</td><td>c. Use the laddering technique when asking follow-up questions.</td></tr>
<tr><td>Part three - Completion of the Investigation</td><td></td><td></td></tr>
<tr><td>12. Finish investigation</td><td>a. Thank the participants for their involvement and ask them if there is something they want to add before the investigation is completed. If yes, take notes.</td><td></td></tr>
<tr><td>13. Summarize the results</td><td>a. Compile all customer needs that have been identified during the applied ethnography, contextual inquiry and in-depth interview.
b. Listen to the recordings from the in-depth interviews.
c. Group customer need according to similarity.
d. Name each cluster of customer needs after a representative need.</td><td>c. All investigators should participate in the grouping and if the investigation was conducted by only one investigator, other people in the product development team should participate. Continue with grouping until everybody agrees upon the grouping.</td></tr>
<tr><td>The Matrix</td><td colspan="2"><table>
<tr><td colspan="2"></td><td>Age of person</td><td></td></tr>
<tr><td colspan="2"></td><td>People above 37 years</td><td>People below or equal to 37 years</td></tr>
<tr><td rowspan="2">Stage of solution in product life cycle</td><td>Maturity</td><td>Breeze</td><td>Walk in the park</td></tr>
<tr><td>Introduction/ Growth</td><td>Nightmare</td><td>Shooting star</td></tr>
</table></td></tr>
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5 Methodology

In this chapter we will explain the methodology of our study. First, we will present our research strategy and design and thereafter we will describe our research process. Throughout this chapter we will include established theories that we have based our methodology on in order to achieve a study with a high level of quality.

5.1 Research Strategy

Research can be quantitative, qualitative or both (Bryman & Bell, 2007). Qualitative research is used for generation of theory rather than testing of theory, which is more quantitative (Bryman & Bell, 2007). Additionally, qualitative research is appropriate when empirical data collection as well as analysis from literature has to be conducted (Bryman & Bell, 2007). Our research entails creating a new method and we have based the creation of our method on an analysis from literature and theories, therefore we have used a qualitative research approach. According to Bryman and Bell (2007), qualitative research accentuates an inductive approach when dealing with the relationship of theory and research. We have therefore used an inductive approach during the first part of our research, the development of our method which we called method proposal.

A deductive approach is used when testing a hypothesis through empirical studies and improving it based on the findings (Bryman & Bell, 2007). In order to test and improve our method proposal, a deductive approach has been used. The testing of the method has been conducted at a Swedish construction company, Skanska.

5.2 Research Design

In order to achieve our aim, to develop a method for finding future customer needs for smart home solutions, we researched how to develop a method. From this systematic investigation we did not find any established theories regarding how to specifically develop a method. Therefore, we had to investigate theories regarding how to develop products, services, environments and experiences and evaluate which of these theories best agreed with how a method could be developed. In addition, the choice of research design was also influenced by our criteria for developing a method.

Our criteria for developing a method included that it had to be possible to create and verify the method within the time, information and budget limits that we had for our master's thesis work. Hence, the research design had to be resource efficient. Moreover, the aim of our research design was to solve an identified need by combining existing theories. In addition, the research design should also be able to facilitate the process of creating a method, which we considered to be a type of product that could be used in the industry by practitioners. Based on these criteria

we considered principles from the Engineering Design Process, EDP, to be suitable for creating our method.

The EDP fulfilled our criteria since it considers many aspects for creating a new product such as: cost and ease to make and use, quality, reliability, environmental considerations, safety, functionality, ease of use, aesthetics, ethics, social and cultural impact, maintainability and testability (Tayal, 2013). Moreover, the EDP is defined as a procedure of meeting an identified and desired need by using various theories from engineering sciences (Draper, 2009 & Tayal 2013). Finally, Tayal (2013) states that the EDP is typically used by engineers in order to facilitate an engineer in creating a new product or service that can be used in practice.

The EDP consists of several steps which may vary but common ones are: defining the problem, do background research, specify requirements, create alternative solutions, choose the best solution, do development work, build a prototype and lastly test and redesign (Tayal, 2013). Since there is no exact definition of which steps should be included and in what order when using the EDP, we will use the steps that fit our aim, project and scope, see Figure 8.

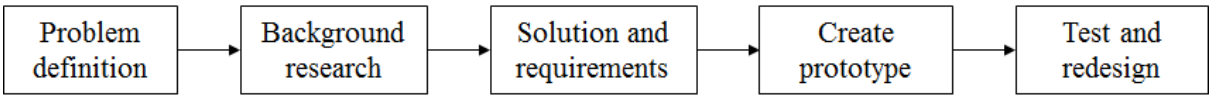

Figure 8: *Our research design.*

In accordance with the EDP the first step we included in our research design was defining the research problem because it is crucial to understand what problem one is trying to solve. We also decided to include a background research since one of the most important steps for research projects is to review the existing literature (Sachdeva, 2009). It would also, according to Sachdeva (2009), allow us to identify related research and set the research project into a theoretical context. The third step in our research design was chosen to be the creation of a solution and defining the requirements of this solution. In contrast to the EDP we decided to only include one solution due to time limitations of this master's thesis work. Moreover, the creation of a prototype was included as a step in order to be able to test our assumptions and conclusions derived from an analysis of the background research. The last step that we decided to include in our research design was to test the prototype and redesign it in order to verify the prototype. We used an inductive approach for the four first steps of our research design and used a deductive approach for the last step.

The EDP is described as open-ended since the solution is not known when the problem solving process has begun and new information is likely to emerge for each step (Tayal, 2013). Due to this, the process is iterative and cyclical, meaning that it may start at, and return to, any step (Tayal, 2013). However, due to time constraints, our research design has not been cyclical and iterative.

5.3 Research Process

The research process describes a number of steps and the sequence of these steps that have to be carried out when conducting research (Kothari, 2004). The steps are closely related to each other and are often conducted in parallel (Kothari, 2004). In this chapter, our research process will be described.

5.3.1 Overview of Research Process

Our research process, presented in Figure 9, describes how the master's thesis has been conducted while including all steps of the research design in order to solve the research problem. The steps that have mainly been conducted in parallel are the background research and the case study.

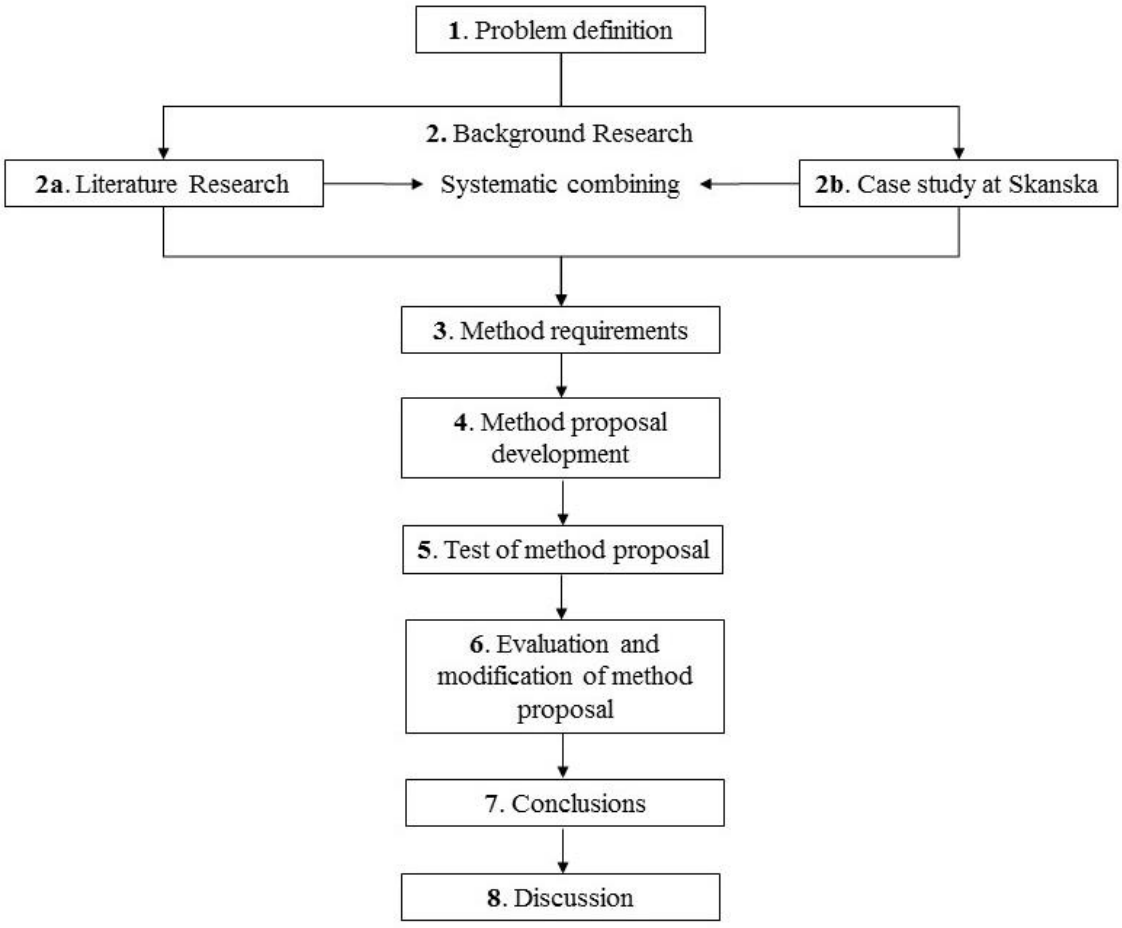

Figure 9: *An overview of our research process.*

In accordance with our research design we started by defining the research problem before conducting a background research. The background research entailed combining literature research and a case study in which the case study enabled obtaining information from various sources at Skanska. Thereafter, we analyzed the findings from the background research from

which we came up with a solution and specified the requirements for this solution. The solution was to create a method for finding future customer needs for smart home solutions. Following that, we developed a prototype of the method. Since the method is a concept and thus intangible, the prototype was immaterial and in the form of a method proposal. The creation of the method proposal was followed by testing it through a field test at Skanska. The results from the test were analyzed and the method proposal was evaluated and modified. Finally we discussed the results from the study and drew conclusions.

5.3.2 Problem Definition

The formulation of a research problem consists of two main steps: understanding of the research problem and rephrasing of the research problem into meaningful terms (Kothari, 2004). In order to understand the research problem we conducted investigations regarding the definition of smart home solutions and customer needs, why the adoption of smart home solutions has been slower than expected, characteristic of smart home solutions within the construction industry and existing approaches for finding future customer needs. In addition to this research we discussed the research problem with our supervisors at both Skanska and Chalmers University of Technology. According to Kothari (2004), research problems are best understood through discussion with colleagues and people with expertise in the matter.

The formulation of a research problem is often sequential and the formulation changes over time as more information is discovered (Kothari, 2004). Since the modified formulation is based on more resources and data, it is more specific than the preceding one (Kothari, 2004). In accordance with this reasoning, our research problem also changed over time. Information obtained during the background research influenced and changed the original research problem. The final research problem for this master's thesis work is that there is no established method for finding future customer needs for smart home solutions.

5.3.3 Literature Research

The background research started by reviewing the existing literature regarding the smart home industry and customer needs. By studying literature we could increase our understanding of the topic which was unfamiliar to us beforehand. After a review of literature we identified research related to the smart home industry and research related to finding future customer needs. However, with the exception of a previous master's thesis, we did not find any research that combined these two topics. Therefore, we had to research these two topics separately.

Since the characteristics of the smart home industry influenced which approaches that were suitable to use for finding future customer needs for smart home solutions we started to study the smart home industry. Generally when reviewing literature one should start by reviewing scientific literature and especially the journals that are most credible (Sachdeva, 2009). However, when we studied the smart home industry we found that most scientific literature regarding smart homes was published in the early 21st century which for this particular topic

could be outdated since the smart home industry is constantly developing. In order to obtain newer facts we strived to find and use more recently published literature.

Information about the smart home industry was mainly provided through the search engine Google and databases such as Google Scholar and online libraries such as one offered by Chalmers University of Technology. In addition, material with information about the smart home industry and technology were provided by our supervisor and other employees at Skanska. After studying literature regarding the smart home industry, the information that we considered to provide a contextual element to the report and that affected the development of our method was summarized in the background and chapter 2

Thereafter, theories regarding customer needs were studied. First, literature about customer needs in general was studied before literature related more specifically to finding customer needs was investigated. According to Sachdeva (2009), one can get inspiration regarding which sources to review by reading the literature review of a similar study. Since, we had found a previous master's thesis conducted by Feng & Klingvall (2016) that related to customer needs for smart homes we started by reviewing their theoretical framework and read literature they had used. Thereafter we continued the literature review by searching for information in the same manner as for the smart home industry, mainly through online databases and search engines as well as reviewing books regarding the subject.

During the process of studying theories regarding customer needs we found many existing approaches for finding customer needs but none that was specifically designed for finding future customer needs for the smart home industry. Sachdeva (2009) states that by reviewing literature one can identify and select the appropriate instruments for one's specific context. Therefore, by reviewing existing approaches for finding customer needs we could determine which ones that were most suitable to use for finding future customer needs for smart home solutions. These methods are presented in the chapter 3. The common theme for these approaches are that they are designed to discover unarticulated needs and especially excitement needs since these are often are difficult to express, just like future needs.

5.3.4 Case Study and Systematic Combining

According to Bryman and Bell (2007), a case study involves the intensive and detailed investigation of a single case. The single case can involve either a single organization, a single location, a person or a single event (Bryman & Bell, 2007). We regard our continuous interactions with employees at Skanska as a case study since it involved intensive investigations at a single organization. The interactions have concerned a specific area, smart home solutions and in particular smart home solutions within Skanska, from which detailed information has been derived. The case study involved numerous meetings with our supervisor at Skanska, several meetings with other employees at Skanska and a workshop regarding the topic of smart home solutions within the construction industry.

A disadvantage with a single case study is that the findings cannot be generalized and representative for an entire industry (Bryman & Bell, 2007). However, in this report we used the case study to influence and complement the literature research. Our interactions with employees at Skanska were also influenced by findings obtained during the literature research. Therefore, we regard this approach as one described by Dubois and Gadde (2002) which is called systematic combining. Systematic combining is a continuous movement between an empirical world and a theoretical world (Dubois & Gadde, 2002). The movement can be described as a process where empirical observations direct and redirect the theoretical framework and vice versa (Dubois & Gadde, 2002). Dubois and Gadde (2002) argue that systematic combining improves the explanatory power of case studies.

5.3.5 Method Requirements

The method requirements were developed after the systematic combining of literature research and case study. Firstly, the method had to be able to find future customer needs for smart home solutions. To find future customer needs the method had to be able to find end-state needs, since these needs are more long term and therefore more likely to remain in the future. Additionally, the method had to focus on finding excitement needs since they will become expected or basic needs in the future.

The requirements of the method also had to account for typical requirements stated by companies such as that it should be safe, easy to use and resource efficient in terms of time and cost. It also had to be academically viable, therefore the method should be able to be used by any company in the construction industry. Finally the method should account for customers' privacy, since the research revealed that it was especially important within the smart home industry.

5.3.6 Method Proposal Development

A hypothesis can be defined as "a tentative assumption made in order to draw out and test its logical or empirical consequences" (Merriam-Webster, 2017). Since we will use the proposed method to empirically test our assumptions and conclusions regarding finding future customer needs for smart home solutions the method proposal has similar characteristics of a hypothesis. According to Kothari (2004), to develop a hypothesis, one has to examine the available material and data related to the subject. Thus, in order for us to develop a method proposal we analyzed the findings in our background research. In addition, Kothari (2004) states that discussions with experts and colleagues are also helpful when a hypothesis is formulated. Therefore, we consulted with our supervisor at Skanska regarding the method proposal formulation. Moreover, since the proposed method should be tested at Skanska we confirmed with Skanska that what we proposed was feasible to test.

5.3.7 Test of Method Proposal

To test the method proposal a field test was conducted at Skanska. A field test is a test conducted in a real-life setting (Bryman and Bell, 2007) and enables better understanding of product specifications and market requirements which in turn creates the foundation for a successful product (Floyd & Spencer, 2011). Moreover, Floyd and Spencer (2011) state that field tests are advantageous since there are environmental and physical interactions that may go unnoticed and need to be observed in real life. Since resources for a field test were available at Skanska it was a cost and time efficient approach to verify our method.

The field test has mostly been conducted as suggested in the method proposal. Part one of the method framework proposal, the preparation of the investigation, has been explained to a greater extent since this part contains deviations from the framework and therefore needs more elaboration. The other two parts of the method proposal have followed the instructions in the method framework proposal (except for type of demonstration for one product) and are therefore explained in less detail.

Part One - Planning the Investigation

The field test at Skanska was conducted for the *shooting star* since our method is developed for the *shooting star*. A field test has not been conducted for the three other squares. Field testing for a new product, in our case our method, typically requires careful planning regarding who, what, where, when, why, and how of the test (Floyd & Spencer, 2011). The planning for the field test started by deciding where the investigation was to be held. Skanska had a "show flat" where they already had installed some smart home solutions. We decided to use the show flat as location for the investigation because it was cost and time efficient while fulfilling our quality requirement. We visited the location and tested the different smart home solutions that were installed. It allowed us to make sure that all the solutions were working as they should for the investigation and that we had enough knowledge to explain them. After discussions with Skanska we decided to include the following five smart home solutions in our investigation: access point for wifi, locking solution by mobile phone for front door, home and away button for electrical appliances and lamps, lightening control by mobile phone and electrical appliances control by mobile phone. These solutions were chosen since they were already installed in the show flat, could be demonstrated easily and had most similar functions.

The next step of the field test was to find people that wanted to participate in our investigation. We decided to ask people that lived in the same housing cooperative as the show flat was located since Skanska had had previous contact with these residents. This type of sampling is called convenience sample, which is when the sample population is selected based on ease of access (Kothari, 2004). Convenience sampling can give a biased result especially if the population is not homogeneous (Kothari, 2004). However, this sampling procedure was preferable due to the challenges of getting people to participate in an investigation. We assumed that it would be more likely that people wanted to participate if they did not have to travel to the location of the investigation. The fact that we investigated people from the same housing cooperative also

facilitated the segmentation, since people living in the same area and have the same type of housing were assumed to have similar preferences regarding smart home solutions.

We reached out to people through e-mail, where we asked if they wanted to participate in the investigation since Skanska already had access to all residents' e-mails. The e-mail was sent to 80 households one week prior to the investigation. Since the field test was to be conducted for the *shooting stars* we specifically asked for people 37 years old or younger if they wanted to participate. Only two people replied that they wanted to participate in the investigation and therefore we asked all residents again if they wanted to participate, but this time through sms. From the sms we got two additional positive responses. Since only four people wanted to participate we decided to include an employee from Skanska in the investigation to generate more customer needs, even though he was older than 37 years and lived in a house. In addition, Skanska wanted to include one of their own employees in the investigation to understand the method better and be able to provide feedback.

Moreover, to prepare for the investigation we formulated questions for the in-depth interview. These questions were then tested prior to the investigation, as suggested in the method proposal. The questions were tested at Skanska's office, on a Skanska employee that did not work in the smart home department and hence was not an expert within the area. Before we tested the interview questions we explained the five different smart home solutions we would demonstrate in the actual investigation and how they functioned. Based on this test, we discovered that some of the interview questions were unnecessary and some questions had to be reformulated.

Part Two - Conducting the Investigation

The investigation took place during one evening and the investigators were the authors of this master's thesis. The investigation was conducted for one solution at a time as suggested in the method proposal. Since we were two people conducting the investigation two people could be investigated simultaneously to shorten the time of the investigations. The investigation time for each participant varied since some participants elaborated more when answering the contextual inquiry and in-depth interview questions. On average the investigation took approximately one hour for each participant. All participants accepted being recorded for the in-depth interview, as suggested in the method proposal.

The investigation was conducted in accordance with the instructions in the method proposal unless otherwise stated. However, one deviation from the instruction occurred. For the lock solution we did not have a physical product to demonstrate, a video of the solution was displayed instead. Therefore it was impossible to observe the participant using the product and hence the applied ethnography step could not be conducted for this solution.

Part Three - Completing the Investigation

All customer needs obtained during the investigations were compiled the day after the investigation. Needs obtained during the applied ethnography and contextual inquiry were

compiled through analyses of the notes taken during these steps. Needs obtained during the in-depth interview were compiled through analyses of notes as well as listening to the recordings. Since the compilation was conducted the day after the investigation we were able to remember the conversations we had had with the participants during the investigations which made it easier to understand the notes from the applied ethnography and contextual inquiry. For all of the product categories, 273 customer needs were discovered and the mean was approximately 54 needs. The number of needs obtained for each category spanned between 32 and 78. These needs will not be presented in this report since they are derived specifically for Skanska and shall not be published for the public.

The grouping of customer needs occurred the day after the compilation, the 28th of April. As anticipated, some of the needs discovered were very similar to each other. Some participants expressed similar needs and some participants expressed a need twice during the investigation, both during contextual inquiry and in-depth interview. After the grouping we had found a total of 118 customer needs for all of the product categories, with a mean of approximately 23 needs. The number of needs obtained for each category spanned between 16 and 34.

5.3.8 Evaluation and Modification of Method Proposal

In order to evaluate and modify our method proposal we analyzed the results from the field test. We discussed amongst ourselves to see if we had the same interpretation how the field test turned out. Also, we compared the actual outcome of the field study with what we had predicted based on the method proposal. The evaluation of the method proposal is not influenced by the specific customer needs that were discovered but rather how the process worked, if we found desired end-state needs and if the method generated as many needs as predicted to evaluate the efficiency of the method. Based on the evaluation, we modified the method proposal for some steps and a final method was created.

5.3.9 Conclusions

Based on the background research and the evaluation and modification of method proposal we draw conclusions from our conducted study and answered the three research questions presented in the introduction.

5.3.10 Discussion

After the final method framework was created, we discussed its limitations. The discussion was based on the background research and the field test of the method proposal. In addition, the method's contribution to the academic society was discussed as well as potential future research related to the method.

5.4 Ethical and Sustainability Aspects of the Thesis

There is a multitude of ethical and sustainability considerations that need to be taken into account when dealing with the concept of smart homes. Which aspect of smart homes that is most important to the long-term acceptance of smart home technologies is debated amongst industry experts. There are positive and negative arguments to almost every aspect. For example, one societal benefit of acceptance of smart homes is that it can significantly improve the life of disabled people (Dewsbury, 2001). In contrast, one negative aspect of smart homes is that it could negatively affect the basic cognitive functions of smart home residents through over-relying on technology (Machidon, 2015). Moreover, Crowley and Coutaz (2015) are of the opinion that establishing appropriate legal and ethical foundations may be as crucial as technological research. Two other important aspects that can affect the adoption of smart home technology are privacy and obtrusiveness (Crowley & Coutaz, 2015, Chung, Demiris & Thompson, 2016). Additionally, according to Chung, Demiris, and Thompson (2016), stigmatization and reliability and maintenance of smart home solutions are factors that should be considered.

The aspects that needed to be taken account for when conducting this master's thesis project mainly concerned the ethical aspects of the method. In both creating and testing the method we had to consider how companies in the smart home industry will find customer needs while maintaining the privacy and limiting the obtrusiveness of their customers through the choice and use of our approaches. We also considered ethical aspects in the development of the method by keeping personal information and final customer needs confidential. Additionally, we ensured an ethical process through working with Skanska who has ethical requirements regarding customer interactions. For example, we were mindful of the way we invited customers to the investigation and the way we communicated with them during the investigation.

The ecological aspect related to this master's thesis project primarily concerned the output of the created method. This is because the creation of the method did not have any considerable effects on the environment since it has used literature and personal interactions as main inputs. The hope is that the final method framework will facilitate the process of finding future customer needs and in consequence reduce uncertainty and risk when dealing with smart home solutions. This in turn may improve speed and decrease costs for developing smart home solutions, decrease material usage and improve prerequisites for creating a solution that more accurately corresponds to customers' future needs. All these factors will benefit construction companies, companies creating smart home solutions and residents of smart homes and thereby contribute to the society.

5.5 Methodology Discussion

In this section we will discuss the limitations of our methodology and analyze it in relation to the ideal situation proposed in literature. We will also discuss the verification and validity of our proposed method and the use of triangulation in this master's thesis.

5.5.1 Limitations of the Methodology

In this section, limitations of the methodology will be discussed and the structure follows the structure of the research process. However, for some steps of the research process no limitations were prominent whereby these steps have been excluded from this section.

Literature Research

The fact that there was a limited amount of recently published scientific literature regarding smart home solutions somewhat restricted our literature research. Some of the references regarding the smart home industry used in this report are from companies operating in the smart home market rather than scientific journals since they contained more updated information. Example of such reference is iControl Networks (2015). Information provided by these sources could therefore be biased since these companies want to promote the smart home market and especially their products. However, we considered the benefits of using these resources to outweigh the downsides of using older resources from scientific literature. The reason is because the smart home market has changed to such an extent that what was true ten years ago might not be true today.

Case Study and Systematic Combining

In our research process we conducted a case study at Skanska. Even though this case study generated knowledge about how construction companies work with smart home solutions and about the topics in general, it was specifically focused on only one company, Skanska. In order to obtain a less biased perspective it would have been beneficial to conduct case studies at other construction companies. It would also have been interesting to conduct a case study at another type of company in the smart home industry since it would have provided other points of view that might have affected our background research and method. However, due to time constraints of this master's thesis it was not possible.

Method Proposal Development

When we developed our method proposal we discussed the design of the method with Skanska who provided feedback. This feedback was taken into consideration when we developed the method proposal. Example of such feedback was that Skanska informed us about the opportunity to conduct the investigation in a show flat. Without this feedback we would not have known about the opportunity to include a show flat in our method proposal. Therefore, the method is more adjusted to Skanska than to other construction companies. For example, other

construction companies might not have access to a show flat and therefore have to adjust the method to their assets. However, to consult with Skanska regarding the design of the method proposal was considered acceptable since it allowed us to confirm with Skanska that what we proposed was feasible to test. Without this communication we could have developed a method that was not testable which would have affected the verifiability of our methodology.

Moreover, in our method framework proposal, we did not state how to obtain participants for the investigation and that this was up to each company to decide. However, our field test revealed that it was more difficult to obtain participants than what we had anticipated. Upon understanding this, it would have been ideal to complement our background research and modify our method proposal with a specific way of gathering participants for customer investigations. This would have allowed us to test such a method. However, when we realized the difficulties, there was not enough time to revise and hence we used approaches that we had not researched to invite participants to the investigation. This might have been a reason for the low number of participants in the study. However, by excluding some instructions from the method framework proposal we obtained valuable insights and were still able to add recommendations for our final method.

Test of Method Proposal

This section includes limitations regarding the matrix and the first two parts of the method proposal. The third part of the method proposal has been excluded since no limitations were found for that part.

The Matrix

We only tested the method proposal for the *shooting stars* since we designed the method for these. Even though we were able to determine whether or not it was suitable for this square we were not able to determine if it would be suitable for any of or all of the other squares as well. We had one participant who was over 37 years old and would fit into the *nightmare*, however since it was only one participant it was harder to draw any conclusions regarding if the method would suit this square. It would have been beneficial to test the method for all squares to be able to determine if our reasoning concerning its applicability was true. Unfortunately, this was not possible due to time constraints for the work of this master's thesis. Although since our method is intended to be used for *shooting stars* it were mainly the reasoning regarding the matrix that were affected and not the method proposal.

Part One - Planning of the Investigation

A limitation with the choice of products was that, unlike recommendations in our method proposal, they did not belong to the same product category since they had different functions. The reason is that Skanska did not have five solutions with the same functionality available for demonstration at the show flat. Three solutions shared a functionality which was controlling electrical devices (lamps and electrical appliances) while the other two solutions had two different functionalities. The fact that the products had different functionalities did not affect

the demonstration, the applied ethnography or the contextual inquiry, but it did influence the in-depth interview. Since the questions in the in-depth interview focused on functionality, we had to prepare questions for three different functionalities. Thus, questions for the lock solution and the wifi solution had to be asked separately while the other three solutions could share questions. As a result, more questions had to be asked and the time to conduct the in-depth interview was longer than if all solutions would have shared functionality. This could have resulted in people getting tired at the end of the investigation and therefore not giving as detailed answers for the last questions as for the first questions. Even though the products had different functionalities they were all in the introduction/growth stage of the PLC which made the matrix placement easy.

The number of participants in the investigation (5) was fewer than recommended in the method proposal (10-15). Thus, we might not have had enough participants for finding all future customer needs for the smart home solutions we investigated. However, the primary purpose of the field test was not to discover all future customer needs for the demonstrated products but to test if our method proposal was suitable to use in order to find future customer needs for smart home solutions. The sample size of a qualitative research can be determined by using the concept of saturation (Boddy, 2016). Saturation is defined as the point when no additional information is obtained by increasing the sample size (Boddy, 2016). To continue to sample until saturation has been reached can be used to justify the sample size of a qualitative study. When evaluating the method proposal we realized that most insights regarding the method proposal were derived from several of the participant investigations. Hence, saturation had been reached and that more participants would not have attributed additional insights regarding our method proposal. Thus, the sample size of five was sufficient to evaluate our method proposal.

A disadvantage with the execution of the investigation was that the authors of this master's thesis, who conducted the investigation, were not trained ethnographers or a part of a product development team as suggested in the method framework proposal. Thus, we might not have discovered as many future customer needs as a trained ethnographer from the development team would have. However, as stated before, the primary purpose of the field test was not to discover all future customer needs for the illustrated products but to test if our method proposal is suitable to use in order to find future customer needs for smart home solutions. Therefore, we considered ourselves sufficiently qualified to conduct the investigation and evaluate the proposed method.

Part Two - Conducting the Investigation

During the investigation we had to show a video of one of the solutions, the lock solution, instead of demonstrating the solution physically as suggested in the method framework proposal. We did this since no physical product of the lock solution, or any other product, was available at the show flat. Thus, there was a trade-off among the amount of products that could be included in the test and the ability to demonstrate all products physically. We decided that it was preferable to include five product in the field test in order to test the proposition that five solutions can be investigated in the same investigation. Further, it proved to be advantageous to include video viewing of one of the solutions since we then could compare people's ability

to understand the concept behind solutions that were demonstrated physically and one that was not.

Evaluation and Modification of Method Proposal

We decided to include the results of the participant who was older than 37 years even though it was not in accordance to our method proposal. This was due to the fact that we had an overall low number of participants and made the judgement that it would be more beneficial to include additional results. This might have impacted the results negatively, however it also allowed us to make comparisons between the results from this participant and the other participants that were younger than 37 years. Even though more participants over 37 years would have had to be conducted to make more reliable conclusions, it was beneficial.

Based on the evaluation and analysis of the field test a modified version of the method was created. This modified version has however not been tested due to the time limitations of this master's thesis work. It would have been preferable to test the revised method in order to verify that the modified version performs better than the original version of the method and that the changed steps work as intended. However, no major alterations were made and the changes that were made are supported by existing theories and the findings from the field test.

5.5.2 Validity

According to Mattocks et al. (2010), verification is the process of establishing that a new test or method is being performed correctly and this is determined against suitable performance specifications. Validation on the other hand is the process of assessing the performance of the test or method in comparison with a gold standard or reference test (Mattocks et al., 2010). In other words, verification entails to determine if the method is being performed correctly while validation entails to determine if the correct method is being performed (Mattocks et al., 2010). In addition, validation should be referenced against the most reliable method that currently exists (Mattocks et al., 2010).

In some cases it is not suitable to both verify and validate a process (Hojo, 2004). For example, if verification is sufficient and cost effective, it may be best to only perform this step (Hojo, 2004). Verification is in our case sufficient and cost efficient which is why we have focused on verifying our method. We have verified our method by using scientific approaches for qualitative research which are described throughout the methodology. To sum up, the process we have used fulfill the previously stated criteria for the method which are that it should be able to find future customer needs, safe, easy to use, account for customers' privacy and resource efficient in terms of time and cost. The method also had to be academically viable which we in this section argue that it is.

Moreover, it is difficult to validate our method in this traditional sense since the output of the method, the future customer needs, cannot be determined to be true or false until 3 to 5 years forward. It would be possible to compare the output of our method by interviewing the same

people 3 to 5 years forward, however this is out of the scope of our study. We could however have evaluated if our obtained needs were excitement needs through conducting a Kano questionnaire survey. According to Taylor et al. (2017), a larger sample is required in order to reduce the sample errors in surveys. Therefore, our field test sample was considered too small and for the Kano questionnaire to be reliable we would have needed to send out the questionnaire to more people than the field test participants. However, since other people might not have experienced the demonstrated product the result of such questionnaire would not be reliable either. In addition, to conduct a Kano questionnaire would be time consuming and due to time limitations of this master's thesis work, it would have compromised other parts of the thesis. We have therefore validate our master's thesis work through four alternative criteria presented by Guba and Lincoln (1989) which are *credibility*, *transferability*, *dependability* and *confirmability*.

Credibility refers to the researchers' evaluation of the result of the study (Guba & Lincoln, 1989). Our research is credible since we throughout the study have used established theories and approaches for conducting qualitative research. Additionally, we have critically evaluated the theories and literature we have used as well as our own methodology and its outcome. Moreover, we have used triangulation to enable credibility.

Triangulation is the use of more than one approach when researching a question and can be used in method development (Heale, & Forbes, 2013). By using two or more independent measures or approaches a more comprehensive picture can be obtained than what the measures or approaches could have done alone, thus increasing the confidence of the findings (Heale, & Forbes, 2013). In order to make sure that a qualitative research has high-quality data, various forms of triangulation can be used (Patton, 1999). We have used methods triangulation and analyst triangulation. Methods triangulation entails the inclusion of several methods for gathering data for qualitative research (Patton, 1999). We used methods triangulation in the sense that we gathered data from the case study at Skanska, through a literature research and from our own field test. Analyst triangulation means that several people have reviewed the findings of the study (Patton, 1999). We used analyst triangulation by independently reviewing the outcome of our study and compared our findings in order to discover selection perception and interpretive bias. Additionally, we used analyst triangulation through having our findings reviewed by peers and supervisors at Skanska and Chalmers University of Technology.

The criterion *transferability* concerns the level of generalizability of the results of the qualitative research to other environments (Guba & Lincoln, 1989). We consider our method to be transferable since it can be used by multiple types of companies, not only construction companies, that want to investigate future customer needs for smart home solutions. Our method could for example be used by smart home solutions manufacturers even though their need for using the method is not as great since their development time is much shorter. Further, our method can be used for technical products, other than smart home solutions, with minor modifications to the method such as the location of the investigation.

Dependability refers to the necessity for the researcher to include an awareness of how the context in which the research is conducted, changes (Guba & Lincoln, 1989). In order to address this, we have discussed how the method may change with changes in the smart home market, with technological advances and how research may change. For example, the way product categories are chosen will probably change with alterations in the smart home market and the way one demonstrates products to customers may change the further along VR and AR-technologies evolve. An example of our reasoning regarding how the research may change is measurements for technological ability and technologies' level of difficulty.

Confirmability is to what extend the results of the study can be endorsed by others (Guba & Lincoln, 1989). We have achieved confirmability through discussions and reviewing of the result of the report by supervisors at both Skanska and Chalmers University of Technology. Further, the report has been peer reviewed.

6 Evaluation and Modifications of Method Proposal

In this chapter we will evaluate and modify the method proposal by analyzing the field test. We will focus on the parts of the method proposal that are crucial for determining the final version of our method. These parts include the concept behind the method proposal (the matrix) as well as the first and second parts of the method framework proposal: preparation of the investigation and conducting the investigation. We will mainly discuss the difficulties that we experienced during the test.

6.1 The Matrix

In order to be able to evaluate and modify the method framework proposal it is important to evaluate the concept of the matrix.

6.1.1 The Concept

The ideas behind the matrix are based on the two previously stated derivations which are:

A person's age affects *a person's overall experience with technology* which affects *a person's ability to understand technology*

In what stage of the product life cycle a technical solution is in affects *the likelihood of a person's experience with that technical solution* which affects *how easy that technical solution is to understand.*

After having conducted the field test it seems as though these derivations make sense due to the results from the tests and modifications will therefore not be made to the matrix. However, we have not tested nor evaluated all four squares of the matrix but mostly focused on the *shooting star* and therefore the reasoning behind the other three squares has not been investigated. Undoubtedly, the derivations have facilitated creating a method and explaining the concept to others such as our supervisors at Skanska and Chalmers University of Technology which further supports their significance.

6.1.2 A Person's Ability to Understand Technology

It is possible to use a person's age to facilitate in determining a person's ability to understand technology and that this in turn helps in expressing unarticulated needs for technological solutions. Additionally, younger people understand technology better and thus express unarticulated needs better. This is because for all participants younger than 37 years of age were able to express unarticulated needs to a good degree and also at a greater extent than the participant that was over 37 years of age. For the participant that was older than 37 years old,

47 needs were discovered while the average amount of needs discovered for the other four participants was 56. The younger participants were in general more interested in the solutions demonstrated, knew more about the technologies and solutions, more easily grasped the concepts after demonstration and were able to more descriptively and in more detail express needs in the contextual inquiry and in-depth interview. Also, comments from the participant over 37 such as “my child has been the one who has decided about and installed the wireless internet solution that I use” supports theories that our matrix is based on. However, no absolute conclusions can be drawn due to the small number of participants, in particular only one person over 37 years of age participated in the investigation, thus more studies have to be conducted in order to fully verify that younger people understand technology better.

Nevertheless, what further supports our argument regarding age is that the youngest participants amongst the participants younger than 37 years of age, had the highest ability to express needs and seemed to understand the solutions best. The youngest participants also seemed to be more open, curious and more inclined of wanting to implement or purchase similar solutions for their homes right now. This could be because they have more overall experience of technology and/or because they have not lived in their own apartment for as long as the older participants and may not have become accustomed and satisfied with their current home solutions. Regardless, this suggests that the age limit of 37 years old could be revised and be lowered or alternatively divided into two different age limits. In order to lower the limit or introduce another one, more studies would have to be conducted. If another age limit was to be introduced, one would have to consider the implications with three values in the matrix.

6.1.3 How Easy a Technology Is to Understand

One can use a technical solution’s place in the PLC to facilitate in determining how easy a technology is to understand and that this in turn helps in expressing unarticulated needs for technological solutions. This is because some of the products that we demonstrated, and products similar to those, were familiar to some of the participants prior to the investigation. The products that the participants knew from before were considered to be in slightly later stages of the introduction/growth stage. It was easier to derive needs from discussions about these products and their functions since the participants understood them better. Also, they were able to compare and draw connections with the functions of the products that we showed and the products that they were familiar with before. Further, this supports the idea of dealing with products in a narrow product category.

6.2 Method Proposal

Most parts of the method proposal worked well in the test, thus the majority of the method proposal will remain the same. However, from the test we obtained interesting insights that we will highlight and that should be investigated further.

6.2.1 Decide Customer Segment

Deciding a customer segment was a rather simple step of the process and one that we will keep. An insight that we gained during the test was that it could be a good idea to have people who are moving into a new home as participants. From the test we learned that participants that more recently had moved into a new place or were inclined to move, were more informed about the smart home market and aware of what they wanted. In other words, their experience level was higher for smart home technologies than for the other participants who seemed to be more accustomed and comfortable with their current standard. We received comments such as "if I would had the choice to have it (the solution) when I moved into my home I would have wanted it, but now it doesn't matter as much". One implication with this approach would be that it may be difficult to find participants that are about to move, since this information might be personal to some.

6.2.2 Choose Product Category and Products

In our test we did not demonstrate five products from one narrow product category, as suggested in the method framework proposal. However, three out of the five products had similar functionalities. One benefit of showing products with different functionalities was that the participants were able to see multiple possibilities for different functions and express needs connected to several functions. An example was that one participant expressed a need for being able to lock the entrance door at the same time as all electrical appliances in the home are turned off. Hence demonstrating different products may lead to the participants becoming more innovative and creative.

However, we also found that it was mainly creative solutions and products that the participants described and not desired end-state needs. Even though needs could be interpreted and derived from the proposed solutions by the participants, the participants might be biased and combining two functionalities simply because they were put in front of them. Also, we found that we got a positive response to all products that we showed. This could be misleading since if only one product were shown from a category, it is easy to have a positive response to that product since it might be a new and exciting concept. We discovered that it was easier for the participants to be critical and analytical when they were presented with the products that had similar functions since comparison was enabled. Due to this, it would be easier to identify excitement needs. Hence, more reliable results can be obtained by demonstrating products from one single narrow product category, as suggested in the method proposal.

Another risk with choosing products from only one product category is that if they also are in the same stage in the PLC they might be very similar to each other. Then experiencing more than one product within that category will not make a big difference in being able to identify new needs. For example, if a new technology has been developed it is likely that many products within the same category and place in the PLC will use that technology, and therefore be similar to each other. It could therefore be beneficial to strive to choose products within the same category but that use various different technologies or concepts, while still being at the same

stage of the PLC. Additionally, if the products are too similar to each other there is a risk that they will have to be installed and used in the same manner and place. For example, if multiple lock solutions are investigated it will be difficult to install them in the same entrance door and having it look and feel realistic. One could solve this by installing lock solutions in other doors, but it would be up to each company to determine products that fit the place of demonstration and demonstrate them in a manner that appear as realistic as possible. These insights will not significantly change the method proposal but are good to keep in mind.

6.2.3 Evaluate Matrix Placement

The evaluation of matrix placement was easy since we had chosen to conduct the test for the *shooting stars.* We also knew what products that were able to be installed in the show flat and hence be used in the investigation. We could therefore easily evaluate in which stage of the PLC they were in. Since, the evaluation of matrix placement worked well in the field test, it does not have to be elaborated further in the method framework.

6.2.4 Find Customers to Investigate

In the method proposal we had not specifically stated how to find customers to investigate but that it was up to the company to decide. This was because we thought that there were probably many different regulations and approaches for how to reach out to customers or other potential participants for different companies.

After having conducted the test we realized that it was harder than we had thought to acquire customers that wanted to participate in the investigation. Since it is a precondition for the investigation we thought it was necessary to share our insights regarding our difficulties and suggestions on how it may be improved even though we have not been able to test them. We will not create a specific guide for how to find customers to participate because it is out of the scope of our project and since it still varies depending on the company in question. However we will offer advice for what will probably work better.

We think that the choice of media had a negative impact on the amount of participants. We would not recommend to solely send out information and invitations through e-mail because it is easy for people to overlook due to the fact that people typically receive many e-mails and if the e-mail is not personally directed towards them they might regard it as spam or similar. However, using e-mail was cost and time efficient. We also sent out a reminder through sms from which we received additional participants. However, it was most likely the reminder that had an impact and not the medium itself. We did not receive any complaints about this. Therefore we would recommend to somehow send out a reminder if few people reply to the first invitation.

We sent out the invitations to the residents only one week before the investigation took place and that could have had an effect on the low number of participants. People might have already

made up plans for the days when the investigation was going to take place. Thus, to facilitate the process of obtaining participants, one should ask people well before the investigation is intended to take place. In addition, it can be advantageous to be flexible regarding the date and time of the investigation. We only offered two days, and all times were during the evening. Some people might work evening and some people might always be busy a certain day of the week. Hence, both morning and evening times should be offered and the more dates that are offered the better. To be even more flexible, one can let people decide themselves, within a time frame, the time and date of the investigation.

The fact that we signed our own names on the invitation instead of the company name could have had a negative impact on the number of participants. If we would have only used the company name instead, the investigation might have seemed more credible. However, this would have been misleading since we conducted the field test. However, when this method will be used in practice, this will not be an issue since companies will perform the investigation.

Despite that the people we asked lived right next to the location of the investigation we had a small number of participants. Thus, it seems as though people did not decline to participate because they had to travel to the place where the investigation was held. It is hard to determine if less people would have participated if they would have had to travel but this would most likely be the case. Therefore, it is advantageous to aspire to conduct the investigation as close to the participants' homes as possible.

Moreover, we did not give the participants any considerable incentives for being part of the study other than an evening snack and coffee. On the positive side, the participants were especially interested in smart home solutions and technology and were thus more experienced, which generated good results in terms of the unarticulated and articulated needs that we were able to derive from them. However, this may be misleading since it may not be representative of the entire chosen customer segment. Although if only trying to obtain optimal results from the study, the approach we used in the field test would be a good choice. On the negative side, it is possible that more people would have wanted to participate had we offered better incentives.

To sum up, our recommendations are to not solely use e-mail, instead use for example personal contact for the invitation, to send out a reminder if few people respond, to send out invitations well in time, be flexible regarding time of the investigation, conduct the investigation as close to the participants' home as possible and not offer too high incentives to participate.

6.2.5 Decide Where to Conduct the Investigation

We are not making any modifications as to where to conduct the investigation since it worked well during the field test. Additionally, it was especially useful to conduct the investigation in an apartment similar to the participants' own homes since it was relatable and helped to point out needs.

We did however conduct this step first in the field test, in contradiction to what is proposed in the method proposal. This worked well and is sometimes preferable since the location of the investigation can influence who should be investigated so that for example people who live close to the location of the investigation can participate. It may also be preferable since it can affect which products that can be used in the investigation. Hence, the steps of the method may be conducted in a different order than what is stated in the method framework proposal. Step one to step five can be conducted in the order most suitable for the company using the method. However, step one and two always have to be conducted before step three and step one always have to be conducted before step four.

6.2.6 Preparation of Investigation

What we found to be especially useful in regards to the preparation of the investigation was testing of the in-depth interview questions. That helped us to estimate how long the interview would take and allowed us to eliminate and add questions. It also helped us to understand where more explanation was necessary and which questions that needed to be reformulated.

In addition to testing the in-depth interview questions we would have also liked to test our revised interview questions again. This would have given us a better estimation of how long time the in-depth interview would have taken and if our new questions were easy to understand. Furthermore, it would have been advantageous to also test the other parts of the investigation, the demonstration, applied ethnography and contextual inquiry, in order to get a better understanding of what parts needed more time and for what products. Since we did not test the revised interview questions or the other parts of the investigation we underestimated how long time the investigation would take. As a result we had to rush the last part of the in-depth interview and the investigation of the next participation were slightly delayed. Hence, when scheduling for the investigations it is important to know approximately how long time the investigation will take for each participant so enough time will be set apart for each investigation.

It is sufficient to only conduct the testing of the suggested parts of the investigation for one person which will also make it resource efficient. To sum up, the method proposal will be modified with the addition of a second round of testing for the in-depth interview and one testing of the other parts of the method.

During the field test, two participants were sometimes investigated simultaneously by two different investigators, which at times was disturbing. The smart home solutions that were demonstrated in the field test were installed in closely related areas of the show flat. Therefore, when one investigator was demonstrating a product to a participant or conducting the applied ethnography or contextual inquiry one could sometimes hear the other investigator and the participant that the other investigator was investigating. Sometimes it was difficult to hear what the participant said during the contextual inquiry and we had to speak up during the demonstration. Further, this was not only disturbing in terms of noise level but could have also

affected the participants' responses during the contextual inquiry since the respondent might have felt uncomfortable with another participant within hearing distance.

Another reason for why only one investigation should be carried out for one participant at the same time is that some solutions might be installed at the same location of a show flat and it is therefore impossible to demonstrate different solutions to two participants simultaneously. This is especially likely to occur when the solutions share functionality. Even though it is less time efficient to investigate one participant at a time when more than two investigators are available, the proposed method will be modified so that it is explicitly stated that investigations should not be conducted simultaneously.

6.2.7 Introduction to investigation

The introduction part of the investigation worked well during the field test and does not require any modifications.

6.2.8 Demonstration

During the field test, both physical products and one video were used to demonstrate the solutions. It appeared that for all participants it was easier to understand a solution that was shown physically. When only a video was used to demonstrate the functionality, as for the lock solution, the participants had a harder time to grasp the concept of the solution. In addition, to only demonstrate a video affected the applied ethnography and contextual inquiry since the participants could not test the solution. As a result, no need could be obtained during the applied ethnography and fewer needs were obtained during the contextual inquiry. For the lock solution, only 14 needs were obtained during the contextual inquiry while the average amount of customer needs obtained during the contextual inquiry for the other four solutions were 20. Hence, it is evident that the participant more easily expressed thoughts and concerns regarding a product when they could test the solution and use the solution to explain a thought. This supports our argument in the method proposal that a product should be physically demonstrated.

Furthermore, for the investigators it was also more difficult to explain the functionality of the solution with a video than by showing a physical product and demonstrate its function. The video used for the lock solution was not made with the intention to use it in the investigation but produced by the company selling the lock solution to promote their product. Consequently, the video was focusing too much on some aspects that were not as important for our investigation while other aspects that were important for the investigation were not included in the video. Therefore, these aspects had to be explained to the participants after the video was shown.

Since we did not conduct the applied ethnography, contextual inquiry and in-depth interview without somehow demonstrating the product, it is difficult to evaluate if the demonstration step helped to acquire more future customer needs. Though, since more customer needs were

derived when a physical product were shown compared to a video we assume that even fewer needs would have been discovered if no demonstration had been used at all. In addition, when we tested the in-depth interview questions, we only verbally explained the products that we would demonstrate in the actual investigation. Therefore we were to some extent able to compare the needs derived from the test and actual investigation and we discovered that we were able to extract more needs during the actual investigation. This suggests that demonstration is needed. Hence, it is advantageous to demonstrate the solution prior to acquire future customer needs.

6.2.9 Applied Ethnography

During the field test we realized that he applied ethnography did not work as intended. This may have been since we were observing the participants from a close distance due to the fact that it was a short applied ethnography and that we had to conduct the contextual inquiry straight after. This is typically not recommended when conducting an applied ethnography. When the participants got the opportunity to test the solutions they immediately started to comment on the solution and ask questions about it. As an investigator it was therefore difficult to observe them under silence since you had to reply to their questions.

The questions the participants asked were well thought out and many supplementary questions could be asked to derive customer needs. Thus, it was intriguing to immediately start with the contextual inquiry and skip the applied ethnography. In addition, we realized that to observe the participant under silence for five minutes did not contribute to the discovery of many customer needs. In total for all the solutions, only 13 needs were discovered through the applied ethnography which correspond to 4,8 percent of the total amount of customer needs obtained in the field test. Hence, to conduct an applied ethnography can be redundant, especially since the needs obtained during the applied ethnography instead can be discovered in the contextual inquiry which also uses observations to identify unarticulated needs.

If the applied ethnography is excluded from the method more time can be allocated to the contextual inquiry. In the method proposal we have only allocated 5 minutes for the contextual inquiry which we during the field test realized was too short. In the method proposal we prioritized a shorter investigation since we thought it would be difficult to get people to participate in investigations that take too long time. For example, it was already difficult to get people to participate in the investigation when we said it was going to take approximately 45 minutes. With longer time for contextual inquiry the investigation in total would be even longer and it would be even more difficult to get people to participate. However, if the applied ethnography is removed from the investigation more time can be allocated to the contextual inquiry. The revised method will therefore not contain step 9, the applied ethnography, and the recommended time for the contextual inquiry will be 10 minutes.

6.2.10 Contextual Inquiry

We obtained approximately 34 percent of the total number of raw customer needs (before grouping) from the contextual inquiry which suggests that it was a successful step of the

method. Therefore, this step will remain in the method, however it will be slightly modified. The average amount of customer needs obtained from one participant for all solutions during the contextual inquiry was 18. Ottum (2012) states that a contextual inquiry normally discovers between 20-40 raw customer needs. Hence, our contextual inquiry does not discover as many customer needs as a contextual inquiry usually does. The reason could be that our contextual inquiry only lasted for approximately 5 minutes for each product, thus 25 minutes in total for all products, which is shorter than the normal length of a contextual inquiry, which usually last for about two hours (Dell'Era & Landoni, 2014). However, in the revised method the contextual inquiry will be recommended to last for 10 minutes for each product, hence 50 minutes in total, and more needs will therefore be discovered in the contextual inquiry. In addition, the contextual inquiry is complemented with the in-depth interview where the majority of the needs were discovered.

The only part of the investigation that we recorded was the in-depth interview, however we realized that it would have been beneficial to record the contextual inquiry as well. This would have allowed us to obtain even more customer needs since we did not have time to write notes for all obtained information during the investigation nor did we remember all information derived from the participants. Besides, all of the participants accepted being recorded during the in-depth interview and would probably not mind being recorded for the contextual inquiry as well. However, if doing this it would be important to have recording equipment that does not interfere with the quality of the investigation. This is especially important if the investigation takes place in a show flat where the contextual inquiry occurs at various places. For example, having a hand held recording device would not be optimal since interaction has to occur with the participant simultaneously. Other than the addition of the recording and length of the inquiry, the contextual inquiry will follow its original instructions.

6.2.11 In-Depth Interview

The in-depth interview generated approximately 61 percent of all of the raw customer needs (before grouping) which is why we have judged this step of the method to be successful. However, we experienced that some of the questions in the categories included in the voice-of-customer framework were for some products redundant. However, if using a narrower product category, this redundancy would be less prevalent since the in-depth interview questions would then be focused on a single function. Since the questions that were redundant varied for each product we will not make any generic recommendations for what questions from the voice-of-customer framework to include or not. Our recommendation is rather to determine if all categories of questions in the voice-of-customer framework are necessary for each investigation.

6.2.12 Finish Investigation

One recommendation that will be added to the process of finishing the investigation is to add a buffer in between customer investigations if they will be conducted in sequentially in the same

location. It is important to have some time to properly finish one investigation, write down notes or solve an unexpected event, such as if a solution would stop working, before the investigation with the next participant starts.

6.2.13. Summarize the Results

Overall, the interpretation and grouping of customer needs went well and these steps will therefore be kept in the method. A requirement for the method was that it should find end-state needs which we consider most of our obtained needs from the field test to be after careful interpretation. As discussed in the methodology, we could not at this stage determine if our method generated excitement customer needs. Additionally, we obtained a rather large number of customer needs before the grouping (273) which we had to group into smaller categories and noticed that it was beneficial to subcategorize the customer needs.

8 Conclusions

To fulfill the aim of this master's thesis, finding future customer needs for smart home solutions, we developed two research questions which have been answered in this report.

Regarding the first research question about the special characteristics of smart home solutions and their market we have concluded that the smart home industry is growing. However, most of the smart home solutions are still in the growth stage of the product life cycle even though a large amount of smart home solutions exist on the market. This is because the adoption of smart home solutions has been slower than expected and is stuck in the chasm between early adopters and early majority. The reasons for the slow adoption are based on the fact that smart home solutions providers are using technology-push as opposed to a demand-pull system. This has led to limited customer demand, high prices for smart home products and privacy concerns. Another main reason for the slow adoption is the long device replacement cycles of smart home solutions. For research question one we also concluded that people are more positive towards using a smart home solution after having experienced it. In addition, younger people, in particular millennials, are more likely to be early adopters of smart home solutions.

For the second research question regarding approaches for understanding and finding future customer needs we concluded that future customer needs are unarticulated needs and especially excitement needs. To find future customer needs it is also important to gather end-state needs since they remain the same for a long period. Approaches suitable for finding these needs are demonstration, applied ethnography, contextual inquiry and in-depth interviews. Demonstration increases the experience level of the customer which enables the customer to express its unknown needs. Applied ethnography and contextual inquiry enable the researcher to discover the customer’s unarticulated needs while in-depth interviews are efficient for detecting detailed customer needs.

To answer the third research question a method framework with suitable approaches for finding future customer needs for smart home solutions was developed. The method framework is based on a concept that we have created and applied in a matrix. This concept states that a person’s ability to express unarticulated needs are favorably affected by two factors: a person’s ability to understand technology and how easy a certain technology is to understand. A person’s ability to understand technology can be determined by a person’s overall experience with technology which in turn can be measured through the person’s age. How easy a certain technology is to understand can be determined by a person’s experience with a solution utilizing that technology which in turn can be measured through determining in what stage of the product life cycle the solution is in.

Our final method framework consists of twelve steps where demonstration, contextual inquiry and in-depth interview are the main steps. After a field test we concluded that applied ethnography did not contribute to a large extent in finding future customer needs and was

therefore excluded from the method framework. The final method framework contains both actions and recommendations for each step.

We have concluded that our method is safe, easy to use, resource efficient in terms of time and cost and accounts for customers' privacy. Most importantly, we believe that the method framework is successful in finding future customer needs for smart home solutions since the method was able to detect end-state needs and unarticulated needs. Additionally, the method was successful in finding customer needs, in the field test 273 raw customer needs were detected by investigating five participants and after interpretation and grouping 118 needs remained.

Step one to step five in the framework can be conducted in the order most suitable for the company using the method. However, step one and two always have to be conducted before step three and step one always have to be conducted before step four. The framework is presented on the next three pages.

Parts and steps of the method	Actions to take	Recommendations
Part One - Planning the investigation		If one is unfamiliar with terms used in the method framework proposal one can find an explanation of the term in the theoretical framework of the master's thesis by Stenseke and Söderholm (2017).
1. Decide customer segment	**a.** *Either* choose customer segment and thereafter gather information on their age. **b.** *Or* choose customers that will optimize the results of the study, people that have a high overall experience with technology.	**a.** If some people in the segment are older than 37 years old and some are younger than 37 years old the company is recommended to conduct the method on those people in the age group that is the largest. **b.** If possible, have people who are moving into a new home as participants.
2. Choose product category and products	**a.** Choose a narrow product category. **b.** Evaluate the product category's placement in the product life cycle. **c.** Choose no more than five or fewer than two products within the product category.	
3. Determine matrix placement	**a.** Determine matrix* placement based on the chosen customers and product category. **b.** If placed in shooting star, no modifications have to be made. **c.** If placed in breeze, allocate more time for contextual inquiry and in-depth interview. **d.** If placed in nightmare, allocate more time for demonstration, contextual inquiry and in-depth interview. Also limit the number of products to three products. **e.** If placed in walk in the park, evaluate if this method is redundant. If it is not redundant, shorten all steps (demonstration, contextual inquiry and in-depth interview).	*The matrix is presented at the end of this framework. **e.** Depending on the participant's familiarity of the product, demonstration may be excluded.
4. Find customers to investigate	**a.** Find 10-15 participants.	**a.** These participants should not be the company's own employees, experts within the field or only existing customers. **a.** Do not solely use e-mail, instead use for example personal contact for the invitations, send out a reminder if few people respond, send out invitations well in time, be flexible regarding time of the investigation, conduct the investigation as close to the participants' home as possible and do not offer too high incentives to participate.

5. Decide where to conduct the investigation	**a.** Select an environment as similar as possible to the participants' own homes, for example a show flat.	**a.** For products that are in an early phase of the product life cycle and still under development, virtual reality and/or augmented reality can be used to let the customers experience the product.
6. Prepare the investigation	**a.** Decide who will perform the investigation. **b.** Prepare questions for the in-depth interview. **c.** Test the questions to make sure that they are easy to understand and interpreted as intended. **d.** Conduct a mock-investigation that entails all parts of the investigation. **e.** Make a time schedule for the investigations.	**a.** The investigator/investigators should understand and have enough knowledge regarding the products that will be used during the investigation. Preferably they should be part of the product development team. **b.** The questions should focused on function rather than features and follow the principles of voice-of-the-customer. Determine if all categories of questions in the voice-of-customer framework are necessary for each investigation. **c.** Preferably test the questions on a person that has previous knowledge about the products under investigation. **c&d.** It is sufficient to conduct the tests on one person. However do not use the same person for c & d. **e.** Add a time buffer in between customer investigations if they will be conducted in sequentially in the same location.
7. Introduction to investigation	**a.** Inform the participants about the purpose of the investigation, how information obtained during the investigation will be used and how the investigation will be conducted.	
Part Two - Conducting the investigation		The demonstration and contextual inquiry, should be performed in sequence for one product at a time whereas for the in-depth interview all products/concepts should be discussed simultaneously. Do not conduct any investigations simultaneously if they occur at the same location.
8. Demonstration	**a.** Verbally describe and physically show how the product works and the concept behind it. Demonstrate and explain the product until the participant fully understands it.	**a.** Demonstrate a solution by presenting the physical product, or if the solution is not physically available, demonstrate a representation of the solution.
9. Contextual inquiry	**a.** Follow the four principles of contextual inquiry: context, partnership, interpretation and focus. **b.** Take notes during the contextual inquiry. **c.** Record the contextual inquiry.	**a.** We recommend the contextual inquiry to last for approximately 10 minutes for each product. **c.** The recording should not interfere with the quality of the investigation.

<table>
<tr><td>10. In-depth interview</td><td>a. Ask for permission to record the interview. If permission is granted, record.
b. Take notes during the interview.
c. Ask the prepared open-ended questions regarding the products that have been demonstrated.</td><td>c. Use the laddering technique when asking follow-up questions.</td></tr>
<tr><td>Part Three - Completing the investigation</td><td></td><td></td></tr>
<tr><td>11. Finish investigation</td><td>a. Thank the participants for their involvement and ask them if there is something they want to add before the investigation is completed. If yes, take notes.</td><td></td></tr>
<tr><td>12. Summarize the results</td><td>a. Compile all customer needs that have been identified during the contextual inquiry and in-depth interview.
b. Listen to the recordings from the in-depth interviews.
c. Group customer need according to similarity.
d. Name each cluster of customer needs after a representative need.</td><td>c. All investigators should participate in the grouping and if the investigation was conducted by only one investigator, other people in the product development team should participate. Continue with grouping until everybody agrees upon the grouping.
d. If many needs have been identified, subcategorize the groups of customer needs.</td></tr>
<tr><td>The Matrix</td><td colspan="2"><table>
<tr><td colspan="2"></td><td>Age of person</td></tr>
<tr><td colspan="2"></td><td>People above 37 years</td><td>People below or equal to 37 years</td></tr>
<tr><td rowspan="2">Stage of solution in product life cycle</td><td>Maturity</td><td>Breeze</td><td>Walk in the park</td></tr>
<tr><td>Introduction/ Growth</td><td>Nightmare</td><td>Shooting star</td></tr>
</table></td></tr>
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7 Discussion

In this chapter a discussion about our conclusions will be presented. The discussion includes limitations with the final method framework, the thesis' contribution and suggestions for future research.

7.1 Method Limitations

In this section we will discuss the limitations with the concept that the method is based on, the matrix, as well as limitations with our final method framework for finding future customer needs for smart home solutions.

7.1.1 The Matrix

Our method is based on several assumptions and one of the most important assumption is that two main factors favorably affect the likelihood of being able to express a customer need. These two factors are how easy a certain technology is to understand and someone's ability to understand technology. The fact that we have not been able to find any established measurements for these two main factors has led us to interpret these characteristics into other measurements and this limits the scientific accurateness of our method. Additionally, our measurements, age and stage in the product life cycle (PLC), are simplifications. In reality, there could be many more factors that for example affects one's ability to understand technology, such as one's occupation and interests. In addition, the assumption that the two main factors have equal impact has not been tested, due to the scope of this master's thesis, and therefore lacks scientific proof.

If more accurate methods for measuring the two main factors would exist or be developed in the future, it could be reasonable to change measurements. However, it is important that the measurements (units) are easy to understand and that it is practical (easy, fast and cheap) to carry out these measurements in order for the matrix to fulfill the method requirements. Moreover, the values applied in the matrix are binary. It could have been more accurate, although more complicated, to have scales where more values could be plotted. For example, in reality, there could be a customer group that are all in the ages close to 37 years in which case the matrix does not give a clear indication of whether or not the method is appropriate to use.

7.1.2 The Final Method Framework

A limitation with our method framework is how products within a product category, but at different stages of the PLC should be handled. We advise the company to use the recommended approach for those products that are in majority, in order to simplify the method. However, a problem might arise if the majority of the products are at the mature stage of the PLC while one

product is at the introduction stage of the PLC. According to the reasoning behind the matrix, matured products need less demonstration compared to products in the introduction stage since it is more likely that the participants have experienced these matured products prior to the investigation. Then, if a product in the introduction stage of the PLC would be handled as a matured product, there is a risk that not enough time will be allocated to demonstrate this product. This could result in people not fully understanding the product and therefore not be able to answer questions or give misleading answers during the contextual inquiry and in-depth interview.

A limitation with the contextual inquiry is that it can be difficult to conduct the observation part of the contextual inquiry for all smart home solutions. If it is a service rather than a product that is under investigation, for example, the fire-alarm is connected to the emergency service who automatically is notified when the alarm is set off, this has to be illustrated or explained to the consumer. For these services, it is not always possible to observe the participant using the product/service. It would then be difficult to conduct the contextual inquiry, since questions asked during the inquiry are based on what is being observed. Thus, for a service the investigation will mostly consist of an explanation/demonstration of the service and the in-depth interview which might not be enough in order to collect all future needs regarding the service, as our method is supposed to do. Hence, our method is more suitable for finding future customer needs for products than for products containing a service element.

In order to use our method one has to be familiar with terms presented in the method framework such as voice-of-the customer, product life cycle and the four principles of contextual inquiry. An explanation of these terms have not been presented in the method framework due to space limitations. Therefore in order to use our method one has to already have knowledge about these terms or research them prior to using the method. However, an explanation of all terms are presented in the chapter 2 and 3 of this master's thesis and is therefore a complement to the method framework.

7.2 Contributions and Future Research

As discussed in the introduction, most research regarding smart homes has had a technical focus and the industry has been characterized by technology-push rather than market-pull. We have in our thesis taken a customer perspective and focused on what needs customers have regarding smart home solutions. Customer needs obtained from the method can be used when new products are developed or when existing products are upgraded. By including customers' opinions and needs in the product development phase, a market-pull system is used, rather than a technology-push system. Hence, through our method framework we have enabled companies to use a market-pull approach which can enable economic, social and ecological benefits.

Additionally, no established method for finding future customer needs exists today. Through combining existing approaches for finding customer needs and information about the smart home industry we have developed a method for finding future customer needs for smart home

solutions. Hence we have expanded on existing theories regarding the understanding and identification of customer needs for technical solutions.

With our thesis we have highlighted the importance of predicting future customer needs and since our method was successful in finding customer needs we hope that more research will be conducted within this area. To further validate the method framework additional studies are required. It would be useful to conduct a longitudinal study where the customer needs are validated within three to five years after the customer needs investigation took place to see if the needs discovered were future customer needs. It would also be interesting to see if, what and how many additional customer needs are discovered at that point in the future in order to determine the needs that were not detected by our method. Moreover, to validate the method framework, the concept behind the matrix has to be investigated further. For example, one can study if the method works for the other squares of the matrix and explore if other measurements can be used to determine a person's ability to express unarticulated needs.

References

Aagaard, J. & Matthiesen, N. (2016). Methods of materiality: Participant observation and qualitative research in psychology. *Qualitative Research in Psychology*, vol. 13, no. 1, pp. 33-46.

Accenture. (2016). Accenture Technology Vision 2016: Executive Summary. *Technology Vision.*

Aldrich, F. (2003). Smart homes: Past, present and future. In Harper, R. (Ed.). *Inside the smart home*. (pp. 17-36). London: Springer

Allameh, E., Heidari Jozam, M., de Vries, B., Timmermans, H., Beetz, J. & Mozaffar, F. (2012). The role of smart home in smart real estate. *Journal of European Real Estate Research*, vol. 5, no. 2, pp. 156-170.

Arabo, A. (2015). Cyber security challenges within the connected home ecosystem futures. *Procedia Computer Science*, vol 61, pp 227-232.

Asan, O. & Montague, E. (2014). Using video-based observation research methods in primary care health encounters to evaluate complex interactions. *Informatics in primary care*, vol. 21, no. 4, pp. 161-170.

Atkinson, P. (2008). Millennials: Researching the application of demographics to build customer relationships and HR strategy. *Management Services*, vol. 52, no 1, pp. 6-11.

Bakewell, C. & Mitchell, V.W. (2003). Generation Y female consumer decision-making styles. *International Journal of Retail & Distribution Management*, vol. 31, no 2, pp. 95-106.

Bayus, B. L. (2008). Understanding customer needs. In Shane, S. (Ed.). *The handbook of technology and innovation management*. (pp. 115-141). Chichester, England: John Wiley & Sons.

Beckley, J. H., Paredes, D. & Lopetcharat, K. (2012). *Product innovation toolbox: A field guide to consumer understanding and research*. Ames, Iowa: Wiley-Blackwell.

Bergman, B., & Klefsjö, B. (2010). *Quality from customer needs to customer satisfaction*. Lund, Sweden: Studentlitteratur AB.

Berndt, E., Furniss, D. & Blandford, A. (2015). Learning contextual inquiry and distributed cognition: A case study on technology use in anaesthesia. *Cognition, Technology & Work*, vol. 17, no. 3, pp. 431-449.

Bess, C. & Bartolini, C. (2011). Cultivating millennials and harvesting the value they produce. *Cutter IT Journal*, vol. 24, no. 9, pp. 11–17.

Beyer, H. & Holtzblatt, K. (1998). *Contextual design: Defining customer-centered systems.* San Francisco, California: Morgan Kaufmann Publishers.

Boddy, C. R. (2016). Sample size for qualitative research. *Qualitative Market Research*, vol. 19, no. 4, pp. 426-432.

Bryman, A. & Bell, E. (2007). *Business research methods*. New York, USA: Oxford University Press.

Carson, D., Gilmore, A., Perry, C. & Gronhaug, K. (2001). *Qualitative market research*. London, UK: Sage Publication.

Chen, J., Damanpour, F. & Reilly, R. R. (2010). Understanding antecedents of new product development speed: A meta-analysis. *Journal of Operations Management*, vol. 28, no. 1, pp. 17-33.

Chinchor, N., Cook, K. & Scholtz, J. (2012). Building adoption of visual analytics software. In Dill, J., Earnshaw, R., Kasik, D., Vince, J. & Wong, P. C. (Eds.). *Expanding the frontiers of visual analytics and visualization.* (pp. 509-530). London: Springer.

Chung, J., Demiris, G. & Thompson, H. J. (2016). Ethical considerations regarding the use of smart home technologies for older adults: An integrative review. *Annual review of nursing research*, vol. 34, no. 1, pp. 155-181.

Cook, D. J. (2012). How smart is your home?, *Science*, vol. 335, no. 6076, pp. 1579-1581.

Crowley, J. L. & Coutaz, J. (2015). An ecological view of smart home technologies. In: De Ruyter, B., Kameas, A., Chatzimisios, P. & Mavrommati I. (Eds.). European Conference on Ambient Intelligence. Nov 2015, Athens, Greece. *Lecture notes in computer science*, vol. 9425. Springer, Cham.

Dahan, E. & Hauser, J. R. (2002). The virtual customer. *The Journal of Product Innovation Management*, vol. 19, no. 5, pp. 332-353.

Dahan, E. & Srinivasan, V. (2000). The predictive power of internet-based product concept testing using visual depiction and animation. *Journal of Product Innovation Management*, vol. 17, no. 2, pp. 99-109.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, vol. 13, no. 3, pp. 319-340.

Davis, F. D., Bagozzi, R. P. & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, vol. 35, no. 8, pp. 982-1003.

Dell'Era, C. & Landoni, P. (2014). Living lab: A methodology between user-centred design and participatory design. *Creativity and Innovation Management*, vol. 23, no. 2, pp. 137-154.

Demiris, G., Rantz, M. J., Aud, M. A., Marek, K. D., Tyrer, H. W., Skubic, M., & Hussam, A. A. (2004). Older adults' attitudes towards and perceptions of 'smart home' technologies: A pilot study. *Informatics for Health and Social Care*, vol. 29, no. 2, pp. 87-94.

Dewsbury, G. (2001). The social and psychological aspects of smart home technology within the care sector. *New Technology In The Human Services*, vol. 14, no. 1, pp. 9-17.

Draper, S. (2009) Engineering design process. *Technology and Children*, vol. 13, no. 4, pp. 8-10.

Dubois, A. & Gadde, L. (2002). Systematic combining: an abductive approach to case research. *Journal of Business Research*, vol. 55, no. 7, pp. 553-560.

Eastman, J. K., Iyer, R., Liao-Troth, S., Williams, D. F. & Griffin, M. (2014). The role of involvement on millennials' mobile technology behaviors: The moderating impact of status consumption, innovation, and opinion leadership. *Journal Of Marketing Theory And Practice*, vol. 22, no. 4.

Ericsson. (2015). Connected Homes: An Ericsson Consumer Insight Summary Report. *Ericsson ConsumerLab.*

Feng, R. & Klingvall, S. (2016). *Exploring user needs for smart urban homes - A cross-sectional study of housing needs and obstacles for their realization*. (Master's Thesis). Chalmers University of Technology. Gothenburg, Sweden.

Floyd, R. E. & Spencer, R. H. (2011). Why field test?. *IEEE Potentials*, vol. 30, no. 1, pp. 10-11.

Fromm, J. & Garton, C. (2013). *Marketing to millennials: Reach the largest and most influential generation to consumers ever.* New York, NY: American Management Association.

Füller, J. & Matzler, K. (2007). Virtual product experience and customer participation - A chance for customer-centred, really new products. *Technovation*, vol. 27, no. 6, pp. 378-387.

Gibbs, G. (2010). *Analyzing qualitative data.* Los Angeles: Sage.

Goffin, K., Varnes, C. J., van der Hoven, C. & Koners, U. (2012). Beyond the voice of the customer: Ethnographic market research. *Research-Technology Management*, vol. 55, no. 4, pp. 45-54.

Granot, E., Brashear, T. G. & Cesar Motta, P. (2012). A structural guide to in-depth interviewing in business and industrial marketing research. *Journal of Business & Industrial Marketing*, vol. 27, no. 7, pp. 547-553.

Greenough, J. (2016). *The US smart home market has been struggling — here's how and why the market will take off.* Business Insider. 10 October. http://www.businessinsider.com/the-us-smart-home-market-report-adoption-forecasts-top-products-and-the-cost-and-fragmentation-problems-that-could-hinder-growth-2015-9?r=US&IR=T&IR=T (Retrieved 2017-04-06).

Griffin, A. (2012). Obtaining customer needs for product development. In Kahn, K. B. (Ed.) *PDMA Handbook of New Product Development*. (pp. 213-230). 3rd edn. Hoboken, New Jersey: John Wiley & Sons.

Griffin, A. & Hauser, J. R. (1993). The voice of the customer. *Marketing Science*, vol. 12, no. 1, pp. 1-27.

Guba, E. G. & Lincoln, Y. S. (1989). *Fourth generation evaluation*. Newbury Park, Calif: Sage.

Gurău, C. (2012). A life-stage analysis of consumer loyalty profile: Comparing generation x and millennial consumers. *Journal of Consumer Marketing*, vol. 29 no. 2, pp.103-113.

Hanington, B. (2003). Methods in the making: A perspective on the state of human research in design. *Design Issues*, vol. 19, no. 4, pp. 9-18.

Harper, R. (2003). *Inside the smart home*. London, UK: Springer.

Hashim, N. M. H. N., Pandit, A., Alam, S. S. & Manan, R. A. (2015). Why resist? examining the impact of technological advancement and perceived usefulness on malaysians' switching intentions: The moderators. *The Journal of Developing Areas*, vol. 49, no. 3, pp. 65-80.

Heale, R. & Forbes, D. (2013). Understanding triangulation in research. *Evidence-based nursing*, vol. 16, no. 4, pp. 98.

Hedlund, P. (2015). Connected Home. *Ericsson ConsumerLab.*

Heinz, M., Martin, P., Margrett, J.A., Yearns, M., Franke, W., Yang, H., Wong, J. & Chang, C. K. (2013). Perceptions of technology among older adults. *Journal of gerontological nursing*, vol. 39, no. 1, pp. 42-51.

Hoffman, D., Kopalle, P., & Novak, T. (2010). The "right" consumers for better concepts: Identifying consumers high in emergent nature to develop new product concepts. *Journal of Marketing Research,* vol. 47, no. 5, pp.854-865.

Hojo, T. (2004). Quality management systems - Process validation guidance. *The Global Harmonization Task Force*. Edition 2. http://www.imdrf.org/docs/ghtf/final/sg3/technical-docs/ghtf-sg3-n99-10-2004-qms-process-guidance-04010.pdf (Retrieved, 2017-04-24)

Holtzblatt, K. & Beyer, H. (2015). *Contextual design: Evolved*. San Rafael, California: Morgan & Claypool Publishers.

Hutt, M. D. & Speh, T. W. (2010). *Business marketing management*. 10th edn. Mason, Ohio: South-Western Cengage learning.

iControl Networks. (2015). *2015 State Of The Smart Home Report*. iControl Networks

Kahn, K.B. (2013). *The PDMA handbook of new product development.* 3rd edn. Hoboken, New Jersey: John Wiley & Sons, Inc.

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. 2nd revised edn. New Delhi: New Age International (P) Ltd, Publishers.

Kotler, P., Keller, K., Brady, M., Goodman, M., Hansen, T. (2009). *Marketing management.* Harlow: Pearson Prentice Hall.

Luojus, S. & Cavén-Pöysä, O. (2010). Utilising user experience in product development - From product development process towards participatory innovation process. *Interdisciplinary Studies Journal*, vol. 1, no. 1, pp. 45-56.

Machidon, O. M. (2015). Societal implications of current and emerging "smart" technologies. *International Journal of Technoethics*, vol. 6, no. 1, pp. 60–70.

Maginn, P. J. (2007). Towards more effective community participation in urban regeneration: the potential of collaborative planning and applied ethnography. *Qualitative Research*, vol. 7, no. 1, pp. 25-43.

Markets and Markets. (2016). *Smart home market by product (lighting control (timer, daylight sensor, occupancy sensor), security & access control, HVAC, entertainment, home healthcare and smart kitchen), software & service (behavioral, proactive), and geography - global forecast to 2022.* Markets and Markets. May 2016. http://www.marketsandmarkets.com/Market-Reports/smart-homes-and-assisted-living-advanced-technologie-and-global-market-121.html?gclid=CKePtuPTj9MCFc4aGAodU8sBdg (Retrieved 2017-04-06)

Mattocks, C. J., Morris, M. A., Matthijs, G., Swinnen, E., Corveleyn, A., Dequeker, E. & Wallace, A. (2010). A standardized framework for the validation and verification of clinical molecular genetic tests. *European Journal of Human Genetics*, vol. 18, no. 12, pp. 1276–1288.

Matzler, K., Hinterhuber, H. H., Bailom, F. & Sauerwein, E. (1996). How to delight your customers. *Journal of Product & Brand Management*, vol. 15, no. 2, pp. 6-18.

McDonagh-Philip, D. & Bruseberg, A. (2000). Using focus groups to support new product development. *Engineering Designer*, vol. 26, no. 5, pp. 4–9.

McKinsey & Company. (2016). *There's no place like [a connected] home: perspectives on the connected consumer in a world of smart devices.* McKinsey & Company. http://www.mckinsey.com/spContent/connected_homes/index.html?cid=other-soc-lkn-mbl-mck-oth-1701&kui=_HMG9hxoXhbpdjBBx92zUg (Retrieved 2017-04-06)

Meade, P. T. & Rabelo, L. (2004). The technology adoption life cycle attractor: Understanding the dynamics of high-tech markets. *Technological Forecasting & Social Change*, vol. 71, no. 7, pp. 667-684.

Merriam-Webster. (2017). *Hypothesis*. Merriam-Webster. https://www.merriam-webster.com/dictionary/hypothesis (Retreived 2017-05-08).

Mikulic, J. & Prebezac, D. (2011). A critical review of techniques for classifying quality attributes in the Kano model. *Managing Service Quality: An International Journal,* vol. 21, no. 1, pp. 46-66.

Mullins, J. W. & Sutherland, D. J. (1998). New product development in rapidly changing markets: An exploratory study. *The Journal of Product Innovation Management,* vol. 15, no. 3, pp. 224-236.

Norum, P. S. (2003). Examination of generational differences in household apparel expenditures. *Family and Consumer Sciences Research Journal*, vol. 32, no. 1, pp. 52–75.

Ottum, B. D. (2012). Market analytics. In Kahn, K. B. (Ed.) *PDMA Handbook of New Product Development*. (pp. 244-264). 3rd edn. Hoboken, New Jersey: John Wiley & Sons.

Oumlil, B. A. & Williams, A. J. (2000). Consumer education programs for mature consumers, *Journal of Services Marketing*, vol. 14, no. 3, pp.232-243.

Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health Services Research,* vol. 34, no. 5, pp. 1189–1208.

Phillips, J. M. & Reynolds, T. J. (2009). A hard look at hard laddering: A comparison of studies examining the hierarchical structure of means-end theory. *Qualitative Market Research: An International Journal,* vol. 12, no. 1, pp. 83-99.

Polukhina, E. (2015). Comprehensive field work instructions: A review of applied ethnography, guidelines for field research. *The Qualitative Report*, vol. 20, no. 6, pp. 826-829.

Powers, B. A. & Knapp, T. R. (2011). *Dictionary of nursing theory and research*. 4th edn. New York, NY: Springer Publishing.

Prasad, V. C. S. (2005). An approach to quality management at the early stages of new product development using technology adoption life-cycle concepts. *Software Quality Professional,* vol. 7, no. 4, pp. 27-33.

Raharjo, H. (2016). *QFD for sustainable product development - chapter 1,* Gothenburg, Sweden: Department of Technology Management and Economics, Division of Service Management and Logistics, Chalmers University of Technology.

Reynolds, T. J. & Gutman, J. (1988). Laddering theory, method, analysis and interpretation. *Journal of Advertising Research,* vol. 28, no. 1, pp. 11-31.

Robles, R. J. & Kim, T. (2010). Applications, systems and methods in smart home technology: A review. *International Journal of Advanced Science and Technology,* vol. 15, pp. 37–48.

Sachdeva, J. K. (2009). *Business research methodology*. Mumbai, India: Himalaya Pub. House.

Sanders, E. (1992). Converging perspectives: product development research for the 1990s. *Design Management Journal,* vol. 3, no. 4, pp. 49–54.

Sanders, E. & Dandavate, U. (1999). Design for experiencing: New tools. In Overbeeke, C. and P. Hekkert (Eds), *Proceedings of the First International Conference on Design and Emotion*, Delft.

Savage, J. (2006). Ethnographic evidence: The value of applied ethnography in healthcare. *Journal of Research in Nursing*, vol. 11, no. 5, pp. 383-393.

Schirr, G. R. (2012). User research for product innovation: Qualitative methods. In Kahn, K. B. (Ed.) *PDMA Handbook of New Product Development*. (pp. 231-243). 3rd edn. Hoboken, New Jersey: John Wiley & Sons.

Shahin, A. & Nekuie, N. (2011). Development of the Kano model: A novel approach based on linear logarithmic transformation with a case study in an air travel agency. *Asian Journal on Quality*, vol. 12, no. 2, pp. 176-188.

Shillito, M. L. (2001). *Acquiring, processing, and deploying voice of the customer.* New York: St. Lucie Press.

Silverstein, D., Samuel, P. & DeCarlo, N. (2012). *The innovator's toolkit: 50+ techniques for predictable and sustainable organic growth*. 2nd edn. Hoboken, New Jersey: John Wiley & Sons.

Solomon, M. (2013). BIZ VOICE: Customer Service and the Millennial Customer. *The Atlanta Journal-Constitution,* pp. D2.

Stamford, C. (2014). *Press Release.* Gartner. 8th September. http://www.gartner.com/newsroom/id/2839717 (Retreived 2017-04-06)

Sundin, E. (2009). Life-cycle perspectives of product/service-systems: in design theory. In Sakao, T. & Lindahl, M. (Eds). *Introduction to product/service-system design*, pp. 31-49. London: Springer.

Suryadevara, N. K. & Mukhopadhyay, S. C. (2015). *Smart homes: Design, implementation and issues*, Cham: Springer International Publishing.

Swaddling, J. & Zobel, M. (1996). Beating the odds. *Marketing Management*, vol. 4, no. 4, pp. 20-33.

Swat, M., Brünnet, H. & Bähre, D. (2014). Selecting manufacturing process chains in the early stage of the product engineering process with focus on energy consumption. In Henriques, E., Peças, P. & Silva, A (Eds.) *Technology and manufacturing process selection: The product life cycle perspective.* (pp. 153-173). London: Springer.

Sørensen, E. (2009). *The materiality of learning: Technology and knowledge in educational practice*. Cambridge, UK: Cambridge University Press.

Takai, S. & Ishii, K. (2010). A use of subjective clustering to support affinity diagram results in customer needs analysis. *Concurrent Engineering*, vol. 18, no. 2, pp. 101-109.

Tayal, S. P. (2013). Engineering design process. *International Journal of Computer Science and Communication Engineering*, IJCSCE Special issue on "Recent Advances in Engineering & Technology" NCRAET-2013

Taylor, S., Van Muylem, A., Howarth, N., Gevenois, P.A. & Tack, D. (2017). CT dose survey in adults: what sample size for what precision?. *European Radiology*, vol. 27, no. 1, pp. 365-373.

Thomke, S. (2003). *Experimentation matters: unlocking the potential of new technologies for innovation*. Boston: Harvard Business School Press.

Ulwick, A. W. (2002). *Turn customer input into innovation*. United States: Harvard Business School Press.

Ulwick, A. W. & Bettencourt, L. A. (2008). Giving customers a fair hearing. *MIT Sloan Management Review*, vol. 49, no. 3, pp. 62-68.

Urban, G. & Hauser, J. (1993). *Design and marketing of new products.* Englewood Cliffs, NJ: Prentice Hall.

Von Hippel, E. (1986). Lead users: A source of novel product concepts, *Management Science*, vol. 32, no. 7, p. 691.

Waite, M. & Dictionaries, O. (2012). *Paperback oxford english dictionary*. 7th edn. Oxford: Oxford University Press.

Webb, W. (2011). The networked home: The way of the future or a vision too far?. In Harper, R. (Ed) *The connected home: The future of domestic life.* (pp. 19-28). London: Springer

Wheelwright, S. C. & Clark, K. B. (1992). *Revolutionizing product development: Quantum leaps in speed, efficiency and quality.* New York: The Free Press.

Wilson, C., Hargreaves, T. & Hauxwell-Baldwin, R. (2017). Benefits and risks of smart home technologies. *Energy Policy*, vol. 103, pp. 72–83.

Oral sources

Ahuja, K. (2017). *The promise of the connected home.* [online]. McKinsey. http://www.mckinsey.com/industries/high-tech/how-we-help-clients/internet-of-things (Retreived 2017-04-06).

Appendix: Interview Questions Used in the Field Test

Wifi, trådlöst internet

Kategori 1: Nuvarande lösningar
Vad använder du just nu för lösningar för att få uppkoppling i hemmet?
Vilken lösning använder du mest?

- Varför?

Katrgori 2: Attityd
Hur ofta använder du trådlöst internet hemma?
Var hemma använder du trådlöst internet?

- Varför använder du inte internet i xxxx?
- Var använder du det mest hemma?

Hur många enheter i ditt hem är uppkopplade till internet?

- Vilka är det?

Hur tycker du att internet fungerar hemma?
Använder du internet i övriga delarna av byggnaden där du bor?

- Hur fungerar det?

Kategori 3: Fördelar som söks
Vilka fördelar får du ut av att använda trådlöst internet?

- Vilka faktorer avgör enligt dig om en lösning är bra eller inte?

Kategori 4: Problem kunder upplever
Vad upplever du för problem när du använder trådlöst internet hemma?

- Hur fixar du dessa problem?

Kategori 5: En ideal lösning
Hur skulle en ideal trådlös internetlösning se ut för dig?

Kontrollera el-enhet (inkl. Borta-hemma knapp, belysning, uttag)

Kategori 1: Nuvarande lösningar

- Hur kontrollerar du idag el-enheter?
- Var i hemmet kontrollerar du främst enheter och vilka enheter rör det sig om?
- Vad använder du just nu för lösningar för att styra belysningen i hemmet?

Katergori 2: Attityd

- Hur ofta funderar du över ifall du stängt av lampor/el-enheter?
- Hur vet du ifall lampor/el-enheter är avstängda?
- Är du mest orolig över att lampor eller andra el-enheter inte är avstängda?
- Vart brukar du befinna dig då du oroar dig över en icke-avstängd el-enhet?

- Hur ofta brukar du behöva gå tillbaka in i lägenheten efter att du lämnat den för att kontrollera så att alla lampor/el-enheter är avstängda?
    - Hur känns det att behöva gå tillbaka?
    - Är det vanligast att du går tillbaks för att kontrollera att du stängt av lampor eller andra el-enheter?
- Vilka lampor i hemmet tänder du när du kommer hem?
- Hur ofta styr du din belysning hemma?
- Var hemma styr du din belysning mest?
    - Varför just i dessa områden och inte de andra?

Hur tycker du att styrningen av belysning och el-enheter fungerar hemma?

Kategori 3: Fördelar som söks

Vilka fördelar får du ut av att kunna styra lampor?

- Är dessa fördelar mer relaterade till att stänga av, sätta på eller dimma lampor?

Vilka fördelar får du ut av att kunna styra el-enheter?

- Är dessa fördelar mer relaterade till att stänga av eller sätta på en el-enhet?

Vilka faktorer avgör enligt dig om en lösning är bra eller inte (tex miljö, kostnad, bekvämlighet, säkerhet, privacy)?

Kategori 4: Problem kunder upplever

Vad upplever du för problem när du ska kontrollera/styra lampor i ditt hem?

- Hur fixar du dessa problem?

Vad upplever du för problem när du ska kontrollera en el-enhet?

- Hur fixar du dessa problem?

Kategori 5: En ideal lösning

Hur skulle en ideal borta/hemma knapp se ut för dig?

- Vart i hemmet skulle du placera en borta/hemma knapp?

Hur skulle en ideal lösning för att kontrollera el-enheter se ut för dig?

Hur skulle en ideal lösning för belysningsstyrning se ut för dig?

Lås via mobilen (låsa/öppna lägenheten)

Kategori 1: Nuvarande lösningar

Vad använder du just nu för lösning(ar) för att öppna/låsa dörren till hemmet?

- Varför?

Kategori 2: Attityd

I vilka situationer behöver du öppna/låsa din dörr till hemmet för någon annan?

- Hur upplever du att det fungerar att öppna/låsa dörren?

Hur ofta behöver du öppna/låsa din dörr till hemmet för någon annan?

Kategori 2: Fördelar som söks

Vilka fördelar får du ut av att låsa/öppna dörren till hemmet?

Hur avgör du om en lösning är bra eller inte?

Kategori 4: Problem kunder upplever

Vad upplever du för problem när du behöver öppna/låsa dörren till hemmet?

- Hur fixar du dessa problem?

Kategori 5: En ideal lösning

Hur skulle en ideal lösning för att öppna/låsa dörren till hemmet se ut för dig?

Finding Future Customer Needs for Smart Home Solutions

A Method Developed for the Construction Industry

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