UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master Degree Project in Innovation and Industrial Management

# The Emergence of the Smart Home Concept

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## Acknowledgements

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## Abstract

**Title:** The Emergence of the Smart Home Concept

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What should be established first, the innovation or the sufficient infrastructure? Similar to the "chicken and the egg" metaphor, is this a struggle many new innovations struggle with. Will customers by an electric car if there is no sufficient infrastructure to use them or will the infrastructure be developed without customers using electric cars?

This report focuses on the transition of an infrastructure caused by an innovation and investigates whether or not a collaboration strategy in the form of an ecosystem could ease this transition. This report has the perspective of the infrastructure development from copper to fiber with its main focus on an innovative concept called the Smart Home. Furthermore, the report focuses upon whether its infrastructure could be developed by an ecosystem approach.

The authors of this report claims, based on this study, a transition in the infrastructure could be eased through this approach. The respondents were positive regarding collaborations as a way to develop the insufficient infrastructure. It is however important to mention, this approach do only have the potential to develop parts of the infrastructure, it will not be able to develop for instance laws and regulations regarding safety issues.


Key words: *Ecosystem, Smart Home, System innovation, Sector Innovation, Infrastructure.*

# Respondents

The list below presents the respondents interviewed in this report. We would once again take the opportunity to recognize them for their contributions.

| Name | Company | Title |
|---|---|---|
| Patrick Isacsson | NODA Intelligent Systems AB | CEO |
| Jan Klarström | Elcenter AB | CEO |
| Mathias Lund | Spotsafe AB | CEO |
| Thomas Bergåker | Karl H Ström AB | Product Manager |
| Erik Fohlin | Moodifier Limited | CEO |
| Tomas Berglund | Cenvigo AB | Market Development Manager |
| Ola Möllerström | Sigma Connectivity AB | Head of Sales |
| Joakim Uddenfeldt | Sigma Connectivity AB | Project Manager |
| Ulf Seijmer | Induo AB | Creative Director |
| Lars Bierlein | E:on AB | Head of Program Office, Business Innovation |
| Mats Hansson | Skylink AB | Marketing Manager |
| Johan Waldenström | Skylink AB | Sales |
| Karin Widergren | The Swedish Coordination Council for Smart Grid | Director |
| Mattias Hultman | Sector Alarm AB | Business Developer |
| Dennis Nilsson | Davids AB | Project Manager |
| Trued Holmqvist | Scypho AB | CEO |
| Jens-Peter Schroer | Scypho AB | CTO |
| Rickard Lind | Microsoft AB | CTO |
| Anders Kjellström | Electrotest AB | CEO |
| Fredrik Björklund | Alleato AB | CTO |
| Michael Peterson | Verisure Securitas Direct AB | Head of Corporate Communications and Media Relations |
| Johan Sahl | Konkurrensverket | Deputy Head of Unit |
| Kristina Mellberg | Post och Tele Stryelsen | Head of section at the Competition Department at PTS |

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# 1. Introduction

What came first, the chicken or the egg? This metaphor has been used occasionally in order to describe the problematic of what was developed first. Could there be an egg without a chicken or could there be a chicken without an egg? The same reasoning is highly applicable on the case of innovation systems (Struben, 2004) such as the phases of the switching fuels in the automobile industries, what should be developed first, the infrastructure or the vehicles? Electrical cars will not be highly attractive without a sufficient infrastructure, establishment of charging stations for example, and it would be difficult to attract funding for the development of the infrastructure when the investors are not sure there is an existing market (Struben, 2004).

Similar challenges as the electric car market stumbled upon and is still phasing to some degree is the telecommunication market facing today. Copper has been used for more than 100 years in order to provide services to its users (Cave and Shortall, 2011). The copper was able to fulfill its purpose when the customer used it for voice calls. This is however not the case anymore due to the development and usage of internet with higher demand on communication through tools like Skype, being able to do safe transactions as well as use new features and innovations such as the Smart Home. Brochier et al. (2008) argues that the best way to handle these new demands is by developing fiber instead of copper.

EU has, in order to manage this new demand, stated a policy declaring more people should have access to high speed communication within the EU (EU, 2010). Sweden has an even higher demand on its citizen's accessibility compared to the once set by EU. There is however a problem with the development in Sweden. Even though the fiber developers are supported by grants from EU are many of the Swedish citizens unwilling to purchase fiber due to the lack of need, according to them, combined with the cost of installing it. This creates a development problem since the actors on the market are not willing to develop fiber unless they find it beneficial. There must be an increased need for fiber among a majority of the citizens in order for these goals set by both EU and Sweden to be reached.

One way to create a need for fiber could be through the development of the Smart Home concept, a new innovation on the emergence of a breakthrough. Many of the Smart Home features requires fiber in order to function and if usage of the Smart Home increases, might the need of fiber increase as well.

The problem with the Smart Home is however once again related to the chicken and the egg problem. There is no clear infrastructure in order to establish the Smart Home concept, a requirement in order for the concept to further emerge. This chicken and the egg problem have to be avoided. This concern is what the report will focus upon through researching the potential of developing the Smart Home infrastructure via collaborations in the form of ecosystems.

The Smart Home concept may be seen as a niche market, niche strategies are a common way to develop a demand for an innovation. The concern is though, as stated previously, the chicken and the egg problematic will still be in place even with the Smart Home concept as a niche market since the infrastructure will not be established. This report will therefore be investigating whether companies in ecosystems, with united forces, may establish an infrastructure in order for the niche market to emerge. .

The following section will in further depth describe the terms infrastructure, ecosystem, niche strategy and how they relate to each other followed by the objective of this report.

## 1.1 Research Problem

Woolthuis, Lankhuizen and Gilsing (2005) argue there is a lack in the literature regarding the relation between innovation and infrastructure. Their research have though only focused upon failures of the infrastructure and not on innovations without a sufficient infrastructure in place. According to the authors of this report, there is inadequate research upon how a transition, caused by an innovation, could emerge without the sufficient infrastructure, hence this research will be focusing upon this.

When a transition is going to occur, as a radical innovation generate, a niche strategy is commonly used (Walz, 2007; Geels, 2002 Geels, 2004; Geels, 2005; Hekkert et al., 2007). This is illustrated in figure 1 below:
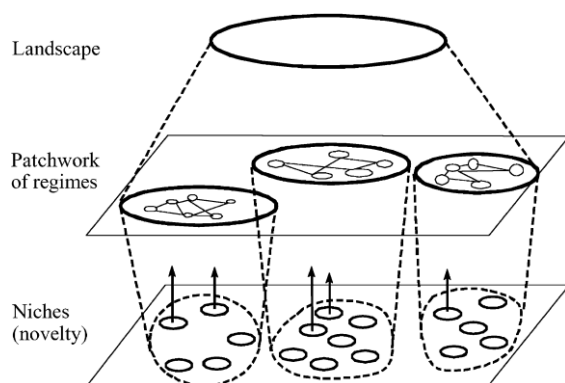


*Figure 1: Illustrating Niches role in radical innovations (Geels, 2002)*

The niche strategy is a way to foster the innovation and create a market for it. The authors found this strategy suitable for the development of fiber optics and use the niche market of Smart Home as an example for this development. The problem however, as mentioned in the introduction, is when the infrastructure is undeveloped, as in the case of the Smart Home concept. The authors' concern is through the use of a niche strategy when an extensive infrastructure is necessary but not yet developed. It is therefore questioned whether a niche strategy is a possible strategy when the needed infrastructure is not fully established and the authors consider this as a gap in the literature. It is not likely to establish a niche strategy in order to develop the Smart Home before the infrastructure is in place. The authors finds this problematic and therefore, in this report, suggest a strategy using collaborations in the forms of ecosystems in order to establish an infrastructure and by this approach foster the opportunities for the niche market of the Smart Home concept.

This report will focus on whether or not an ecosystem strategy would be considered suitable in order to develop the Smart Home concept. The development of the infrastructure building blocks is similar to the development within an ecosystem. Marbela (2002) describes the infrastructure from a sectoral perspective arguing the development of the building blocks; actors and networks; knowledge and technology; and institutions are iterative and the development of one building block affects and develops the others. This process is similar to the relationship among actors within an ecosystem were they should co-develop using an iterative process within the ecosystem.

In order to describe the infrastructure, a system innovation approach will be used which has gained great approval in the research literature (Bergek et al., 2008; Geels 2004; Geels 2005; Hekkert et al., 2007). The building blocks previously mentioned by Marbela (2002) will be used as the definition of a sectoral infrastructure in this report.

This report will hence, due to the problems of using a niche strategy to develop the Smart Home without the required infrastructure, aim at investigating whether or not collaborations in the form of ecosystem could help develop the infrastructure and help foster the innovation of the Smart Home concept. The objective of this report will be described in the upcoming section.

## 1.2 Objective and Research questions

The objective of this paper is to find out whether or not a transition in the infrastructure due to an innovation, in this report with the Smart Home concept as an example, could be eased by collaborations among firms in the forms of ecosystems. Further, the aim of this paper is to research whether such collaborations could become a reality, with the purpose of establishing the concept of the Smart Home. It is however difficult to research whether or not ecosystems could ease a transition in the infrastructure without knowledge about it. This study is therefore aiming to identifying the requirements of the infrastructure as well as what of these requirements still needs to be developed.

These objectives have led to the following research questions:

The first research question:

*What requirements are still yet to be developed in order for the Smart Home to further develop?*

- *What are the requirements of the infrastructure in order for the Smart Home concept to further develop?*

The second research question:

*Could collaborations in the form of an ecosystem ease a transition in the infrastructure, caused by an innovation?*

- *Why would this be a suitable strategy?*

- *Why would this not be a suitable strategy?*

The third research question:

*Are companies interested in collaborations, in the form of ecosystems, in order to further establish the concept of Smart Home?*

*- What are the benefits of an approach as such?*

*- What are the drawbacks of an approach as such?*

# 2. Literature review

As stated in the research problem, system innovation has gained approval in recent studies during the 21th century (Bergek et al., 2008; Geels 2004; Geels 2005; Hekkert et al., 2007). Geels (2005) mention examples of system innovations explaining they can be national, regional or sectoral. This report will focus upon on the last of the examples, namely on the sectoral system innovation.

The technological aspect may in itself be a system innovation, the authors have though chosen to incorporate the technological section in the sector innovations as argued by Geels (2004). Furthermore, this chapter will present the different building blocks within a sectoral system innovation infrastructure as presented by Malerba (2002; 2004). This chapter will also describe the process of an ecosystem which could foster the development of an infrastructure and hence enhance the development of the different building blocks in order for the Smart Home concept to further develop. Furthermore, this chapter will present the features and usage of a Smart Home in order to highlight what a Smart Home actually is, what effects the establishment of it could have and the main reasons for its development. Lastly, a section will follow explaining the case study of this report as well as the case company and its potential role within an ecosystem.

## 2.1 Sector innovations

Innovation derives in different matters dependent upon what sector. In some sectors, like pharmaceuticals for example, science is an important factor and both firms and universities contribute towards the innovation in this sector. In telecommunications on the other hand, the actors, networks and institutions are the major players characterizing the innovativeness. What they both have in common is that innovation occurs when there is a knowledge sharing interaction between different actors (Weitzman, 1998) Furthermore, the links and the additional services, so called complementarities, are important to consider when examining the birth of innovations. A quote from Malerba (2004) will be used to define the use of sector; "*A sector is a set of activities that are unified by some related product group for a given or emerging demand and that share some basic knowledge*" (Malerba, 2004, pp. 10). Finally, viewing industries as sectors generate the possibility of grasping the structures, boundaries and as mentioned above innovativeness in the particular business industry (Malerba, 2004; Malerba, 2002).

This part of the literature review, sector innovations, generates building blocks acting as requirements for the industry, Smart Homes in this case, in order to function well. These will act as the base for the whole industry of Smart Homes and the opportunity for ecosystems. Without these building blocks apparent and functioning in the way wished upon by the literature, the Smart Homes will not be a thriving business sector according to Malerba (2004; 2002). It is however important to understand there is a co-evolution between these blocks and its various elements. Development within one block will help the development within the others and so forth (Malerba, 2004), quite similar to the development process of different actors within an ecosystem. Further below, these building blocks will first be presented and then followed by the literature's view upon what their functions are and their importance. The aim of this part of the report is to explain what is needed to be present, according to the literature, in order to establish an infrastructure within the Smart Home sector (Malerba, 2004; Malerba, 2002).

## 2.2 Building blocks of sector systems

Malerba (2004) argues innovation within the sector is composed by so called agents. These agents will be explained in the following quote which further explain the interactions between the agents, the sector and the building blocks; "*Sectoral systems have a knowledge base, technologies, inputs and (potential or existing) demand. The agents are individuals and organizations at various levels of aggregation, with specific learning processes, competencies, organizational structure, beliefs, objectives and behaviors. They interact through the processes of communication, exchange, cooperation, competition and command, and their interaction is shaped by institutions. A sectoral system undergoes processes of change and transformation through the coevolution of its various elements*" (Malerba, 2004, pp. 10).

The building blocks the authors will use were mentioned in this quote which also explains the relationship between the same. The same author, Malerba, argues for a couple of other blocks in an article from 2002 but the authors have chosen to exclude these since they are not mentioned as single building blocks in the later published book. The demand have also been excluded since there will not be any focus upon the customers' perception in this report. The authors do instead recommend this for future research. With this said, the building blocks used in this report are (Malerba, 2004; Malerba, 2002);

- Knowledge and technologies

- Actors and networks

- Institutions

### 2.2.1 Knowledge and Technologies

The technology within the sector plays a major role in the boundaries and organizations within the sector. In many cases, the firms must manage several technologies, even though they are only focusing upon one single technology. As mentioned above, the authors incorporate the technology system innovation in this parameter of the sector innovations. Technological systems is defined by Carlsson and Stankiewicz (1991 p. 111) as

*"…networks of agents interacting in a specific technology area under a particular institutional infrastructure to generate, diffuse and utilize technology. Technological systems are defined in terms of knowledge or competence flows rather than flows of ordinary goods and services. They consist of dynamic knowledge and competence networks."*.

Also the links between the firms within the sector and the complementarities they offer each other are of great importance. When discussing knowledge, learning is considered the single most important determination of new innovations (Edquist, 2010). There are mainly two important terms to consider when using the term knowledge, the accessibility and the appropriability. The accessibility concern how easy it is, both internal and external, to get access to the knowledge. The level of this may for example determines to what degree the competitors may replicate and imitate the offers. Regarding the appropriability, high appropriability and high cumulativeness leads to a Mark Schumpeter II pattern, a sector with large companies and with barriers for entry, on the contrary low appropriability and low cumulativeness leads to Mark Schumpeter I pattern, a sector with small entry barriers and with entrepreneurs having a more important role (Malerba 2004; Malerba 2002).

### 2.2.2 Actors and networks

Actors within a sector may be firms or non-firms organizations. These, so called agents, may for example be characterized by competencies, beliefs and objectives and they are connected in both market and non-market relationships. Also the suppliers and users affect the sector, the innovativeness in particular, since these two agents must be ready and well adapted for the new requirements, as mentioned previously though, the authors will not focus upon the users. It is the heterogeneity between the firms which play the most crucial role. These relationships between the agents may develop themselves as well as the sector. The strategies, believes and organizations for example may be affected in different ways dependent upon the

heterogeneity among the firms. Looking at the non-firms organizations, these are for example; universities, institutions and government agencies. These non-firms organizations affect the sector differently dependent upon what industry they are active within. For example, the emergence of innovations may vary greatly from different sectors (Malerba 2004; Malerba 2002).

### 2.2.3 Institutions

Institutions include for instance norms, routines, rules, laws and common standards which affect the actions of the agents and the interactions among them. When discussing institutions, the national aspect is important to consider. The property rights and the patent are two examples of how the national factor affects the institutions. The differences with patents between different nationalities may affect the actions by the firms. They may though also affect each other the other way around, the sectors affect the institutions. Large, important sectors and companies may affect the institutions in one particular country to the extent that these sectors controls and determines the institutions within the country (Malerba 2004; Malerba 2002). The authors have chosen to focus upon the regulative part of the institutions as Geels (2004) calls it.

### 2.2.3 Concluding remarks

The literature explains how the different sectors and differences within the sectors, such as the three building blocks, affect the requirements and outcomes of the sector. Malerba (2004; 2002) argues the differences with the building blocks co-develop during the evolvement of the sector though affected by the external factors. This knowledge and argument will from here on act as a statement to proceed from when examining the industry of Smart home as a sector. Further on, they will motivate the interview questions when investigating the different companies' and personal opinions of the interviewees when conducting the interviews regarding the requirements, opportunities, threats and drawbacks within the industry of Smart Home.

### 2.4 Ecosystem

The concept of business ecosystems have emerged from the biology (Li, 2009; Iansiti and Levien, 2004). In similarity to the biology, there are organizations and components dependent on each other motivating a strategy which proposes collaborations, as an ecosystem for example. This may be motivated by quoting Iansiti and Levien (2004, pp. 69);

*"Stand-alone strategies don't work when your company's success depends on the collective health of the organizations that influence the creation and delivery of your product. Knowing what to do requires understanding the ecosystem and your organization's role in it".*

The importance of business ecosystems for a firm's success is also motivated by Westerlund, Leminen and Rajahonka (2014) stating that the more integrated world through networks forces businesses into more complex business ecosystems. The same authors explain a business ecosystem as organizations anchored to a platform, an organization of things. Furthermore, Muegge (2013) defines business ecosystem as an organization of economic actors. Iansiti and Levinen (2004) discuss the success of Wal-Mart and Microsoft and argue their success derive from their business ecosystems. Even though they hold great capabilities by themselves, their success would not have been as extensive without the ecosystem they have organized around themselves. This theory is strengthened by Marbela (2002), arguing firms do not innovate in isolation and innovation has to be seen as a collective process.

### 2.4.1 Characteristics of ecosystems

Iansiti and Levinen (2004) consider three aspects as crucial for a business ecosystem to be defined as successful. These are *productivity*, *robustness* and *niche creation*. The importance of *productivity* is quite obvious, but this also concerns the innovativeness in order to decrease the costs. The *robustness* concerns the sudden changes in the industries which might occur and the importance of managing these. Finally the *niche creation* states the
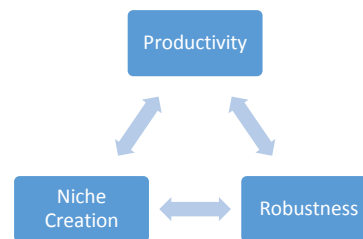


*Figure 2 : Illustration made by the authors based on the article by Iansiti and Levinen (2004)*

importance of the ability to diversify the offered products and services. These three aspects are according to Iansiti and Levinen (2004) crucial in order for a healthy business ecosystem. Carbone (2009) agrees to this and mainly the second aspect of robustness explaining how an ecosystem may establish resilience against external changes, similar to what Iansiti and Levinen (2004) explain as sudden changes. Furthermore, Carbone (2009) claims both the large- and the smaller players have a better opportunity challenging the dominant players in the industry through an ecosystem. What can be learnt from this is mainly, an ecosystem offers greater possibilities for companies, both larger and smaller, to compete, since they together may provide greater offers. Two examples are the possibilities to diversify into niches, since the ecosystem to greater extent offers stability and secondly, the companies

within the ecosystem may take greater risks and compete with the dominant players since the ecosystems with joined forces better may compete with the dominant players through handling external changes. As described in the section, research problem, the authors propose an ecosystem strategy as a way to establish a new innovation which causes a transition in the infrastructure when a necessary infrastructure is not already established. What is argued above declare, firms in ecosystem may achieve advantages when the innovation has entered the market as well, not only during the process of developing the needed infrastructure and establishing the transition forced by the innovation on the market.

According to Li (2009), a business ecosystem has mainly three characteristics, *symbiosis*, *platform* and *co-evolution*. The *symbiosis* concern the loose networks within an ecosystem and the benefits the different organizations may draw from this collaboration. Secondly, a *platform* is similar to what Westerlund, Leminen and Rajahonka (2014) discuss, anchoring the different firms to a *platform* where they might unite in order to improve the performance of the firms. It is also important to state the change of only focusing on the value from the products to instead consider the value as something created for the network. This is also explained by Iansiti and Levinen (2004) stating the success of Wal-Mart and Microsoft to a great extent have emerged from the business ecosystem created around their offers. *Co-evolution* between the companies regards the aspect of complementary products and services enhancing the core of the business ecosystem as the final characteristic.

Adomavicius et al. (2007) share a different view on the technology ecosystem explaining it through the aspects of *product/application*, *components* and *support and infrastructure*. The *product/application* is the object the companies in an ecosystem offer which acts as a center for the whole network. The components are what the *product/application* consist of, therefore an important part of the ecosystem. Finally the *support and infrastructure* concern the actions adding value to the *product/application* creating a system of use (Adomavicius et al., 2007). Regarding this in the aspect of the above mentioned by Li (2009) and Iansiti and Levinen (2004) it shows a somewhat different view of what is required in an ecosystem and what should be in the center of the focus. Li (2009) and Iansiti and Levinen (2004) consider the companies in the ecosystem to be in the center meanwhile Adomavicius et al. (2007) puts the *product/application* in the center and as essential for a success for the ecosystem.

No matter the view on it, either the firms or the products/applications in the center of the focus, the descriptions of ecosystems are similar to the ones describing system innovations and sectoral systems. The same characteristics are mentioned which, as mentioned in the

introduction and research problem description, opens up the opportunity to investigate whether initiating an ecosystem may be an approach when establishing an innovation causing a transition. This is to an even greater extent interesting when an infrastructure needs to be established before a niche strategy may be valid, which as mentioned by Iansiti and Levinen (2004) is one of the parts of an ecosystem.

### 2.4.2 Our focused aspects in an ecosystem

It is definitely possible to view either the products/applications (Adomavicius et al. (2007) view) or the firms (Li's and Iansiti and Levinen (2004) view as center of the ecosystem. Since this is a case study on Bjäre Kraft (2.6.1) and our research questions concern the motives whether different firms would participate in an ecosystem or not, we will keep the firms in the center of the ecosystem when focusing on the benefits for the ecosystems.

### 2.5 Smart Homes

The concept Smart Home is described by Taylor et al. (2006) as homes with a continuous increase of intelligence, built into the homes, interacting with the physical world on daily routines and social arrangements. Chan et al. (2009) use a similar explanation describing a Smart Home as a residence, prepared with technologies which should contribute to ameliorate the way of living and to improve the health. Another definition is *"A smart environment is a physical world that is richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives, and connected through a continuous network"* (Arora et al., 2014, 596). As shown, there are different definitions of the same concept and the authors have found several more in the literature which were chosen not to mention in this report. This shows, according to the authors, Smart Home is not a well-established concept yet with one consistent definition and the authors will therefore explain it through different paragraphs aiming at explaining the concept by exemplify it and explain its many features.

One thing all the definitions, mentioned above, have in common is that a Smart Home is an interaction between techniques and everyday objects of the users' lives. The possibilities are many and hence it features can be applied in many different areas in order to improve the way of living. Chan et al. (2009) describe how it can be used in order to improve the Health Care sector. Furthermore, Chetty, Tran and Grinter (2008) argue Smart Home can, by improving resource management, improve the environment. Fensel et al. (2013) writes about how Smart Homes can be used in order to increase energy efficiency and Marsá-Maestre et al. (2005) argues all these techniques can be used in order to improve the efficiency at the office. The

possibilities are many and the applications rendered by these as well, the authors will dig deeper into this further below. There are some risks with Smart Homes as well due to complications with transferring human need to the devices (Dewsbury, Taylor and Edge, 2014) and some legal and ethical issues as well (Chan et al. 2009). The problem with legal and ethical rights, the use of Smart Homes and the benefits with such an environment will be discussed more in detail in the forthcoming paragraphs.

### 2.5.1 The requirements for Smart Homes

In order for a Smart Home to function as intended, there are some requirements which need to be fulfilled. Arora et al. (2014) explain ten desired features for the wireless technology of the Smart Home, these are;

- Reliability of the communication
- Security of communication
- Low radio emission
- Ease of use
- Reasonable price
- Modularity and future proof design
- Interoperability
- Investment protection
- Features and capabilities
- Low interference with other signal frequencies

The first two features concern the communication, both the reliability and the security. The important aspect regards the communication between the transmitter and the device. It must be reliable and it cannot be allowed, either by mistake or on purpose, for a third party to interfere with the communication. The devices connected to the Smart Home cannot emit a large amount of radio waves since this might endangered the health of the user. The fourth and fifth features state the price issue, it cannot be too expensive and it has to be easy to use. Furthermore, there has to be compatibility between the Smart Home devices and the rest of the home and its furniture. The seventh feature, interoperability, is something which will be explained below. Similar to the modularity, it is important to ensure the devices are easy to replace and that they offer opportunities exceeding the controlling part, the devices and the users should be able to interact. Finally it is important to avoid the interference between the Smart Home automation with the wireless devices (Arora et al., 2014).

## 2.5.2 Interoperability and semantic interoperability

A residence classified as a Smart Home requires a vast amount of data. This needs to be transformed into meaningful information whereas the term semantic interoperability is necessary to define and explain. Semantic interoperability is based on algorithms ensuring the interacting systems to understand each other. The issue regards to guarantee the systems to mean the same thing with a certain word, expression or similar (Heiler, 1995), in other words, ambiguity. The way to handle this is through ontology, but it comes with great challenges (Ouksel and Sheth, 1999). According to Minwoo, Jaeho and Jaeseok (2015) there are some technologies which might ease this concern. One example is the Tim Berners-Lee's Semantic Web which aims at solving this concern. The idea behind this feature is to connect all the web pages into one gigantic database. This may be explained by instead of viewing it as different isolated islands, it is connected into one huge mass of information (Kück, 2004).

## 2.5.3 Features of Smart Homes

In order for a Smart Home to function as intended, there are some features that could be installed. Augusto et al. (2013) identifies five different areas (figure 3) which all could be installed in order to reach the Smart Home. The authors of this report have chosen to call it an intelligent environment, these are:
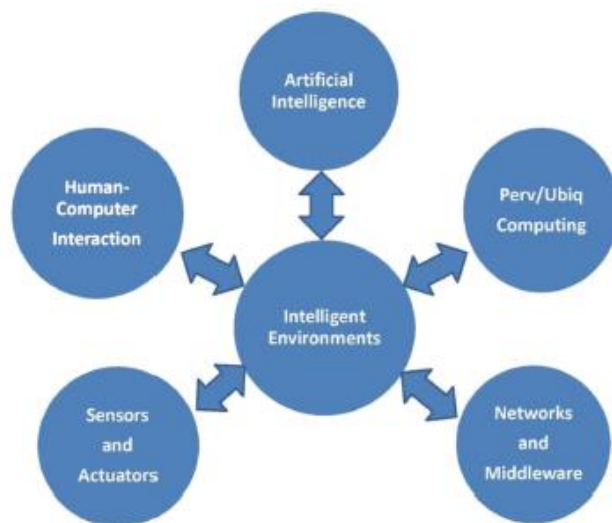


*Figure 3: Components of an Intelligent Environment (Augusto et al. 2013)*

Sensors and actuators: The sensors and actuators is a way of collecting data and provides the ability to measure, on among other things, temperature, movement, radiation, sound, identification and position (Delsing and Lindgren, 2005). The reason behind installing these is to help the environment collect both valuable simple data such as temperature and more advanced data like fingerprints, sound and video (Augusto et al. 2013). The problem with using different sensors is however they need to be integrated with one and another in order to function at its best and such a system, a perfectly functioned system, is still yet to be developed (Augusto et al. 2013).

Network and Middleware: Most of the Smart homes have different kinds of sensors which provide knowledge about the current status in the house. A wireless or wired network is needed in order to channel this data. There are though some problems occurring with this kind of system since it sometimes has to deal with incomplete information and how it should be able to respond to real-time interaction (Augusto et al. 2013). These problems are usually dealt with something called middleware which is a kind of software helping the networks' different parts to understand each other (Kumar and Zambonelli, 2007).

Pervasive/Ubiquitous Computing: A paradigm centered on a variety of devices. It explores the development and changes of the environment and updates the central system. The system keeps track of the individuals in the environment and the reports generate developments depending on the characteristics of the individuals (Augusto et al. 2013). It is related to the term context-awareness which basically means it has the capability to be aware of real time situations, follow patterns in the evolution of the system, report this to its modules and create a response to this change (Dey, Abowd and Salber, 2001).

Artificial Intelligence: Artificial intelligence is one common way to improve the comfort within a Smart Home. It is a way to make sure the services provided by the systems are the same services a human would deliver in a similar situation. It is therefore important to create autonomous decision making which is what artificial intelligence will contribute with to the environment (Augusto et al. 2013). Furthermore, it is able to react and learn by the behaviors of humans and use this data in order to improve the service (Aztiria, Izaguirre and Augusto, 2010). It has the ability to reason and decide whether it should act or not within a specific situation (Augusto et al. 2013) and the authority to be autonomous in order to decide when and whether it should act or not. The autonomy is needed in all levels of the system if it should be able to, for instance, be self-healing (Satoh, 2011).

Human Computer Interaction: One of the aims with a Smart Home is for the users to be able to use it without a vast amount of training. However, there are a lot of improvements required before the systems are easy enough to use for its consumers (Augusto et al. 2013). There are though some tools in order to create an interaction between the computer and the human in a natural way, for instance facial expression recognition, emotion recognition and/or a spoken dialogue (Augusto et al. 2013).

### 2.5.4 The need of Smart Homes

There are several benefits and opportunities motivating the development of Smart Homes, the authors have though found two areas the literature focus most upon when stating the possibilities of Smart Homes. One is the treatment of elderly and disabled people (Healthcare), discussed by Chan et al. (2008); Chan et al. (2009); Augusto and Nugent, (2004); Courtney et al. (2008). The second major reason for developing Smart Homes is its possibilities to contribute to a better climate. Allameh et al. (2012); Chetty, Tran and Grinter (2008); Jacobsson, Boldt and Carlsson (2014) and Hargreaves, Nye and Burgess (2010) argue Smart Homes have the possibilities to reduce the environmental impact by creating resource awareness and to reduce unnecessary usage of energy. How a Smart Home can create a better climate and why it is needed in order to help everyday life of elderly and disabled people will be discussed more in detail in the forthcoming chapters.

#### 2.5.4.1 Climate

There are many sustainable challenges in the world in need to be dealt with during the upcoming decades in order for future generations to live in a sustainable environment (Allameh et al. 2012). Some of these are the limited amount of natural resources and an increasing demand of energy (Chetty, Tran and Grinter, 2008). A way to tackle these issues could be the development of Smart Homes (Allameh et al. 2012). Smart Homes have the opportunity to face these challenges through some of its features, by among other things increase peoples' awareness of the consumption (Chetty, Tran and Grinter, 2008). For instance, smart energy systems could help users control energy consumption both at the workplace and at home (Chetty, Tran and Grinter, 2008), this would help reduce the amount of energy used. Jacobsson, Boldt and Carlsson (2014) state, in Sweden only 75% of the population have knowledge about their energy consumption and feedback on their consumption could reduce their usage with up to 20%. Hargreaves, Nye and Burgess (2010) agree with this and argue systems providing feedback could increase consumer awareness and by doing so reduce the use of energy.

Beside peoples' awareness, energy could be reduced by having a system controlling the change in temperature depending upon if people are in the room or not (Swann, 2008). A sensor to control the lights is another way to decrease energy costs (Swann, 2008). Furthermore, smart grid is one of the most important features of a Smart Home in order to reduce energy consumption. Such a system includes communication channels and smart meters in order to visualize the energy consumption (Khanna, 2012). It also offers the

opportunity to turn off devices the user might forgotten to turn off (Khanna, 2012). These features help reduce the energy consumption and by doing so positively affect the environment. EU aim at reducing the energy consumption by 20% in Europe, Smart homes could be one important feature reaching this goal. (Fensel, Kumar and Tomic, 2014).

### 2.5.4.2 An increase of elderly people

The UN Department of Economic and Social Affairs (2004) predict there will be an increase of life expectancy from the span of 49-89 years old to the span of 66-99 years old during the 21st century. They also predict there will be an increase of retired people over 65 and a decline in the amount of children. This means, there will be more elderly people per working individual and the demand of the people supporting the elderly generation will increase (Augusto and Nugent, 2004). This will in turn increase the demand on those taking care of the elderly and disabled people, Smart Homes could be a way in order to deal with this potential problem (Chan et al., 2008; Chan et al. 2009; Augusto and Nugent, 2004). Smart Homes open up the possibilities for more people to receive health care at home since there is too expensive to help all these people at nursing homes (Chan et al. 2009). It could also be the case this type of solution would be beneficial for the people in need since these Smart Home systems could be tailored to the specific needs of an individual and hence adapt to help the specific needs of the consumers and help them in their day to day activities (Courtney et al., 2008)

### 2.5.5 Concerns regarding Smart Homes

There are many benefits and opportunities with Smart Homes, as mentioned above, but there are some complications the Smart Home concept is struggling with. One of the issues concern the smart devices comprehending the huge amount of data (Tsai, Lai and Vasilakos, 2014; Bandyopadhyay and Sen, 2011). The things connected to the internet within a Smart Home are supposed to interact with the people and collect data in order to improve life standards for the people using it (Dewsbury, Taylor and Edge, 2014). This means a large amount of data will be collected in order to deal with these issues (Bandyopadhyay and Sen, 2011). There might be a problem for regular computer system not having the capacity to store this amount of data without being overloaded (Tsai, Lai and Vasilakos, 2014). One of the problems concern the real time interaction with the devices since they do not have enough space to process the data in real time and hence affect the interaction with the user (Tsai, Lai and Vasilakos, 2014).

The interaction between different systems is another concern within the smart home concept (Jacobsson, Boldt and Carlsson, 2014). It is likely Smart Home systems will be integrated

with additional systems and hence it is important they are able to integrate with one another in order to function as intended (Jacobsson, Boldt and Carlsson, 2014). This could create frustrations among the users and hence affect the purpose of a Smart Home improving the comfort for its users (Dewsbury, Taylor and Edge, 2014). Arora et al. (2014) mention a lot of different systems could be used when implementing a Smart Home but there has to be overall standards created in order for Smart Homes to reach its full potential. A concern linked to this is the problem of having several individuals within a Smart Home (Augusto et al. 2013). If different people have different preferences it is important the system can detect who is in the room in order to support the specific individual's needs (Augusto et al. 2013). A way to solve this problem could be to install face recognition cameras but this will most likely create other problems instead e.g., privacy (Augusto et al. 2013).

Another major concern regarding Internet of things and Smart Homes is the security and privacy issues with these concepts (Tsai, Lai and Vasilakos, 2014; Bandyopadhyay and Sen, 2011; Jacobsson, Boldt and Carlsson, 2014). Jacobsson, Boldt and Carlsson, (2014) state, people will be more exposed to hackers if more devices are connected to the internet. Since this is something new, people are inexperienced and hence they are not aware of the risks with for instance use of a poor choice of password for the devices. Another problem according to the same authors is the lack of perfect way to integrate the devices within a smart home making the whole system poorly integrated. This generates a weak system hence more exposed to hackers. Related to the previous concerns are the ethical and legal issues the Smart Home creates (Chan et al. 2008). If these technologies for instance are used in the Health care, there are laws that need to be established in order to make sure the new ways of helping people does not affect the quality of the treatment (Chan et al 2008). How the service providers should use the information collected from the users is another grey area. These service providers could use this information for commercial purposes or sell it to other firms in order to help them attract customers (Jacobsson, Boldt and Carlsson, 2014; Augusto et al. 2014). Should this be legally allowed and is it ethical right to use this information? How the usage of this data should be used when investigating a crime is another ethical and legal issue. What should be private and what data should be handled to the police when they, for instance, are investigating a crime (Bandyopadhyay and Sen, 2011)?

## 2.6 The case study

EU has, as mentioned in the introduction, stated a policy, all citizens within Europe should have access to internet with 30 Mbps (Megabits per second) and at least 50% should have

access to internet above 100 Mbps (European Commission, 2010). The goal is even higher in Sweden, at least 90% should have access to 100Mbps. There is though a problem with reaching this goal, the development is controlled by the market. The companies offering this speed prefer to develop their infrastructure in more attractive areas with a higher density of people (SVT, 2015). SVT (2015) made a screening of the fiber development in Sweden and found that 61%, in October 2014, already has access through high speed broadband. However, there is a difference in the fiber infrastructure depending on the different regions in Sweden (SVT, 2015)[1]. Speaking in general terms, the connection on the country side is poor compared to more dense populated areas. On



*Figure 4: The development of high speed broadband in Sweden (SVT, 2015.)*

the countryside, only 13% of the 1.1 million has access to broadband through fiber (SVT, 2015). This could create a problem since the people living on the country side might not be able to use new technologies due to the lack of connection and broadband capacity. The Swedish high speed development is illustrated in figure 4. The green color means that over 55% of the people in that region has access to it whilst red means that only 0-10% has access to it.

A well-developed digital infrastructure and new solutions to provide internet to the people is therefore needed in order to support this increased demand as well as supporting people on the less dense populated areas. The issue concerns how this might be solved since the privately owned companies will, as they have done throughout history, focus on the attractive areas.

This is however not the main problem in this case study. Bjäre Kraft addressed their main concern as the fact their customers do not see the need for fiber, even though they establish the infrastructure for fiber does the customers not purchase and use it. They have no trouble developing the infrastructure even though they operate on the countryside as long as the customers are willing to pay for the fiber which once again proves the problematic of

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[1] For more information about the fiber development in Sweden see link: http://www.svt.se/nyheter/inrikes/stora-skillnader-i-snabbt-bredband-for-svenskar

developing an infrastructure, no actor is ready to take the risks or the costs. The following section will describe the case company and their market more thoroughly.

### 2.6.1 The case company and its industry

As stated above, the case company Bjäre Kraft is already establishing fiber infrastructure on the countryside, the issue do though concern the customers and the fact they are not willing to pay for it since they do not feel any need of it. In order for the authors to provide any solution to this, in the perspective of the literature, it is firstly important to establish a sufficient knowledge among the reader of this report regarding the case company's reality. The following sections will fulfill this purpose.

The fiber infrastructure in Sweden is based on an open market which means the market is divided to its users on a non-discriminated and fair basis. The actors within this market are divided into three different sectors; *physical infrastructure providers*, *network providers* and *service providers* (Forzati et al., 2013).

Bjäre Kraft and its subsidiaries are active in all sectors and categories mentioned in previous paragraph. They build the infrastructure by digging cables, provide their customers with broadband and network and they are also offering them after sale services (Bjäre Kraft, 2013). They are focusing on the local market and have approximately 12 500 customers they can reach with their infrastructure and 8 000 they can provide their network services to. This number will however increase as they keep on digging new cables in order to be able to match the future needs of its customers (Bjäre Kraft, 2013).

The Swedish electricity market is deregulated and is a part of the European electricity market. There are approximately 120 actors selling electricity on a competitive market. The distribution of electricity is however divided on a monopolistic basis in specific given areas. The Swedish market is in this case divided in approximately 170 actors (Swedish Energy Market Inspectorate, 2014). Bjäre Kraft operates on both markets. This has affected their overall strategy and they only sell their electricity and fiber within the same region as they are able to provide with electricity. They were able to reach 2 000 households at the year of 2013 but they are currently adding fiber in order to be able to reach more households (Bjäre Kraft, 2013).

### 2.6.2 The Ecosystem's role in the infrastructure development

The literature addresses the issues regarding the insufficient infrastructure and the authors have found a possible solution to this referred to as collaboration strategies in the form of Ecosystems. Similar to how Malerba (2002; 2004) describe how the building blocks correlate with each other is the ecosystem strategies described as iterative processes. The building blocks might in ecosystems be developed through iterative processes, solving the insufficient infrastructure by developing the required needs.

### 2.6.3 The role of the case company in an ecosystem

The fact Bjäre Kraft operates as a fiber developer means they have an important part of the infrastructure development and especially the fiber. As an actor providing such an important building block as fiber, they could become a keystone player within an ecosystem

From a theoretical perspective, Iansiti and Levinen (2004) discuss the term keystone players as companies able to improve the health of the whole ecosystem by their actions and the exclusion of a keystone company will lead to a collapse of the ecosystem. In spite of being a small company, the keystone's role in the ecosystem is extensive and their decisions and actions affect the whole network. The keystones have two parts in an ecosystem, the first is to create value and the second is to share the value. Finally, one of the requirements of a keystone is to create a platform, a service or a tool for the other actors. This could be connected to what Li (2009) and Westerlund, Leminen and Rajahonka (2014) discuss, in the ecosystem chapter, regarding anchoring firms around a platform.

Viewing these descriptions of keystones from the perspective of Bjäre Kraft generates great consistency and makes it possible for us to draw the conclusion of Bjäre Kraft as a keystone actor in an ecosystem. Bjäre Kraft, with their customer base and their great influence on the consumers, as the supplier of electricity and broadband, shows how their actions affect the whole ecosystem and an exclusion of them would harm the ecosystem greatly. Finally, Bjäre Kraft may create and share the value through the requirement of the platform and service they offer via the electricity or broadband.

### 2.6.4 Concluding remarks

In order to conclude the literature's perspective upon what challenges the case company might be facing, how they might be solved and the case company's role within it, the authors have in the previous sections stated concluding remarks of the literature.

The authors have, before considering the empirical findings, reason to claim that the case company's greatest challenge is to increase the demand of fiber. This challenge concerns all the infrastructure requirements but since the case company is a supplier of fiber, have the authors focused upon the challenges from this perspective. The Smart Home concept may illustrate an example of a niche market increasing the demand for fiber, this created though a chicken and the egg problematic. The Smart Home concept will not be developed without a sufficient infrastructure and the infrastructure will never be improved unless there is a need for it. There is not a clear statement upon what should be developed first. The authors did not find any clear model or framework upon how this might be solved and have therefore proposed collaboration strategies in the form of ecosystems in order to solve this. Five building blocks have been found and the development of these has been compared with ecosystems strategies. The authors have investigated whether ecosystem strategies may solve this challenge and, according to the literature it is a possible solution towards this challenge.

It is also important to declare the role of the case company within a strategy as such. Bjäre Kraft does, as a fiber developer hold a role as a keystone player in an ecosystem. The authors do therefore claim that, when analyzing the challenges from a theoretical perspective there is a great opportunity to solve the chicken and the egg problematic by initiating ecosystems.

# 3. Methodology

## 3.1Research Strategy

There is an ongoing process between new concepts and new ecosystems. "Smart Homes" is one of the emerging concepts developing through the Internet of Things. According to the authors, this concept and the relationship between Smart Home equipment and its demand on quick and fast broadband, in order to function as intended, is interesting. The emergence of Smart Home generates a radical innovation in an industry with a lack of sufficient infrastructure. With the lack of research, as explained in the research problem and the interesting emergence of Smart Home, this report will be investigating the opportunities for companies collaborating in a form of ecosystems when establishing an innovation in a market without the sufficient infrastructure.

The authors have chosen to conduct a qualitative study, as supported by Bryman and Bell (2011) who argue a qualitative research approach is most suited when applying research on a case study. The reasons for conducting a case study is mainly based on the motive of the authors choice, to not base this report upon already existing literature and instead focus on a gap in the same. Due to this, the complexity motivated the authors to focus upon a specific region or firm's reality. The same complexity did also imply the authors to conduct the empirical findings through interviews instead of surveys since the respondents' personal opinions were of great value and their contributions could lead to further investigations in the literature. Semi-structured interviews would in this case be more suitable since they gave the researchers an opportunity to get more detailed information (Bryman and Bell, 2011) and such interviews have therefore been conducted during this research.

As the above have been explained, an abductive approach appeared as the most natural way of conducting this report. It is according to Andersen and Kragh (2010) important the researcher start its research creating a pre-theoretical knowledge before collecting empirical data. This reduced the risk of replicating previous findings and, in addition, helped the authors avoid unnecessary data gathering. When the authors gained new empirical knowledge, leading to a need of revising the theoretical frameworks, the authors investigated that matter before proceeding with the report. These actions have been done in order to ensure an abductive approach have been followed and both the literature and the empirical findings have been affecting each other in order to reduce the gap in the literature and ensure the necessity of this

report. There was however a risk of the authors being too theoretical predetermined and let this affect the directions during the data collection. These risks have been mitigated through the choice of semi structured interviews, with both experts within the field and typical profile companies, since the interviewees have ensured the outcome of the report to not be too focused upon the theoretical findings and instead replicate their reality in a true sense. This has been a risk during the whole research process and something the authors have been aware of. With a critical mind and a continuous analyze of both the empirical and theoretical findings, the authors are confident the risk of this has been minimized to its minimum.

## 3.2 Research design

### 3.2.1 The case company

Bjäre Kraft is a business association located on Bjärehalvön, a peninsula in the southern part of Sweden. It consists of the parent company, Bjäre kraft business association, and the subsidiaries Bjäre Kraft Energi AB and Bjäre Kraft Bredband AB (Bjäre Kraft, 2014A).

Bjäre Krafts business idea is to provide and create infrastructure for electricity, fiber and broadband for the residents in the northwest parts of Skåne and the southern parts of Halland. They are focusing on creating a business providing renewable energy, with a reliable electricity grid and good fiber in order to satisfy their customers and to handle future customer needs (Bjäre Kraft, 2014B). The whole business constellation had 47 employees and 166 millions in turnover 2013 (Bjäre Kraft, 2013).

### 3.2.2 Primary Data

Since the authors of this report have intended to examine the view of collaborations from the view of a Smart Home solution provider in the form of ecosystems, the authors have been conducting interviews with both experts within the fields and firms active within the same. The interviews with the experts were made in order to find their perspective on the opportunities of ecosystems and their view of the future of Smart Homes. The interviews with the firms were made in order to find out their interest and perspective on potential collaborations and their opinion on the future of Smart Home concept regarding issues such as what infrastructure is needed for their products to work; what are the main barriers for the development of their Smart Home products and if they think it is the future for their business?

The firms chosen to be interviewed were carefully chosen in order to fulfill the criteria's. The criteria's were; the companies need to be active within the concept of Smart Home and able to co-develop strategies with others in order to develop the Smart Home concept further. Finally, typical sectors and industries were chosen from where to gather the primary data, these were

the broadband and electrical segment, the E-health, the alarm sector, the industries of control devices like KNX, the heating and the lighting sector.

Moreover, individuals with product knowledge as well as the ability to influence the strategy at the firms were chosen as respondents for this paper. These people were mostly found through LinkedIn which the authors found as a relevant tool in order to find respondents matching the criteria's. It was also a way for the authors to mitigate the problem of being passed forward within the larger firms trying to find the relevant person. The authors are aware not all potential respondents use LinkedIn and have therefore used the more traditional method of contacting the firms as well. LinkedIn did though provide enough relevant respondents in order for the authors to view this as a suitable method of choice. Another benefit with LinkedIn were the fact it gave the authors the possibility to access relevant groups with people interested in the Smart Home concept and use these groups as a way of finding both relevant  respondents and firms.

The authors chose to conduct Semi-Structured interviews in order to collect empirical data. A Semi-Structured interview provides the interviewer with the opportunity to adapt the interview dependent upon the interviewee's responses (Bryman and Bell, 2011). It is however still structured enough to make sure the main subjects are included during the interview (Bryman and Bell, 2011). The authors found this way of conducting the interviews well suited for their research since it offered the opportunity to ask question within the research area and at the same time adapt the interview dependent upon what the interviewee responded. This led to interviews where the interviewees could gain further knowledge with the help of the respondents. As mentioned above, the primary data and the secondary data have developed the theoretical knowledge of this report and the authors have, dependent upon what the interviews led to, used this feedback in order to investigate the insights gained from the interviews in the literature.

Moreover, the interviews were held either via phone, Skype or face to face. A face to face interview is always to prefer since it gives the interviewer the potential to get more information from for instance the body language. The interviews were though settled all over the country and it was not possible to visit them all face to face and we therefore had to conduct most of them either via Skype or by phone.

Furthermore, most of the interviews have been conducted in Swedish, the native language of the respondents, and translated into English by the authors. The interviews have been concluded and sent to the interviewee in order for the respondent to approve the authors have understood them correctly. This was done in order to secure both the reliability and validity of this report. Each interviewee was also given the opportunity to be anonymous as a way of making sure that they could speak freely. One of the firm active in the same industry as the case company chose to be anonymous and in order to handle this did the authors decide to let all respondents from that industry to be anonymous including the respondents at the case company.

### 3.2.3 Secondary data

Our introduction and theoretical framework have been conducted through secondary data. This implies, scientific journals, articles, books and these have mainly been retrieved through E-sources. The studying of these frameworks have given us further knowledge within the subject and combining this with the primary data have led to further investigations.

Since we have three quite broad topics to cover in this project, ecosystem, system innovation and Smart Homes, we are not going to complete any systematic literature review. The literature used in this thesis will be classified as Scholarly and Peer-Reviewed in order to certify the reliability for the literature. The only exception for this rule is in the introduction where some of the statements may be connected to newspaper articles. The literature was collected through the data base via the University of Gothenburg's library.

We used a couple of keywords and references as a way of finding the right articles, this is usually referred to as the "Snowball effect". The Snowball effect is a way of browsing through the literature where the researcher uses the same keywords and references founded in the articles in order to retrieve new ones. This method may be criticized since there is a risk the authors end up in a too narrow scope when only using the same keywords and the references each article is referring to. This has though been managed through using the Snowball effect on the newly founded articles as well.

### 3.2.4 Limitations of the Smart Home

The concept of Smart Homes is, as mentioned in the theoretical framework chapter, not an established concept yet and there are many different areas to consider when using the term, Smart Home. Yilmaz (2011) uses four different aspects when describing the Smart Home concept:

- The physical structure of the house.

- The system including for instance security and power control.

- The services providing the system with what it needs, for instance Internet.

- Management controlling for instance lights and the energy consumption.

Yilmaz (2011) argue some aspects have to be included when actually building the house, the first aspect. Factors such as great isolation, warming and natural conditioning are of great importance regarding energy savings. The other three aspects can be included when there already is an existing building. The aim of this report has not been to cover all these aspects. The authors have been focusing on the system and the service part since they are the most appropriate parts for this case study, since neither the actual building of the house or the monitoring of devices are services the case company is engaged in. The case company itself will be able to provide the services and the potential collaborations with the system providers in order to develop an ecosystem and this have been more in line with the focus of this paper.

## 3.3 Research Challenges

One of the major challenges for this research were to find relevant firms to interview since this research concerns a new non- established innovation. As mentioned before has the authors chose to include the different services within a Smart Home and tried to interview firms active in these industries. A problem has however been to get interviews with big actors on the market since these firms sent the respondents in a loop contacting different people who all sent the authors to another person. This problem was mitigated to some extent by the use of LinkedIn but it was still a problem in some cases.

Another challenge were the fact that the concept of the Smart Home is quite new and undefined which made it difficult to find the right keywords and articles regarding the Smart Home. The authors had a similar problem regarding the ecosystem literature since it as well is a relative new concept in the since as it is used in this report.

Another challenge with using a qualitative method with Semi-Structured interviews as the tool to gather empirical data were the fact that this creates a lot unstructured data compared with a quantitative approach. Semi-structured interviews opens up for discussions as mentioned earlier and a challenge was to keep these discussion on topic and at the same time in a way for the authors to understand the terminology. Since the Smart Home is a new

unestablished innovation were most of the interviews made with individuals who had a technological perspective. Some of the respondents were eager to speak in technical terms in a way which the authors in some cases had poor knowledge about since this report focus more on a business perspective.

## 3.4 Reliability and Validity

This study is reliable based on the definition by Rosenqvist and Andrèn (2006) stating reliability means how trustworthy a study is. The authors has managed to cover the key areas with respondents active in the health, energy, light, alarm and the heating industries, key industries in order to establish the Smart Home concept. Besides these industries, the interviews were made with Smart Home experts in order to strengthen the results. They were also used in order to identify if the firms within the different industries has the same perspective of the Smart Home as the experts has. Moreover, interviews have been made with agencies in order to find if there are, especially from an ecosystem perspective some concerns to be found in order to develop the Smart Home concept through ecosystems.

With this said, there are some issues which could reflect the reliability of the report. Even though a total of 25 respondents have been interviewed is it not safe to say the result will be completely reliable since it has been actors within the industry who have been interviewed. Moreover, could the discussion of how appropriate semi structured interviews are be raised. Would the outcome be the same if it would have been other researchers conducting this report? It is also important to mention the discussions regarding the future of the Smart Home were in some cases speculative since it is not yet an established concept and the result might have been different if the same is made within a couple of years when/if the concept becomes more commonly known. Another thing which could have affected the result is the fact that an interview sometimes creates moments where interpretation could occur. This problem was however mitigated, as mentioned previously (3.2.3), by sending a summary of the report to the respondents in order reduce the possibilities of interpretations in the empirical findings.

The authors consider this report to have validity based on the definition by Rosenqvist and Andrén (2006). They argue validity is defined as a study that investigates what it was supposed to investigate and the research method used during the research process were the method which was meant to be used in the research. The planned research process were the once which were used and the objective remained the same without being impacted from neither the respondents nor the case company when the research had started. The research is

not conducted in order to satisfy the need of the respondents nor has the research objective changed during the research process in order to satisfy the case company.

## 3.5 Concluding remarks

The whole research process, described in the methodology chapter is summarized in Figure 5. The figure shows briefly what research process the authors found most appropriate in order to find the answers to the research questions as well as to fulfill the objective of this report.
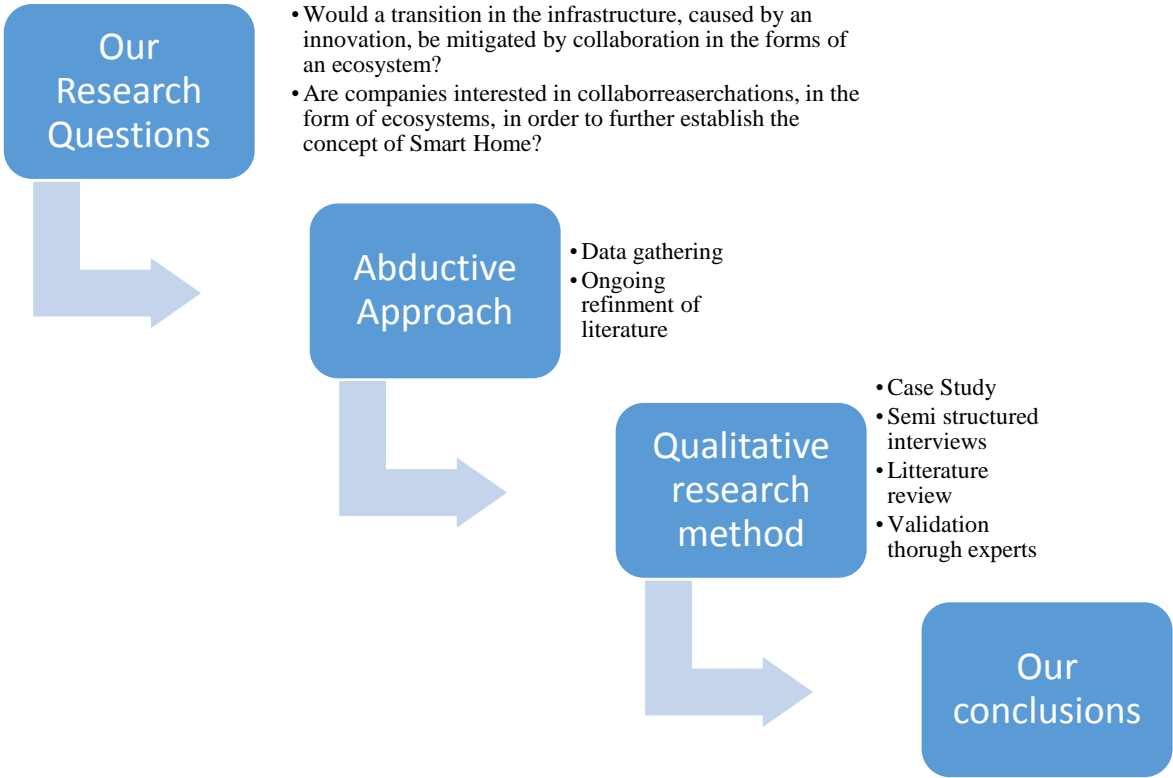


*Figure 5: The research process*

# 4. Empirical findings

This chapter will present the data from the interviews. The data is presented based on different topics in regards to the theory section. It will start with the infrastructure regarding the requirements and problems towards it, followed by concluding remarks regarding them. The sub sections in this part are created based on the interviews and considers the requirements of the infrastructure according to them. Moreover will the respondents view on collaborations in the form of ecosystems be presented followed by other findings the authors found relevant but did not manage to cluster in any of the other sections

It will, during the first sections, be referred to figures concluding the responses of the respondents, presented in section 2.5.1. The requirements are presented in three different figures, one including all of the respondents and the other two separating the experts from the other firms. The experts are chose based on the criteria's mentioned in the methodology chapter (3.2.2). The experts are *Anders at Electrotest*, *Ola and Joakim at Sigma Connectivity*, *Dennis at Davids* and *Ulf at Induo*.

## 4.1 Actors and Networks
### 4.1.1 Open Mindset
Most of the respondents, as seen in the figure 6, stated an open mindset or rather the lack of it as a barrier for the development of the Smart Home. The term, open minded, may be described as peoples' or firms' willingness to change and adapt to new technologies, processes etc., they cannot be too conservative. As mentioned, most of the respondents stated this as an issue that the people and firms within the different industries need to overcome before the concept may become a commodity.

The reason for why the respondents felt this conservatism in the industry may, according to the respondents, be explained from two perspectives circulating around a shift in generations. The first perspective concern the entrance of a new generation of technology, referred to as Internet of Things, causing a period of time where different organizations are situated in different phases in this shift. The outcome from this is a period where the organizations who have adapted to the change consider the others to be too conservative before everyone is on board. The other perspective regards the employees, the younger generation has a tendency to be more open minded regarding changes in technologies and may therefore consider the older generations to be too conservative. Patrick at Noda for instance, argues new technologies are constantly emerging and can create

a mess for both the firms and the consumers trying to adapt to new technologies. Jan at Elcenter is of the same opinion, it is important for the employees of the older generations to try to adapt to the new changes in technology.

Furthermore, both Jan at Elcenter and Dennis at Davids exemplified the electrician market as conservative and the fact it is resistant towards adapting to new technologies. Michael at Verisure Securitas Direct agree to this and explained how the lack of innovativeness in the industry might have led to a non-innovative culture, there has, according to him, not existed any need for innovations for the electricity companies. Furthermore, Michael argued the potential within the market is huge due to the extent of customers for most of those firms as well as new technologies, as long as they are able to remove the conservatism within the industry and become more innovative.

Another industry seen as conservative, according to the respondents, is the construction industry. Both Mats and Johan at Skylink have faced narrow minded construction firms. These firms prioritize, according to them, the short term wallet and fail to see the potential with long term investments into the sufficient infrastructure. Systems, like for instance KNX, needs to be integrated in the buildings during the construction in order to use its full potential. This is due to the extremely complicated integration in already existing buildings, according to Thomas at Karl H Ström. Mathias at Spotsafe is of the same opinion and he sees the power central in the house as the key of the Smart Home since a lot of the Smart Home features have the potential to be controlled from this central. It is important the actors within the industries get on board and adapt to the new concepts in order for the Smart Home to develop further. The conservatism mentioned above is, according to Mathias at Spotsafe, delaying the emergence of the concept.

Overall, the respondents are of the same that an open mind is needed (figure 6; 7; 8) in order for the Smart Home to develop and hence is a lack of an open mind is a problem for the development. They have different views upon where the issue originates depending on which industry they are active in but the overall problem is, as mentioned above, the same. One aspect to consider is the overall impression among the respondents that the concept will develop in the nearest future meanwhile the struggles with the conservatism and open mind at the same time will be solved when the concept have gained a further establishment. Similar to the "Chicken and the egg problematic", the authors questioned whether the concept ever will

develop further with these narrow minded actors or if the actors will become less conservative if the concept never emerge? Dennis at Davids explained how they use partnerships as a way of solving these issues since the company, through this strategy, may educate and illustrate the benefits of the Smart Home concept and open up the views among the conservative and narrow minded actors in the industry. The construction industry is not the only conservative industry, the healthcare sector is a conservative and narrow minded industry towards new technologies according to Tomas at Cenvigo. This is also agreed upon by Richard at Microsoft stating the health and the retail sector as two conservative sectors while the two sectors, automobile manufacturing and the transport industry overall are more eager to change. Furthermore, Trued and Jens-Peter at Schypo active in the automatic heating industry is of the opinion it is not whole organizations per se that are conservative, it is individuals within this industry that are the conservative ones.

## 4.2 Knowledge

One of the other requirements needed, according to 17 of the 22 respondents (figure 6), is sufficient knowledge and a removal of the knowledge gap that exists. Fredrik at Alleato did for instance mention the lack of knowledge as the main obstacle for the spreading and development of the Smart Home.

The knowledge is referred to both from a consumer and firm perspective. It is important there is no knowledge gap among the consumers. It is therefore crucial the firms with potential to develop Smart Home solutions possess sufficient knowledge within the field. Dennis at Davids argues one of the main challenges among the concept of Smart Home is to spread the word about it, the consumers are not aware of it. The technologies and knowledge are in place, the problem according to both Ulf at Induo and Dennis at Davids is to spread it. David uses word of mouth and is trying to educate other actors like the electricians and architects since they are key actors when constructing the Smart Home. Rickard at Microsoft has a similar idea but states, the executives within the firms needs to be educated in IoT and the Smart Home as a way to overcome the knowledge gap from the business side. Ola and Joakim at Sigma Connectivity highlight one of the main problems with developing the Smart Home as the lack of knowledge and understanding among firms. Furthermore, this is related to their unwillingness to learn and risk their market position by finding new ways of doing business. One of the anonymous respondents argues, firms are lacking the sufficient knowledge regarding the new technologies and this is the main reason for the

lack of awareness among the consumers. It is exemplified as, the firms are not able to offer products and services attractive enough for the consumers. The word of mouth will therefore not help to spread the word in order to attract and create further awareness of the concept. This is also agreed upon by the other anonymous respondents explaining one of the great challenges for the company is to explain the need and benefits of the concept for the consumers. They further explained the consumers, due to this, did not help the spreading of the concept since they do not have any experience of it.

Michael at Verisure Securitas Direct agrees with Ulf at Induo and Dennis at David stating in a previous paragraph the knowledge and technology is in place. The problem is however, according to the respondents, the people with the sufficient knowledge are among the technicians who develop the products and not among the ones taking the decisions within a firm and deciding the future of the firm. This creates a problem when creating a business model around the technology since important factors will not be considered when trying to implement the Smart Home concept as a commodity. Finally, Michael mentioned this as an issue in several industries, there is many cases when new innovations emerge within an immature market but the knowledge is not spread in order to establish the concept.

Another problem related to the lack of knowledge, explained by the respondents, is the so called abuse of the term Smart Homes in many cases. Jan at Elcenter argues some firms claim they offer "Smart" products and services which he does not consider as "Smart". He explained how this could create a negative view of the concept which affects its development. Patrick at Noda highlights a similar problem, though from another angle, when arguing the unclear definition of what a Smart Home actually is creates the issues where neither the consumers nor the companies may determine what is "Smart" or not. Patrick mentioned there are a lot of products the consumers are using already, whether they notice it or not, which would fit in within the Smart Home concept. The consumers would though not consider themselves living in a Smart Home. He declares, everyone knows what it is but few have it. The lack of knowledge, defining what an actual Smart Home is, is a problem for the development of the concept. The authors of this report have tried to find a definition during the interviews, unfortunately it is not any clearer now than before. Even the experts within the field cannot explain the concept through a simple definition and Anders at Electrotest explained it as the home is getting smarter and smarter for every product or

service installed and integrated with each other. There are therefore not any clear pillars needed in order for the consumers to live in a Smart Home.

Moreover did some of the respondents argue one of the reasons there is a great knowledge gap is due to the lack of Case buildings. Mats and Johan at Skylink argues the lack of simple solutions and the lack of clear cases is some of the reasons the knowledge is poorly spread. Jan at Elcenter has a similar opinion, there need to be some great cases showing the development of Smart Homes as a way of bridging the gap between the conservative people and the new technologies. Some of the respondents have however mentioned cases which are used as a way of spreading the knowledge of the Smart Home. Davids and Electrotest uses their own previous solutions as cases in order to spread their expertise and knowledge. Dennis at Davids explained how they use previous customer cases as a way of marketing their expertise. Anders at Electrotest uses for instance his own Smart Home as a case for spreading the word of Smart Homes and he invites people to visit. Ulf at Induo agrees cases could be a good way in order to spread the knowledge, it is however important the cases are successful. Ulf mentioned an example of a house in Stockholm where a couple of firms joined forces and created a Smart Home. It was an expensive house to build and it only managed to save 74 SEK during the first six month.[2] It is safe to say, as Ulf stated, this case is considered as a failure.

## 4.3 Technology
### 4.3.1 Fiber
The need for good connectivity and especially fiber is something all of the experts (figure 7) as well as most of the other firms (figure 8) consider to be needed in order for the development of the Smart Home. However, there are some differences regarding the need of its requirements and how well developed the infrastructure needs to be developed in order for the Smart Home concept to develop, according to the respondents. Some of the respondents are of the opinion it is well enough established today while other disagree. The differences in opinions regarding this and to what extent the fiber is needed will be further discussed in upcoming paragraphs.

One of the respondents arguing the fiber optic development is not something that should slow down the Smart Home development is Anders at Electrotest. He argues the infrastructure in

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[2] For more information about this project see link: http://www.nyteknik.se/tekniknyheter/article3883234.ece

Sweden will due to its rapid development be sufficient within a few years in order for the concept to further develop. Joakim and Ola at Sigma Connectivity are of the opinion the fiber optics infrastructure today is well enough developed but claims it could work as an accelerator towards further development of IoT and the Smart Home concept. Furthermore, Trued and Jens-Peter at Schypo and Rickard at Microsoft described Sweden as a country which is well developed compared to the rest of Europe regarding this aspect. Rickard at Microsoft argued the infrastructure is good enough for the future development as well. He did however mentioned that he could not determine whether fiber optics will be required or not in the future. The respondents at Schypo though, agree it is enough in order to deal with today's requirements but it needs to be further developed in order to cope with the potential future demand. Mathias at Spotsafe also finds the potential with fiber intriguing and argues it would help foster the development of their products. Tomas at Cenvigo is of the opinion, everyone should have the right to access good connectivity. He declared though the connection today is well enough established for their products. However, a development of fiber optics would be needed in order for the establishment of Smart Homes and for the development of the overall welfare. He uses the security issue as an example for arguing why fiber is currently more secure than for instance 4G.

Ulf at Induo agrees with the respondents in previous paragraph arguing the connection today is enough. However, fiber would be beneficial for the Smart Home and especially when communicating with the house from outside. This communication is explained as companies who offer the Smart Home solutions may to a greater extent use their functions when monitoring the products and services via fiber optics. Dennis at Davids has a similar opinion arguing the main reason for having good connectivity within the Smart Home would be in order to communicate with the products and services within the same from a distance.

Moreover, Noda has according to Patrick been forced to adapt to the reality and offers therefore services adapted to the reality without fiber optics. It is however beneficial with fiber and such a development is something Patrick would welcome in order for them to further develop their products.

Mats and Johan at Skylink argues the infrastructure regarding connectivity in Sweden is well enough established in order for the Smart Home to emerge and develop completely. Fiber optics is according to them therefore not something needed in order for the development.

Furthermore, The majority of the Swedish citizens do not see any clear value with fiber optics, according to Mats and Johan at Skylink, since most of the Swedish citizens do not use products or services to the extent that they require fiber optics.

Several respondents mentioned the "chicken and the egg problematic" which might be applied to what Mats and Johan described regarding the fiber optics development in the previous paragraph. The users will not feel any need for it while they do not use any products or services requiring fiber optics meanwhile they will never start use any products or services requiring fiber optics without the fiber optics. Jan at Elcenter also uses "the chicken and the egg" metaphor when describing the development of fiber optics. He sense there is a problem not having a government financing the development of fiber. The municipalities in his region are slow with a development as such and it is too expensive to develop such infrastructure for the firms without any collaboration or support from the government. This creates a "chicken and the egg" problem in the development of Smart Homes since the concept itself will have a hard time to establish if there is no infrastructure in place and it is hard to convince the government the infrastructure is needed if there is no real case where firms needs it in order to develop further.

### 4.3.2 Sensors

The need for better and cheaper sensors was something that 4 of the 5 experts (figure 7) and 1 of the 17 other respondents (figure 8) respondents mentioned as a factor that needed to be developed in order for the Smart Home infrastructure to be in place. Ola and Joakim at Sigma Connectivity were the first two respondents discussing this issue. They are of the opinion the development of Sensors is more important than the development of fiber in order to foster the Smart Home development. The technology is in place but they are however quite expensive and they need to become cheaper in order for the concept to accelerate. Anders at Electrotest is also of the opinion the sensors needs to become cheaper. He mentioned the importance of economics of scale and argues it would be beneficial if they would to be mass produced. Regarding the technology aspect, Anders is of the opinion the devices within a Smart Home have to be both wireless and without the need of batteries in order to make them as handy as possible for the users. This concerns the development of sensors as well. Wires are harder to integrate and install than devices without wires according to Anders. The increase of comfort is also the reason for sensors without battery. Battery has a short lifetime and this will create some troubles for the users.

Fredrik at Alleato is of the opinion that sensors should have the right protocols in order to develop and communicate with each other. He is, however, of the opinion these types of protocols will be developed during the year of 2015. The last respondent mentioning sensors was Thomas at Karl H Ström. He talked about its importance, especially towards his area of expertise which is Smart light systems. Sensors in that area has an important role but they are quite expensive to install, at the moment, compared to systems controlled by a switch. However, the long term benefits of reducing energy consumption and hence saving both cost and reducing environmental impact would be factors increasing the willingness to implement them.

### 4.3.3 Integration and Ease of Use

Two aspects mentioned by some of the respondents were the integration and the user friendliness which needs to be further developed. Ulf at Induo mentioned this problem arguing the technical infrastructure is in place but there is a need to produce products/services which are user friendly and moreover create a need for them. If the products/services would be developed to its maximum features, a lot of the customers would get lost due to the perceived complexity and they would not sense how basic it is to understand what is offered. Mats and Johan and Skylink agrees to this stating the problem for the slow development is linked to the fact there are no solutions, simple enough, developed in order to attract the average person. Mats and Johan argues the Smart Home will become more common in the future when the actors on the market creates a concept easy enough to understand and use for the consumer.

The ease of use could also concern the integration of systems and not being forced to have several remote controls and boxes in the house, as mentioned by one of the anonymous respondents for example. Mathias at Spotsafe had a similar opinion and mentioned an example which he thought would improve the user friendliness. The companies installing the power plant in the buildings should focus upon generating conditions for smart solutions. This is due to the fact it would be easier to control all the devices from one single unit instead of all the wall sockets in the building.

The integration aspect was one of the most complicated parts of installing a Smart Home according to Dennis at Davids but he did at the same time state they manage this. He did mention this in the aspect of the integration within the house. The initial infrastructure in the

building is mostly creating one central point which has the possibility to integrate all different systems. This is similar to the idea mentioned by Mattias in the previous paragraph. These central points are customized for each individual's needs in order to make it easier to use. The tricky part is to manage to get each system to integrate with each other. They integrate the different parts with a control panel like for instance a KNX system. Most of the solutions are connected to the network (IP) and Dennis is of the opinion it is possible to integrate a Smart Home as long as the right conditions already is in place. This would imply it is easier to integrate Smart Home solutions when constructing the house since the required conditions may be established right away.

## 4.4 Institutions

As mentioned in the Open minded chapter, the transition from "the old to the new world" is an issue stopping the concepts like Smart Home to further emerge. Patrick at Noda explains how the fast developing reality due to the emergence of internet is causing a mess for both the companies and the consumers. It is hard for both sides to grasp the opportunities. Furthermore, Patrick states one way to handle this might be through industry standards providing a structure ensuring that the companies are aiming at the right actions. Finally, Patrick mention one solution to this would be an independent organizations deciding upon standards benefitting the actors within the industry equally, in order to develop the concept further. Anders at Electrotest mentioned an organization of firms striving for this exact purpose of setting up a standard for companies within the industry to adapt to. Anders explained it more precise as a certificate required to be achieved by the companies in the industry in order to collaborate and integrate the product and services with each other's. The only difference compared to what Patrick described is that the organization of firms aiming at establishing the certificate is not independent firms, they are all active within the segment of IoT and may therefore be affected by their own interests when striving for certificates.

Similar to what has been explained above, Ulf at Induo mentioned a standard like GSM or Bluetooth may ease and help the development of the concept further. Jan at Elcenter is of another opinion and disagrees to this showing there is not a united opinion regarding standards. Standards may though not only be referred to as a structure or basic pillar for the companies to originate from. Several respondents discuss standards as standardized solutions for the Smart Home products and services. There is though, also regarding this, different opinions among the respondents whether this would be successful or not. As Jan

at Elcenter explains it, every case is unique and the customers want to adapt the solutions for their special needs, this would not be possible with standardized product and service offers.

Fredrik at Alleato is of the opinion the standards already exists in order for the development of the Smart Home. He describes an ISO standard they include in their software which over 200 firms is using when developing their smart products and among them are most of the big actors within the electronic industry included. He further described Z-wave, connected to over 1 000 products with various functions. Alleato is delivering the software with the standards making it possible for all these products to communicate with the gateway.

The safety and security issues were also something mentioned by some respondents. Rickard at Microsoft argued the infrastructure in Sweden is quite well developed in many aspects. He did however mention one obstacle, the security aspect with IoT and especially Smart Home. This is not sufficient yet and it is not safe enough in order for the concept to get established. The importance of safety was also something mentioned by the respondents at the firm's active within the alarm industry. Mattias at Sector Alarm for instance mentioned safety is of utter importance in their industry. It is due to this reason certificates are needed as a way of securing this safety. This is something that could slow down the further development of the business, according to Mattias, since these new product and services needs to be certified as well.

The institution part is though not only norms and standards, laws and regulations is also a part of it which definitely might affect the concept, as mentioned by the respondents at Sigma Connectivity Connectivity. It is though, as they explain, more the lack of laws and regulations causing troubles with the emergence of the concept and making it unclear.

The final remark regarding the institutions concerns the involvement of the municipalities and the lack of subsidies in order to establish fiber optics in Sweden. As mentioned by both Jan at Elcenter and Tomas at Cenvigo, a developed fiber infrastructure would help develop the concept of Smart Home. Jan at Elcenter mentioned the "chicken and the egg problematic" meanwhile Tomas described it as, it should be everyone's right to have good connection. This was however not agreed upon by one of the anonymous respondents stating the fiber developer in their region is getting financial support by subsidies from EU with the aim to foster the development and good connection. Rickard Lind at Microsoft AB was also quite

optimistic regarding the financial support from the government and mentioned Vinnova and their investments into the IoT sector. During this and the last year these investments reach close to 45 million SEK showing the government slowly starts to adapt and face the opportunity with fostering the development of IoT.

## 4.5 Concluding Remarks of the Infrastructure
## 4.5.1 Requirements of the Smart Home Infrastructure

The following three figures present a summary of the requirements of the infrastructure, according to the respondents, for the Smart Home concept to further emerge. The first includes all of the respondent's opinions, the other two presents either the opinions of the experts or the chosen firms.
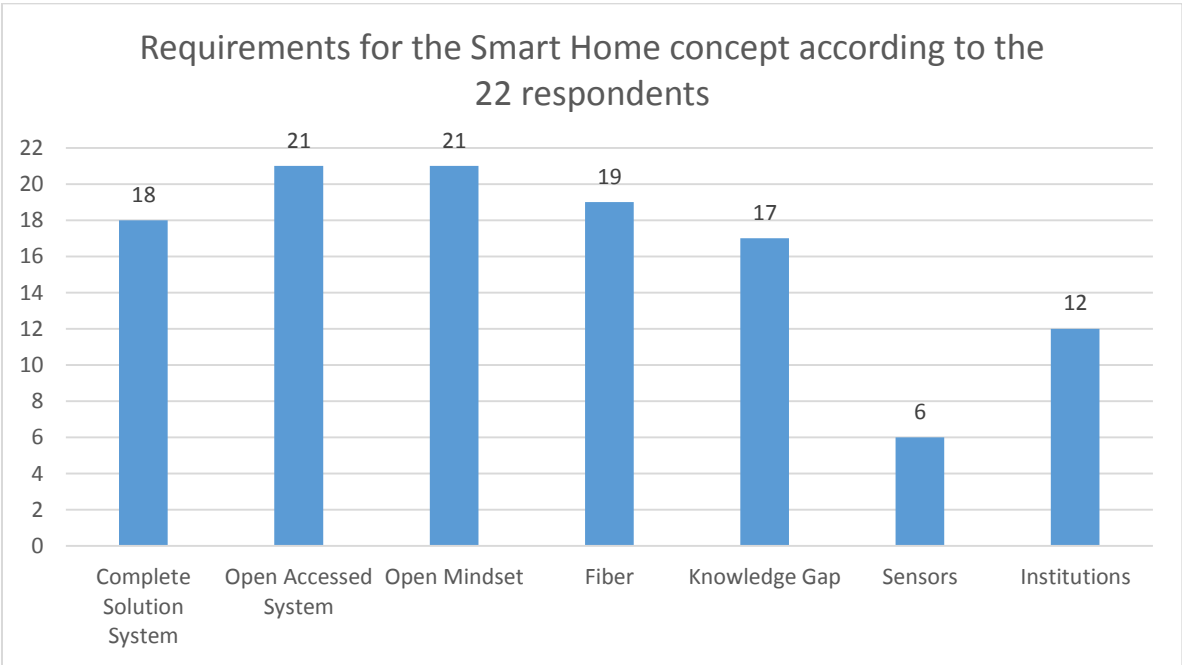


*Figure 6: Requirements for the Smart Home concept according to the 22 respondents*
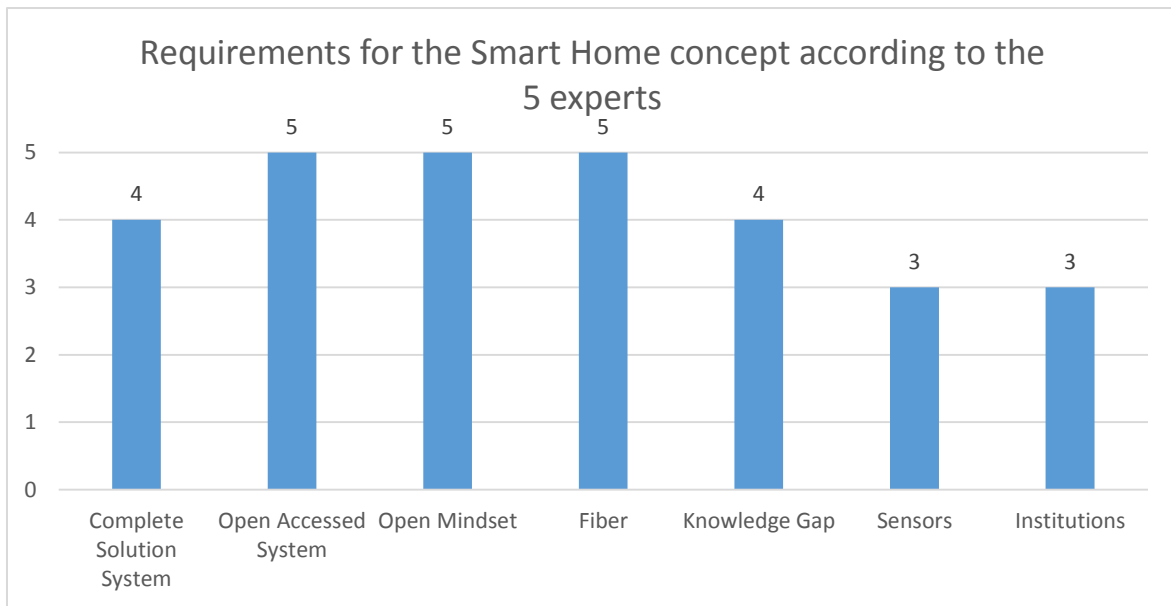
*Figure 7: Requirements for the Smart Home concept according to the 5 experts*



*Figure 8: Requirements for the Smart Home concept according to the 17 respondents from the characteristic firms*

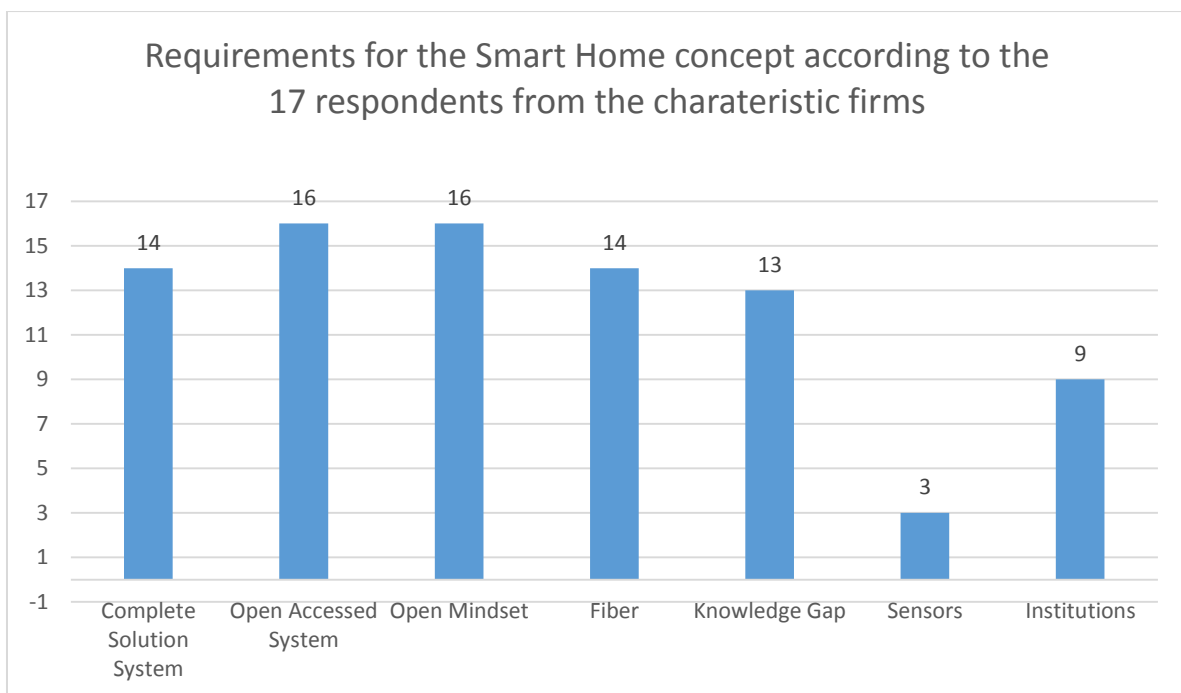### 4.5.2 The main hinders in the infrastructure

The table below (figure 9) summaries what main challenges in the infrastructure development the Smart Home is phasing. It is based on the response from the respondents presented in previous sections in this chapter.

| | The main hinders in the infrastructure |
|---|---|
| **Actors and Networks** | • Remove conservatism within industries and firms. |
| **Knowledge and Technology** | • Spread the knowledge among actors and potential consumers.<br>• Remove the abuse of the term Smart Home.<br>• Create smarter and cheaper sensors.<br>• Increase the ease of use among products and services.<br>• Improve integration opportunities among products and services. |
| **Institutions** | • Develop standards.<br>• Modernize laws and regulations. |

*Figure 9: The main hinders in the infrastructure development*

## 4.6 Ecosystems

All of the respondents in this report answered positively towards collaborations in the form of ecosystems. Some of them have already initiated such collaborations, some are investigating whether they might find partners and finally there were respondents who answered they would be willing to join an ecosystem if it would emerge one as such, suitable for the company. There are though differences among what the respondents consider as suitable or not which will be presented in the upcoming paragraphs.

Similar to the chapter regarding the infrastructure, the conservatism is an issue causing a reality where the different firms within the industries are irresistible towards collaborations. Jan at Elcenter tried to explain this through the attitude among the companies and as he explained it, the greediness among the same. Furthermore, Jan described it as instead of consider the potential opportunities, the companies sees it as a great idea but are not willing to take it one step further. Mats and Johan at Skylink mentioned the firms within their industry prioritize the short term wallet over the future opportunities as a reason for the conservatism. Finally, both the respondents at Skylink and Jan at Elcenter agreed to the fact this causes a "Chicken and the egg problematic" and the collaboration in the form of ecosystem may be a way to avoid this issue.

The conservatism mentioned above is something other firms have experienced as well and they explain how they manage this through collaborations creating an iterative process where

the companies within the ecosystem may educate each other and spread the knowledge among them as well as outside the ecosystem. Both Dennis at Davids and Richard at Microsoft discussed this matter. Davids collaborates in this sense mainly with electricians and architects meanwhile Microsoft creates platforms or some sort of hub which other firms may use their products and services together with.

Furthermore, both Fredrik at Alleato and the respondents at Scypho mentioned they are active in ecosystems and sees both benefits and drawbacks with the strategy mentioned previously. Scypho uses the same approach as Microsoft and Davids, the iterative, and consider it to be time consuming. On the other hand, they consider ecosystems to have the potential to be a catalyst towards the further emergence of Smart Home but it is not enough in itself in order to establish Smart Home as a commodity. Fredrik at Alleato agrees to the education part of ecosystem and state the security as an issue. Who own the information and when and for what may it be used? Patrick at Noda mentioned the same problem stating everyone in the ecosystem wants to "own" the customer. Mattias at Sector Alarm explained this problem further as, the concern regards which company the consumer will have a relation with. All the other companies will have to share the information with this company which creates issues. These issues concern some of the companies will have to rely upon the other company in contact with the consumer. This might be risky since the consumers perception of the company may be affected by the other companies' performance.

The problem regarding who should own the customer was something Joakim and Ola at Sigma Connectivity brought up as well and they also had some concerns regarding how the financial situation should be solved. They were however positive regarding developing the Smart Home through an ecosystem stating that this would be a modern solution since we live in the "the age of collaboration" as they recall it.

Michael at Verisure Securitas Direct answered positively towards the ecosystem approach where different products are integrated, he mentioned this as an already existing collaboration at the firm. Michael explained how collaborations with Panasonic and companies installing locks improve the offer towards the customers since the companies within the ecosystem may offer better and more complete services. Michael further argued one of the single most important feature at an immature market, besides a strong brand, as the ability to customize

products and services and stated ecosystem could be a good strategy in order to better customize the products and services.

### 4.6.1 Open Accessed- and Complete Solutions Systems

Thomas at Karl H Ström argued an iterative process is important within an ecosystem and includes the users as well explaining an ecosystem may to a greater degree open up possibilities to incorporate the users early on and create a win-win situation. Furthermore, Thomas argued the concept may further evolve through ecosystems since these collaborations can offer complete solutions. The complete solution part was mentioned by 4 of the experts (figure 7) as well as 14 of the other respondents (figure 8) as a requirement of the infrastructure. The respondents did also address this aspect regarding the ecosystems declaring some pillars in order to make it function properly. The complete solution should not be standardized, the consumers' needs to be offered openness as referred to by Thomas at Karl H Ström. Rickard at Microsoft explained the same when stating their platform or hub needs to be available for other companies to connect to in order to use its features in order for the platform or hub to fulfill any meaning. Erik at Moodifier addressed the same concern stating the avoidance of lock-ins as critical, isolated systems needs to be avoided to the greatest extent possible. Mathias at Spotsafe agreed both to the part regarding complete solutions and the win-win situation of ecosystems. As he explained it, the companies in the ecosystem share the same consumers but offer different products and services, they would therefore benefit from a strategy as such. One of the anonymous respondents were of the same opinion as well stressing the importance for the consumer to be able to choose what parts of the offers they would like to include. It should also be possible to include offers from other firms as well in order to create the home suitable for the specific individual.

There is an agreement among the respondents, for instance Dennis at Davids, Tomas at Cenvigo and Thomas at Karl H Ström, regarding ecosystem and how these may develop both the concept of Smart Home as well as the actors within the ecosystem. Important is though, as mentioned previously, to avoid the lock-ins and Patrick at Noda argue one way to go with this might be to formulate an industry standard the companies may follow. Furthermore he declared this might be done via an organization formed by independent organization. Anders at Electrotest agreed to this and mentioned an organization, Thread group, active in this sense where a great number of firms have joined forces in order to formulate industry standards. The only difference with the Thread group and

what Patrick referred to is the Thread group do not consist of independent organizations, it is firms interested in the Smart Home concept with own interests. The goal is though the same, to formulate industry standards. As Patrick at Noda declare, an independent organization might manage to formulate a standard benefitting companies, consumers, start-ups, emerged companies and the barriers would be avoided.

Ulf at Induo also agrees with the previous arguments stating it is important to have both standards and openness in order for the ecosystem to be successful. Furthermore, he also mentioned this type of approach would be beneficial as a way to compete for smaller firms against the bigger firms' complete solutions. He uses the example of Apple and their opportunities with their smart phones and stating an ecosystem might be a way to compete towards such an actor.

### 4.6.2 Laws and Regulations Regarding an Ecosystem

As stated above, the respondents are positive towards ecosystem as long as the requirements mentioned previously are fulfilled. The authors did though have a concern regarding the rules and laws from a competition perspective and did therefore interview both Kristina at Post och Telestyrelsen and Johan at Konkurrensverket. Johan at Konkurrensverket declared as long as the companies within the ecosystem are competing in different industries he cannot see they would have any concern regarding this since the cause is to foster a new innovation. There might not even be problem if two firms within one ecosystem competes in the same industry if Konkurrensverket decides the outcome if this strategy will be benefitting the customers in the future. Kristina at Post och Telestyrelsen declared regarding the approach of ecosystems, there are similar collaborations taking place already. TeliaSonera for example, collaborate with other service providers in order to improve their offering regarding options around the TV and the amount of channels etc. Furthermore, if the collaborations results in an inefficient competition, Post och Telestyrelsen have the option to analyze other markets within the sector to determine whether or not regulation would be proportionate. When a situation as such is taking place, Post och Telestyrelsen have the possibility to regulate and a regulation opens up the possibility for the customers to have a broader choice. In the end it is though the customer who decides which operator should deliver their broadband services.

## 4.7 Other Findings

These following sections will include information given by the respondents which the authors found important but did not fall in under any of the previous categories.

### 4.7.1 The Price

The importance of a reasonable price was something some of the respondents mentioned in order to further develop the concept. Ola and Joakim at Sigma Connectivity mentioned during the interview they believed Smart Home has a bright future and will most likely become a commodity within five years. They did however mention, even though the emergence of Smart Home and IoT are happening at the moment, there are still some hurdles to get pass before it could become a commodity. One of these problems is the fact firms think too much with their wallet and fails to see the bigger picture, they do not have any long term perspective. Aspects affecting the strategy and scope among the firms may be related to factors the firms are unavailable to affect. One example of this is the energy prices, Thomas at Karl H Ström as well as the respondents at Skylink addressed this issue. Thomas mentioned cheap prices on the energy market as a problem for the attractiveness of energy saving solutions like light systems. The energy prices on the Swedish market is already low and they keep on decreasing making the development of long term solutions even slower since the firms will keep on failing to see the benefits from a longer perspective.

Furthermore, there was not a consistent view among the respondents whether the price for the products and services are an obstacle or not. Anders at Electrotest did mention the price as an obstacle for the development. Mattias at Sector Alarm agreed with Anders meanwhile Erik at Moodifier described how this was a problem previously but now, after the recent development, has been solved and he does not concern this as an issue anymore.

One respondent who contracted the other respondents mentioning the price was Erik at Moodifier. He mentioned that this was a problem previously but that the development has led to less expensive prices and argued that the price was not a problem anymore. This was not agreed upon by Mattias at Sector Alarm as well as the previous mentioned respondents. Mattias said that one reason causing the concept of Smart Home to not have emerged more than it has is the issue with the infrastructure and the fact it is too expensive to establish one as such. Worth mentioning though, as explained above, Mattias Hultman believes it will only get cheaper in the future and it might therefore not be any problem anymore.

### 4.7.2 Positive Effects of the Smart Home

Regarding the healthcare industry, a lot of savings could be made according to Fredrik at Alleato. It is fairly expensive to treat an elderly at an elderly care center, around 80 000 SEK per month. Adapting to smart solutions like sensors and cameras would save a lot of money. This could be a way to remove the non-efficient night services and switch method from personal visits to monitoring by cameras and sensors. These nightly visits cost a lot of money and time and they usually disturb the patient in their sleep. Using around 8 hours of home services per day together with installing and using these technologies would still be less expensive than taking care of the elderly people at an elderly care center.

Another benefit with the Smart Home according to some of the respondents is the increased possibility to reduce energy consumption which will have positive effects on the environment. Karin at Energimyndigheten mentioned a feature called Smart grid, this feature might increase the user's awareness and knowledge regarding their energy consumption and create positive effects on the environment. Furthermore, she also mentioned how this knowledge increases the power of the customer and they may choose to use locally produced electricity. The final benefit with Smart grid concern the integration part and how this feature generate the possibility for the companies to develop products that are able to be integrated and through this decrease the energy consumption since they may optimize their efficiency.

# 5. Analysis

As mentioned in the theory (2.2.2) actors may be both firms and non-firms organizations such as municipalities and the government. These actors, or agents, affect the sector innovations in various ways where both the institutions and the industry environment are affected by these agents. The networks and the heterogeneity in particular between the different actors is a crucial part regarding the sector innovations according to Malerba (2004; 2002). Furthermore, the same author argues for co-evolution among the different actors within a network. It is an iterative process where the knowledge is shared among the knowledge and the different pillars co-develop. This implies that a development among one of the pillars will lead to further evolvement among the others within the network. This co-development is similar to what Li (2009) refer to as co-evolution when discussing business ecosystem. The authors of this report have therefore, as mentioned earlier, connected the sector innovations with business ecosystem. This has been done in order to investigate whether a business ecosystem strategy, according to the respondents, may lead to a completion of the important building blocks in sector innovations. The analysis will be structured by an introduction why the Smart Home concept is needed, followed by the requirements regarding the infrastructure, both the requirements already in place and the ones which still needs to be developed. This is followed by a part regarding ecosystems where the requirements are discussed from the perspective of how ecosystem strategies may establish the ones not in place already. The analysis is finalized by a section of obstacles the ecosystem strategies may not overcome and therefore needs to be solved through other measures in order for the Smart Home concept to emerge.

## 5.1 The need of Smart Home

As illustrated in both the introduction and the theory, there is a concern regarding how to handle the trend of an ageing population and the fact there will not be enough people working in order to finance the health care of the elderly and disabled people. This concern creates a need for an alternative caution in order to rehabilitate these people than nursing homes. One way to go with this might be the concept of Smart Home as argued by the theory and agreed upon by the respondents. As the UN Department of Economic and Social Affairs declare, there will be an increase of life expectancy from the span of 49-89 years old to the span of 66-99 years old during the 21st century. They also predict there will be a decrease in the amount of children resulting in a reality where the demand at the working individuals will increase. Fredrik at Alleato mentioned how expensive the healthcare at a care center is per individual, the mentioned figure was 80 000 SEK/month. He also declared how this could be decreased

by nursing these individuals in their own homes through the smart solutions offered by the Smart Home. As Fredrik explained, it would be cheaper to install sensors in order to monitor the elderly and disabled during the night and offer 8 hours of home service per day when the individual is awake than monitor them the way it is done at the moment.

The second major need for the Smart Home concern the climate and how this may benefit from the establishment of the Smart Home, as mentioned in the literature. This was agreed upon by the respondents and this matter was especially discussed with Karin Widegren. Karin declared the need for Smart grid and how this might increase the awareness among the consumers and decrease the use of energy. Furthermore, Karin mentioned two other features with the smart grid, other companies may develop products and services connected to the smart grid like the healthcare sector for instance and the users may use the smart grid to integrate locally produced electricity. There are other features offered by companies, as mentioned in the empirical findings, benefitting the climate. Smart heating, alarms and sensors are some examples of products and services the firms offer the consumers with the feature of decreasing the effect on the climate.

## 5.2 The Infrastructure

The following section will be based upon the theory section regarding the sector innovations with the addition of the respondents' answers regarding the requirements of the infrastructure.

### 5.2.1 Knowledge

There is no agreed upon definition of the Smart Home concept to be found when browsing through the literature, neither did the authors of this report find any consistent definition when interviewing the respondents. Even the ones the authors call experts answered it by firstly state the complexity and secondly formulate their own definition. This correlates well with the literature where most of the authors use their own definition when describing the concept (2.5). This was according to some of the respondents a problem for the development of the concept. Jan at Elcenter mentioned the abuse of the term "Smart", due to the lack of a definition, causes a negative view of the concept. The authors of this report agree to the fact it is an issue a common definition or reference of the concept have not been established yet. As of now, actors within the industry may discuss the same matter without noticing it since they use different terminology. This causes issues both for the firms delivering the concept and the consumers and the authors of this report claim this issue relates back to the lack of knowledge within the industry.

Furthermore, Patrick at Noda argued neither the firms nor the customers have the knowledge to determine whether or not something is considered as "Smart" or not. The consumer might already live in a house with many Smart Home features without even realizing it. Patrick did also mention everyone knows what a Smart Home is but few have it, consistent with the previously mentioned issue of not realizing if the customer is living in a Smart Home or not. The authors of this report agree upon the fact there is an issue with the unclear definition and how this might affect the further development of the concept. This problem relate mostly, according to the authors, to the lack of knowledge within the infrastructure. Since the knowledge among potential actors developing the Smart Home industry is insufficient, according to the respondents (4.2), it is a logical consequence the knowledge among potential consumers is poor as well. In order to reduce the gap in knowledge among the actors in the industry, the authors of this report suggest a definition of a Smart Home as "*A home where the products and services are integrated with each other, interact with the user on a daily basis and adapt the service dependent upon the user's behaviors and needs*". The definition has been developed during the process of conducting this report through the literature study and the interviews.

Michael at Verisure Securitas Direct mentioned the technological knowledge is in place among the technicians at the firms, it is though not well spread internally causing the ones responsible for the strategic decisions to lack the sufficient knowledge. Rickard at Microsoft had a similar opinion stating the executives within the firms needs to get introduced to the possibilities with IoT in order to overcome their lack of knowledge. The internal accessibility (2.2.1) is hence low among the actors within the industry, even internally. The authors of this report do therefore claim it is of great importance to start improving the internal accessibility in order to improve the external accessibility generating the knowledge to spread among the actors and consumers within the industry.

Learning is the single most important determination of innovation according to Edquist (2010). Without the actors within the industry learning from each other, the knowledge will never spread and the missing pillar in the infrastructure will never be in place causing the Smart Home concept to never emerge. It is however hard to learn when being resistant towards sharing the knowledge and learn from the others. Ola and Joakim at Sigma Connectivity mentioned this problem arguing many of the firms are unwilling to learn and risk market positions by finding new ways of doing business. This might be one of the reasons for the internal accessibility to be poor, people are conservative towards learning and

conducting the business in new ways. Hence, what mentioned above by Michael, it might be difficult for the technicians to share their knowledge when facing resistance and the sufficient knowledge is therefore not in place in order to further establish the Smart Home concept.

Due to the reasons mentioned previously, the authors argue there is a "chicken and the egg problematic" regarding the knowledge spreading and the development of the concept. It is not likely the knowledge will spread if there is not an established concept in place. It is however hard to establish the concept when the knowledge is insufficient. One easy way to spread the knowledge, as referred to by the respondents, is the word of mouth but this is not possible without any experience of the concept. Some of the respondent mentioned therefore the usage of Smart Home cases as a way of spreading the knowledge since this could be a way for consumers and firms to experience the concept. It is though hard to create a well-functioning concept if collaborations and technology is not in place. Ulf at Induo mentioned a case (4.2) considered as a great failure which will rather result in the opposite, actors within the industry to disapprove the Smart Home concept. The authors therefore claim a prototype, so called a case, would not be successful as long as the knowledge and the technological requirements are insufficient among the actors. It may further be explained through the perspective a Smart Home should be based upon the customer's wished upon desires and a standardized case would not fulfill this need. The customer will not be able to define what they require without the sufficient knowledge. To conclude, the authors proclaim neither the requirements are in place in order for a successful case nor will the case's purpose be reached. This strategy is therefore not the right way to go in order to spread the knowledge to further establish the Smart Home concept at the moment based on the previously mentioned arguments.

To conclude the building block, knowledge, the authors of this report argue there is a knowledge gap among the actors within the market, this gap relates to several reasons. Firstly, there is not a common terminology all the actors' uses, this cause a reality where they may discuss the same matter without realizing it. Secondly, the conservatism within the market and actors not being willing to adapt to the new reality leads to a "Chicken and the egg problematic" since the concept will never spread without the sufficient knowledge meanwhile the knowledge gap will not be solved without the concept established. Furthermore, the authors do not agree cases are the right method to spread the knowledge, the authors do instead proclaim, as will be explained further below, an ecosystem strategy in order to solve the knowledge gap.

### 5.2.2 Technology

Many of the technological requirements of the Smart Home (2.5.1), mentioned by Aurora (2010), is already in place. For instance regarding secure communication, the alarm developers has managed to successfully create smart and secure systems. As the respondents have explained, the integration is of great importance as well as the ease of use and it is therefore crucial these solutions may be integrated with other systems in order to achieve the benefits of the Smart Home concept. Many of the respondents argued standards needs to be developed in order for different systems to communicate with each other, ease the use of the systems and open up for the possibilities to control everything from one single box and remote control. For instance, Anders at Electrotest mentioned the importance of ease of use and the possibilities for the consumers to install and repair their systems by themselves in order for the concept to spread. Furthermore, he mentioned battery- and wireless sensors as requirements in order to reach these features. This is exactly in line with Aurora (2014) requirements stating it is important for the user to be able to use and change the devices by themselves using wireless solutions. The hardware and software in order to produce such systems are already developed, the actors do though need to overcome the price issue before this could be a commodity. According to Anders, some of the other respondents and the literature (2.5.1) it is a requirement before the Smart Home concept may become a reality. According to the authors may this either be solved by developing the technology even further in the purpose of reducing the price, this regards mainly the production costs which might be decreased with a developed technology. A second way to go with this may be for the firms to create a demand high enough for the products and services that the consumers are ready to pay the high price. The authors claim neither of these solutions are in place at the moment.

The communication has to be reliable in order to be considered as secure. As mentioned in the introduction, fiber is needed in order to be able to deal with the future demand of the telecommunication infrastructure. The fiber is more secure than the copper and this is something according to the respondents (figure 6) which is needed of the infrastructure and some of them were of the opinion, as mentioned in the empirical findings (4.5.1) are of the opinion that its development is sufficient enough for the Smart Home concept to emerge. The authors of this report consider the fiber optics development similar to the development of the hardware and software. As Bjäre Kraft have stated, when initiating this project, they are able to deliver fiber to a greater number of users than today but there is not a demand among the consumers. According the authors, this prevents them from reaching the potential customers.

Similar to the hardware and software problematic is the technology developed, it suffers though the same problematic of being too expensive at the moment.

### 5.2.2.1 Sensors

Sensors were, according to most of the experts (figure 7), one specific area of development with great importance in order for the Smart Home concept to develop further. Sensors have an important role in the Smart Home according to both Anders at Electrotest and the respondents at Sigma Connectivity. These respondents mentioned the technology is developed but stated though an issue regarding the cost of the sensors, they need to become cheaper in order to become relevant. The respondents did also mention they expected this to be solved when the issue is paid higher relevance due to a higher demand. Anders did also stress the importance of battery- and wireless sensors. Furthermore, Fredrik at Alleato mentioned standard protocols for sensors would be developed during the year of 2015 in order for the sensors to communicate with each other. The development of sensors is needed in order to improve the ease of use of the Smart Home technology which, according to the literature, is crucial for the further establishment. The literature also stresses the need of a reasonable price which once again is in line with the reasoning mentioned by Anders, Joakim and Ola.

To conclude the technological building block, the authors argue the technology is developed and according to the respondents ready to be delivered in accordance to what is required by the literature. There is though not a sufficient demand among the consumers, at the moment, causing them to be resistant to pay the high price of the technology. The authors argue, as will be explained in detail further below, an ecosystem strategy will solve the issue, either by increasing the demand or reducing the cost of the technology.

### 5.2.3 Institutions

Institutions were not something many of the respondents stated as important (figure 6) regarding the Smart Home infrastructure. It is however, according to the literature, one important building block when viewing the infrastructure from a sectoral perspective. The respondents who mentioned matters related to institutions did mostly focus upon standards as a requirement which is reflected upon in the institution section (4.4). The standards are needed, according to the respondents, as a way of increasing the interoperability since the solutions would then be developed towards these standards. Standards could hence be a way to fulfill the requirement regarding the interoperability and also improve the ease of use, mentioned by Arora (2014), since it will be easier to monitor the Smart Home. It seems however like some firms have already initiated the task of creating standards as such. Anders

at Electrotest mentioned the project Thread group, described in the institution section (4.4), in order to exemplify how some of the actors are aware of the issue and is working towards initiating standards in order to foster the development of the Smart Home concept. As the literature state, actors and networks may affect the sectors and the institutions, it does not only go the other way around. The authors of this report consider therefore this initiative as positive in order to establish standards within the sector.

Furthermore are the authors of this report of the opinion it as unlikely the institutions within each country will unite and create a standard the Smart Home products could be developed towards, hence it is needed for the big actors to unite and by themselves create these standards. Ideally would be if an independent organization, as mentioned by Patrick at Noda, would initiate such standards but also this is seen as unlikely by the authors and the firms will probably have to settle with this solution. One respondent contradicting the part regarding institutions and standards were Fredrik at Alleato. It is described in the empirical findings how Alleato already are working with standards used by many firms. Also this shows an unawareness and lack of knowledge among the actors in the industry. Even though the standards Alleato is using may not be implemented by all the other respondents, it would be beneficial if they used the experience from this case when developing their own standards. This would though require them to be aware of the standards Alleato is using and it is questionable whether the actors within the industry are aware of this or not.

Furthermore, laws and regulations is something included in the institution building block according to Malerba (2002; 2004). This was also something mentioned by the respondents at Sigma Connectivity as one of the major concerns regarding the development of the Smart Home concept. Other issues mentioned were, the safety and privacy which might become an issue as well, who should own the information? Regarding the safety and the ethical aspect, hackers and whether the firms have the right to use the information of their consumers were mentioned in the literature (2.5.5) as issues which need to be regulated. In order to mitigate these concerns, the authors propose laws and regulations towards these must be developed and established in order to maintain the safety and privacy among the consumers. This is not a matter only the actors within the industry can solve since they might benefit from receiving more information about the customers. It is important, according to the authors, laws regarding information sharing and who should own the information and what this owner can do with this information should be conducted in order to protect the customer. The connected

home will lead to more information about the consumer and this might become harmful for them.

Regarding the hacker problem mentioned previously, requirements about technological standards and safety should be conducted forcing the developers to create solutions safe enough to use. The authors are aware of the fact, hackers as well as the technology constantly develop but this could be a way to at least make it more difficult to hack the system in the house. Lastly it is important for the government to be active in this new technological age since the fast development of smart things leads to new ethical and safety issues. The government needs therefore to modernize laws and regulation in order to be able to control the development regarding the safety and privacy of the consumer.

The authors argue the institution building block is a bit more complicated than to be solved only by the ecosystem strategy. The part regarding standards may be solved since the companies within the ecosystems may collaborate in order to initiate such standards to develop the product and services towards. Note though, the authors do not argue standardized offers towards the customers will solve this issue, there still need to be customized offers since the consumers have different needs. There do though need to be standards the companies keep in mind when developing their products and services in order for integration to exist within the industry. There are though still the issues regarding laws and regulations. The authors argue these should be developed before the concept emerges in order for the companies to be aware of the precautions before developing the products and services. There is though more likely these will be developed afterwards when the institutions realize the problematic with the more integrated reality and the fact companies hold more information about the users than previously.

### 5.2.4 Actors and Networks

There was a rather united attitude among the respondents regarding the actors and the main obstacles towards the further development of the Smart Home concept. One of the main concerns was the lack of open minded actors in the industry described through two perspectives of shift in generations. The shift in generations was either referred to as the age structure where younger employees face older ones described as narrow minded, by the respondents, causing a feeling of conservatism in the industry. The second generation shift concern the technological and the fast development of new technologies causing actors to lack behind compared to others. This might as well be referred to as conservatism or a lack of an open mind.

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Another aspect of the conservatism regards the economic aspect and the fact several firms and actors prioritize the short term wallet over the long term, causing a lack of investments for the future. Mats and Johan at Skylink addressed this issue, particularly in the construction industry which Thomas at Karl H Ström and Mathias at Spotsafe agreed upon. The lack of an open mind is, according to many of the respondents as discussed in the empirical findings (4.1.1) delaying the further emergence of the Smart Home concept. Finally they addressed the companies installing the power centrals as the actors with the greatest responsibility. This creates an issue when Michael at Verisure Securitas Direct argue the firms in the electricity industry as the most conservative ones and since they have been active in an industry without any particular need of innovations, this is not any of their main concerns.

Finally the conservatism may be connected to the "Chicken and the egg problematic" since the actors await the concept to emerge which, according to them, will loosen up the conservatism meanwhile the concept will never emerge with the conservatism still in place. There are though companies managing the conservatism in rather successful ways. Dennis at Davids mentioned how they, through their ecosystem strategy, may educate the actors they are in contact with in order to improve the situation. It was explained as an iterative process where the actors within the ecosystem share the knowledge and co-develop through these actions.

The authors of this report consider the actors within the industry and the obstacles of the knowledge and conservatism as crucial factors to overcome before the Smart Home concept may emerge. As stated above, both these issues may be solved through collaborations such as ecosystems via the iterative process among the actors. The authors of this report do therefore suggest the firms to initiate collaborations such as ecosystems in order to have a ground or base to proceed from when developing the Smart Home.

## 5.3 Ecosystem

All of the respondents answered positively towards initiating collaborations in ecosystems, some of them even argued they are already in collaborations similar to ecosystems. There was though not a consistent view upon whether the strategy of ecosystems may generate a completion of all the important building blocks and several difficulties emerged during the interviews which will be presented in the following paragraphs.

### 5.3.1 Actors and Networks

When the respondents explained the requirements in order for the Smart Home concept to further emerge, it relates to the other actors within the industry. The firms will, according to

the respondents, not be able to establish the concept without collaborations and actions provided by the other actors. This is well illustrated in the literature as well as in the quote by Iansiti and Levien (2004, pp. 69);

*"Stand-alone strategies don't work when your company's success depends on the collective health of the organizations that influence the creation and delivery of your product. Knowing what to do requires understanding the ecosystem and your organization's role in it".*

Furthermore, Westerlund, Leminen and Rajahonka (2014) and Malerba (2002) declare how important the collaboration is and especially when it comes to innovations. Carbone (2009) illustrates this very well when stating how smaller firms in collaborations such as ecosystem to a further degree may compete with dominant actors. Ulf at Induo mentioned this as a benefit for the ecosystem strategy and stated that if some of the companies with well-known brands launch a complete solution may this be the only way for smaller actors to compete.

### 5.3.2 Knowledge

An ecosystem strategy may also be a suitable choice in order to overcome the chicken and the egg problematic. Two of the main requirements as shown in figure 6 are to have knowledge and an open mind regarding the Smart Home and these may be fulfilled by adapting an ecosystem strategy. As described by the respondents, an iterative process may, as used in an ecosystem, educate the different actors within the network in order to spread the knowledge, widen the view among the narrow minded actors and increase their innovativeness. With the Smart Home concept awaiting the actors to become more innovative meanwhile the lack of knowledge causing a hinder for the further establishment, there is a gap in the process of the concept to further emerge, referred to as the "Chicken and the egg problematic". The actors are expected to receive the right knowledge and be ready to adapt to the new reality when the concept emerge meanwhile the same actors need to be the triggers for the concept to further emerge.

The authors of this report argue an iterative process, reached through an ecosystem strategy, may solve these issues. As described in the literature, learning is crucial for innovations and innovations are reached through collaborations. Also among the respondents such as Dennis at Davids, it was stated how they managed the knowledge gap and the conservatism within the market through the iterative process within the ecosystems. With this said, the authors

claim the "Chicken and the egg problematic" may be solved through ecosystem strategies and for the most via the iterative process. Finally, since the lack of knowledge and an open mind are two of the most apparent requirements (figure 6) which also occur as obstacles for the Smart Home concept to further emerge does the authors argue the iterative processes should be prioritized by the actors in the industry. To conclude, the authors argue companies through ecosystems may solve the obstacles of knowledge gap and lack of innovativeness via the iterative process. It is however important to mention the authors are aware there has to be some knowledge and open mind among some actors in order for them to create such ecosystems in the first place.

### 5.3.3 Technology

As mentioned in the literature (2.5.5) the increased amount of collected data, which is an inevitable side effect of the Smart Home, may cause some issues. It is further explained how the interaction between the different systems in the Smart Home to an even greater extent may increase the amount of data monitored and handled by the different systems. The authors of this report agree to the fact this is an issue, it might though be argued for how ecosystems may solve this. Instead of as it is for now, the different systems are integrated afterwards, may the companies through the strategy of ecosystems integrate the product and services earlier on in the process. The benefit regarding the huge amount of transferred data would be a decrease of this since the product and services already are integrated. As mentioned in section 4.5.1, there is not a consistent view upon whether the fiber optics is a requirement, developed enough or if it is sufficient as it is at the moment. As shown in the introduction, reports have emerged stating an alarming situation regarding the development of the sufficient infrastructure concerning broadband in Sweden.

As illustrated by the case company when initiating this report, it is hard to explain the need of fiber for the consumers, they are not interested to pay the high price without having the sufficient demand. The authors of this report propose ecosystem strategies may solve this. Similar to what is stated regarding complete solution systems, the companies may through the ecosystem strategy offer the products and services cheaper if they are combined in a complete solution offer, either by selling it cheaper to the consumers or decreasing the production and development costs through collaborations and economic of scale. Also the companies delivering fiber optics may be collaborating within these ecosystem and offer fiber optics within this complete solution in order to increase the demand of fiber among the consumers.

Even though there was not a consistent view among the respondents whether fiber optics is a requirement or not, the majority mentioned it in the terms of a future necessity.

### 5.3.4 Institutions

Open access was one important factor for the development of the Smart Home mentioned by the respondents regarding the development of the concept (figure 6). Open access was mentioned both in the terms of open standards which everyone should be able to use when developing products and services but also in the terms of open access in the ecosystem. One of the anonymous respondents did for instance stress the importance for the consumer being able choose what of part of the offers from the ecosystem he should be able to include in his Smart Home. The term open access cannot be found in the theory section, the term integration may though be found implying the importance of the same matter. It is crucial according to the respondents the companies avoid lock-ins in order for the products and services to be able to integrate with each other. The authors and some of the respondents are of the opinion lock-ins will create frustrations regarding the Smart Home concept since this will reduce the opportunities to adapt the system to each individual, as described by the theory (2.5) as important.

Moreover, the consumer may be a part of the iterative process in the ecosystem and their role might not be as beneficial if they are not able to choose freely in order to customize dependent upon their need. Without the openness, it is more likely they will feel like one of the anonymous respondents mentioned, frustrated by the fact they would need a lot of hardware installed within the house instead of just one system if they would like to integrate devices outside the locked-in offer.

Furthermore, the institution part regards norms, laws, regulations and the participation grade of the municipalities as well. As stated in the literature, big and important actors may affect the institutions as well as the other way around. This argue for firms initiating collaborations in the form of ecosystem since this to a greater extent may affect the institutions and their decisions since these ecosystem may have greater power than the small firms by themselves. With this said, the authors argue firms in ecosystems may affect the institutions to a further degree but it is not certain and the ecosystem will not to any degree be able to establish new laws and regulations. The issues regarding laws and regulations would therefore, even with the ecosystems in place, still be an issue.

Institutions may also improve the infrastructure by either funding it completely or, as of now, provide subsidiary in order to foster the development. The case company's greatest concern regards this, the development of the fiber infrastructure. One of the major obstacles is the high price and even though, as mentioned by the respondents, there are some funding already existing within the development of IoT and as one of the anonymous respondents mentioned, they get funding in order to develop the fiber infrastructure it is not enough in order to raise the consumer demand to a sufficient level. The authors of this report argue this issue may be solved either by initiating complete solution offers and therefore decrease the price for the consumers and/or lower the cost for the development of the infrastructure such as fiber for instance.

To conclude, the authors claim some of the problematic regarding the institutions may be solved by initiating collaborations in the form of ecosystems. This strategy would though not guarantee these issues to be solved and do therefore have to state there will still be some issues unsolved even with ecosystems in place. This will be further explained in the section, concerns regarding Smart Home.

### 5.3.5 Open access and complete solution systems

In addition to what has already been mentioned regarding the avoidance of lock-ins, standards and how the ecosystem may benefit this, will the ecosystem to a further degree also open up the possibilities for complete solution systems and alternative offers. As mentioned both in the literature and among the respondents may firms active in ecosystem to a further degree diversify their offers into niches. A company in an ecosystem is not solely dependent upon their own success, they may also rely upon the other firms within the ecosystem. The benefits of complete solution systems have been mentioned previously in the analysis and this is easier reached by the companies when collaborating in the form of ecosystems. A final remark regarding the complete solution system approach and especially from an ecosystem perspective is the win-win situation. Since the companies in ecosystems have the possibility to unite their offer with firms offering other products and services they will not be competitors. It will instead be complementarities which to a large extent may generate a greater amount of customers providing the win-win situation.

### 5.3.6 Other findings

It has previously been discussed in the analysis how the price and demand is an issue. The authors of this report propose an ecosystem strategy may solve these issues since the cost may

be decreased through economic of scale or the price towards the customer may be decreased through collaborations within ecosystems. There are though aspects regarding cost the ecosystem strategy may not manage. One of these are mentioned by Thomas at Karl H Ström describing how the low energy price in Sweden prevent the customer and companies to innovate products and services in order to reduce the energy consumption. Since actions fulfilling this would not be economical beneficial are the companies not considering this. The authors of this report do therefore conclude this as an issue which cannot be prevented by ecosystem strategies. Even though companies may raise the awareness through the iterative process it is not likely any of the companies will prioritize this due to the above mentioned reasons.

## 5.4 Conclusion: The Role of the Ecosystem

Figure 10 below summarizes the role of the ecosystem and what parts of the infrastructure the ecosystem could develop, according to authors, as well as what hinders still to overcome since the ecosystem approach cannot solve all of them.

| | Challenges in the Infrastructure | Infrastructure development through ecosystems | Challenges still to overcome |
|---|---|---|---|
| **Knowledge and Technology** | - Spread the knowledge<br>- Reduce prices<br>- Increase ease of use<br>- Create a definition | - Spreading the knowledge<br>- Increase ease of use<br>- Reduced price<br>- | - Create a definition |
| **Actors and Networks** | - Remove conservativism<br>- Create a long term perspective | - Remove conservativism | - Create a long-term perspective |
| **Institutions** | - Develop standards<br>- Adapt laws and regulations | - Develop Standards | - Adapt laws and regulations |

*Figure 10: The role of the ecosystem*

## 5.5 Concerns regarding Smart Home

The major issues for the Smart Home concept, according to the authors of this report, which cannot be managed by the ecosystem strategies concern the safety and privacy of the

consumers. Jacobsson, Boldt and Carlsson (2014) discuss this matter in detail and state both the problem regarding how exposed the user will be of hackers and declare the issue regarding who will own the information about the consumers and what will the companies be able to do with it? The information is rather private implying it would be sensitive for the consumers to share this with the companies installing the Smart Home solutions. The respondents' view upon the security issues is inconsistent as well. Michael at Verisure Securitas Direct declared how they through their safe communication tool have avoided the issues concerning hackers meanwhile Rickard at Microsoft sees the security as one of the main issues for the Smart Home concept. Regarding the privacy issues of the information, the respondents who mentioned this agreed upon the problem of who will own the information and in what occasions may this information be used? Joakim and Ola from Sigma, for instance, discussed during the interview the issue regarding who will "own" the customer and in turn the sensitive information as an obstacle to overcome which was agreed upon by one of the anonymous respondents.

The authors of this report argue, as mentioned in the institution section (5.2.3) in the analysis, the laws and regulations are insufficient at the moment in order to handle these issues. Even though it would be beneficial for the companies to have established laws and regulations in place when developing the products and services, it is not likely this will be the reality. As illustrated in the same institution section, the respondents mentioned actions taken by some companies collaborating in organizations in order to establish norms and standards the industry may develop towards. These organizations may be compared with ecosystems showing some of the issues may be solved by ecosystems strategies, these collaborations may though not establish new laws and regulations implying this issue would still be present even with ecosystems in place.

# 6. Conclusion

This chapter will present the conclusions of each research question aimed to be investigated as well as the objective of this report. Moreover, the limitations of this report are discussed, followed by suggestions for future research related to this report in order to present ideas aiming to broaden the research regarding the Smart Home.

The first research question:

*What requirements are still yet to be developed in order for the Smart Home to further develop?*

- *What are the requirements of the infrastructure in order for the Smart Home concept to further develop?*

This study has identified several requirements, presented in the empirical findings, in order to create a Smart Home Infrastructure. Some of these requirements are already in place according to the respondents, for instance the fiber development, while some are still yet to be developed in order for the Smart Home concept to further develop. One of the main challenges according to the findings of this report were to spread the knowledge about the concept. The knowledge exists but is it not well spread in order for more companies focusing on developing smart products, nor create a demand for them among customers. Besides the knowledge gap, are the lack of existing standards, conservative thinking and create more user friendly products some of the main aspects the respondents mentioned as hinder yet to be solved regarding the infrastructure in order to establish the Smart Home concept.

The second research question:

*Would a transition in the infrastructure, caused by an innovation, be mitigated by collaboration in the forms of an ecosystem?*

- *Why would this be a suitable strategy?*

- *Why would this not be a suitable strategy?*

According to the respondents of this report may strategies in the form of ecosystem bridge the transitions in infrastructure and two out of three important building blocks may be mitigated, see figure 9, meanwhile the third one could be affected but it is not certain it would be completely mitigated. The building block, Actors and Networks and the concerns regarding the same, according to the view of sector innovations, would be solved by ecosystem strategies. The fact innovations are a collaborative process argue for companies to initiate

ecosystems in order to establish innovations. Regarding knowledge and technology it is thoroughly described how the iterative process, fulfilled in an ecosystem, may solve the knowledge aspect and all it concerns. The collaborations may also ease the technological requirements and challenges since the interaction between the companies bridge the difficulties. As explained above, innovations are a collaborative process and this is especially notable regarding the technology.

The third and final building block, institutions may not to the full extent be mitigated by ecosystems since this concern factors firms do not have the measures to affect, such as laws and regulations. Firms in ecosystems may though affect the institutions to a greater degree and the authors of this report do therefore argue companies have a better opportunity to solve the institution challenges in ecosystems than by themselves all alone. Lastly, the authors are of the opinion, based on the findings from this report, an ecosystems would be a suitable approach in order to mitigate the infrastructure development of the Smart Home concept.

The third research question:

*Are companies interested in collaborations, in the form of ecosystems, in order to further establish the concept of Smart Home?*

*- What are the benefits of an approach as such?*

*- What are the drawbacks of an approach as such?*

All of the respondents answered positively towards an ecosystem strategy even though it is an initial idea at the moment. The benefits are, as illustrated above, the transitions in the infrastructure and the challenges following would be mitigated through an ecosystem strategy. Since an ecosystem strategy implies the companies to develop the products and services in collaborations and through this measure, improve the offers towards the customer a strategy as such will ease the establishment of the Smart Home concept. The concerns regards the collaboration aspect of who will "own" the customer. The authors of this report agrees this is a relevant concern and therefore a drawback with the ecosystem strategy. However, the authors argue the benefits are greater than the drawbacks and the ecosystem strategy will generate an overall positive outcome both for the firms and the Smart Home concept.

## 6.1 Limitations

An issue hard to mitigate is the fact a researcher has a cautious learning curve during the research period. With this said, the authors of this report were more knowledgeable regarding the different perspectives of the topic when conducting the last of the semi structured

interviews compared to the first ones. The topic during the interviews stayed the same but a semi-structured interview in its nature opens up for discussions. These discussions depended of course upon the respondent and their point of view but they might as well have been influenced by the change of knowledge among the authors. The authors did, as the abductive approach implies, create a pre-theoretical knowledge before collecting data in order to mitigate this problem. It is however in the nature of the abductive approach to revise the theoretical frameworks when data is collected and hence it is not possible to fully reduce the learning curve during the data gathering.

Regarding the change of knowledge are the different views of perspective from each respondent something that most likely has influenced the results as well. Each respondent has their own perspective of the Smart Home and they are not able to offer the Smart Home as a commodity. Due to this reason, the empirical findings in this report will be influenced by the fact each respondent has answered from their perspective which most likely is influenced by their products. Many of the respondents represented smaller firms with a local perspective. This means their answers most likely, regarding for instance if the fiber development in Sweden is well enough developed for the concept of Smart Home, is based from their local perspective.

As mentioned in the methodology chapter, LinkedIn was our main tool in order to find the most suitable respondents and their contact information. The approach of contacting respondents via LinkedIn is however not unproblematic and especially the ones found in LinkedIn groups. People active within such groups, especially regarding new innovations, are enthusiasts and they often have a technological background. With this said, the authors are aware of the fact many of the respondents in this report may have a too optimistic view of the innovation. This fact and the issue of the respondents having own interests regarding the authors of this report to share a positive view of the concept may have affected the responses.

All of the contacted firms are also developing and selling smart products hence it is relevant to argue whether they have a too positive attitude towards the future of these types of products. With this said, there is a risk there might be an absence of a pessimistic mindset from the respondents perspective in this report. One way to mitigate this risk could have been to contact respondents active within firms who have disclosed the Smart Home products, either where they have chosen to not proceed with this at all or changed direction after first initiating a strategy with these products and services. The problem however with contacting this kind of firms, if they exist, is firstly the time and resource issue where the authors have

not been able to manage this. Secondly, this is a concept which has not emerged enough in order to be an established concept and people within firms not interesting within this field may not have the sufficient knowledge to be able to respond.

Moreover, as mentioned previously, many of the respondents have a technical point of view of the Smart Home. They have sufficient knowledge but many of them are claiming firms and industries are conservative. A problem discussed in the analysis is the fact the industry has poor internal accessibility when sharing the knowledge regarding Smart Home. The authors are of the opinion the respondents might not be successful pitching the idea. Instead of consider the other actors as conservative, the authors of the report question whether it is the respondents responsibility to share the knowledge and by doing so mitigating the conservatism or if the other actors truly is conservative.

## 6.2 Future research

This report has investigated the emergence of the Smart Home concept with its main focus on the infrastructure in Sweden. It would, according to the authors, be interesting to compare its development in Sweden with other countries or regions.

It was also found during this research, many of the respondents thought the Smart Home concept would become a reality within five years. It would be, if this is the case, interesting to study whether or not this concept will have the positive effects on the caretaking sector as well as the environment as previous research has predicted.

Finally, a future recommendation would be to investigate whether potential consumers believe in the concept of the Smart Home. This report have only focused upon the attitude among the companies, it would be interesting to investigate the attitude among the customers.

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## Infrastructure

- Tell us about yourself and the company you are working at?
- For how long have you been working at the company and this position?
- In what industry are you as a company active?



- What technological infrastructure is needed in order for your products/services to function?


- Knowledge?
- Technology?
- Actors?
- Networks?
- Institutions?



- Is fiber optics necessary?
- Would it increase the features of your products?
- Is the fiber optics infrastructure sufficient at the moment?
- Could this be a driving factor for your products/services development?



- What do you think about the future opportunities?
- Fiber?
- Infrastructure?
- Your products/services

## Ecosystems

- Are you selling your products/services alone or in some sort of package?


- What is an ecosystem according to you?


- What collaborations are needed for your company/products/services?
- Which of these do you have?
- Which of these do you want?
- Why are these important?
- How would these be managed, legally? Financially?
- What are the obstacles for collaborations as ecosystems?

- Would you as a company be interested in collaborations as an ecosystem?
- Why?
- Why not?

- What is your personal opinion regarding collaborations in ecosystems?

## The Smart Home

- What is your product/service role in the concept of Smart home?

- Do you think, even though there is no infrastructure in place, that a niche market strategy is suitable for establishing the concept of Smart Home at the market?

- Do you think a better strategy would be through collaborations, from an ecosystem perspective?
- Why?
- Why not?
- How would, a collaboration as such, take place?

- Do you think the concept of Smart Home would develop further through ecosystems?
- Why?
- Why not?

- Would you as a company be interested in collaborations with firms developing/delivering the technology infrastructure?
- Why?
- Why not?
- How would, a collaboration as such, take place?