The future of Real estate lies in the Internet of Things

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Preface

This bachelor thesis in business economics was written during the spring term of 2018 at Halmstad University. We have gained knowledge in Value Creation, Internet of things and the Real estate industry. Hopefully, this essay will provide knowledge about value creation in symbiosis with IoT in the real estate industry. Furthermore, we hope that this research can work as foundation for future studies. We want to express our gratitude to those who have helped us during the processes of this thesis. First, we want to thank all the companies that we have been in touch with. As well, the persons interviewed for our study, without you this thesis would not have been feasible. We would also like to thank our supervisor Navid Ghannad who has been helpful during the entire process of this study with useful feedback as well as guidance. We hope you find this study interesting and useful.

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Abstract

Title: The future of Real estate lies in the Internet of Things
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Purpose: Understand how IoT can create value when implemented within real estate companies

Frame of reference: In this part we will present our frame of reference. Our key concepts when gathering this secondary data was IoT, Value creation. These key concepts formed how our model for Value Creation in IoT for real estate companies would look like.

Method: In this chapter we have described the method we used to collect our primary data. We have also presented a discussion about why we have chosen the methods we have used and what relevance they have for our survey. Finally, we present the reliability and validity of our sources and research.

Empiric: We have interviewed three companies active on the Swedish real estate market. How they use and how they look at the use of IoT technology in an enterprise perspective.

Analysis: We have made both a within and cross case analysis on the empirical findings and this has resulted in our model explaining the primary value drivers of IoT in real estate companies.

Conclusion: With the help of our primary value drivers in our model and innovation, it’s suggested that the real estate companies can create value with the help of IoT solutions.

Keywords: IoT, IoT and real estate, Smart cities, value creation, IT and value creation, IoT value creation and value chain model.

Examiner: Thomas Helgesson
# Innehållsförteckning

1. Introduction ......................................................................................................................... 5  
   1.1 Background .................................................................................................................. 5  
   1.2 Problem discussion ...................................................................................................... 7  
   1.3 Purpose ....................................................................................................................... 8  
   1.3 Research questions ....................................................................................................... 8  
   1.4 Delimitations ............................................................................................................... 8  
2. Frame of reference ............................................................................................................ 9  
   2.1 Michael E. Porter’s Value chain ................................................................................... 9  
   2.2. Value Creation .......................................................................................................... 10  
   2.3 IoT ................................................................................................................................ 13  
   2.3.1 Data .......................................................................................................................... 13  
   2.3.2 Sensors ...................................................................................................................... 13  
   2.3.3 Automation .............................................................................................................. 14  
   2.3.4 Cloud ....................................................................................................................... 14  
   2.4 Innovation and intellectual capital ............................................................................... 15  
   2.5 Requirements ............................................................................................................... 15  
   2.6 Value Creation with IoT in real estate ........................................................................... 16  
3. Method ................................................................................................................................ 17  
   3.1 Overall research effort ............................................................................................... 17  
   3.2 Qualitative method ...................................................................................................... 17  
   3.3 Sample selection ......................................................................................................... 17  
   3.4 Semi-structured interview .......................................................................................... 18  
   3.5 Choice of respondents ............................................................................................... 18  
   3.6 Data gathering ............................................................................................................ 19  
   3.7 Interview design .......................................................................................................... 19  
   3.8 Primary data ............................................................................................................... 19  
   3.9 Secondary data .......................................................................................................... 20  
   3.10 Data analysis ............................................................................................................. 21  
   3.11 Reliability and Validity/ Reliability and authenticity .................................................... 21  
   3.12 Multiple case studies ............................................................................................... 22  
4. Empirical framework .......................................................................................................... 24  
   4.1 Interview 1 HFAB ........................................................................................................ 24  
   4.2 Interview 2 HFAB ........................................................................................................ 26  
   4.3 Interview 3 Castellum ................................................................................................. 28  
   4.4 Interview 4 Willhem .................................................................................................... 31  
5. Analysis ............................................................................................................................. 35
5.1 HFAB Within-Analysis of adoption of IoT .................................................................35
5.2 HFAB Within-Analysis of innovation an intellectual capital .................................35
5.3 HFAB Within-Analysis of requirements for usable IoT systems that give benefits .....36
5.4 Castellum Within-Analysis of adoption of IoT .........................................................37
5.5 Castellum Within-Analysis of innovation an intellectual capital .............................37
5.6 Castellum Within-Analysis of requirements for usable IoT systems that give benefits 38
5.7 Willhem Within-Analysis of adoption of IoT .........................................................38
5.8 Willhem Within-Analysis of innovation an intellectual capital ..............................39
5.9 Willhem Within-Analysis of requirements for usable IoT systems that give benefits .. 39
5.10 Cross-Case analysis .............................................................................................40
5.11 Model for Value Creation in IoT for real estate companies ..................................43
6.0 Conclusion .............................................................................................................46
6.1 Limitations ..........................................................................................................47
6.2 Further research ....................................................................................................47
7.0 Reference .............................................................................................................48
1. Introduction

In this first chapter, a short introduction of the background of this study will be presented. The purpose is to give an understanding about the Internet of Things and the digitalization in our world. Additionally, it will have a problem discussion that brings up why this area should be studied and the purpose of this study. These will lead to the research questions and the delimitations of the study.

1.1 Background

It is easy to understand and overlook the impact that technology have on our day to day life. The progress of technology is vast and things that only where dreams years ago, are now things we take for granted (Gilian & Hammarberg, 2016). One part of this is Internet of Things (IoT) and has become one of the main topic within the tech-world. This phenomenon is assumed to essentially change the way we live and interact (Manyika, Chiu, Brown, Bughin, Dobbs, and Roxburgh, 2011). Various IoT solutions are developing in a high pace and it is forecasted that the total amount of units connected will reach 20.8 billion in the year of 2020 (Meulen, 2015). Camhi (2015) predicts that there will be 500 billion devices online by 2025 and because of the fast-technological pace and industries inability to keep up with the development will result in replacement of 40% of today's companies. With all these devices connected and integrated large amount of data will be produced and this will result in opportunities as well as challenges. According to the CEO of IBM, Virginia Rometty, data will be one of the main commodities/natural resources of the 21st century. She stress this by claiming that companies who can access and process all created data and turn it into information and finally capitalize from it will be successful (Frank, 2013).

The Swedish telecommunication company Ericsson estimates that there will be 20 billion IoT connected devices by 2023. The compound annual growth rate (CAGR) are 26% in “Wide-area IoT” and 18% in “Short-range” IoT (Heuveldop, 2017). Microwaves, refrigerators and telephones are all inventions that have been made possible due to the progress of technology. They are products in our everyday life that we come in contact with almost daily and a lot of people take these products for granted. But they have in their kind of way changed how humans see, live and interact in their life with other citizens of this world (Heuveldop, 2017).

The Internet of Things (IoT) lies in the beginning of its wave and the innovators are using this technology as we write this thesis. But it just getting started. Connected devices have existed since the introduction of computer networks and consumer electronics. But when the internet came in an extended way in 1990s the thought about a globally connected planet came to shape (Greengard, 2015). One of the companies that caused this revolution is Apple that put the smartphone in ordinary people's hands. With the introduction of the iPhone in 2007 that made the smartphone folksy. From 2007 to 2014 they have sold almost 500 million IPhone to the broad mass. Today, the total smartphones that being used worldwide are around 2 billion. In 2019 the telecom company Ericsson estimates that that number will go up to over 5.5 billion smartphones that being used globally (Greengard, 2015). Each of these phones can perform things like record data, voice, video, audio, motion, location and much more. These phones, they allow us to connect to other machines and we can use the smartphone as a remote control, dashboard that shows personal data and information feeds and a bunch more. (Greengard, 2015). Our smartphones enables us to do so many things, for example hold
boarding passes, use social media to interact with other people, have payment systems on them, measure our movement etc. (Greengard, 2015). The world that we live in are changing because of the technology and at first glance everything that's happening feels a little science fiction than science fact. But this is a fact and the Internet of Things get us people connected with machines and physical objects that have made us to enter a new digital world (Greengard, 2015).

In an industrialized country, we spend around 90% of our life indoors. Our home, our workplace, the gym and sport centers are some of the places that we spend the time in. And these places are producing approximately 40% of the total greenhouse gas exposure to the world. In the year of 2030 the German Industrial conglomerate Siemens have foreseen that we will consume 50% more energy than we do today. But with smart property and IoT solutions in real estate, can we decrease these CO2 emissions (Siemens, 2017; Walters, Carlock Jr, and Hage, 2014).

Since many tech giants (Google, Amazon, Microsoft etc.) are investing heavily in their IoT products it become very obvious that IoT are important for both companies and consumers. It is suggested that investments in IoT will be as high as 4.8 trillion dollars by 2021(Mathur, §5, 2017). And a part of these 4.8 trillion dollar investments are the IoT products for housing. Such as; smart fridges that can understand voice commands. But there is more to “smart homes”, it includes things as; alarm systems, CCTV monitoring, fire and gas leak detection systems, smoke/fire detectors and much more (Mathur, §8-9, 2017)

Another thing IoT can contribute to is decrease the environmental impact when managing and building real estates. Existing and new produced buildings are contributing to nearly 50 percent of EU’s carbon emissions. If the operator of the real estate know how much energy is being consumed at any given time and how to dispose it more efficient (very rare today) through IoT systems, this will help the owner save money and decrease the impact on the environment. For instance, in office environments, approximately 40-50 percent of the space is not used but it still costs the user and owner rent, cooling, heating etc. (Feller, 2017). According to Feller (2017) next generation real estate, thanks to IoT, will be more personalized, efficient and profitable. They also state that smart and connected real estate solutions will; enhance the end user experience, reduce total cost of ownership and provide environmentally sustainable properties.

As mentioned before, big corporates are investing heavily into IoT solutions even though studies show that greater spending on IT rarely result in improved financial results (Carr, 2003; Hu and Plant, 2001) or as Hitt and Brynjolfsson (1996) found out, that IT affect the output of a company but not the profitability. Carr also states that the strategic importance of IT has diminished and the way corporations approach IT investment and management will need to change.
1.2 Problem discussion

For the last decade, the Internet of Things have grown to a large talking-point around the world because of the wide digitization that is present (Meulen, 2015). The opportunity to transform anybody who carries a smartphone into a potential data point is revolutionary. The possibility of extracting data from devices helps consumers, businesses, governments etc. to analyze with greater depth and gain better insight. Instead of making good guesses it is possible to analyze data to better understand patterns, behavior and trends in a much more profound and larger scale. Something that really differentiate connected devices is that they have the ability to incessantly report about usage, operating behavior and much more information, or as Greengard (2015, pp. 34) describes it; “they generate a lot of data that can be analyzed and acted upon”. The development of millions powerful, internet-connected devices, such as smartphones, traffic lights, laptops, cameras etc. These internet-connected devices are a part of IoT. Currently there are billions of IoT devices that are used around the globe and their number, opportunities and the possibilities are constant growing. Gartner and Meulen (2015) forecast that there will be 20.8 billion connected devices by 2020. They also project that in 2020 we will spend 3 billion dollars on connected devices (hardware, smart services etc.). With these numbers in mind we can see that IoT is the next “step” of internet (Meulen, 2015).

As Gilan & Hammarberg in their book Get Digital (p.110) there are four truths about data and they are: 1. Everything that can be connected to the internet will be connected to the internet. 2. Everything that be connected to the internet will store data. 3. Everything that store data will enable data driven decisions. 4. Data driven decisions gives efficiency, speed and growth.

As Meulen (2015) and Gilan & Hammarberg (2016) says, the IoT market is on a rise and it is a large business opportunity for any business sector and market. A large segment that can use this technology are the real estate and housing market. One of the markets that has a huge potential in a IoT point of view are the real estate market. The internet of things (IoT) enables a lot of opportunities both on an individual level and for the broad mass in a real estate point of view. For instance, with Smart Property management, the operating costs can be reduced as well as the impact of the environment. A landlord can get the best of two worlds, profit increase and the climate impact get reduced. For anyone how lives in a building that “think and are smart”, the ordinary life can get easier, more convenient and you get cheaper living costs. For example, a sensor can be under the sink that recognize if there are any leakage. So, both the insurance company, the landlord and the consumer can be sure that the house won’t be water damaged (Siemens, 2017)

Walters et al. (2014) predicts the real estate market will have broader opportunities, greater risks and new value drivers. They also believe that the cities around the globe will increase in population due to migration. Since the energy prices are high, the climate change is a fact and governments are pushing for more sustainability among real estate, we will need technological solutions that are more efficient. The progress of technologies will make real estate’s more “green”. As the cost of improving buildings environmental performance align with the lower cost of technological features. This will make the lessees demanding this features and they will accept paying a premium. “If real estate players don't understand these new value drivers they'll be at a competitive disadvantage.” - (Walters et al., 2014, pp.25)
The global stock of real estate will expand to 45.3 trillion dollars by 2020, compared to 29.0 trillion dollars in 2012. This indicates that the real estate market is huge. With the expanding population the need for real estate grows and by 2030 we will need 50 percent more energy and 40 percent more water. Since cities and real estate contribute to an estimated 70 percent of the world's greenhouse emissions they have a big problem to solve (Walters et al., 2014).

Kratzert, Broquist, Collignon, Vincent (2016) states that the IoT solutions will create a impact value (GDP) in Eurozone in 2025 of 940 billion Euros. Which 165 of those will be created through IoT solutions in “housing and hospitality”. Where the main source of value created will be from energy savings. These energy savings are estimated to save 25 billion Euros of the households in the Eurozone. It will be enabled through better monitoring and control of consumption due to IoT solutions (Kratzert et al., 2016). Kratzert et al. (2016) also indicate that IoT’s importance regarding competitiveness in the real estate market is 2.8 out of a scale of 4.4.

1.3 Purpose

The main purpose of this dissertation is to understand how IoT can create value when implemented within real estate companies. This is expected to result in a model which will provide important information of the value drivers when real estate companies considering whether or not to implement IoT.

1.3 Research questions

What are the primary value drivers for real estate companies in IoT?

1.4 Delimitations

According to Söderbom and Ulvenblad (2016) there are three concepts to use at delimitations; aspect, level and perspective. Aspect is when you choose to look at certain aspects of a problem. Level is when you choose to study a certain level such as social level, company level, group level and individual level. Perspective is when one chooses a certain “filter” or “angle” when studying things (Söderbom and Ulvenblad, 2016).

We only focus on residential and commercial real estate since these are similar and therefore we exclude industrial real estates. Regarding aspects, we have chosen to focus on how IoT will create value in real estate companies. There are still many other things and processes that creates value. IoT together with other things may create greater value than IoT alone. But we have isolated IoT to the possible extent to keep our focus on IoT i.e. we have excluded all other processes that create value, both alone and in symbiosis with IoT. There is also the fact that IoT must exist with other technologies to function but these other technologies have been omitted. We will concentrate on corporate level and what value IoT creates on a company level. We also exclude the private housing market and the construction of private housing. We concentrate on real estates on the renting market in southern Sweden.
2.0 Frame of reference

In this section we present our frame of reference. Secondary research will be presented in this chapter with an emphasis on IoT and Value Creation and the data is retrieved from databases like Scopus, Diva, Emerald, Web of Science and Google Scholar.

2.1 Michael E. Porter's Value chain

The value chain can be used as a tool for understanding how IT affects companies. The value chain can be described as different types of activities where a service or product is created and then delivered to the end consumer. All companies, regardless of industry or type, perform value-creating activities that are linked, such as manufacturing a component, delivering a product or service. These activities are, to a certain extent, linked to the activities of suppliers, customers and other channels and the value chain is a tool for identifying and analyzing how these activities affect a company's costs and value creation. Each value chain activity includes information either in the form of creation, processing or communication, and IT has a significant impact on the value chain. For example, the advantage of the Internet is to be able to link an activity with some or other, thus enabling real-time data available for both internal and external use (Porter 2001).

![Figure 1. Porter's Value Chain (1985)](image)

Michael E Porter (2001, pp.10) also says that: "The Internet is arguably the most powerful tool available today for enhancing operational effectiveness. By easing and speeding the exchange of real-time information, it enables improvements throughout the entire value chain, across almost every company and industry. And because it is an open platform with common standards, companies can often tap into its benefits with much less investment than was required to capitalize on past generations of information technology."
2.2. Value Creation

Several theories have identified different value drivers in terms of value creation (Schumpeter, 1934; Doz & Hamel, 1998; Porter, 1985; Porter & Millar, 1985). The value chain, coined by Porter (1985), shows how activities that a company perform can be controlled in order to increase value. By a company lowering its costs in primary activities and implementing support activities more efficiently, the value of a company can be expanded to a full extent (Porter 1985). He further claims that the profitability of a company depends largely on the attractiveness of the industry in which they operate. Thus, the goal of a company's strategy is to control competition in their industry, resulting in increased traction for the individual company. He discusses five competitive forces that decide the capability of a company to capitalize on their investments (Porter 1985). The forces that Porter have identified are “the entry of new competitors, the threat of substitutes, the bargaining power of buyers, the bargaining power of suppliers, and the rivalry among the existing competitors”. Continuingly, he discusses two ways for a company to gain competitive advantages, and this is by keeping low costs or by differentiating themselves. How effectively it is to differentiate depends on the company's skill to be unique in the market in which they operate (Porter 1980).

Schumpeter (1934) describes the significance that differentiation does on value creation, this is known as creative destruction. He discusses that differentiation includes innovation that is also a factor in creating value (Schumpeter, 1934; Teece, 1986). Schumpeter also believes that new combinations of resources serve as a factor in innovation and value creation. New combinations of resources are a source of innovation and hence also a way of creating value. This view of resources suggests that by combining different resources is creating value, but also that resources in itself are value-creating (Penrose, 1959).

Gulati (1988) specifies tactical coalition with other firms as “voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies, or services”. A company's own assets and abilities form the basis of the rents they manage to create. But it is also affected by their position in relation to the network of other companies (Gulati, Nohria & Zaheer, 2000). Thereby tactical coalition or networks are two sources of value creation. Network results in three competitive advantages and thus value creation which are Lock-in, Lock-out and learning. Lock-in and lock-out discloses refers to the coalition or the absent coalition of firms after the partnership between them. When two or more firms are partnering, some firms are not able to create a similar kind of cooperation. At the same time, companies partnering is cannot enter into other cooperation due to limited resources, which may be in the form of money but also time limitations.

Learning refers to when one firm partners with another firm and both parties’ utilities on each other’s knowledge and abilities. But, if the advantage of the partnership is of greater value than the credited knowledge, companies can dissolve themselves from the partnership after one having got to know all the information (Gulati, Nohria & Zaheer, 2000).

The theories above were developed before the internet was used to a greater extent and thus some part may need to be excluded or revised. Example of this, we find in an article by Amit and Zott (2001) who have a discussion about the change that e-business has undergone in terms of value creation. The fundamental thing in this article is that value is specified as the total value created in e-business transactions is created by the participants involved in the
transaction. This approach is taken from Brandenburg and Stuart (1996) where the sum of all value created can be derived from all participants in the transaction. This approach differs from other theories where value instead is focused on from an enterprise perspective without taking into account the others involved. Instead Brandenburg and Stuart (1996) suggests a new model of value creation where efficiency, complementarities, lock-ins and novelty are what creates value.

Figure 2 Sources of value creation in e-business (Amit & Zott, 2001)

Efficiency

A company's overall costs can be reduced by making each transaction more efficient and there is evidence that the use of IT do reduce these costs associated with transactions (Malone, Yates & Benjamin, 1987) and by doing this, the transaction itself will create an added value for the company (Williamson, 1979, 1981). When comparing businesses in traditional markets between the virtual markets. The efficiency can be better if the lack of conformity between buyers and sellers are reduced. The Internet can promote information flow by being as close to real-time as possible and by enabling the availability of information for other parties. If the information stream in company are improved, the firm can reduce opportunistic behavior of suppliers (Williamson, 1979) and the search and barging costs of customers (Lucking-Reiley and Spulber, 2001). With the wide adoption of the internet, the transaction efficiency is better, and the decision-making takes place on more reliable information. Studies by Garicano & Kaplan (2001) showed that the transaction costs comparing offline and online car auctions, shows that the transaction costs are distinctively lower in online markets.
Complementarities

Amit and Zott (2001) refers complementarities to be that products or services together provide more value than individual products or services. When another company’s products together with the firm’s own product are valued more by the customer, then it would be alone, it is called a complementor (Brandenburger & Nalebuff, 2011). Complementarities are also often split in two different categories and they are, vertical and horizontal complementarities. Where aftermarket services are considered vertical, while bundles of goods are considered horizontal. Combining resources and skills from different companies can, in terms of the offer, create more value. From a customer perspective, complementarities can also increase efficiency, for example when a taxi company provide information about tourist attractions (Amit and Zott, 2001).

Lock-in

To lock-in the customer is crucial because, the transaction costs associated with a transaction with an established customer are lower than it is with a new customer (Dyer, 1997). When locking-in the customers, partners to the firm become more motivated to improve and maintain the partnerships with the firm. Amit and Zott (2001) talks about different lock-in effects in e-business such as loyalty programs, brand and trustful relationships etc. Smith, Bailey and Brynjolfsson (2001) talks about that multiple e-business now use click analysis, buying patterns and recommendations. This is to make their shopping as convenient as possible. And by using the data from their purchasing behavior to make a more individualized shopping experience the next time they shop there. The shopping experience will be tailored to each specific customer, this is to create a positive feedback loop (Arthur, 1990) and this results to a incentive for the customer to come back and shop from the same place. Srinivasan, Anderson and Ponnavolu (2002) discusses that e-businesses have created gathering places around their businesses where customers can integrate with each other and this results in increased customer loyalty and which, in turn, increases the lock-in effect.

Novelty

Schumpeter’s (1942) “creative destruction” shows how innovation can be sources of value. Innovation in offline markets have proven as a source of new value, such as manufacturing processes, production innovation and it’s been attention paid to business model innovation (Teece, 2010). E-business from around the world are great examples of innovated business models. Amit and Zott (2001) has a great example in eBay, the first successful company that introduced customer-to-customer auctions. Many e-businesses today have eliminated a lot of the transaction cost connected to the offline markets, one of these companies are Uber. Another one is Foodora they are allowing customers to order food in an app from their favorite restaurant and then after that delivery it to you. Virtual markets have showed that it's a good source of new opportunities of business models. For example, they eliminate geographical issues and it can also connect markets and industries that earlier was divided. E-business innovators can achieve first-mover advantages simply by innovating their models of the business (Liberman and Montgomery, 1988). This can create lock-in effects by connecting the brand to the new business model.
The four components Efficiency, Complementarities, Lock-in and Novelty were argued as the primary value creating for e-businesses. Amit and Zott (2001) wrote about this in the beginning of the 21st century and since then a lot advancement have been done in the field of IT and IoT. These innovations enable continued development of the economic environment and the market.

2.3 IoT

The internet of things (IoT) are commonly talked about to be a range of devices or systems that communicate to each other and among them, including other internet enabled devices and systems (Tien, 2017). Industrial internet is the heart of IoT according to Samuel Greengard (2015). It enables the infrastructure which supports connected machines and data. Industrial internet refers to the link and incorporation between machines with sensors, communication systems and software that is the fundamental of IoT. This connected world is referred to as “industry 4.0” as it is the fourth wave of industrial innovation (Greengard, 2015; Szozda, N, 2017). The industrial internet and IoT rely on the same technology substructure although the industrial internet is considered a component of IoT. Both of these share the common goal to mixing the physical and virtual worlds so that they can produce greater intelligence than any machine can generate by their own. Up to this point the industrial internet has centered almost solely around smart utility gauges, asset and vehicle tracking and optimization of plants, facilities and machines. The coming years the digital devices will coordinate with machines in a deeper and wider way. Furthermore, the industrial internet will be the base for the expanding selection of consumer system and devices (Greengard, 2015).

2.3.1 Data

Most basic function and what IoT and industrial internet are about, is data and to withdraw value from it. As the number of devices are increasing and as they operate as channels for collecting, sharing and accessing volumes of data, this results in data and bytes being distributed almost everywhere around the globe (Greengard, 2015). As Ahmed, E., Yaqoob, I., Targio Hashem, I. A., Khan, I., & VVasilakos, A. (2017) writes in The role of big data analytics in Internet of Things “To generate benefits from IoT, enterprises must create a platform where they can collect, manage, and analyze a massive volume of sensor data in a scalable and cost-effective manner”. The term “value of perfect information” was coined by data scientist and refer to the capability to sort and utilize different type of data to create deep knowledge and insights. To reach this goal is a big challenge because of the variables that the system needs to take into account. For now, to many of these variables exist for having perfect information. Instead of building perfect models, data scientist focus on building the best possible (for now) models. These models rely and uses big data and applied analytics. With the information from these models businesses, organizations, government etc. can make better decisions and even save lives. This makes data a precious asset and the consulting firm Gartner predicts that data assets will be a part of the balance sheets of organizations within the next couple of years (Greengard, 2015; Gartner, 2015).

2.3.2 Sensors
The sensors in the Industrial internet are a big part of it to work. Advances in the sensors technology have created new opportunities to sense things in our environment. The sensors pick up data that our machines and system later can read. Some of the data input and connected systems include things as geolocation, GPS devices, vibration sensors, pressure sensors and much more. When the sensors collect data we also need computers, software and storage systems to understand the data we have received and to put it in a context. For example, when a person get in a store a system can provide face recognition and look what the customer have bought before and guide the customer to the products they usually get (Greengard, 2015). The possibilities for a business to use this technology are endless and according to McKinsey consultants Michael Chui, Markus Löffler and Roger Roberts this is a new wave of opportunities. This is best exemplified by Michael Chui et al. (2010, §3) “The predictable pathways of information are changing: the physical world itself is becoming a type of information system. … These networks churn out huge volumes of data that flow to computers for analysis. When objects can both sense the environment and communicate, they become tools for understanding complexity and responding to it swiftly. What’s revolutionary in all this is that these physical information systems are now beginning to be deployed, and some of them even work largely without human intervention”.

2.3.3 Automation

The final component of the industrial internet is the making of systems that use machine intelligence. This can be described as artificial intelligence (AI). It can be to automate processes and decisions. To remove the humans out of the equation in processes and decision making can make speed and efficiency in many areas of society. Robots are now taking over the manufacturing process and they can be automated because of their artificial intelligence. The advances in machine intelligence will expected lead that robots and other systems will constantly analyze performance and to learn from their own mistakes. And it will also learn from other machines and people. This can be put in context with that a mall use this technology to learn the consumers shopping habits and the machine intelligence of the information system analyze it. After the system have analyze it the system makes in-store marketing to every individual customer when they enter different kinds of stores throughout the mall. (Svane, T. lecture informationsystem, 29 September 2017)

2.3.4 Cloud

Cloud computing refers to applications delivered over the internet, both as services and hardware and it also refers to the software in the data centers that providing these services (Armbrust, Fox, Griffith, Joseph, Katz, Konwinski, Lee, Patterson, Rabkin, Stoica, Zaharia, 2010). Many of the traditional applications have been transferred to the cloud systems because of the service providers and developers and as well customers don't have to worry about or invest in infrastructure, application deployment, hardware updating and maintenance (Zuo-Ning Chen, Kang Chen, Jin-Lei Jiang, Lu-Fei Zhang, Song Wu, Zheng-Wei Qi, Chun-Ming Hu, Yong-Wei Wu, Yu-Zhong Sun, Hong Tang, Ao-Bing Sun, Zi-Lu Kang, 2017). The national institute of standards and technology (NIST) defined five essential characteristics. The essential characteristics that specify cloud computing are; on-demand-self-service, broad network access, resource pooling, rapid elasticity and measured service. On-demand-self-service refers to the consumer’s ability to access computing capabilities, e.g. server time and network without the need to interact with each service provider. Broad network access refers to access of capabilities that promote the use of e.g., mobile phones, tablets, laptops and
workstations. Resource pooling, is the providers computing resource that are pooled to serve multiple consumers. Example of this is storage, processing, memory and network bandwidth. Rapid elasticity, capabilities can be provided and released elastically to rapidly scale outward and inward. Measured service, Cloud systems control and optimize resource use automatically by leveraging a metering capability. Resource usage can be controlled and reported which provides transparency for both supplier and customer (Mell and Grance, 2011) Greengard (2015) points on the ability to process and synchronize data much more efficiently. He also states that it would be almost impossible to build data infrastructure that supports IoT. Through the use of application programming interfaces (API), which are basically small programs that links applications, it become possible to build much more complex flexible and automated environment. There are also different levels of APIs which stacks on each other to provide more functionality and makes it possible to build higher level of cloud applications and services. And it is through of these “layers” of APIs that cloud systems can be built and cloud services and applications are enable (Zuo-Ning Chen et al., 2017; Greengard, 2015; Armbrust et al., 2010).

2.4 Innovation and intellectual capital

Innovation is the best way to have competitive advantage and it is essential for success and survival of any organization (Del Giudice, M., Della Peruta, M.R. and Carayannis, E.G., 2010; Egbu, 2004). The digitalization and technological progress which is a reality in all organization, demands knowledge among workers and the increase of demanding customer leads to greater importance of intellectual capital rather than financial capital (Petty, R. Guthrie, J., 2000; Murray, Papa, Cuozzo, Russo, 2015). According to Murrays et al. (2015) findings, IoT have an positive effect on improving intellectual capital in one’s company. Intellectual capital refers to the knowledge available to an organization and it can be defined as, capital or intellectual assets (Stewart 1997; Nahapiet, Ghoshal, 1998) and knowledge that can be converted into profit (Murray et al. 2015). Intellectual capital can be acknowledged or identified by three components; human capital, relational capital and structural capital (Murray et al. 2015). Human capital signify a certain set of knowledge, capacities and skills obtained during the lifespan of an individual. Relational capital refers to relations that the organization establish with employees and community and different types of relational capital include; image, company reputation and trust. Structural capital is coded and uncoded knowledge obtained by the organization. It can be described as knowledge within routines of a company (Bontis, 1998).

When innovation is applied and embraced by an organization, the need for qualified and specialized professional skills greatly increase. This is because of the data received needs to be converted into information (Murray et al. 2015). Knowledge and intellectual capital affect innovation and innovation affect the capital constituents and therefore they affect each other (Murray et al. 2015).

2.5 Requirements

Greengard (2015) states that there are mainly three functions IoT must fulfill to be usable and to be of benefit. The first is that IoT systems must be functional on practical level and the complexity of the system must be manageable by the society. If the IoT systems either are functional on practical level nor manageable by the society, this will result in avoidance of IoT systems. The second one is that IoT systems must be of benefit for the government, business and consumers, without any obvious losers. Accordingly, they must solve real
problems without developing new ones or adding to already existing problems. Last and most important requirement of IoT systems or devices must fulfil is to be user friendly. Devices must deliver the right type of data and/or information at the correct time in the correct coherency. But this is not enough, they must fulfil this requirement and at the same time do it with a high level of dependability.

2.6 Value Creation with IoT in real estate

Today the value in real estates derive from its location. But with IoT in the picture this is about to change. IoT enables real estate companies to focus not solely on cost reduction which have been the case. With the IoT technologies on the progress this enables features as, more efficient building operations, improved tenant relationships and new possibilities of other revenue streams. Examples of this is the thermostats that automatically adjust temperature, humidity and light all based on the resident’s preferences and conditions. This and other possibilities will result in opportunities for real estate companies to have direct conversations and establish relationships with all users, not only tenants (Kejriwal, Mahajan, 2016). Relationship with customers is one way to reach competitive advantage and competitive advantage is one of the major sources of value creation (Porter, 1985).
3.0 Method

The data used in this paper is primary data are collected from three companies during four different interviews and secondary data collected from scientific papers. Primary data is data that is collected from a field under control and supervision.

3.1 Overall research effort

We have used a deductive theory because we proceeded from theory and then to empiricism. We applied the deductive theory since we emanated from the empiricism that IT (IoT) could create value and continued to gather information and lastly we analyzed to see if our collected empiricism together with theories can generate greater understanding (Bryman 2011; Jacobsen, 2011). The main goal with the deductive theory is primarily to create expectations on how somethings is and then proceed to gather empirical to see if the expectations are consistent with reality. The expectations one have, are founded on former empiricism and existing theories. The risk of deductive theory is that the researcher solely searches for information one find relevant. This risk has been considered all through our research (Jacobsen, 2011).

3.2 Qualitative method

The definition of a problem should be of foundation when one choosing primary data (Jacobsen, 2011). There are two approaches, either quantitative or qualitative. If the researcher uses a qualitative approach, qualitative data is used to develop a greater understanding of a certain problem (Saunders, Lewis and Thornhill, 2009). As the purpose of this study is to point out the value drivers for real estate companies a qualitative approach has been applied. This research also includes interviews from companies working with IoT in the real estate industry. Answers from respondents are of great importance as they affect our conclusions and the interviewees may have different views on the same subject. The main objective of our qualitative survey is to increase the understanding of how real estate companies look at and treat IoT. Hence, it is important that our respondents comply with this and that they have knowledge of the subject (Jacobsen 2011). We have chosen to limit our study by interviewing companies active in the Swedish market and with good insight into IoT.

3.3 Sample selection

Probability sampling and non-probability sampling are the two ways to choose from when choosing a sample selection (Saunders et al., 2009). Probability sampling is most commonly used when doing surveys and experiments, which means that it is most suitable for studies where the data is collected randomly. Saunders et al. (2009) states that probability sampling is not best suited when doing qualitative studies and will thereby not be used in this study. On the other hand, when using non probability sampling, the selection is deliberately selected in order to be as representatives of the chosen audience (Saunders et al., 2009).

We chose the companies we felt could represent the "real estate company population". This is because we chose Willhem, which is the second largest real estate company in Sweden with 26,500 residential properties (Karström, 2018) Castellum, one of the largest listed real estate companies in Sweden (Real Estate, w.y.) and HFAB, which is a little less with 10,000 tenancy rights and a part other properties (HFAB, w.y.). This means that we have done what is called
purposive sampling, which is a subcategory of non-probability sampling. Purposive sampling can be described as the respondents being selected after researcher’s judgment. The disadvantages of this selection process are that we may have made mistakes about which companies are representative. This in turn contributes to reduced ability to generalize our results (Black, 2010). We had to settle for these representatives because the time was scarce and that it was quite difficult to get companies to agree on being interviewed. We contacted a total of ten companies where three chose to participate.

3.4 Semi-structured interview

The interview questions are structured to a certain extent. The interview questions are in a semi-structured manner, i.e. we go out in greater detail to the question area than focus on narrow questions. The purpose of the interviews is to get the respondents personal, in the context of a business, view on the values of IoT. We have detailed questions prepared if we feel there is information missing (Hedin, 1996). We also chose to have more open questions at the beginning that step by step becomes more narrow. Semi-structured interviews are based on pre-written questions but the questions change during the interview depending on what appears (Patel, Davidson, 1994; Kylén, 1994). This means that our interviews are not performed in exactly the same way.

3.5 Choice of respondents

What research question you have is solely for the type of people you should interview. It also depends on whether to do a quantitative survey or qualitative. In quantitative surveys there are rules for how to make selections from a particular group. Such rules do not exist when researcher makes qualitative interviews. Still one cannot ignore selection problems, and you must carefully think about those they want to interview (Ahrne, Svensson, 2011)

When doing a survey on organizations, it is advantageous to first make a selection of organizations instead of individuals (Ahrne, Svensson, 2011). This approach is in line with the way we did, i.e. we chose organizations that we knew or felt to have implemented IoT in their business, which made them interesting for our study.

After the selection of organizations, one will be dependent on a collaboration with an individual within the organization as it will be with this person who will be interviewed. The best option is if you can choose who you want to interview. But this is not always possible, and as a researcher you may have to be contented with being assigned a respondent (Ahrne, Svensson, 2011). Unfortunately, we were unable to choose the respondents themselves, but we were assigned these by the companies when we called and explained what we wanted to know. This can affect our information because the person we talk to when we first made contact with the company, can keep in mind choosing the people who provide the most positive image of the company (Ahrne, Svensson, 2011)
3.6 Data gathering

The two most important types of sources, primary and secondary data are discussed in this study. Where primary data means data is collected directly from the source. While secondary data is collected from sources other than the direct source. It is advantageous to use different types of data as it is very difficult to use only one type (Jacobsen, 2002). Interviews and observations are just two ways to make use of when collecting primary data. But Interviews are best suited for qualitative studies (Saunders et al., 2009) and will therefore be used.

We interviewed four different employees on three different real estate companies, active on the southern Swedish market. We chose to have two respondents at one of the companies because the first meeting did not give us enough information. Since our purpose is to get as wide picture as possible of what value IoT creates we have chosen to perform few but deep interviews. Three are few respondents but since the interviews are detailed and because we do not aim at statistical generalizability this is considered satisfactory (Hedin, 1996).

3.7 Interview design

In qualitative interviews you can do differently and vary the number of fixed questions you want and the extent to which you want more open questions. Through open questions you can get descriptions of situations that are difficult to illuminate through completed questions. However, it does not rule out the use of standardized questions even in qualitative analysis (Ahrne, Svensson, 2011).

We prepared relatively many standard questions to use as initial questions for further discussion of what we wanted to touch. These questions also helped to get along with what we wanted to highlight.

The questions we chose to ask are a result of our own review of the reference frame. We got our interview questions through our perception of reality, which we then standardized using our two models. Then the questions are asked so that they touch these models and our perception of what is true. In order to get answers of what is important with these models but in a different context than they were first developed for.

3.8 Primary data

We conducted the interviews in the form of personal meetings at the respondent’s offices. This is very time-consuming, but as the information may be of a sensitive nature this is the most appropriate way of interviewing when the questions, as in our case, are more open. And also when fewer items are being reviewed (Jacobsen, 2011). We have chosen to perform the interviews at the respondents work place since this is a natural place for the respondent and hence we reduce the risk of the contextual affect (Jacobsen, 2011). Personal interviews also have the advantage that it will be more difficult for the respondent to lie, resulting in increased credibility of the collected information (Frey, Oishi, 1995). The fact that we ask open and supplementary questions enables us to observe the respondent and how he/she
behaves. This results in better understanding of how much information we can collect from the informant and hence a better source of information (Jacobsen, 2011).

We audio recorded the interviews in order to not miss anything of importance. The interviews were done on different days in order to reflect on what needs to improve until the next interview and also to transcribe the data. We audio recorded the interviews in order to enable understanding what the respondent said and the underlying meaning of what was said (Jacobsen, 2011).

The first interview lasted for 46 minutes and 50 seconds, the second interview lasted 39 minutes and 42 seconds and the third interview lasted for 1 hour, 18 minutes and 50 seconds. We felt that after the first interview that we didn't got all the information needed thereby we did a second interview at the same company but with a different employee. This corresponds to the suggested time frame of one hour to one and a half hour (Jacobsen, 2011).

3.9 Secondary data

We have with the databases ABI inform, Scopus, Diva, Emerald, Web of Science and Google Scholar got to know information from scientific reports and articles. We have had some issues to find two or more sources presenting the same information since this is relatively new subject. This have affected the credibility of the presented information (Jacobsen, 2011). The sources which discusses IoT is to the highest possible extent, published 2010 or later since the technology develop quickly. Regarding value creation, which is a well-studied subject, we have to the highest possible extent used sources publis...
3.10 Data analysis

Graneheim and Lundman (2004) recommend that the latent content should be in focus when doing qualitative studies. This means that the researcher makes interpretations of the underlying meaning of the text. In order for us to understand the underlying meaning we will do this through four steps. The following steps are adapted from Jacobsen (2011);

1. Transliteration (transfer of speech to writing)
2. Mark and comment important concepts from the same topic but with different angles of view
3. annotate i.e. summary of each interview
4. Translate from Swedish to English

By following these steps, the researcher ensure that important information is not overlooked (Graneheim, Lundman, 2004).

3.11 Reliability and Validity/ Reliability and authenticity

Reliability and validity are two commonly known terms but are questioned in the terms of qualitative research and many researchers thinks they should be reformulated (Bryman 2011). Instead Bryman (2011) describes two terms that can replace Reliability and validity which in this paper is called; reliability and authenticity. In the term of reliability there are four sub-criteria’s. The first criteria credibility reflects the general term; internal validity. The second criteria transferability reflects external validity. The third criteria, dependability can be compared with reliability and the fourth confirmability corresponds to objectivity.

Credibility is a criterion for a research and is about that the results which emerges shall be trustworthy. To secure this criterion the researchers shall make sure that the research are done by given rules and report the results to the ones who took part in the study. So they can confirm that the results are trustworthy (Byrman 2011). In order to ensure the credibility of this paper we will report back to the respondents so that they can verify the trustworthiness of our empirical findings.

Transferability corresponds to external validity (Bryman 2011), which describes to what extent the results are generalizable to other situations (Cohen, Louis, Manion, Lawrence and Morrison, 2011). Since, in qualitative studies, are focused on the unique and the goal is to get a deepness instead of wideness there are less focus and relevance that the study should be able to implement again and get the same results (Bryman 2011).

Dependability refers to the fact that a statement of the research process is complete and accessible. This because other researchers shall be able to assess the quality. But this is rarely done since it is very demanding work that includes a review of large amount of data and therefore dependability corresponds to reliability (Bryman 2011). As can be read throughout our method we have clarified our research process. Thereby our process of this research is accessible and we have to some extent secured the papers dependability.

Confirmability relates to that the researcher are trying to show trough evidence that the one have acted in good faith and attempted to avoid personal opinions and values affecting the results and conclusions (Bryman 2011). Regarding “confirmability” we have taken actions
such as to go through our empirical findings with the respondents to make sure that we, to our ability, excluded personal opinions and interpretations of the overall meaning.

In terms of authenticity (validity) there are five criteria. Fair Image, Ontological Authenticity, Pedagogic Authenticity, Catalytic Authenticity, and Tactical Authenticity (Bryman 2011).

Fair picture refers to whether the survey provides a sufficiently accurate picture of the different views and perceptions found in the group studied (Bryman 2011). We have used open questions, which results in freedom in the response options. We have also highlighted that, for example, Mattias feels that he does not really understand the concept of IoT; "I have not really understood IoT". Or as Ulf stated "Feels that he does not really understand the concept of IoT" I have not really understood IoT ".

Ontological authenticity is about the study helping those who have contributed to a better understanding of the social environment they are working in (Bryman 2011). We will contribute to a better picture of how IoT can be a value driver for real estate companies using our model.

Pedagogical authenticity is about the fact that the survey has helped participants get a better picture of how other people in the environment experience things (Bryman 2011). With our survey, we can see it from three different business perspectives when we interviewed at least one person in three different real estate companies.

Catalytic authenticity means whether the survey has made it possible for those involved to change their situation (Bryman 2011). With the help of the survey and our conclusions, the real estate companies in the survey can get an idea of how the other real estate companies work with IoT. Which allows you to access this information and improve your own business.

Tactical authenticity means if the survey has meant that the participants have had better opportunities to take the necessary actions (Bryman 2011). Because we show the effects of the value creation with IoT and not how to apply the IoT technology, we do not meet this requirement.

3.12 Multiple case studies

According to Daymon and Holloway (2011) within the qualitative approach, there are many ways to absorb information, such as ethnography, case studies and grounded theory. If the question is about "how" and / or "why" it usually fits a qualitative case study. This because it provides one with detailed information. A case study is also considered appropriate if you investigate a phenomenon within a specific context (Daymon, Holloway, 2011). Examining a problem within a specific context is exactly what we do in this study and with the research questions in mind, a case study is the most appropriate. Since a case study strives to investigate a phenomenon in a particular context by triangulating i.e. using multiple types of evidence (Yin, 2014) and we are examining value drivers with IoT in real estate companies. Does it suit this research to use a case study with triangulation to answer our question. Yin (2014) describes multiple case studies as presenting cases individually. But then presented in a cross-case table. Furthermore, Yin (2014) argues that triangulation is an advantage in case studies because it provides the researcher with not only one type of sources but also more deep insights. In-depth insights as to which value drivers IoT has in real estate companies, we have counted on us through interviews with individuals at the companies and observations of
their websites. Thus, we have information from two different sources. This may increase the validity of the research and also contribute to reduced biases that are obtained if data is collected from a single perspective (Daymon, Holloway, 2011).
4.0 Empirical framework

In this chapter we present our qualitative data. Each qualitative part begins with a brief presentation of each of the four interviewed persons. Then we have summarized each interview and given the most important parts of the interviews. We have chosen to interview three real estate companies that are close to Halmstad because we wanted to have a face to face meeting with all of the interviewed personas.

4.1 Interview 1 HFAB

Mattias Prytz is an operations engineer at HFAB that are a municipal property company in Halmstad, Sweden. He has been working at the company since 2010. His duties are about installation projects involving heat pumps, pellet boilers, district heating plants and control and regulation of these. He also helps the new construction of properties, including sensors in the buildings.

Mattias feels that he doesn't really understand the concept of IoT “I have not really understood IoT”. However, this is deliberate since IoT is a fairly new concept and can be explained by, among other things, M2M (Machine to Machine). Nevertheless, we received valuable data and information thanks to Mattias. Today, HFAB has two main computers in their headquarters that are connected to a control system and this is then connected to various products, such as sensors. This is presented as pictures and numbers and this information are available on his computer. Some of the systems they work with are Ecoguard and Infometric. These systems monitor the hot water measurement and the measurement of electricity consumption. This is Mattias focus area. He says, "I focus more on the fact that heating, water and ventilation will work for every tenant. I'm down at the sensor level. But then there is more focus on the sub-centers and not the apartments themselves." This reflects much of this interview, and Mattias explained very technical details about the properties and how energy costs can be reduced by using IoT technology.

The IoT technology currently connected to HFAB is "What is connected today is the sensors in the apartments to check the temperature in them. The heat pumps for each property are also connected and they speak with the superior control system for how hot it is in the property. The electricity meters and hot water meters are also connected, and these are then charged to the tenants." Just the energy costs play a major role in a real estate company, and this means that if all these sensors and control systems were to disappear, the firm would need to budget 20 million more in energy costs throw their company. "If you remove all control and regulation and connectivity, energy costs will increase due to things in the properties that we are not in control of. For example, things that break or that someone goes and raises the heat in their apartments on their own initiative" Mattias believes that just this is what generates the most value for their business and that the company's infrastructure is the part that can generate the most value through IoT technology.

HFAB today have an innovation project using IT and IoT. They have a number of apartments in this project and in this project, there are more sensors and more data collected. Mattias says "In the new IT project, people have just moved in. And in these apartments, there are, for
example, moisture sensors in the sink to detect moisture. We also have window magnets to see if the window is open or not.”

Mattias thinks the key element, "the best" with IoT is "It is very rational that a person can sit and keep an eye on a large proportion of the company. From heat, hot water, ventilation and temperatures in the apartments. It's very easy for someone to keep an eye on all this." Mattias consider this to be one of the components that make IoT value for HFAB. When we talk to Mattias we see that they do not have a clear definition of innovation in the company, but they are working on an IT project today. However, Mattias considers that he does not see the benefits of implementing a lot of technology without knowing what the products in themselves are beneficial for. He thinks it is difficult to come up with goals with IoT technology and that it is quite expensive with this technology. He is also careful about new technology as he has encountered technical problems on other parts of the company. Because if they then implement a lot of technology in each apartment they are going to own and manage, it can be a problem if it does not work properly.

HFAB right now does not really know what to use the IoT technology, but with the help of the IT project, trying to solve this problem. One of the ideas they have today is to use the water heater to see if something has happened in the apartment. For example, "A few liters of hot water are used every day in each apartment and if it stays still for a few days, this may trigger an alarm. It may be that an older person is sick and tricked and then there will be an alarm call". This is just one of the parts they have thought of, but they have not begun with this practical.

With the help of, for example, temperature sensors in the apartment, can Mattias see when an error message indicates that it is cold or hot in an apartment. Even what things need to be done, for example, that the temperature differs from what it should be, this will be sent to the property managers, who can then take action. Mattias says, "When using IoT technology, it becomes less work for us when we already know in advance how things should work with the help of the IoT network"

The actual data they get from these sensors is in the database that we wrote about earlier. In most cases, this data lies with external partners, such as Ecoguard. Mattias says "The data is in our database, but if I want it in real time, I need to browse in to their website and get what I need." But today there are both internal and external data. The data available today, the company can handle but not develop. The development of data in, for example, platforms, services and applications is purchased or hired using, for example, consultants. However, with the help of this information, the company has reduced its visits in both sub-offices and in the fan room. This has meant that they have also saved capital here.

HFAB also believes that with the help of the IoT technology, new services will be provided to customers. An example of this is an alarm in the apartments. Right now, this is quite unusual in their apartments today. "I have alarm at home in the villa today and it costs 200-300 kr per month so it's a lucrative market" says Mattias. However, he thinks it can be difficult to pay for similar technology because in most cases it is the people who have a little less money living in apartments. A question that Mattias also sets itself is what a housing company really should do for services. Mattias says, “At the moment we are fully focused on making drainage leaks that we have to fix and we have 1200 bathrooms that have to be renovated in the next few years. So the question is whether we as housing companies should be driving in developing this kind of technology.”
Mattias also believes that IoT can improve several parts of the company. These are the company's infrastructure, HR management, procurement, daily operations and aftermarket. In the company's infrastructure, he thinks that IoT technology can increase the quality of the information collected. Mattias believes that "With the introduction of more hot water and temperature measurement at several apartments, we save both water and heat. Planning in the company is also better because you see shortcomings and errors a lot earlier, which in turn creates this a much easier way to plan which apartments to visit and that you do not have to visit all apartments all the time to see if there are any errors right there." However, he thinks that just because there are sensors in the apartment, one should not believe that everything is perfect in them.”

HR management in the company can also be improved with the help of IoT, does he believe. An example of this is to improve employee surveys that are conducted annually on the company.

Procurement and purchases is also a part that can use IoT technology. It is already managed electronically by means of programs that show the cheapest and best options. Daily operations are a big part of what Mattias believes can be improved with the help of IoT. As we wrote at the beginning of this section, it's saved around SEK 20 million a year thanks to IoT technology as sensors and similar to reducing operating costs. This capital can then be invested in other parts of the company. For example, development of real estate and similar things. "In today's day-to-day operations, technology is being used as an iPad for property managers when there is an inspection and there is all the information they need in it and also information about other real estate," says Mattias

With the help of IoT, the company has improved its communication with customers with, for example, electronic invoices and market research after people have moved in to newly made properties to see if everything is working as it should. With the help of the data Ecoguard and Infometric have about the customer’s energy and water consumption, each individual customer can get an amount that is their exact consumption, which is added to the invoice that the tenant pays. With the help of market research, the company can improve its business and create greater value for the customer. This is done now in paper form but this could be done digitally.

4.2 Interview 2 HFAB

Eric works as an IT and digital manager and is thus very involved in IoT technologies and works to drive HFAB’s processes and projects forward. He has a positive attitude towards digitizing the real estate industry, which he considers to be very conservative. But he understands that some companies choose not to invest time and money on it, "If you do not do anything, you’ll get the most out of it, an apartment is difficult to rent out today. But someday there will be apartments that cannot be rented out as it was in the 90's, it is wiser to stay ahead and become a judicious and smarter landlord”.

Eric believes that innovation such as various IoT solutions can create new opportunities and services for both the property owner and the tenant. Eric also says that there is a pronounced direction to be at the forefront of innovative apartments. But he also says that "it is not therefore decided that we will digitize our entire property flora at the present time. But
Today, some IoT solutions are fully used, such as heat and ventilation sensors, but it has been something that has been going on for many years according to Eric. But if you refer to the IoT solutions that are often associated with the word IoT, it is still in the test stage. He describes this as: "real IoT and digitization is essentially the setting of sensors that you then synergy and exploit with third parties". He mentions this as "apartment version 2.0", where from the construction stage it is already sensors that can be interconnected with all service providers and that it does not happen that you have to take down all sensors and then install new ones just because they are not compatible with a particular service provider.

Eric's idea of the project is to create an infrastructure that HFAB can use but as a third party supplier. This means that HFAB installs sensors that measure moisture damage, but at the same time, for example, an activity alarm or the like regardless of the hardware. He believes there are obstacles to implementing IoT and that the main thing is transparency and flexibility. He believes that data generated by different products may be used without requiring permission from the supplier.

"At present, it is mainly ventilation and heating that HFAB has interconnected and can control this "so it's not really advanced today". Data arising from heat and ventilation sensors is collected because it is the basis for the rent. But also, to be able to view historical data in order to make better decisions based on more information about heat and ventilation usage. But for the time being, discussions are taking place on the company with what to do in the future. Eric states "If you live in an apartment, for instance, you are demented or have a disease. Then you can gather information and say that after 100 days suddenly you will not get up when you usually do and, in that situation, the sensors may know and send a message to their closest relative or the like".

In a house owned by HFAB, it has been chosen to show to the tenant how much heat and water one consume. This in order to take social responsibility and reduce climate impact. Eric thinks that the key element of IoT for value creation around real estate is to create services that tenants can use and improve their everyday lives. He thinks that the forms it uses today with IoT, for example, control of heat and ventilation and other things. But what eventually drives IoT is their tenants and if they want to rent or buy digital services of any kind that the company has. Thus, this will be another set of attracting customers and another way of making money. It may also be that it sells these services through other partners. Eric said, "Just look at Husqvarna now when they sell a chainsaw they are not only selling chainsaws, but also services that are linked to it. I think we should go another way from just delivering 4 walls and roofs to deliver a housing service. For example, it may contain a bedroom but also a digital refrigerator."

The value creation within IoT compared to other parts of the company thinks Eric is different. This is because you have to think differently about things such as your business model. The capital flow is an example of how it will look different. Eric says "There will be so many more parties involved in an IoT world than it is right now. There we and other parties need to think differently than we do today. We can compare it with Appstore. Thanks to the entry of an Appstore, the entire market, players and values turned around, and you have to think differently."
Reducing the risks within the property is part of what IoT can do for the property. An example of this is to connect sensors and systems to the fire station, and then you know if there is more than 60 degrees in an apartment, the fire station knows this directly and can act before something bad happens, and the risk of someone not calling in alarm decrease significantly. Something that HFAB and Eric also seems to have a great positive impact with the help of IoT is the reduction of climate impacts that occur using IoT technology in the properties. Through a reduction in energy consumption the environmental footprint will decrease for all parties that are involved in the building. Another part that Eric talks about to reduce climate impact is to visualize the data the sensors have picked up regarding each apartment's consumption of, for example, electricity and hot water. "This can reduce energy consumption".

The part of the company that Eric believes can generate the most value using IoT for them is the Aftermarket. The other parts are Company Infrastructure, HR Management and Technological Development.

In the company's infrastructure, Eric thinks it is obvious that several sensors make them better aware of their business, tenants and other parties. He says that in the future will have a sensor in the refrigerator that allows an alarm go of if there are some problems with the compressor and you can fix the refrigerator before all the food has gone bad. In HR-management, Eric once again believes that the more data you have about the staff, the better the decision can be made and not guessing what is good or bad for the company. The technological development of the company is also a part where Eric believes that IoT can make great use. One example that Eric mentions is "If you are living in student apartments and we have a clever solution to ease your everyday life as students. And we provide you with that solution with the help of, for example, a partner to us in Stockholm. This will make you become satisfied and probably you will say to your friends that it is better to stay at our properties then a competitor to us."

Other parts of the company that we are taking up with Eric are Procurement, Inbound logistics, Daily operations, Outbound logistics. These parts he considers does not generate as much value for the company in an IoT purpose as the other parts above. In the logistics part Eric believe that right now they cannot generate so much value to them but more for their subcontractors. In the daily business, he thinks that there is currently no sufficient IoT technology in their company, but he has a vision that everything that today can be done on their computers in the various control systems shall be able to be doable on mobile devices.

4.3 Interview 3 Castellum

Ulf works as a project developer in Helsingborg, Sweden. Which means that he is ultimately responsible for new housing are being built. As well as finding tenants and also developing older properties that are in the portfolio. In summary, it means that product develop a property, partly new and partly existing.

You have to distinguish between new and old houses, new properties can be adapted to technical solutions, while with older homes you need to compromise more. Ulf talks about environmentally certified properties, which, according to him, "means that you can sit in the office and have full access and the ability to control, for example, ventilation and heating." Castellum has also begun with self-regulating real estate i.e. the property itself controls ventilation and heating as well as alarms if something would be wrong, this is done using IoT
solutions. It is also true that some of these alarms can be addressed directly from the office, while some still need to be addressed physically.

He continues to talk about the difference between older and newer real estate. "The older properties have what we call constant flow, i.e. heat, ventilation and light are constantly in use and do not take into account that the room is empty and this is not environmentally friendly" while in new Real estate has energy-efficient solutions that send 17 degrees of air, for example, while the air extracted is 25 degrees, the IoT solutions feel that the difference is too high and creates faster air change which is completely automated

Castellum is working with innovation because, according to person Ulf, they have realized how important it is. "... we have realized that we are going to support and support the intelligent stuff and are currently testing a storage and delivery solution”. These solutions will save the tenant money and increase convenience. He also believes that the real estate of the future and then mainly offices will be about utilizing the surfaces, but that it must be economically viable and that this is achieved through smart solutions. "The real estate industry has been so rigid ... the economy will be much faster in the future. Which also means that no one wants to tie up but instead be able to control over their own time and then a real estate technology must support this. But at the same time, a house cannot be run around the clock, because then it costs a lot and then it's about finding these new smart solutions." Ulf exemplifies this as allowing people to unlock an office with the phone and be able to book a part of a property and pay only for the part that is used and that the consumption of, for example, heat can be adapted to the parts of the property being used.

Castellum also collaborates with new companies that can test their products in Castellum's real estate and if it is profitable, one can grow together with the new company. "This is a way to develop a property [...] the real estate industry has to start thinking about new courses. Instead of signing a contract in three years, you may be able to sign contracts for a few months."

On the question if they think they are leaders in the industry in terms of innovation, he says that they have understood the meaning and want to be with and push innovation forward but that they do not know where it will lead. He believes that we live in a stressful society where many people for example, find it hard to work out. "Everybody is very stressed today and we are talking about how to make it easier for the individual. We are trying to renew the properties by, for example, making it more fun and encouraging for people to take the stairs. This by using a display in the staircase telling you that yesterday too many took the elevator and so much energy were used [...] we try to make it a sport to keep it down". He also says that as soon as they install smart solutions like IoT technology, they save money and are very profitable investments "We see that as soon as we do something in a property we lower the consumption curves and we save money and we can count it economically. A big investment can we usually count in after 3-5 years by saving money on consumption through smart houses"

Ulf believes that the biggest problem involved in implementing new IoT technology in real estate is that it must go together economically and that everyone does not have the financial capacity for it. He also believes that there are two reasons for implementing new technology. 1) The change has to be done. 2) You are switching to something smarter because it is economically viable. "We will be awaiting all technological development that can help us in everyday life, but everything costs in some way, one has to take into account that certain
things is imperative but it may also be so clever that we earn money or reduce our costs so that investment is one we are prepared to take"

Ulf then considers that tenants and authorities are making increasingly high demands regarding what materials are used in a property and how environmentally friendly they are. He also believes that they themselves must be driving on this issue to be competitive. "Tenants place higher demands on this, but also authorities and this process, we must actively participate in whether we want to be competitive"

As regards Castellum's use of data, they make energy reconciliations every month and can use the collected data to see, for example, whether a fan assembly has stopped working. "We measure all the time and we want to be able to measure all the time to understand how a house lives. For example, if there are a lot of people in the room, more cold air is being used ..."

Castellum visualize their data as they get in from their sensors both internally and externally. The partners they work with, such as the ventilation companies, have access to their systems. This competence for this is something they buy in and these are also specialists in the subject. Right now, people how work with operating supervision around these systems at Castellum, can if they have any problems, contact the ventilation companies to get guidance. For example, if they follow 20 sensors in a property that shows a problem, they can see this. But then they contact these specialists instead who can find the problem and see what actions can be taken. They can handle this internally or a consultant to fix this for them. Today, the company currently has television screens in the entrance to a building that shows how much energy that property has consumed over a certain period of time. This allows the tenants to see exactly how much they consume and that they can make a change and lower their energy consumption.

Ulf think that the largest value driver for their IoT solutions is that it makes intelligent and smart houses. This gives them a completely different overview of their property portfolio. Ulf stated that "With the help of the smart properties, we do not have to put resources on staff who walk around the houses to see how they feel. The digital world facilitates our daily lives and we can monitor the operation by just checking on a screen. For example, we can look at five properties at the same time and if everything looks normal, we do not have to go out to these buildings and if we did not have these systems, we need to physically take all these houses. So it saves a lot of time. We therefore streamline our entire business."

With the help of IoT technology in the properties, Ulf thinks that the risks are minimized by, for example, a fire. Which means that you are both informed of the fire and that action can be taken quickly. Castellum always want to work a step in advance, thus preventing things from happening. Through intelligent solutions, it can detect the danger as early as possible and preferably in advance.

The company's infrastructure is part of the company where Ulf believes IoT can make great use. Using the quality of the information collected, it can read and control the properties in a completely different way. Castellum is working to reduce the energy consumption as much as possible. At the same time, they give them a whole different set of work to see if a measure in a property makes a difference in property energy consumption. With the help of technology development, a lot of money can be saved for the company.
The intellectual capital will also increase with the help of IoT. Ulf believes that with this, they will get more and better knowledge. This is very important because technology is moving so fast, so with the help of IoT, knowledge slots can be reduced. He also believes that all knowledge need not be external, but there must also be some internal knowledge as well. This is because you have to see the technical benefits as a whole over the entire system. When implementing new technology, the internal skills must be available. For example, to read the values correctly and to understand why things happen in a building. Ulf says, "Care of the property can’t depend on other parties, then our business model will not work."

With the help of IoT technology, procurement may be better managed. An example of this Ulf says "If we are buying green electricity, we should not only look at a property, but we have to check our entire stock and then we can procure using our data from the whole stock to get better prices for all our properties."

He also thinks that IoT can’t improve their inbound logistics because it does not have much in stock today, which makes it unnecessary.

The day-to-day operations are also a part where he believes IoT can make great use. With the help of digital solutions, malformations that need to be addressed from tenants can be managed more smoothly and then go straight to the operator’s smartphones, the day-to-day business becomes smoother and problems can be done much earlier, which will also make the tenant happy as a result of a reduction in lead times.

With the help of digital solutions, outgoing logistics to customers can be easier. Ulf says, "Using e-invoices and writing e-credentials contracts, this saves a lot of time for both us and the customer."

The part of Castellum that Ulf believes generates most value with the help of IoT is technological development. He believes that it’s creating the future of the company and using it to make the development of all the other elements. The understanding of being able to read the properties and knowing in advance what happens in their properties is affecting the other parts that will make Castellum ending up with saving money.

4.4 Interview 4 Willhem

Therese have been working as development manager at Willhem for 1.5 years. She is responsible for a relatively sparse unit that includes everything from customer support to business development. She has a background in retail with marketing as a focus, establishment of stores and e-commerce. She is most recently from the IT industry where she has run a small company that develops software in business systems and digitalization.

Asking if she feels she can take a lot from her background into the real estate industry, she answers both yes and no. She believes that Willhem is a real estate company that wants to act and think differently. She studied marketing at university and became acquainted with models like the 4 p:s but saying "today it is completely different. It has turned 360 degrees. You have to think differently. This trip I have seen and been a part of". She continues "I was in 2005 with one of the owners of the biggest shoe group here in Sweden who was my closest boss for 6 years and I said we must start thinking about this with e-commerce. He then replied" Do you think anyone is so stupid that they buy shoes over the net? " Therese believes that the real estate industry is extremely traditional and conservative and that being a company that wants
to think differently is quite difficult. She says it's about restructuring a lot to meet the new opportunities that arise through new technology. She gives an example that Willhem has to digitize its flows and think through different perspectives regarding customers.

She also says that they have a special situation on the market right now "We are in a zero-competitive industry. We sit with our biggest competitors and share various insights and strategies because there is no competition for customers today. “Demand is so much greater than supply and it does something with an industry”. There is no natural driving force in the market because there is no battle against the customers, as other industries have. So, from a customer perspective, there are no driving forces, however, we need to find other driving forces that create business benefits that streamline and save money "

She then reply to the question if they have located any such driving forces and answer "Absolutely, there is just about anything". She claims that Willhem can do this by automating and streamlining, for example, the flow of contracts between them and the customers, and that they can spend time on things that create value instead of spending time on things that do not create any kind of value. Since they do not have the client as a driving force, it will be natural for Willhem to look at real estate technology and infrastructure in the properties, and there they have seen that there is a lot of money to save through optimization. She exemplifies this, "with sensors, it's a lot about seeing where there are savings by actually looking at where things go wrong and who is responsible."

The conversation is then led to innovation, and at Willhem they talk about the "thinking house" where they have three legs from which they originate; "Simple everyday life for the customer, smart management and energy management ". They are working to get these three parts together, starting with the property itself and how they will work with different suppliers. Parallel to this, they run projects around "building management systems" that aim to streamline and optimize the properties.

Therése then mentions that Willhem has received a prize for their “smart houses”. She then says that she believes that in general, one will see some self-reassessment about what will be digitized, she believes that there has been a bit of exaggeration, but not in the real estate industry. She believes, however, that IoT creates value for example in contract signature, selection of tenants, etc. She further develops "... allows us to spend time on other things, really, I can sit and gabble benefits with IoT for many hours".

She believes that the biggest problem with the implementation of IoT for Willhem has been to link the entire chain to the customer and that it is the functions around which is a problem. For example, support may be a problem or the problem may be of a contractual nature. Another problem is that there are a lot of parameters that will be connected and there are many involved, but Willhem take it step by step and their ambition is to monitor everything in their real estate’s from the office.

The data collected by Willhem is made available to employees. Their ambition is that data should be customized according to the employee's duties. Therese, however, states that it is difficult with data, what is relevant and how to use it. Another problem that Willhem has is that they do not have the ability to develop and capitalize on the data being collected. "It demands an organization to organize and structure and to keep up with developments that are very fast. It has been thrown over many industries earlier ... And if we are to come along with
these questions, we have to think differently about the skills and the way we do our projects." Their views on how to assimilate this competence are either to use partners or to hire staff.

This leads the discussion on whether Willhem has many partners at the present time. Where Therese says they co-operate with other industry actors. But feel that Willhem has a lot to learn from other industries and that solutions can be found that are transferable to the real estate industry.

Therese believes that if IoT is used properly, it is possible to create benefits for Willhem and its customers. But it implies hard demands on the handling of, for example, agreements with partners. She says "purely business model, it will happen very much within this. For example, what players should enter the business model, who owns data, how to use it and who can charge for what and so on." She also thinks that IoT promotes time savings and cost savings when it comes to allocation of resources. She says, however, that they are only in the initial phase of this.

Willhem has done some automations of its properties, mainly in terms of ventilation and heating. However, they have an ongoing project, for example, if a sensor gives up an alarm, this alarm will go to the correct partner or person at Willhem, and she further develops "with this, we create time savings and cost savings e.g. when the customer informing us that we need to come when any problems arise and then we save time and money on this by having the right person get the information and that correct actions are taken."

Therese believes that IoT can improve Willhem's infrastructure by increasing the quality of data collected. "Absolutely, data collection and the right kind of data provide us with added value for customers and contribute to savings." She describes that their CEO, whom she meets once a month, is very interested in how much they spend per sq. meter and that with the help of IoT he can get better data. She also says that someone does not have to collect and compile data every time. She also believes that IoT helps to increase intellectual capital. "If we know where to put our forces, we run on the right stuff, which, in turn, makes people feel better for doing something that creates added value. And we do not have a lot of paper handling that does not benefit anyone. Or that with the right data and analyzes, we see who does the right things and that someone does not do the wrong things."

She also thinks that IoT enables improved ingoing logistics and that they have come a long way in this aspect. They have their own logistics solution together with a partner who makes their renovation of apartments more efficient. An employee enters an apartment and notes what to renovate, which in turn is sent to the partner in form of a digital checklist. This checklist is sent to someone who packs the goods needed for the renovation and this is then shipped to the renovation object. Where craftsmen start with the renovation and have all the material needed directly on site. This will allow Willhem to get control of all the goods and know exactly how much is needed for the renovation.

Therese believes that IOT will enable better customer service because, for example, sensors can enable them to act proactively for errors. Instead of the customer having to make a call and then correcting the error.

Therese feel that IoT generates the most value in the customer perspective and that in terms of competition, it is most important to have the customer in focus. This can be achieved by offering security housing or service functions such as cleaning. "What does Oskar, 92 want
for help and support with digitization, for example, can be to see if he is lying in bed or not. They have developed different customer groups according to how they look at their customers and how IoT can make improvements for these”. Willhem has, for example, developed a separate app where tenants can book a laundry room and the functions will be built to control the heat of the apartment, etc. This is something they work continuously and successively on.
5.0 Analysis

In this part, the result of the study is analyzed. The theories about value creation and empery that we got from the interviews are tied together. Firstly, a within case analysis are presented, each interviewed company is analyzed individually and described on the basis of the theoretical reference framework. Thereafter, a cross-case analysis is presented. And at last our model of the primary value drivers for real estate companies in IoT are presented in a model.

5.1 HFAB Within-Analysis of adoption of IoT

Tien (2017) talks about the Internet of things to be a range of devices or systems that are communicate to each other and among them, including other internet enabled devices and system. After the interviews with Mattis and Eric we state that at HFAB they are using this kind of technology. They are also using sensors in their daily operations and it's a fundamental aspect in the studied companies. HFAB are also discussing this one their website. According to Mattias and Eric they are currently using sensors, but it’s mainly the ventilation and heating systems that use this tech. Advances in the sensors technology have created new opportunities to sense things in the real estate environment (Greengard, 2015). Sensors is a foundation for automation and machine intelligence. The result of automation is the removal the human factors, which enables rapid and efficient decision making. Automation is an important part of the companies studied. Both Mattias and Eric stated that, with the help of automation, they get better control and efficiency in their heating and ventilation systems. This corresponds to what can be read on their website; “In the years 2001 to 2017, HFAB has reduced its energy consumption by 32%”.

5.2 HFAB Within-Analysis of innovation an intellectual capital

HFAB does currently not have any clear definition or strategy for innovation. According to the interviewed, does HFAB not really know how to use their IoT technology, and by doing the IoT project trying to figure this problem out. Eric has a positive attitude towards innovation and the digitalization that’s happening in the real estate industry. He believes that real estate companies today don’t need to invest time and money on innovation because the apartments will be rented out anyway because of the market situation. But, if they want to be able to cope with another market situation the real estate companies need to innovate to stay ahead. This correspondent with what Del Giudice et al. (2010) suggest since innovation is crucial for success and survival of any organization, and innovation is one of the best ways to competitive advantages regardless of organization. Mattias suggest that with the help of new IoT solutions, can HFAB provide new services for the customers. Mattias stated an example that with a partner provide alarms for their customer’s apartments. Eric also discuss other innovations thoughts about the real estate market. Such as, a new way of attracting customers and other income streams. This can include services through other partners in order to not only deliver housing but instead deliver a housing service, such as a digital refrigerator. With these services the capital flow for the companies will be different according to Eric. Since there will be more parties involved in a fully adopted IoT world. Eric suggest that HFAB and
other Real estate companies on the market need to think differently. Increasing of demanding customers leads to greater importance of intellectual capital. The digitalization and technological progress which is a reality in all organization and require knowledge among the workers (Petty et al., 2000; Murray et al., 2015)

But, with innovation and new technology, Mattias thinks that HFAB needs to be careful because they have encountered other technical problems in previous innovation projects. This can be caused by lack of intellectual capital. This is explained by Murray et al. (2015) as the need for qualified and specialized professional skills greatly increase when innovation is applied and embraced by an organization. Mattias is doubtful whether HFAB should be one of the driving actors in terms of innovation in the real estate-industry. But, as Murray et al, (2015) states that innovation is affected by intellectual capital and knowledge and innovation affect capital constituents and therefore they affect each other.

Intellectual capital can be divided into three subcategories where one of these is the relational capital (Murray et al. 2015). Which refers to the relationship organization establishes with their employees (Bontis, 1998). HFAB are currently doing this by conducting surveys to create greater understanding of their employees.

According to the interviewed, the more data you have about the staff, the better decisions of how to allocate the workforce can HFAB make. This is according to Murray et al. (2015) defined as structural capital. Structural capital refers to knowledge within routines of a company (Bontis, 1998).

5.3 HFAB Within-Analysis of requirements for usable IoT systems that give benefits

First and foremost, IoT systems must be functional on practical level and the difficulty of the system must be manageable for everyone involved. Secondly Greengard (2015) discuss that IoT systems must benefit the business by solving real problems without adding new ones. Lastly the most important requirement is that it is user friendly. The devices that use IoT-technology needs to deliver data and/or information understandable for the user and also at the correct time (Greengard, 2015). Both Mattias and Eric thinks that one key component of way HFAB are using IoT is that is very convenient, because one person can overlook a large part of the company such as in this case, heat, hot water, ventilation and temperatures in the apartments. But Mattias also stated that if technology is overused it may cause manageable problems. If they wouldn’t have access to the right information about their heat and ventilations systems at the right time, HFAB would need to budget 20 million SEK more in energy costs.

Mattias is also careful about implementing new technology in their apartments, do to previous problem with tech that are not dependability. And According to Eric the IoT technology that HFAB are using today are not sufficient for the daily operations. That is because some of HFAB IoT systems are not functional in a practical level, do to some parts of the various control system can only be controlled on a computer and are not doable on mobile devices. So, HFAB needs to figure these technical problems out. IoT that are useable, beneficial and functional on practical level needs to manageable or this will result in avoidance in the IoT systems at HFAB (Greengard, 2015).
5.4 Castellum Within-Analysis of adoption of IoT

Castellum are also using IoT solutions in their buildings for the ventilation and heating systems. They are using devices or systems that communicate to each other and among them and this is as Tien (2017) says, are the internet of things technology. This is also featured on their website as they have the most environmentally certified properties in Sweden. Which means that they work with, for example, energy savings and reduction of carbon dioxide. The IoT-solutions regarding ventilation and heating have sensors that collected data. And with this data Castellum makes energy reconciliations every month and they can with this collected data see, for example, if a fan assembly has stopped working. To gather this kind of data and withdraw value from it is one of the most basic functions what IoT are about (Greengard, 2015). Castellum has also begun with automatization in their real estate regarding self-regulating of the ventilation and heating as well as alarms if something would be wrong. This is a kind of machine intelligence, that can be described as artificial intelligence (AI). The machine intelligence automates processes and decisions and take away the human factors so the ventilation and heating systems become as efficient as possible (Svane, T. lecture Informationsystem, 29 September). Castellum demonstrates this in their brochure of their well-house concept where one for example, can get personalized air and temperature. Cloud technology are one of the cornerstones in the IoT. And that refers to data or information that are delivered over the internet, both as services and hardware (Armbrust, et al. 2010). Castellum are currently using this kind of cloud technology when they visualize the data they gathered from their sensors both internally in the company and externally to the partners they work with, such as the ventilation system partners.

5.5 Castellum Within-Analysis of innovation an intellectual capital

Castellum are working with innovation because they have understood how crucial it’s for them according to Ulf. Castellum are also write about this on their website. Ulf says that Castellum have understood the meaning of innovation and that they want to push innovation forward in the real estate sector. Such as, collaborations with new companies that can test their products in their real estates to see if it’s profitable for both parties. Castellum thinks that the largest value driver for their IoT solutions is that they make intelligent and smart houses. This gives them completely different overview of their property portfolio. Castellum believes that innovation and technological development are creating the future for their company and that all to other elements of their business be develop do to innovation. Castellum thinks a lot like what Del Giudice et al., (2010) ; Egbu, (2004) wrote about innovation as the best way to have competitive advantage and that it’s essential for success and survival of any organization. Ulf also said that “With the help of technology development and innovation, a lot of money could be saved for the company”. Ulf believes that the companies intellectual capital will increase with the help of innovation in IoT. Ulf believes that with this, they will get more and better knowledge. This is very important because technology is moving so fast, so with the help of IoT, knowledge slots can be reduced. As Murray et al. (2015) wrote about intellectual capital “It represent knowledge that can be converted into profit”. And when innovation is applied and embraced by an organization, the need for qualified and specialized professional skills greatly increase. This is because of the data received needs to be converted into information (Murray et al. 2015).
5.6 Castellum Within-Analysis of requirements for usable IoT systems that give benefits

Greengard (2015) states that there are mainly three functions IoT must fulfill to be usable and to be of benefit. One of the three functions are that IoT systems must be of benefit for the government, business and consumers, without any obvious losers. Accordingly, they must solve real problems without developing new ones or adding to already existing problems. Castellum are currently working with this in risk minimizing by, for example, a fire. They both inform that the fire are happening for the tenants and that an alarm go directly goes to the firestation and actions can be taken quickly. Castellum do always want to work a step-in advance, thus preventing bad things in their properties to happen. Through their intelligent solutions can they detect danger as early as possible and preferably in advance. Greengard (2015) also states that the most important requirement of IoT systems or devices must fulfil is to be user friendly. Devices must deliver the right type of data and/or information at the correct time in the correct coherency. And just this does Ulf say they have in their daily operation system. "With the help of the smart properties, we do not have to put resources on staff who walk around the houses to see how they feel. The digital world facilitates our daily lives and we can monitor the operation by just checking on a screen. For example, we can look at five properties at the same time and if everything looks normal, we do not have to go out to these buildings and if we did not have these systems, we need to physically take all these houses. So it saves a lot of time. We therefore streamline our entire business. "

5.7 Willhem Within-Analysis of adoption of IoT

Willhem has to some extent implemented IoT in its real estate and operations. For example, they have installed sensors that control temperature and ventilation. They also have ongoing projects where sensors alarm if something indicates errors. This alarm then goes directly to the right part. They also work with having connected homes that automatically communicate with other technologies and this is according to Tien (2017) IoT. Therese discussed this and it is also possible to read about this on their website. This automation also means that Willhem can remove the human factor and streamline its activities in some ways (Svane, T. lecture information system, 29 September 2017).

The data that Willhem collects is made available to the employees and the ambition is that it will be personalized, but it is not today. Therese also describes how their CEO is very interested in how the energy consumption per square meter is in their properties and that with the help of IoT, they can improve this information. Thus, to some extent, they have a value of data collected, but Therese states that it is difficult to process data. According to Greengard (2015) managing data and capitalizing on it is one of the basic features of IoT and helps make better decisions. This is something that we got the impression that Willhem was aware of and that they are working to improve this.
5.8 Willhem Within-Analysis of innovation an intellectual capital

Willhem currently have an innovation strategy and they call it the “thinking house”. The “thinking house” have three parts and they are: “Simple everyday life for the customer, smart management and energy management”. They are working with this points in every innovative ide throughout the company so they so that they can merge together and the aim are to streamline and optimize their organization and their properties. This is as Del Giudice et al. (2010) suggest that innovation is the best way to have competitive advantage and it is essential for success and survival of any organization. And with the innovation and digitalization that's happening at Willhem, the knowledge among workers needs to increase and that leads to greater importance of intellectual capital rather than financial capital throughout the company (Petty, R, et al. 2000; Murray, et al. 2015). Therése believes that IoT technology can increase the intellectual capital and according to Murrays et al. (2015) findings, IoT have an positive effect on improving intellectual capital in the company that it’s have been implemented in. When this innovation strategy is applied and embraced by Willhem, the need for qualified and specialized professional skills greatly increase. This is because of the data received needs to be converted into information (Murray et al. 2015).

5.9 Willhem Within-Analysis of requirements for usable IoT systems that give benefits

As previously stated, there are essentially three functions that IoT must meet to be of use and advantage (Greengard, 2015). First, it must be of benefit to a company and consumer. Which in Willhem’s case is an advantage for them because they can streamline their staff and allocate staff to the tasks that actually creates value “it’s a lot about seeing where there are savings by actually looking into where things go wrong and who is responsible”. This also results in them making financial savings. Willhem has three points in their innovation strategy. One of these is "simply everyday life for the customer", and according to them, they deliver services to facilitate the everyday lives of their customers. This results in ease of use which is one of the most important requirements of the IoT system (Greengard, 2015). According to Therese, the quality of data collected using IoT increases the level of practicality throw out their company. Which are the he third requirement that IoT system must achieve (Greengard, 2015).
5.10 Cross-Case analysis

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<tr>
<th>Primary value drivers for real estate companies in IoT</th>
<th>HFAB</th>
<th>Castellum</th>
<th>Willhem</th>
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<tbody>
<tr>
<td>Better planning for the company</td>
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<tr>
<td>Does IoT enable innovation</td>
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<td>Improved your product</td>
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<td>Procurement of products and services</td>
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<td>Logistics for incoming materials or storage</td>
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<td>Does IoT improve your daily operations</td>
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<tr>
<td>Do you believe that IoT can give you better services to customers</td>
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In the data collected regarding value creation we have used the value creation model from Porter's value chain and translated the items of the value drivers to be more applicable for the real estate industry in an IoT-perspective.

When implementing IoT in the real estate industry one of the largest value drivers are better planning for the company studied. With IoT-technology such as sensor can the companies allocate resources much better than they could before. For example, Mattias believes that HFAB’s planning can be much better with IoT-technology. Since it helps the company to see shortcomings and errors a lot earlier which results in more efficient allocation of personnel. Eric thinks that it's obvious that with more sensors you get a better understanding of the firm’s infrastructure. But, he believes that it's not one of the primary value drivers of IoT. Ulf feels that with the help of smart properties, Castellum doesn't need physically monitor their
properties instead they can do this digitally from a smartphone or a computer. This results in savings both economically and timewise. They can therefore streamline their entire business. Therese at Willhem argues that "If we know where to put our forces, we run on the right stuff, which, in turn, makes people feel better for doing something that creates added value. And we do not have a lot of paper handling that does not benefit anyone. Or that with the right data and analyzes, we see who does the right things and that someone does not do the wrong things." Therefore, the planning for Willhem becomes improved with the IoT solutions.

Mattias thinks that HFAB have improved there heating and ventilation systems with the innovative IoT solutions. But, he is doubtful about if HFAB should be conductive of innovation in the industry. Because he thinks that other tasks such as renovation should be focused on instead of developing innovative technologies. On the other hand, Eric has a positive approach of innovation and he thinks that innovation can create new opportunities and services for all of HFAB properties and an increased satisfaction of their tenants. Castellum are working with innovative solutions because they have realized the importance. These new solutions will save the tenants money and make their life more convenient according to Castellum. Willhem has an innovation strategy where they work to simplify the everyday lives of tenants using digitalization solutions and IoT solutions in the so-called "thinking house"

All the companies think that IoT have improved their products. According to all the companies they have improved the climate standards in their buildings with the help of IoT solutions. Such as, sensors that generates insights on how to allocate heating, cooling and hot water in an improved manner. Which in turn results in an improved way regarding the environment and in capital savings.

Regarding procurement of products and services, none of them had any IoT related improvements towards this aspect. This may be because of they are no large purchasers of products and service in that manner. None of them stated any benefits of this when acquiring real estate.

About incoming logistics and storage of materials, HFAB and Castellum couldn’t see any benefits in IoT solutions. They say that they don’t have any significant storage or incoming logistics of materials. But, Willhem believe that IoT enables improved ingoing logistics and that they have come a long way in this aspect. They have their own logistics solution together with a partner who makes their renovation of apartments more efficient. This will allow Willhem to get control of all the goods and know exactly how much is needed for the renovation.

According to the all the companies the daily operations have been improved with IoT technology. When the sensors are connected to any system and companies get correct information the daily operations become easier. And in a time saving manner IoT gives them advantage in that aspect also. As Mattias at HFAB said about it. "Just the energy costs play a major role in a real estate company, and this means that if all these sensors and control systems were to disappear, the firm would need to budget 20 million more in energy costs". This 20 million are now going to somewhere else at HFAB daily operations and can be relocated to other parts of the company, for example renovation. Eric talks about how IoT innovations can improve the everyday life of their tenants and in the end, it helps them in their daily activities. Castellum’s daily operations have been improved with the help of digital
On the question if the companies believe that IoT can give them better services to customers, all of the companies said that IoT can enable this but in different aspects. Mattias believes that with the help of the IoT solutions, new services will be provided to their customers. He gave examples of this: "A few liters of hot water are used every day in each apartment and if it stays still for a few days, this may trigger an alarm. It may be that an older person is sick and tricked and then there will be an alarm call " and that an ordinary home security alarm can be installed in their apartments. Mattias also said another example, "I have alarm at home in the villa today and it costs 200-300 kr per month so it's a lucrative market". Eric thinks that the key element of IoT for value creation around real estate is to create services that tenants can use and improve their everyday lives. He thinks that what ultimately drives IoT forward is their tenants and that they want to rent or buy digital services of any kind that HFAB provides them. Thus, this will be another set of attracting customers and another way to get another income stream to HFAB. Eric also think about a business model that they sell these services through other partners. Eric said this examples to get better customer services. "Just look at Husqvarna now when they sell a chainsaw they are not only selling chainsaws, but also services that are linked to it. I think we should go another way from just delivering 4 walls and roofs to deliver a housing service. For example, it may contain a bedroom but also a digital refrigerator. " and "If you are living in student apartments and we have a clever solution to ease your everyday life as students. And we provide you with that solution with the help of, for example, a partner to us in Stockholm. This will make you become satisfied and probably you will say to your friends that it is better to stay at our properties then a competitor to us. ". Castellum are currently working with innovative IoT solutions to better their customer services and they are currently working with innovative storage and delivery solutions to their tenants. These solutions will save the tenant money and increase convenience throughout the building. Castellum are also collaborates with new companies that can test their products in Castellum’s real estate and if it is profitable, they can then partner up and they grow together with the new company. Ulf also says “{...} the real estate industry has to start thinking about new courses {...}” and Castellum want to be the driving force in thinking new. Willhem can with the help of IoT solutions enable better customer service due to, sensors that act proactively for errors. Instead of that the tenants needs to make a call to correct an already existing problem. Another solution that Therese talks about is by offering security housing or service functions such as cleaning partners.
5.11 Model for Value Creation in IoT for real estate companies

In Figure 3, the primary value drivers in IoT for real estate companies where getting identified during our analyzes with a within and cross case analysis. Value in this case is defined as the created value from the perspective of the real estate companies. Our model is based on the Amit & Zott (2001) model of sources of value creation in e-business and is influenced by the value chain model from Michael E Porter (2001). The primary value drivers identified are Services to customers, Partnerships, Daily operations and Product improvements are discussed below. We suggest that these are the primary value drivers in IoT for real estate companies based on the research in this study.

![Figure 3 Model for Value Creation in IoT for real estate companies (Made by the authors)](image)

Service to customers
Service to customers was one of the primary value creation drivers identified during this case study. After our data collection can we see that all the companies say that services to customers are one of the primary value drivers in IoT for real estate companies. Amit & Zott (2001) refers complementarities to be that products or service together provide more value than separately. With the services that Castellum has as for example with their innovative storage and delivery services will this emphasizes a value to their tenants. And what Willhem are doing with their “Thinking houses” is that they simplify the everyday life for their tenants. With the real estate companies’ product (housing) together with another firm's products such as delivery services to their tenants. Will their tenants value this more than the product (housing) would be alone (Brandenburger & Nalebuff, 1996). With this kind of aftermarket services with IoT-technology the real estate companies can get a new revenue stream to their company (Kejriwal, Mahajan, 2016). This corresponds to what Eric said about installing digital refrigerator as a service to their tenants which can result in a new income stream. And
with this kind of innovation strategy the real estate companies have found a way to get competitive advantage against their competitors (Del Giudice et al., 2010; Egbu, 2004).

Partnerships

To have partners is crucial for the IoT-solutions to bring value for the real estate companies. All the companies have in one way or another partners regarding their IoT-solutions. Such as, HFAB has with Ecoguard that helps HFAB to gather data from their sensors. And improve their daily operations regarding energy efficiency. Castellum are using partners to help their operating technicians with the ventilation systems. If they encounter any problem, the operating technicians can always call their partners for the ventilation to get help with these problems. HFAB has also thought of a partnership with an alarm company that can help customers if they want an alarm system in their apartment. And as we wrote earlier, Castellum has partnered with another company in their new delivery solutions. Bout of this IoT-solutions can bring a lock-in effect to the customer (Amitt & Zott, 2001). With the new delivery solution and the alarm system, can make the tenants feel safe and their lives become more convenient. When the tenants have this solution they can feel a need for this kind of service and can't live without it and this will make a lock-in effect to the tenant. (Amitt & Zott, 2001). To lock in the customer is crucial because, the transaction costs associated with a transaction with an established customer are lower than it’s with a new customer (Dyer, 1997). The real estate companies own assets and abilities depends on their network structure to the other partners. But, if it works out they create a tactical network that brings value for both of their companies. And this network will give them competitive advantage and value creation which is a lock-in effect (Gulati et al., 2000). Willhem have this kind of network with their renovation partner which work as a tactical coalition thereby is a source of value creation (Gulati et al., 2000).

Daily operations

With IoT-technology the real estate companies become more efficient in their daily operations and they save both money and time according to all the companies. When making every transaction more efficient, a business overall transactions costs can be reduced. With IoT-solutions this happen (Malone, Yates & Benjamin, 1987) and when you implement IoT in the company the transactions will create more value for the firm (Williamson, 1979, 1981). For example, HFAB saves 20 million SEK each year in operating costs according to Mattias at HFAB. This capital can then be carried out in other parts of it's daily business to improve the company. IoT enables real estate companies to focus not solely on cost reduction which have been the case. With the IoT technologies on the progress this enables more efficient building operations (Kejriwal, Mahajan, 2016). The efficiency in the daily operations have also been improved with IoT solutions for Castellum and Willhem. Castellum have improved the information to their drift engineers regarding malfunctions in their apartments. If their tenants have any problem the information about this go straight to the drift engineer’s smartphone and the problem can be fixed much earlier. Willhem have also with the help of their IoT solutions improved their daily operations. "with sensors, it's a lot about seeing where there are savings by actually looking at where things go wrong and who is responsible."
Product improvements

IoT-technology improve the real estate companies’ product (housing) in many different ways and are one of the primary value drivers in IoT for the real estate companies. With IoT solutions the real estate companies can improve for example the buildings climate. This includes the temperature, air quality and lighting. With sensors in the building that collect data, the building can be adjusted to a person or group's references how it should be in their particular room or apartment. The product can also be improved in a way as the real estate companies innovate the business with new services to the customers. As Eric at HFAB said,” I think we should go another way from just delivering 4 walls and roofs to deliver a housing service. For example, it may contain a bedroom but also a digital refrigerator. " Innovation in the real estate companies have been proven as a source of new value to the companies (Teece, 2010). As Amit & Zott (2001) wrote that e-business from around the world have innovating business models. Such as, Foodora that allow their customers to order food i an app from a restaurant and then it's been delivered to you. Castellum can innovate their delivery service even more by for example partner up with foodora and connect their system with foodora. This makes Castellum's tenants feel it's even more convenient to live in their real estate than in other companies. This can also create lock-in effects by having a unique business model for the real estate companies. Willhem can with the help of IoT solutions improve their product with example better customer service due to, sensors that act proactively for errors. And problems can be fixed before the tenants even noticed it. Another product improvements that IoT can help Willhem with are for example by offering security housing.
6.0 Conclusion

In this chapter the most important conclusions from the analysis are presented, as well as the theoretical contributions and practical implications of the study. We also provide suggestions for topics that may be interesting for research further.

This increase of IoT and digitization that takes place around us has created a way for this companies in this study to create value for themselves by using IoT. With the understanding of this, the purpose of this study is to: *Understand how IoT can create value when implemented within real estate companies. And this is expected to result in a model which will provide important information of the primary value drivers when real estate companies considering whether or not to implement IoT.* With the collection of data both in our primary and secondary data did we see a rapid rise of IoT in general, and the interest of this in the real estate market. All the data that we collected shows that that IoT usage in the real estate market will increase over the next years and the people that we interviewed are excited and hopeful on how the future will look in a IoT and real estate perspective.

By collecting the data from the four qualitative interviews with HFAB, Castellum and Willhem. A within and cross case analysis was made to identify patterns of the primary value drivers for the real estate companies in IoT. The analysis lead to the creation of a model with four primary value drivers for the real estate companies in IoT and they are: Services to customers, Partnerships, Daily operations and Product improvements.

With this study, we want to connect the literature regarding IoT and value creation to the real estate market. With our data and literature in value creation and IoT, this study shows what the real estate companies primary value drives in IoT are.

To answer our research question: *What are the primary value drivers for real estate companies in IoT?* A model of the primary value drivers in IoT for real estate companies was made to show the result from our data collection and to answer our research question.

Furthermore,

Using our data in our survey, we see that it is almost as obvious today that real estate companies use IoT in energy efficiency and cost-saving purposes. But with the help of our primary value drivers and innovation, could the real estate companies create comparative benefits to the other companies. As for example Castellum with their new delivery and storage solutions, they meet all four primary value drivers. Then they through a partnership could provide a new service to their tenants that simplify and improve the daily operations for themselves and eventually improve the product for Castellum.

But what our companies in our survey thought was the most difficult with Just IoT. Was to know exactly what data to extract and how to use it to get some value. This may be because the knowledge of IoT is generally too bad in the industry or that the knowledge is allocated in the wrong place for companies to understand.

We also noticed that the real estate industry itself is very late in digitization and that the industry is conservative. We got the feeling that many in the industry think “This is how it always has been, and it will always continue to be like this”. However, this may be possible
now when the Swedish real estate companies can do a bit as they want, because there is housing shortage and housing queues are long. As both Eric at HFAB and Therese at Willhem said that this may now work as a real estate company today, to not digitize and to use IoT. But when the market turns, real estate companies must be prepared.

6.1 Limitations

The results of this study should not be used to generalize the entire Swedish real estate market. This is because it is a qualitative study and that we only studied three different companies. A study of more than three companies would create a higher validity and the result would be more generalizable. Because we have only had Swedish companies in our study. Should not the results be applied to countries other than Sweden. But this can be applied if you enter the real estate companies' situation in the country to which the model is to be applied.

6.2 Further research

With a quantitative study of the primary value driver in IoT for real estate companies will increase the validity of the results and enable the researcher to generalize the results of the real estate companies in Sweden. An additional suggestion is to examine what the primary value drivers are for the real estate companies’ tenants, do this thesis only studying the primary value driver in IoT in the real estate companies’ perspective. A third suggestion for further research are to examine if there are any changes in the primary value drivers for real estate companies in IoT in other parts of the world, for example United States of America and China.
7.0 Reference


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Appendix 1-Interview guide

Introduktion
Vad är din roll på företaget?

Innovation
Hur beskriver ni innovation på Företag X?
Har ni någon innovationsstrategi på företag X?
Skulle du beskriva företag X som en ledare inom innovation eller en efterföljare inom innovation?

Internet of Things
Användar ni IoT lösningar?
Om Nej – Varför har ni inte implementerat/investerat i IoT lösningar?
Har ni en plan för framtida investeringar inom IoT?
Vilka fördelar har/tror ni fått ifrån IoT?
OM Ja – Har ni IoT relaterade mål?
OM Ja – Vad är erat största problem med att komma fram till målen för IoT?

Tekniska aspekter (om de använder IoT- teknik)
Vilka produkter är sammankopplade redan idag?
Vilken slags IoT-teknik använder ni idag?
Fokusera ni på en slags teknik eller på flera?
Har ni kasserat någon teknik idag?
OM ja – Varför?

IT-hantering
Användar ni någon moln service idag?
Vilka problem löser ni med moln tekniken?
Jobbar ni med att samlar data som ni får upp med hjälp av IoT-tekniken?
Vad använder ni er (planerar ni att göra med er) samlade data till?
Visualiserar ni er data idag? Internet/extern?
Har ni den interna kompetensen att utveckla och hantera din egen datalagring, plattform, service och applikationer?

Värdeskapande
Vad tycker ni att nyckelelementen i värdeskapandet i IoT är?
Är värdeskapandet liknande eller annorlunda inom IoT som andra delar av företaget?
Genom IoT, vilka värden tror ni att det skapar när det gäller komfort / flexibilitet inom fastigheten/ företag X?
Genom IoT, vilka värden tror ni att det skapar när det gäller att minska riskerna inom fastigheten/ företag X?
Genom IoT, vilka värden tror ni att det skapar när det gäller tidsbesparinger / kostnadsbesparinger inom fastigheten/ företag X?
Genom IoT, vilka värden tror ni att det skapar när det gäller klimatpåverkan inom fastigheten/ företag X?

Företags infrastruktur
Tror du IoT kan öka kvaliteten på information som samlas in för företag X och varför?
Tror du att IoT kan möjliggöra bättre planering för företag X och varför?

**HR-hating**
Tror du IoT kommer öka det intellektuella kapitalet inom företag X och varför?
Kan IOT det hjälpa er att bättre förstå era anställda och på vilket sätt kommer det att göra det?

**Teknologisk utveckling**
Kan IoT hjälpa er att förbättra företag X:s design av produkt? (Om ja - På vilket sätt?)

**Upphandling**
Kan IoT hjälpa er att förbättra erat arbete med upphandlingar, inköp etc.? (Om ja - På vilket sätt?)
Kan IoT hjälpa er att förbättra företag X:s tekniska aspekter (värme, kyla etc)? (Om ja - På vilket sätt?)

**Ingående logistik**
Tror ni att IoT-tjänster kan förbättra logistiken för inkommande material eller lagring för företag X.
Har ni detta idag?

**Dagliga verksamheten**
Kan IoT-techniken förbättra dagliga verksamhet på något sätt?
Användare ni den här tekniken idag på något sätt? (Ipads till fastighetsskötare etc)

**Utgående logistik**
Användar ni IoT på något sätt i logistiken till kunden? (Fakturor etc))
På vilket sätt?

**Eftermarknad**
Tror du att IoT kan möjliggöra bättre kundservice? På vilket sätt?

**Summering**
Vilken av det senaste delarna tycker ni kommer generera mest värde för företag X?
Fabian Henningsson
International Marketing Student
at University of Halmstad
focusing on IoT and Value creation

Harley Ljungdahl
International Marketing Student
at University of Halmstad
focusing on IoT and Value creation