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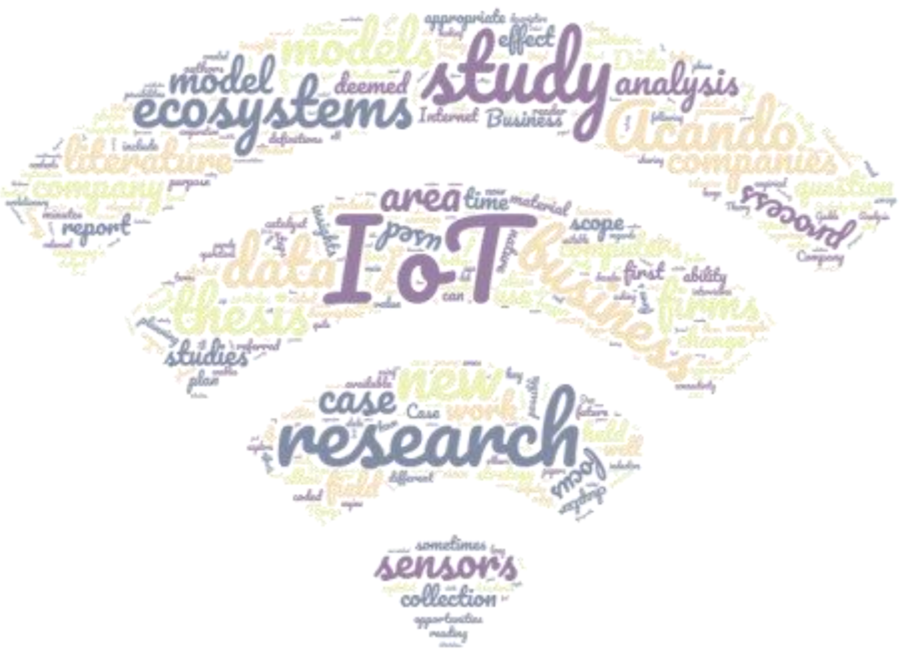

What firms need to consider when adapting their business models for IoT

A multiple case study

Master's thesis in the Master's Programme
Management and Economics of Innovation

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Preface

This master thesis was written in the spring of 2017 in collaboration with the consulting firm Acando. We the authors, Daniel Chiniquy and Anton Skoglund, are aspiring engineering students in Industrial Engineering and Management at Chalmers University of Technology. In this thesis, we hope put our knowledge gained over the past 5 years to good use.

During our work, we have gained many insights to the field of IoT and how new technology affects firms. We feel that the analytical toolbox provided by our university has been plentiful and helped us to write the thesis in a timely and qualitative way.

We would like to thank all the friendly employees at Acando, our supervisor Helena Ljubicic and Lars Sigfridsson at Acando for their input and support and our sponsor Magnus Dahlbäck for all the inspiration and motivation. We would also like to thank all interviewees, internal and external and all the people that made this thesis possible.

Furthermore, we would like to thank our academic supervisor Charlotta Kronblad for valuable insights and support throughout the process. As a final note, we would also like to thank Christian Sandström, head of the master's program Management and Economics of Innovation for never ending inspiration and a solid foundation acquired during the years, and of course Chalmers University of Technology for 5 fantastic years coming to an end.

Gothenburg, May 2017

"I have no special talent. I am only passionately curious"

- Albert Einstein

Daniel Chiniquy Engström   Anton Skoglund

Abstract

Title:	What firms need to consider when adapting their business models for IoT
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The possibilities with IoT seem endless, but even though new technology is developed and firms know what needs to be done, it is not so simple to transform an entire business. On behalf of the consulting firm Acando we have been assigned to study the effects of digitalization on firm profitability, with a focus on Internet of Things (IoT) and its effect on firms' business models. This study focuses on the transformation that companies might go through when adopting IoT, by performing a multiple case study of a descriptive and exploratory nature. Three companies have been studied, with qualitative semi structured interviews being performed. Companies were selected in cooperation with Acando based on IoT proficiency. A systematic combining approach to the work structure has been used, with literature studies and case studies taking place side by side. The Business Model Canvas (BMC), institutional theory and network theory have been used as theoretical frameworks to analyze the results, which led to the following valuable insights: The business model change resulting from IoT is highly variable and depends on the earlier context of the firm, but information infrastructure and proper adaptation of key activities are necessary to generate value from IoT. Firms can also benefit from IoT ecosystems through partnerships and data-sharing, but they need to consider the implications of institutions such as laws, regulations and norms.

Keywords:	IoT, Internet of Things, Business models, IoT ecosystems, Business Model Canvas, Data-sharing, Institutions, Partnerships

Contents

Introduction

In this chapter the background for the thesis is described, followed by the problem description, research problem and purpose of the thesis. After that the delimitations and disposal of the thesis are stated.

Background

Computers and the use of information technology are among the most important innovations since industrialization and have fundamentally changed the way we go about our daily lives. The use of computers and digital technology have enabled information to flow free in real time and created new products and markets in a faster pace than ever, and we now use products and services that were unthinkable just decades ago. Today, computers do not only play a central role in businesses, but are the driving force behind development in the world, both in terms of new products, but also when it comes to human development and disease prevention for example. (El-Darwiche, Singh and Ganediwalla, 2012)

In the industrial setting, the adoption of computers in industry first took the form of digitization, where information in the firm was converted to a digital format. Later followed digitalization, where computers played a bigger role in managing the data and eventually substituted manual processes in some areas. (Kreiss and Brennen, 2014) Today, computers are at the very heart of many firms, both in terms of the product or service offered, but also in the firm’s strategy and operations. The process has transformed entire industries over decades; Stock exchanges have become digital and grocery shopping have recently entered the digital era.

Today, microprocessors and digital sensors have developed and can be integrated in everything from engines to diapers. Sensors can communicate with other sensors and computers to send and receive information. The sensors that are connected to the internet or a network in some way make up the “Internet of Things”, hereinafter referred to as IoT. The sensors that are referred to as IoT sensors come in different shapes and forms. Some measure pressure or velocity, while others sense the current position of an item for example. The limitations are almost non-existent, as long there is a physical state that can be measured. These sensors could have been put there a long time ago, and recently got connected, while other sensors are newly developed to leverage the new possibilities that connectivity enables. The technology that enables sensors to connect to the internet has been around for many years. With recent development, the technology is now widely available and connected sensors can be found in more and more settings. The figure below demonstrates this explicitely.

Figure 1: Illustrative example of IoT (Wikimedia Commons)

The saying; “There is more computing power in today’s cell phones than in a space shuttle in the 1960’s” elegantly paints a picture of how fast computer technology has developed (Grossman, 2017). Thanks to Moore’s law, computers and technology with transistors are better, faster and smaller than ever imagined (Moore, 1965). With sensors positioned virtually everywhere, we can now measure data that was unattainable before. Data extracted from this technology could further support development and entirely change the way the firms do business. The undergoing change is sometimes referred to as industry 4.0, taking after the earlier phases with lean production, outsourcing and automation that is the industrial standard today and changed the industry tremendously at the time (Baur and Wee, 2015).

This development creates new opportunities for firms, and new markets are created every day thanks to developing technology. Firms grab this opportunity naturally, as the capitalist market is evolutionary and firms’ ability to reach for new markets is the fundamental impulse for the capitalist engine (Schumpeter, 1943). In this evolutionary development, some firms struggle with staying competitive and profitable while others embrace the change and use it as a catalyst for growth.

Problem description

With IoT as an additional catalyst for development in the industrial setting, firms are more than ever prone to defend their position and change their ways of doing business. IoT affects companies’ business models to various degrees, and sometimes changing them fundamentally (Dijkman et al. 2015) (Arnold, Kiel and Voigt, 2016). Studies in the area are currently in an exploratory state and are still finding its way forward (Dijkman et al. 2015). Future studies could complement the area by further investigating IoT and business models in different approaches, and especially study how firms can co-create value in ecosystems by sharing IoT-generated data with each other (Arnold, Kiel and Voigt, 2015)

The possibilities with IoT seem endless, but although the stars seem aligned for new IoT projects, it is not quite that simple to transform an entire business. Firms experience struggles within the organization to execute and uncertainties whether they should outsource new activities or not. Furthermore, firms experience concerns about data-sharing and data security, and sometimes they do not see clear business cases to invest in with new technology (McKinsey Digital, 2016). These institutions could influence how new technology is implemented and how business models are developed with regards to IoT. How exactly these institutions matter in relation to business model development and IoT implementation is hard to say, and Peng et al. (2009) suggests that that the area in general needs further research and that it should play a bigger role in forming company strategy.

Purpose and research question

On behalf of the Swedish IT and management consultancy firm Acando we have been assigned to study the effects of digitalization on firms, with a focus on Internet of Things (IoT) and its effect on firms' business models, which captures one of the biggest trends in digitalization today. Our aim is to study firms' ability to change their business model to fully exploit IoT and to help them utilize IoT in their business models more effectively.

This leads to the research question:

What do firms need to consider when adapting their business models for IoT?

IoT and its effect on business models is quite a new area due to the young age of the technology, therefore research in the area is quite new and not very comprehensive. Earlier research tends to focus on specific areas, like *if* business models change and *what* changes occur. We hope to broaden the knowledge and contribute to research by setting the focus on the *process* of the change IoT might bring, and what firms should consider when adapting their business models for IoT. Also, having a process based focus makes the research more actionable and applicable for practitioners in the field.

Delimitations

The study focuses on the transformation that companies might go through when adopting IoT rather than the technology in IoT itself. Therefore, the report will not focus, nor explain the technology more than necessary since it might be to technical for the uninitiated reader.

In regards to the definition of Internet of Things, it will include different interpretations in the area such as “Internet of Everything” or “Information of Everything” that are neighboring definitions that are used in research. These definitions are sometimes used to emphasize the connectivity between all connected devices or that information from connected devices is the value driver. In the report, IoT will be considered to include these definitions, and since the focus is not on the technology itself, IoT will be considered as the changing agent, or catalyst in firms.

Disposal

The report is structured into six major parts:

- Introduction
- Methodology
- Literature
- Case descriptions
- Analysis
- Conclusion

The report starts by introducing the reader with the subject, explaining the background and why the area is of interest. The introduction also includes the problem description as well as the research question that are to be answered in the analysis and discussion part of the thesis. Following the introduction is the methodology chapter which describes both the work process and the research design used for the study. This is followed by the literature chapter which lays out the theoretical frameworks used to answer the research question. After literature comes three case studies based on interviews with representatives for each company. The information from the case studies is then analyzed, using the theoretical frameworks, in the analysis chapter, after which the overarching themes and insights are discussed in the discussion chapter. Finally, in the conclusion chapter, the main findings of the paper are presented, together with a short discussion on credibility, academic contribution and recommendations for further research.

Methodology

In this chapter the methodology used in the thesis is described. First the work process is described, followed by the research design. The research design includes sampling, data collection, literature study and data analysis.

Work process

The work process for this thesis is divided into four main steps that are progressed through in a linear but overlapping manner. The four steps are planning, research, analysis and presentation, as demonstrated by the figure below. Through all these steps reading of theories has been integrated as well as constantly writing on this thesis.

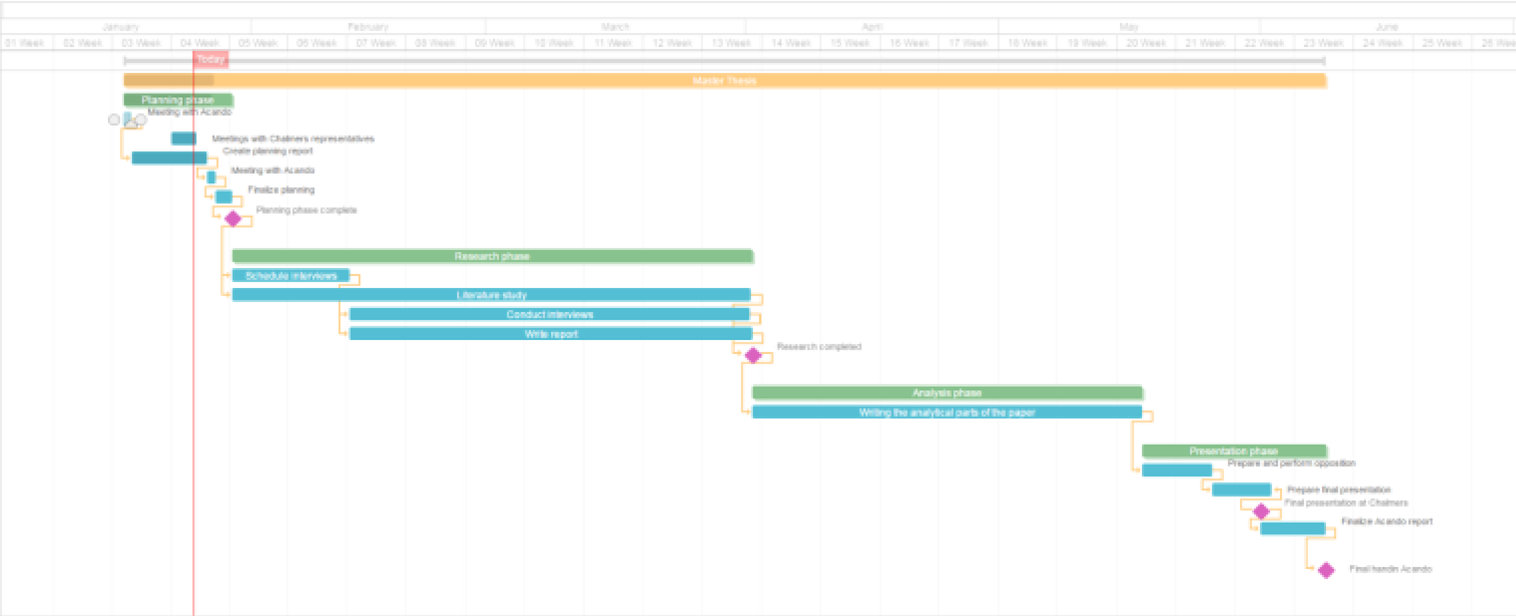

Figure 2: Time plan developed during the planning phase

The thesis was initiated in cooperation with Acando, and was to be focused on the area of IoT, but the research question was not explicitly stated to begin with. Thus, the first weeks were dedicated to reading academic papers on IoT and its effect on businesses, talking to experts in the field, and asking new questions about IoT with the purpose of defining the scope of the study. Whilst this was underway, a planning report was made to structure the work and provide a preliminary time plan. No plan survives first contact with reality, but overall the above time plan has been followed quite closely. The scope of the study was decided, in cooperation with Acando and Chalmers, to focus on what considerations are necessary when adapting a business model for IoT. This scope is purposefully vague enough to allow the research and data collection to dictate the direction of the study as new data is discovered. Once a suitable scope of the thesis was selected, a fitting research approach was required, the details of which are described below.

Research design

This thesis is a multiple case study of a descriptive and exploratory nature, meaning that a research question has been stated and explored with the knowledge that this research question may change based on insights acquired throughout the study (Easterby-Smith, Thorpe and Jackson, 2015). These types of studies are well suited to base further studies on whilst also providing useful data to further the knowledge of the field (Krishnaswami, 2010). The beginning of the work on this thesis has been descriptive, as the focus was first to describe and understand both the companies in question and the literature underlying the area of IoT and business models. After the data was collected and described the work transitioned to an exploratory focus, with the goal of uncovering insights based on the data gathered through the case studies. As unexpected data regarding key partnerships, institutional boundaries and data-sharing ecosystems emerged in the case studies, the opportunities and challenges in these areas were investigated and described, this is detailed further in the “Analysis” chapter.

This study is neither purely deductive nor purely inductive in nature. Deductive research is aimed at testing theory, while inductive research aims to discover new theory through new data (Krishnaswami, 2010). This study uses systematic combining to move back and forth from theory and practice. Systematic combining is a process where theoretical framework, empirical fieldwork, and case analysis evolve simultaneously (Dubois and Gadde, 2002). This approach is deemed appropriate due to both the limited time available for the authors to conduct the research, as well as the inherent uncertainty in the field of IoT and its effect on business models.

As this thesis is a multiple case study, qualitative methods are appropriate, with in-depth interviews as the main source of data (Krishnaswami, 2010). This is appropriate in part due to the complex and quickly evolving nature of IoT, evident by the young age of the sources used in this thesis. A framework of questioning was used by asking open-ended questions and allowing the interviewee to talk, but making sure each of the points in the framework were covered before moving on, a so called semi-structured approach (Krishnaswami, 2010). This framework is available in the appendix.

Sampling

Companies for the case studies were chosen who were deemed, after discussions within Acando and after online research, to be sufficiently proficient with IoT for it to have had an impact on their business models. Due to constraints in traveling opportunities as well as business contacts, the companies chosen all had offices in Sweden. Interviews were held with high ranking members of each company, all of which possess intimate knowledge of the company’s strategy and operations within the area of IoT and digitalization. This means the sample is theoretical, as the cases are selected due to them fitting in to the research aim and the selected theoretical frame. Company A is a small technology company that operates in the railroad management industry. Company B is a medium sized company that provides technological mobility solutions in the healthcare industry. Company C is a large manufacturing company that provides machine parts for use in industrial applications. These companies are sufficiently different, both in terms of size and industry, to allow them to be contrasted in the analysis.

Data collection

Semi-structured Interviews with three companies were held to gain insight into how these companies work with IoT, and how this work has impacted their business models in the past and present, as well as possible implications for the future. The interviews were all conducted in Sweden, although they were conducted in both English and Swedish. Due to the uncertainty inherent in these types of studies (Krishnaswami, 2010) the questions for the interviews were purposefully kept wide enough to allow for a wide set of data covering a large area, allowing a shift in focus during the analysis phase if needed. If one wants to know how the management of a company truly thinks, qualitative interviews are required (Krishnaswami, 2010). Interviews provide a depth that is otherwise very tough to reach. As this study is partly of an exploratory nature, meaning it intends to understand and uncover the inner workings of the area, qualitative interviews are appropriate (Easterby-Smith, Thorpe and Jackson, 2015). Interviews were held in person when possible and over the phone when the distance did not allow for an in-person interview. The interviews lasted from 60 minutes to 80 minutes and were recorded using a smartphone and subsequently transcribed manually into a shared cloud service. After interviews were conducted, transcribed and coded, the work shifted to analysis and insight generation, attempting to answer the research question based on the data gathered throughout the study. All throughout this process relevant articles, often recommended by experts in the field, have been read to further the authors knowledge of the field.

Literature study

In parallel with the interview process a literature study was conducted to allow the authors to better understand the field of IoT, business models, institutions and data-sharing ecosystems. Literature was gathered from the following sources:

- Chalmers online library service, allowing the download of academic papers and articles
- Google Scholar, a search engine for academic journals, books and articless
- Web sites of consulting firms and companies
- Books on research design and methods
- Presentation material from experts in the field of IoT

The literature study was conducted continuously throughout the project, with a peak in activity in the first two months. The process of studying literature entailed reading the material, talking to experts and discussing the findings at length to gain a deep understanding of the material. The literature on IoT and its effect on business models is scarce and incomplete, and as such the purpose of this thesis to explore this area was judged to be suitable.

Several theoretical frameworks have been found in the literature study and been used for analysis of the gathered data. These frameworks include Osterwalder and Pigneur's (2009) Business Model Canvas (BMC), Porter and Heppelmann's (2014) model of IoT expansion of industry boundaries, North (1990) and Scott's (1995) combined models of institutions, and Tuten and Urban's (2001) model of company relationships. These models are described in further detail in the literature study section of the thesis, and are used extensively in the analysis.

Data analysis

After collecting data through interviews at the case companies, the transcribed interviews were color coded per the following system:

- Green: Information on the company history and history of the interviewee.
- Yellow: IoT use in the case company.
- Blue: Business model effects.
- Pink: Data and data-sharing.

The coding system allowed the structuring of information for describing the case in the "Case Descriptions" chapter of this thesis, while also allowing a simplified cross-referencing between cases. After thoroughly describing each case using the gathered and coded data, brainstorming sessions were held to generate key insights. Once key insights were identified, the complete transcripts were combed over to find any evidence for or against this insight. Since the number of transcribed interviews were limited to three, color coding was arguably just as efficient as any computer aided program. Also, the color coding aided in making the empirical material visual which aided in finding patterns and deviations.

Literature

In this chapter the literature and theoretical models used in the thesis are explained, starting with business models and IoT, moving on to industrial networks and partnerships, followed by IoT ecosystems and data-sharing, and finally describing institutional theory.

As the research question of this thesis is a highly complex problem with sparse amounts of studies to use for guidance, a holistic approach is used in literature selection, with both macro and micro based theoretical models. The Business Model Canvas allows a micro-level analysis, while theory on partnerships and institutions allow a macro-level analysis. Also, theory on networks and ecosystems allow for a meso-level analysis in between the micro- and macro-level.

Business models and IoT

To understand the implication of technology changes in the firm it is necessary to understand what a firm is and how it works. Magretta (2002) defines a business model as "the way the firm works". More figuratively Magretta puts it to words as "at heart, stories - stories that explain how companies work". Drucker (1994) did not mention business models as we know them today, but asked questions that are comparable, such as: Who is the customer? And what does the customer value? According to Drucker (1994), a description of a firm should also answer the fundamental questions every manager must ask: How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost? Over time, several frameworks for these stories and questions have emerged, or rather frameworks for business models; OGSM, Component Business Model and Business Reference Model to name a few. In 2009, Osterwalder and Pigneur released a framework called Business Model Canvas (BMC) that aims to describe the rationale of how an organization creates, captures and delivers value (Osterwalder and Pigneur, 2009). Business Model Canvas has since been widely adopted both among practitioners and in academia and is often used as reference point to describe a company when talking about business models.

The Business Model Canvas, as seen below, describes the firm by dividing it into nine areas that covers customers, offer, infrastructure and financial viability - the main areas of a business (Osterwalder and Pigneur, 2009).

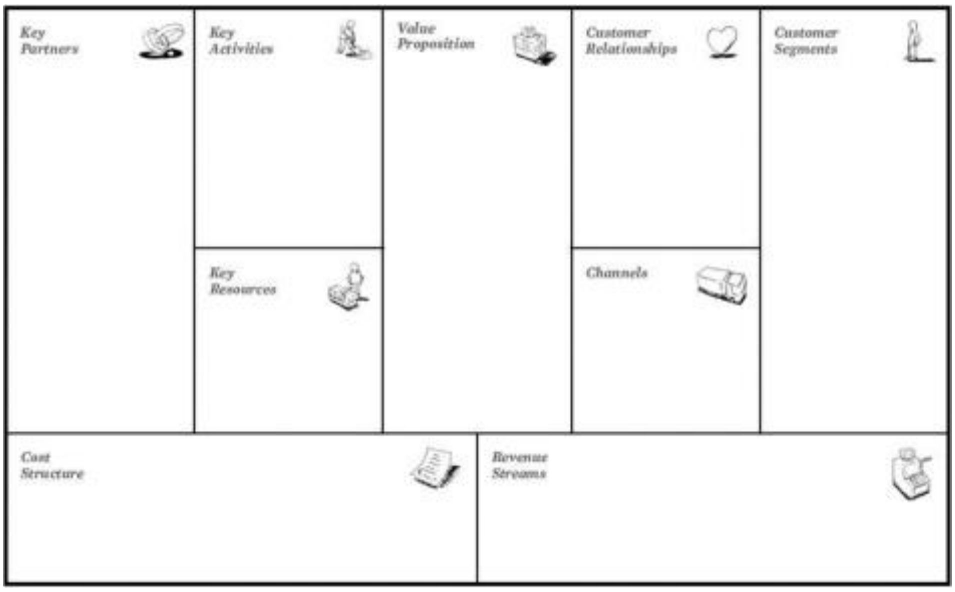

Figure 3: Business Model Canvas (Osterwalder and Pigneur, 2009)

To get a better understanding for the Business Model Canvas, it is useful to discuss the areas and define its boundaries. As a complement to the Business Model Canvas in the IoT area, Dijkman et al. (2015) used the canvas as a basis for how IoT affects it after adoption. Although every finding in a Business Model Canvas might be unique to a specific firm, Dijkman et al.'s (2015) research shows that on an aggregated level all areas were affected by IoT.

Customer Segments

Customer segments refer to customer groups with common needs, behaviors or other attributes that are reached and served by the organization. Segmentation can be done either by products, markets or customers among others and aims to clarify which types of customer a company has. (Osterwalder and Pigneur, 2009) The simple question is really "Who buys the stuff a company makes?" Innovation or new products might cause business model innovation to change customer segments, together with other fields in the BMC. (Laudien and Daxböck, 2016). In an IoT perspective, Dijkman et al. (2015) argues that multi-sided and or niche markets might occur due to the entrance of IoT related products. As IoT is an innovation, innovations can lead to new products, and segmentation can be made on a product basis, there is an argument to be made that customer segments might change due to the use of IoT (Dijkman et al. 2015). However, it is unclear whether IoT adds segments or changes the way a company segments.

Value proposition

The value proposition describes the bundle of products and services that create value for a specific customer segment; it is the reason a customer chooses one company over another (Osterwalder and Pigneur, 2009). Arnold, Kiel and Voigt (2016) saw changes in value proposition in approximately 90% of companies after IoT was introduced in a firm, however, since the value proposition consists of factors such as performance, new value dimensions are not necessarily always introduced; Existing ones can also be improved (Dijkman et al. 2015). Since IoT enables more data to be created (Jernigan, Kiron and Ransbotham, 2016), the value proposition tends to change in a data driven direction where convenience and the ability to "get the job done" is improved due to increased data transparency. The improved flow of data also gives the possibility for updates to continuously improve the product and correct software bugs. (Dijkman et al. 2015)

Channels

Channels describe how a company communicates with and reaches it customer segment to deliver its value proposition through a mix of communication, distribution and sales channels (Osterwalder and Pigneur, 2009). Since channels varies with the product, it is hard to say that IoT generally changes channels into a certain direction, according to Arnold, Kiel and Voigt (2016), channels and customer segments were among the least changing areas among companies in relation to IoT. However, web-based sales could be more prevalent due to the increased data that IoT enables. (Dijkman et al. 2015)

Customer relationships

Customer relationships describes the types of relationships a company establishes with specific customer segments, ranging from personal to automated (Osterwalder and Pigneur, 2009). With IoT entering the firm, many tasks are becoming more and more automated, this enables customer relationships to be more automated with factors of self service. Another factor to consider is cocreation of value that occurs when two firms share data that can be beneficial for each other (Dijkman et al. 2015). In that sense, customer relationships could evolve with IoT through interconnection between firms to entire ecosystems that itself can add value and change business models further. (Porter and Heppelmann, 2014)

Revenue streams

Revenue streams are how the company makes money from its customer segments. It is possible to generate multiple revenue streams from the same customer (Osterwalder and Pigneur, 2009). When IoT changes the value proposition in a firm, new or changed revenue streams might occur, like subscription or user fees (Dijkman et al. (2015). With more data accessible it is possible to form revenue streams based on the problem a certain product solves. As an example, Dahlin and Lindgren (2016) sees possibilities to charge for the uptime of a product, rather than subscriptions with service fees, which incentives the firm to deliver as much value as possible. IoT could enable this with predictive maintenance or shared data for example (Dahlin and Lindgren, 2016).

Key resources
Key resources are the physical, financial, intellectual and human resources a company requires to create and offer its value proposition to its customer segments and earn revenue. Key resources can be owned by the company or acquired from key partners (Osterwalder and Pigneur, 2009). With IoT entering the firm, intellectual property such as software and data becomes more important as a resource (Dijkman et al. 2015). For an IT company, however, changes might be smaller and more concentrated to the data generated through IoT since software is present already. Based on the firm's activities, employee competencies as a resource could possibly change to match new activities and become critical to support those activities (Dijkman et al. 2015).

Key activities
Key activities are what a company must do to make its business model work. They are often dependent on the company's key resources (Osterwalder and Pigneur, 2009). Depending on a firm's resources, new activities might be necessary both for implementing, developing and sustaining the new technology. IT-savvy companies are naturally closer than industrial companies in its initial activities, and do not have to change to the same extent. According to Dijkman et al. (2015), software and product development activities changes are more prevalent when firms start with IoT. Changes to logistics and sales are also natural as more parts of the company and the value proposition are becoming digital. (Dijkman et al. 2015) Arnold, Kiel and Voigt (2016) suggests that core competencies, which is similar to key activities in Osterwalder's and Pigneur's (2009) Business Model Canvas, is the factor that changes in most cases when business model innovation occur due to IoT.

Key partnerships
Key partnerships describe the networks of suppliers and partners that make the business model work. These partnerships can be either strategic alliances, coopetition, joint ventures or buyer-supplier relationships (Osterwalder and Pigneur, 2009). Related to key activities and key resources, key partnerships tend to change depending on the firm's changing activities. Arnold, Kiel and Voigt, (2016) saw that partnerships changed in approximately 60% of the cases, lower than the change that affected competencies (approximately 95%) which could indicate that companies tend to do things by their own. New partnerships usually include software, hardware and data analytics (Dijkman et al. 2015), but could also include partnerships in the value chain or the ecosystem as Porter and Heppelmann suggests (2014).

Cost structure
The cost structure describes all the costs associated with running the business model (Osterwalder and Pigneur, 2009). The cost area in BMC should not be confused with the potential lowered cost to customers in the value proposition. While IoT can help lower the cost for customers it may result in demands for other activities within the own firm

(Osterwalder and Pigneur, 2009), (Dijkman et al. 2015). Depending on industry, more IoT could mean more IT resources consumed as the cost structure is closely related to the firm's activities, on the other hand can sensors and automation lower the need for manpower and lower production costs (Dijkman et al. 2015).

The BMC is interconnected
As seen above, most areas in the Business Model Canvas are related to each other. As an example, the activity of a firm impacts which partners to cooperate with or what resources are needed to succeed with the new activities. The opposite would also be a good example: new resources (i.e. IoT technology) and new partners could enable the company to change its activities. When analyzing a company with help of the canvas, it is necessary to understand this dependency and understand that a firm is a complex entity and not quite as simple as the BMC might suggest (Osterwalder and Pigneur, 2009). In the context of IoT, Dijkman et al. (2015) and Arnold, Kiel and Voigt (2016) suggests that most areas of the business model are affected by IoT, however, areas in the business model might just be improved rather than adding entirely new dimensions (Dijkman et al. 2015). One should also remember that IoT does not bring the same changes to all firms, and that the IoT proficiency within the firm sets the bar for what is achievable (Porter and Heppelmann, 2015)

Industrial networks

In a free market, firms can decide whether they want to outsource their activities or internalize them entirely. In a network based view, both extremes are combined in a way where companies interact with each other in extended partnerships for some of its activities, whereas other activities are still conducted in-house at the firm's own discretion (Powell, 1990). In a network based view, partners and activities are more dependent on factors outside the firm, and therefore it is important to take the network into consideration when forming strategic outlines for the firm (Gadde, Huemer and Håkansson, 2003). Furthermore, the competitive aspect of strategy becomes less important as firms tries to create value together (Gadde, Huemer and Håkansson, 2003).

Firms engaging in networks could reap benefits by lowering transaction cost as defined by Coase (1937) and find new value together with partners in the network (Gadde, Huemer and Håkansson, 2003). However, firms acting in networks could experience resource dependency that could hinder or impair them from pursue other activities or possibilities. (Gadde, Huemer and Håkansson, 2003). Furthermore, the network itself could suffer from issues like collective action problems, where actors in the network fail to act due to low incentives for each one of the actor in the network to take action or change direction (Glasmeier, 1991). Even though networks could create unwanted effects, there is no doubt that firms benefit from cooperating with each other, however, they should have knowledge about the implications (Gadde, Huemer and Håkansson, 2003).

Partnerships

Business to business partnerships are formed for the following perceived benefits according to Tuten and Urban (2001): Desire for lower costs, providing increased service, enhancing competitive advantage, improving performance indicators and increasing product/service quality. The benefits a company hopes to gain, and the actual benefits accrued after a partnership is entered, can differ substantially (Tuten and Urban, 2001). The actual benefits of the partnerships can sometimes be in unexpected areas such as word of mouth advertising. There is oftentimes a difference between expectation and reality.

Tuten and Urban (2001) describes three key factors for a successful partnership: improved communication, trust/honesty/fairness and satisfactory performance indicators. Both suppliers and buyers need to express clearly and honestly their goals and expectations if the partnership is to become successful. This view is shared by Mohr and Spekman (1994), who found that trust and commitment are important factors for the success of partnerships, as it helps quell fears of opportunistic behavior. Unsuccessful partnerships on the other hand are characterized mainly by a poor relationship between the partners (Tuten and Urban, 2001), meaning the partnership lacks trust, reliability, honesty and fairness. For a successful partnership, communication is key.

Entering a new partnership for a business can be tough, and may entail a significant change in corporate culture for the buyer and the supplier (Tuten and Urban, 2001). Joint participation and the openness it requires puts pressure on management to develop communications skills and learn to accommodate its traditional concern for decision autonomy (Mohr and Spekman 1994).

Partnerships are an important part of the BMC (Osterwalder and Pigneur, 2009), and as such it is important for companies to put proper consideration to both its own antecedents regarding a new B2B partnership (Mohr and Spekman 1994), but also to continuously evaluate the partnership (Tuten and Urban, 2001). As IoT adoption has the potential to change the key partnerships of the BMC (Arnold, Kiel and Voigt, 2016), it is vital for management to have a deep understanding of how partnerships work when attempting to implement IoT into their companies.

IoT Ecosystems

The use of smart, connected products offers capabilities that have the potential to transcend established industry boundaries (Porter and Heppelmann 2014). This occurs as the basis of competition shifts from discrete products, to product systems consisting of closely related products, to systems of systems that link an array of product systems together. A company producing tractors may find themselves moving from competing in the tractor industry, to the wider farm automation industry, with smart, connected machines receiving live weather and irrigation data to optimize the output of the whole farm.

In the context of the firm's offering, every product should be made to address a certain need, or to complete a certain 'job' (Christensen et al. 2007). A farmer buys a tractor to assist him in, for example, tilling and transportation. Those jobs, in turn, lay behind the primary need, to have a large harvest from his farm. If there existed a single product that could solve the job of maximizing the total output of the farm, one can imagine farmers would be very willing to buy that product. However, that product does not yet exist, and as such, farmers are forced to divide that job into several smaller jobs to be done, such as tilling, planting seeds, harvesting and irrigation. With the introduction of smart, connected products, the tractor that was once for sale as a solution for the job 'till the soil' is now for sale as a component of a larger farm equipment system, including tractors, planters and combine harvesters. The integration of these products into larger product systems can enable better overall equipment performance, and is a clear trend in industries with IoT adoption. (Porter and Heppelmann 2014)

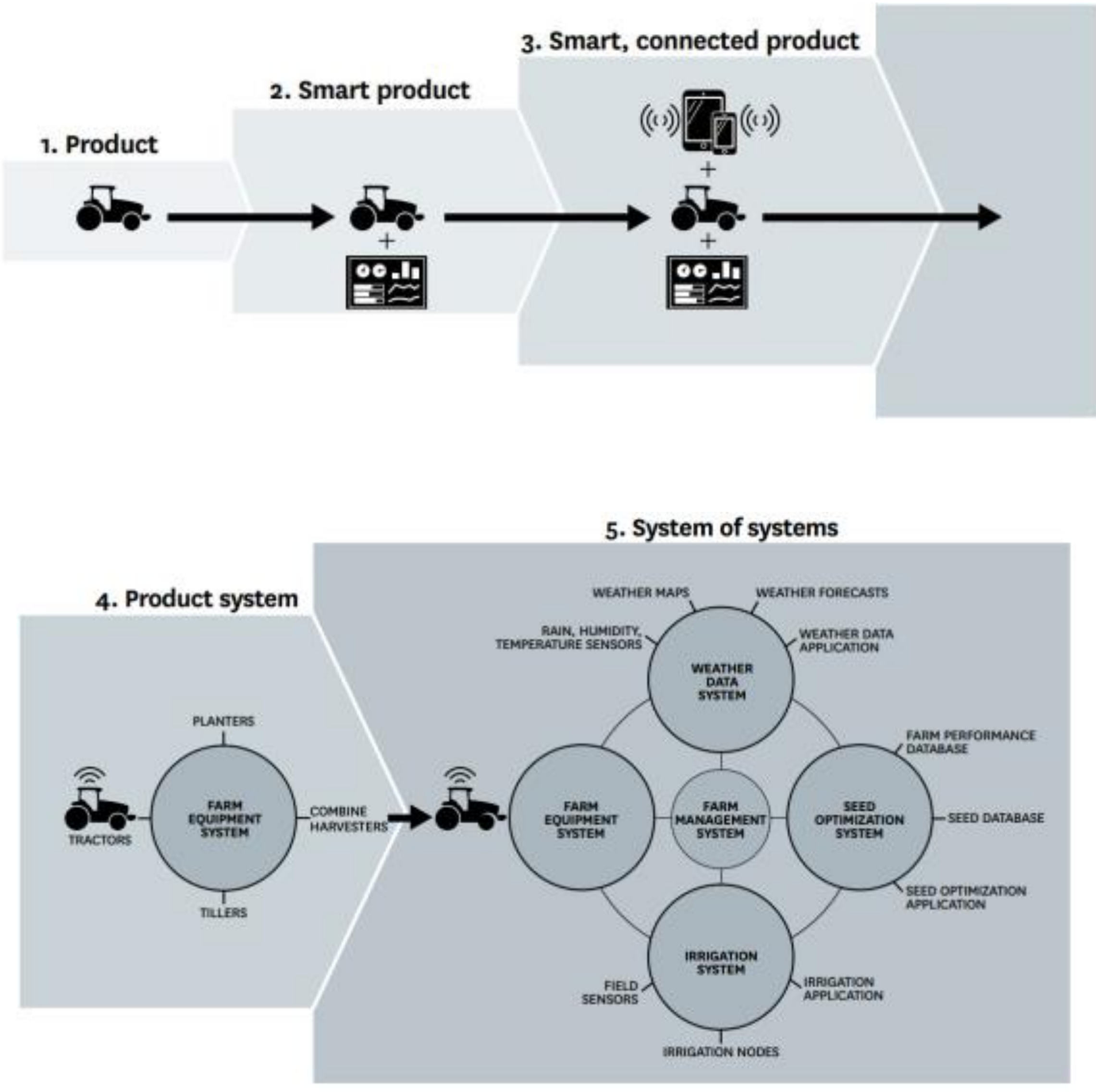

Figure 4: A description of the expanding industry boundaries produced by IoT use (Porter and Heppelmann, 2014)

The farmer previously mentioned now has a farm equipment system for his farm equipment, a weather data system to help predict weather patterns, a seed optimization system to analyze and optimize what seeds to plant and where to plant them, and an irrigation system. These systems were all previously divided into smaller jobs, but the benefits of aggregated data and automation (Porter and Heppelmann 2014) have led to an increasing unity in the products the farmer is using. The next step is to join these product systems together into a total farm management system with all the product systems communicating and synergizing with each other, as is illustrated in the figure above. At that point the "farm management system" product solves his main need of maximizing farm output. (Porter and Heppelmann 2014)

Expanding firm activities outside the boundary of the industry is not without risks. Adner and Kapoor (2016) describes the risks of an organization transitioning to new technology too fast for its ecosystem to handle. Adner (2006) defines it as integrations risk, the risk of having the solution adopted across the value chain. Furthermore, Adner (2006) identifies interdependence risks and initiative risks. Interdependence risks is related to the interdependence of other actors in the ecosystem innovation process, while initiative risks are related to the project itself and its possibility to be accomplished. (Adner, 2006) As an example, it is important not to let new technology blind the organization, lest they be struck by the "Right tech, wrong time" syndrome, a common integration risk defined by Adner (2006) and Adner and Kapoor (2016) Despite these risks, partnering up to improve an organization's chance of innovating in an ecosystem is a well-established success factor (Furr, O'Keeffe and Dyer, 2016).

Data-sharing

The internet of things gives birth to big masses of data, but not all data is available to those who can use it for value (Jernigan, Kiron and Ransbotham, 2016). Data can be stored in silos, and held onto as a form of data protectionism. A producer of a wearable health application would likely be interested in receiving information on the user's diet, the weather at the user's location and other relevant information, but this is not always possible. Sometimes laws and regulations prevent it, but often it is companies or users themselves who are not willing to give up the information (Jernigan, Kiron and Ransbotham, 2016). At the same time, the organizations who have the most commercial success with their IoT investments are those who share data with other organizations, including suppliers, customers and competitors (Jernigan, Kiron and Ransbotham, 2016).

Sharing data with other organizations has some issues that managers would do well to consider. First off, security. As organizations cooperate and become more and more interdependent they become reliant on each other's security systems; Weakness in one system means weakness in the others. Secondly, the accuracy of the system is important for the organization using the data. If two competitors share data, and one decides to provide manipulated data to the other, then that could have serious financial consequences. The same is true if hackers manage to access and manipulate data, which could lead to faulty analysis for the organizations using the data (Jernigan, Kiron and Ransbotham, 2016). This issue of integrity of data has been emphasized heavily by consultants (McKinsey Global Institute, 2015) and is something companies are still not taking seriously (Jernigan, Kiron and Ransbotham, 2016).

Another data-sharing issue is identifying who is responsible for developing, monitoring and adjusting the data-sharing practices used in the IoT network. When should data be shared? And who does the data ultimately belong to? How do disputes get handled? These questions are important but difficult, and are made even more so by institutional barriers such as laws, regulations and organizational habits (Jernigan, Kiron and Ransbotham, 2016) (North, 1990).

To prevent IoT from becoming the "Insecurity of Things" it is important to have proper security in the IoT devices and protocols used by an organization (Saito, 2017). Despite many companies realizing the importance of security, few companies see security is an important issue (Jernigan, Kiron and Ransbotham, 2016) (McKinsey Global Institute, 2015). An obvious and terrifying example is that of self-driving cars; if a nationwide fleet of self-driving cars were hacked and its brakes turned off, the results would be disastrous. Getting security right is challenging, but vital.

Institutions

Institutions are regulative, normative, and cognitive structures and activities that provide stability and meaning to social behavior (Scott, 1995), or more informally described as the rules of the game in a society - the humanly devised constraints that shape human interaction (North, 1990). Institutions can be divided into formal and informal institutions (North, 1990), as seen in the figure below, where formal institutions include laws, regulations and rules and are supported by regulative power and Informal institutions which include norms, cultures and ethics which are backed by normative and cognitive power (Scott, 1995). An example of a formal institutions would be if a law came into place that requires a company to provide financial information to the public, whereas an informal institution could be if a company made it a habit to pay for IT systems through a lump sum and must overcome that habit to purchase from a supplier that wants to sell through a subscription based model instead. Informal institutions might not be as visible, but are nevertheless important for companies to consider (North, 1990) (Peng et al. 2009).

Degree of Formality (North, 1990)	Examples	Supportive Pillars (Scott, 1995)
Formal institutions	• Laws	• Regulative (coercive)
	• Regulations	
	• Rules	
Informal institutions	• Norms	• Normative
	• Cultures	• Cognitive
	• Ethics	

Figure 5: Formal and informal institutions (Peng et al. 2009)

Institutions govern the firm in many ways, whether we like it or not and it is important to consider the formal and informal rules of the game when making strategic choices (Peng et al. 2009) In relation to IoT, formal and informal institutions might play an important role to both bolster and inhibit development. New laws might open for new business opportunities (Drucker, 1985), while for example company culture or formal regulations could inhibit changes of activities or partnerships in the firm that Dijkman et al. (2015) and Arnold, Kiel and Voigt (2016) describes in IoT-related business models. Companies implementing IoT experience coordination problems across the organization and sometimes lack the courage to push through change (McKinsey Digital, 2016). Issues like these are apparent not only in IoT related projects, but for most organizational changes in general, and are examples of institutional barriers that might hinder business model innovation.

Case descriptions and empirical results

This chapter details the results of three case studies used in this thesis; first company A doing business in the railway industry is described, then company B producing technological healthcare solutions, followed by company C producing mechanical parts for industrial applications. Throughout these case studies observations will be presented that regard the company's business model, ecosystem, partnerships and data-sharing, as well as institutional boundaries.

Throughout the case studies, colored case highlights are presented with especially interesting observations regarding their business models. The use of these highlights for certain observation, however, does not exclude other observations from importance.

Case A

Company A (CA) is a small Swedish company with 20-50 employees doing business in the railway industry. The company was started within the past 10 years and its main business is providing a traffic management system as well as an information and data integration system.

The company was originally part of a larger company providing digital control of different types of utilities. CA used parts of this technology to focus on the railway industry, and is now its own company with a separate knowledge base and focus. In company A, IoT is used as a way of gathering information and assisting with data analysis.

Interviewee A (IA) has worked at CA for several years and is chief of development at the company. IA is responsible for the direction of development for the company's products, ensuring that their products will continue to be attractive to buyers in the future. IA is familiar with the business model canvas, but does not use it too often. IA works close to marketing and sales, helping them understand the technical aspects of the products to be better able to explain their benefits to the customers.

With CA's two main products, its traffic management system and its data integration system, it works to provide its customers with the ability to make data driven decisions. CA's data integration system allows the collection of data *"... from any source, could be IoT devices or very complex things, really anything."* Once the data has been gathered *"... we work with analyzing the data with the goal of enlightening the organization with ways they can optimize their operations. It's about having a good base of knowledge to make better decisions about infrastructure investments."* As an example, IA brings up the optimization of bottlenecked train routes, stating that *"By having an established way of measuring your operations you can make a change, and then measure the effects afterwards to see that you are getting a return on your investment."*

The pros and cons with public procurement

CA does almost all of their business *"... through public procurement, that is what we are good at. They have clear requirement specifications"* Public procurement has both pros and cons. IA explains that *"When it comes to analysis there is more creativity involved, and then public procurement starts working worse. It is hard to get an edge among competitors when public procurement is used since they have to choose only based on certain criteria. It is only what the customer has thought of that is measured. If we then realize that the customer should do this or that, it does not benefit us, since it is not a part of the criteria on which we are judged."* Public procurement also discourages CA from putting all of their analytical abilities up for display: "*When we feel that we have an edge we do not want the customer to take that edge from us, because then other competitors will say 'Yes we can do that too!'... Public procurement is a double-edged sword in that regard, you even out the competition but you also limit the incentive to innovate."*

The biggest value CA offers its customers is *"... traditionally in operations, in giving a reliable operation of trains through controlling railroad switches and so on. Since we have such deep knowledge of our domain we have the ability to understand the data generated from that domain and we know how to make the dark data in these systems available and useful."* CA monitors an extensive network of data points and is "... *closing in on digital industry 4.0. We have in our systems a ton of data that we are saving. This is information that* *no one has analyzed further, but we are now starting to do this ourselves. We might look at the performance of a railroad switch over time for instance, watching for signs of aging."*

CA's customers are *"... the big international train and railway systems providers, as well as communal railway companies in Sweden and Denmark."* IA sees potential for new customers down the line: *"Our integration platform and analysis is something that works not only for the railroad industry, but rather cross-functionally. This is something we are interested in, and we realize that this is very relevant in other areas. Many have the same problem of having a ton of data that is hardly known that could be used for analysis."* Changing the business model is difficult however: *"I think our business model has been pretty much the same for a very long time. This is due mainly to our customers, when it comes to pricing for instance, they are not very willing to take on costs as a service, they are more willing to pay a lump sum. We want to sell upgrade agreements where you pay a monthly sum for us to keep the system updated with the latest security patches, but this is hard for us to change."*

Cooperation as a key to future success

CA is interested in future new partnerships. *"Within the railroad system there is something called signaling control, which acts as a security barrier controlling switches and signals to make sure trains do not collide… Those who work close to this system would be a perfect partner for us, since we would then be able to provide a complete solution with installation throughout the tracks. This is not something we do today, we are more of a control-room player… I think this is a key part of our future success, to be better at cooperating than we have been traditionally."* This cooperation is not without its potential problems however, IA explains that when cooperating with infrastructure owners and other parties there *"... exists an interface for data transfer, but typically people will want to hold on to their own data."*

CA does not have access to all the data that could be valuable for them. IA states that *"If we could bring in weather data, as well as the producer of the railroad switches into our data set we could make correlations. We could see which companies' railroad switches do not handle rain and snow well."* When talking about these sources of data that exist throughout the railway systems IA states that *"We want to gain access. We know this data exists out there. We know that temperature is recorded in certain places already in different locations, and has been done for a long time… The two biggest reasons we haven't done this already is data protectionism, and that often times the infrastructure owners do not themselves fully understand their own systems."*

On the topic of sharing data with CA's customers, IA expresses a willingness to do so: *"We are looking at licensing models for data. We want to give it out to our customers as open data completely, in some sort of data warehouse so it is open to analysis. That's the ambition… To start off we would do this to specific customers, but considering data networking effects, this becomes very interesting, and the infrastructure owners do not realize how beneficial this* *would be for them, because they are so used to what they already have. This is more of a revolution, and revolutions are hard to sell."*

Going for open data is not straightforward however, IA explains: *"... some of our data is vital for national security, and in those cases, you need special contracts and agreements. There are benefits to open data, but you need to find a nice balance and understand what is classified and what is not... Our traffic control systems are run in a separate network, far from the internet. So, if we are to connect a bunch of data this is something we have to deal with. There exists a great enthusiasm in society for open data, but behind it lies a vulnerable and serious reality."*

Case B

Company B (CB) is a technology healthcare company based in Sweden developing and producing equipment for disabled individuals that aims to improve life quality and mobility. The vision and mission of the company is to be one of the world's best providers of advanced rehab mobility solutions and accessories. The company was founded in the 1960s and is based in Sweden and has between 100 and 300 employees. Products are sold globally and serves people with a wide range of conditions that are helped by mobility rehab solutions. In company B, IoT is used as a part of the product offering, with sensors being included in the latest wheelchairs.

Interviewee B (IB) works as Chief Innovation Officer (CIO) at the company and has done so for 4-5 years. IB is familiar with the business model canvas as an instrument to describe a company and often use as a reference when talking about business models. IB has primarily worked with reorganizing the IT-organization and setting up a new electronics department to be able to cater to the internal needs of equipment and IT-knowledge within the firm for R&D and production.

The wheelchairs are sold either directly to users, via insurance companies and distributors or through national social insurance systems. In Norway for instance, IB explains that *"The procurement process for new wheelchairs occurs every 5 years, so it can therefore take up to 5 years before our new models reach that market."* Wheelchairs are sold to fit the user and is serviced by distributors or by actors within the national social insurance system. When sold to national insurance systems, there is often a procurement process where CB competes against competitors on different points, such as price, warranty or technical specifications.

Public procurement is used for large parts of the technology healthcare industry. IB explains that *"New innovations such as standing wheelchairs cost more to produce, and there is no 'code' for this, so they are not purchased. This is true throughout the industry, and it slows down innovation."* The 'code' refers to the public procurement classification; without a code the product cannot be sold through public procurement. To get their innovations to the market, IB explains that lobbyism is part of the product development process, *"For instance,* *Nick Gleason has ALS and runs his wheelchair through eye-tracking controls. Gleason had to lobby to make this type of wheelchair covered by law, it is called the 'Gleason act'. Now everyone who needs it can have eye-tracking controls"* CB's new fleet management system is not a part of the public procurement process.

IoT based bedsore prevention
CB has, in cooperation with an American university, developed an application that prevents bedsores for the users of their electronic wheelchairs. In the united states, IB explains that *"As many people die from bedsores as from traffic accidents. This costs a lot of money, and if we can reduce this number then that is of great value. Our entire company is striving for this, a better outcome."* This application works for nearly all the electronic wheelchairs that CB produces. The cost of the application is usually handled through a subscription for the user, where both software and hardware is included. The insurance companies are interested in the application, IB states that *"We have received a 'code' for the application for the use in public procurement, allowing it to be a part of the complete price that they pay."* In Sweden, however, things are moving more slowly. *"We have done tests in Sweden, but it is a conservative industry. The county doesn't want you to fiddle with the chairs at all."*

New technology in the wheelchair has initiated work within the company to investigate future revenue streams and possible changes to pricing models. Some data such as lowered service cost through online error codes already supports the added value of IoT. The company recently hired a professor from a well-renowned university in Sweden as well as analysts to help with big data and analytics. As IB states: *"The actual connecting of IoT devices is just a small part of it, the big issue for us is service development, that is where the money is going."*

CB has a close cooperation with their supplier of electronics for their wheelchairs. IB states that *"We have no plans of developing new wheelchair electronics, however, we have developed the parts that connect to the internet and are integrated into the electronics that we get from our supplier."* When buying core electronics from third parties, data ownership can become an issue. CB avoids these problems by having *"... agreements that give us full access to the data generated through these electronics. It was a pretty long discussion. We integrated our own processor into their stuff, so we do not want them to sell what we are developing to other parties, and they have been very positive towards this agreement."* CB has other suppliers for engines and such that they considers to be partners, but they do not have the same data-sharing agreements, since the data is generated through the main system previously mentioned in this paragraph.

A wheelchair generates several data points, among them chair angles, leg rest position, tilt, seating angle and lift, and battery charge. This data is then used to deliver value through allowing its users to *"live as good a life as possible."* For instance, as IB explains, *"The wheelchair can be used to open doors or garage ports. It can give the user a notification that the chair needs charging ... The chair can also give the user reminders to change seating* *position to avoid bedsores based on how the chair has been positioned."* This technology has also enabled the company to develop other functions and services, such as active geofencing through GPS technology, which keeps the user in a certain area for their own safety, as well as the ability to send distress signals if the wheelchair were to tip over.

The road to value based healthcare
The company describes that their activities have changed over the past decade. Earlier, the focus was mostly on technical specifications such as battery power, speed and max lifting weight, while the focus is on *"Value based healthcare"* now. The change has led the company to focus more on robotics, analytics and gathering of data. *"The goal for us is to use the data in three ways, to help our customers, to provide data for research and R&D, and provide value based pricing for our customers."* Note that CB does not currently use value based pricing, as they *"... need data first to prove our hypotheses, but we need more data. It takes time since there is a delay for our new chairs that can collect such data to reach the market."* CB also cooperates with health care providers to access data, but they run into problems with patient confidentiality laws preventing complete data-sharing.

CB is very keen on owning the data that is produced through its products, *"In the United States there was a company that wanted our system on all of its wheelchairs, but we had to decline the offer… It is a complex ecosystem with a lot of actors wanting the data, for instance relatives who want to know where the patient is at all times. Insurance companies also want the data to help combat insurance fraud through the use of GPS data. Our data is valuable and we know it."*

Case C

Company C (CC) is a large Swedish manufacturing company producing industrial parts and applications for industrial purposes. Products range from basic applications in household appliances to advanced large installations in heavy machinery. The company has a global presence and offices around the globe. The company was founded in the early 1900s and still produces their main product today with an installed base of more than 4000 customers worldwide. In company C, IoT is used both internally in production, and externally through sensors included with the company's products.

Interviewee C (IC) has worked at CC for 21 years and started at a lower position and has climbed within the company. He is now global director of services and solutions and sponsors several internal projects related to digitalization.

CC produces mechanical products used in various applications, such as appliances or heavy machinery. Products are sold both off the shelf and as complex solutions for more advanced applications. IC states that the company is used to the business model canvas, but does not use it to steer the company. The company's products are integral in some machines and are sometimes crucial for advanced equipment to work. The company is well known for its high quality, as IC explains, "*Up until the 80s and 90s customers were willing to pay 20% premium on top of the average price of the market just because of the quality. After that we had to differentiate because our products were being commoditized and the distances between competitors shrunk. That's when we got into other areas.*" These other areas refer to products that help the performance of their main product through, for instance, maintenance and installation.

In the 1980s CC bought electronic and software companies, as well as instrumentation companies that would allow them to monitor the products in operation. *"The sensors allow us to know if there are any forces in the machine that would shorten the life of the product, and take proactive action against that… Those products remain, we still do that."* In the 2000s sensors became more portable and installed on a wider base. Since the early 2000s sensors are connected and have the possibility to transmit data in real time.

The key resources and processes of CC has changed due to its digitalization process, as IC explains, "*We now need people that know analytics for instance. We now need to ask questions on the digital side that we didn't do before, or didn't know how to ask, and that is complicated… We have changed the way we are organized and how fast we work. Before it was waterfall, and now we have adopted agile development since two years ago.*" Today CC also has more active partnerships than they previously had, for example with cloud storage solutions, data analytics and software engineering companies. IC also says that *"we happily enter new partnerships with services that are not in our core business, we want to focus on what we are good at."* The core business of CC is still the same, but digitalization has shifted some requirements from staff to software.

Although CC have historically mostly been a product company, they have been offering services since the end of the 20th century. IC explains that *"Our services include implementation and ensuring the customers that they will not spend more for the upkeep of our product than they should, and that they will not have less uptime than is normal for them."* IC goes on to describe CC's market strategy *"We have always been about differentiation. Our entry into providing services is an example of this. Now digitalization is our new way to differentiate our business from the competition… But it also has some issues, like how do you make money from it?"* IC continues to state that their mission is and has always been *"to offer uptime and performance for our applications"*.

CC already has 2 million products connected today. IC explains how *"part of the evolution curve initially for IoT is having machines to monitor, we already have that. Our problem has been that only a small percentage of those products we monitor connect to the actual sale of the product … If i have a guy monitoring that product and he identifies that it is going to fail, the CC salesman of that product doesn't know about it. That would be important to know! Some do, but our point is that we want that all of those should know… We were not producing data for the people who buy the products, they also need to know what product is going to fail and how critical it is."* The data has instead been used for predictive maintenance services, with CC having hundreds of these contracts since the early 2000s.

Looking towards Industry 4.0

IC explains how the entire production chain can achieve benefits from the data gathered by the company's sensors, and how they are going about achieving these benefits today, *"We realized that the data is already there. All the sources and monitors are there. We just haven't produced the means and dashboards and given access to the people who need the information. We are developing technology to make that data more available. Different people will need different data. For example, the procurement guy need to know, when i order a product, what is the lead time? If the product is going to fail in 3 months, and the lead time is 5 months, not a good situation. The planner maybe needs to know the product condition, so he can plan the maintenance. Different people need different data. We are trying to do it with portals, and the portal connects to the process where the customer buys a product from us."* IC explains that this work is largely done manually today, so there are possible benefits in process optimization to be had using this data. *"In an ideal world we would not even need stock, because we would know exactly what's going to fail when, and just produce what is needed."*

With regards to data-sharing with customers, IC explains that *"We share data with our customers. That's a sensitive matter in these days. Actually, the customer owns the data. The sensitive matter is what we do with the data. We don't care if we don't own it, but we want to have the right to do certain things with it, and act responsibly with that data… We want to use this data to better improve the service. If customers decide to stay isolated, we're fine with that, but it will decrease the possible performance we can provide, and we make them aware of that."*

The value of data-sharing with key partners

"We have a partnership with an industrial control company with a huge installed base. We can measure temperature and vibration, whereas they can measure for example pressure. When separate, we can't correlate that data, but by combining our data we create huge value. In one case, a mining company had to stop production to clean a fan every 5-7 days and change a machine part in an electrostatic capacitor with a shaft. Dust accumulated on the fan and made it unbalanced which caused vibrations, we could see that, but not more than that. However, by working with our partner we saw, through their data, that the shaft was expanding under heat which damaged the machine part. So we changed to another part that could hold the changing shaft. After this they only needed to clean it at a monthly basis. This is the power of digitalization, the ability to correlate data and analyze it. So partners are very important."

- Global director of services and solutions, Company C

CC wants to *"monitor everything everywhere",* but they know they cannot do this by themselves, so they need partnerships. *"Right now we have pilot partnerships and we are addressing customers together with those partners… We give information to our partners, and we choose our partners in a way that there is no conflict of interest."* This was not always the case however, as IC explains, *"Before it was more difficult to have partners, but we had some. I never felt that it actually did anything; it was more just a press release than anything else. Today partnerships matter a lot more."* Getting access to data-sharing partnerships is not always easy though, as IC explains *"Some customers are very siloed, meaning that the information is contained within the company."*

Analysis

In this chapter the results of the case study will be analyzed and contrasted with existing literature with the purpose of answering the research question. First the business model effects will be examined, followed by observations on data-sharing, partnerships, ecosystems and institutions.

Business model effects

Business Model Canvas as described in the literature was mentioned in all three cases as the model to use when referring to business models in the firm. Furthermore, interviewee C said that the canvas was a good way to paint the picture of the firm, but that they do not actively use it to steer the firm. The Business Model Canvas aims to describe a firm (Magretta 2002), and does not have a steering purpose other than creating an overview of the firm and how it creates, captures and delivers value (Osterwalder and Pigneur, 2009). Only business model effects that are related to digitalization/IoT projects are described below.

Customer segments
As IoT is an innovation, and innovations can lead to new products, and segmentation can be made on a product basis, there is an argument to be made that customer segments might change due to the use of IoT (Dijkman et al. 2015). Laudien and Daxböck (2016) argues that IoT might cause business model innovation and change customer segments, however, it is unclear whether IoT adds segments or changes the way a company segments. IoT has somewhat changed the product or service offering for all cases, where company B is in the forefront by offering an IoT based application to minimize bedsores which changes the offering dramatically. Even though the offering changes, the customer segments are still mainly the same for all three companies, company A still sells to railroad system operators, company B helps disabled people and company C still has the same customers for its industrial applications.

Value proposition
Arnold, Kiel and Voigt (2016) saw changes in value proposition in approximately 90% of companies after IoT was introduced in a firm, however, (Dijkman et al. 2015) argues that new value dimensions are not necessarily always introduced, but existing ones can also be

improved. Since IoT enables more data to be created the value proposition tends to change in a data driven direction (Jernigan, Kiron and Ransbotham, 2016). In Case A, the company aims to change its value proposition to be based more on data generated by its product to offer customers more value. Company A experiences issues with offering the new value since public institutions often procure goods and services based on solving a specific task and do not take added value in terms of data into account. Company B increased its offering by introducing an application that minimizes bedsores which helps the users to stay healthy. Since the main offering is focused on keeping users as happy and healthy as they can, their offering can be considered enhanced rather than changed. In the case of company C, IoT has brought new possibilities such as predictive maintenance and analytics to improve the product. These improvements are strongly related to the products main purpose and its basic offering; keeping the industrial applications working at a high uptime with good performance. In company C's case IoT helps to improve the offering rather than change it. All three cases either have changed, want to change or in the midst of changing their value proposition, however, some experience struggle due to various reasons.

Customer relationships

Dijkman et al. (2015) argues that when IoT enters the firm, many tasks become more and more automated, which enables customer relationships to be more automated with factors of self service. Furthermore, cocreation of value could occur when two firms share data that can be beneficial for each other (Dijkman et al. 2015). In that sense, customer relationships could evolve with IoT through interconnection between firms to entire ecosystems that itself can add value and change business models further (Porter and Heppelmann, 2014). Company A mainly interacts with its customers as before, with the exception that they want to cooperate more around data and data-sharing. They do experience difficulties altering their relationships due to data-sharing laws and procurement policies. Company B's recently released application has brought its customers closer, and they aim to cooperate more to generate more data on users and their health. In case C, the company experience big changes to the way they interact with customers that are connected to IoT applications. Customers can now track performance and maintenance in real time together with company C. Furthermore, data generated by IoT applications have been beneficial together with other actors' data in the network, showing that company C is moving towards an ecosystem of information where value is co-created via data-sharing. There is a clear difference between company A and company B and C, company A want to change how they go about their relationships but experience barriers, while B and C successfully have managed the transformation.

Channels

According to Arnold, Kiel and Voigt (2016) channels and customer segments were among the least changing areas among companies in relation to IoT. However, web-based sales could be more prevalent due to the increased data that IoT enables. (Dijkman et al. 2015) As the customers in all three cases are still mainly the same, there is reason to believe that the channels have not changed because of IoT, however, it could be possible that channels have become more digital and web based as an effect of digitalization.

Revenue streams
With more data accessible, it is possible to form revenue streams on the basis of the problem a certain product solves (Dijkman et al. 2015). As an example, Dahlin and Lindgren (2016) sees possibilities to charge for the uptime of a product, rather than subscriptions with service fees, which incentivizes the firm to deliver as much value as possible. (Dahlin and Lindgren, 2016). Company A has more data available thanks to IoT, but finds it hard to explore new revenue streams both because of public procurement and that buyers do not yet see the value that data generated in the system could give to their organization. Company A tries to change this by offering as much data as possible with their product so that organizations can experience this value by themselves and hope that it will lead to new revenue streams in the future. In the case of company B, they gather data "*to mainly use in three ways: to help customers, provide data for research and R&D, and provide value based pricing for our customers."* but in regards to value based pricing, the state that they *"... need data first to prove our hypotheses, but we need more data. It takes time since there is a delay for our new chairs that can collect such data to reach the market."* Company B is working on changing their value streams towards a model that incentivizes them create more value, but they experience that the change takes time. Company C does not aim to change their revenue streams because of IoT and tries to stick to their main mission *"to offer uptime and performance for our applications"* There is clearly a difference between the companies and their willingness to change their revenue models. Company A and B wants to change it, but face different hinders, while company C try to improve their current one.

Key resources
Dijkman et al. (2015) argues that intellectual property such as software and data becomes more important as a resource when IoT enters the firm. For an IT company, however, changes might be smaller and more concentrated to the data generated through IoT since software is present already. Based on the firm's activities, employee competencies as a resource could change to match new activities and become critical to support those activities (Dijkman et al. 2015). Since company A is a software company, they have not changed their resources, more than they are considering using more analytics resources in the future to create value with all the data generated in their systems. Company B has had a slightly different path and has changed their business model more towards robotics and digital solutions that can be connected to the cloud. Furthermore, they now focus more on analytics and sees their data as a key resource to provide better value in the future. Company C sees IoT technology as an important resource, not only can sensors bring value to the customer in the applications sold, but they could help lower production costs and optimize the firm's operations. In connection to IoT, software development is becoming more and more important and is now a key resource at company B where it is used to get the full potential of IoT.

Key activities
According to Dijkman et al. (2015), software and product development activities changes are more prevalent when firms start with IoT. However, IT-savvy companies are naturally closer than industrial companies in its initial activities, and do not have to change to the same extent

(Dijkman et al. 2015). This is true for company A that is spun out of data-heavy software based system. Although company A has a software background, more analytical activities will be conducted due to the increased amount of data generated by IoT. Company B experience slightly more change in its activities thanks to moving from analog to digital products which has the possibility to generate data. Since this data could be of value for the company and its users, it is important for company B to utilize this via analytics and software development, as in the example with the application that aims to minimize bedsores. In case C, the company is changing its activities in line with company B to handle all the data generated for better decision making, they also use IoT internally to change its production and logistics activities due to the potential the technology unlocks. Dijkman et al. (2015) argues that changes to logistics and sales are also natural as more parts of the company and the value proposition are becoming digital, which is true for company C.

Key partnerships

According to Dijkman et al. (2015), key partnerships tend to change depending on the firm's changing activities and resources. In the IoT perspective, new partnerships usually include software, hardware and data analytics (Dijkman et al. 2015), but could also include partnerships in the value chain or the ecosystem as Porter and Heppelmann suggests (2014). Since company A is a software company, they do not see the same need as "analog" companies to change their partner as most of the activities are part of their core business. However, they do try to cooperate with other actors and create partnerships to access data and states: *"I think this is a key part of our future success, to be better at cooperating than we have been traditionally."* Furthermore, they also say that "*typically people will want to hold on to their own data."* which implicates that creation of new partnerships relies on the willingness of others to share their data. Company B states that they are continuously considering new partnerships that relate to IoT and have become partners with other organizations over the past years. As an example, the new application that aims to minimize bedsores was developed in partnership with a well-renowned university in the United States. Company B has also hired an analytics professor part time from a Swedish university and are partnering up with analytics and cloud solutions partners to better manage new technology. In the case of company C, they now have more active partnerships than they previously had; for example with cloud storage solutions, data analytics and software engineering companies. The core business of CC is still the same, but digitalization has shifted some requirements from staff to software. Interviewee C states that *"Before it was more difficult to have partners, but we had some. I never felt that it actually did anything, it was more just a press release than anything else. Today partnerships matter a lot more."* and *"we happily enter new partnerships with services that are not in our core business, we want to focus on what we are good at."* Company C also tries to cooperate with actors that are not directly linked to the company in the value chain with the purpose of data-sharing. That could be beneficial for all parties, and in the long run increase the value of their offering. In the example with the mining company, a new partnership with an adjacent actor in its ecosystem provided new value through data sharing. Interviewee C described this as *"the power of digitalization, the ability to correlate data and analyze it."* and that it is why "*partners are very important."*

Cost structure

Dijkman et al. (2015) argues that more IoT within an organization might change the cost structure as more IT resources are consumed. However, cost could be lowered if IoT is leveraged in a way that enables cost cutting (Dijkman et al. 2015). In Osterwalder's and Pigneur' s (2009) Business Model Canvas, the cost structure should not be confused with the potential lowered cost in the value proposition, but focus on the firm's own cost. In company A and B, the cost structure has changed somewhat in line with the firm's activities since more IT resources are consumed. In company C, the cost structure changes also towards IT, however, since company C has a large production facility and logistics network, IoT could also be used to lower cost in production.

The BMC is interconnected

Osterwalder and Pigneur (2009) states that the different fields in the business model canvas can correlate with each other, depending on the company. Furthermore, Dijkman et al. (2015) and Arnold, Kiel and Voigt (2016) suggests that most areas of the business model are affected by IoT. As seen above, many of the areas interact with each other. Company A strives to offer a product with more data to its customers and knows that they need more data that can be obtained by partnering up with other actors. They also see the need of increased analytics activities to make use of the increased data generated in their system. Company B sees potential in IoT and has integrated it in some of their products. They say that it is yet too early to draw conclusions of data generated by sensors, but they have changed activities and partners to get better use of the data, which they now consider to be a key resource. They hope to monetize the data by offering a more value based product in the future. Company C experiences an overhaul of their activities and resources to better meet the customers demand, however, they state that they are staying true to their core business and that their goal is to offer high quality products. In that sense, IoT, new activities and partnerships are key factors for enhancing, rather than changing the value proposition. Examples from the cases above prove the point that most, if not all parts of the business model canvas are interconnected and a new technology can cause change across the board, whether firms plan for it or not.

Data-sharing, partnerships, ecosystems and institutions

The successful use of IoT depends on the analytical capabilities of the firm (Jernigan, Kiron and Ransbotham, 2016). IoT devices generate massive amounts of information, so it stands to reason that the firms who are most adept at making sense of this information through data analysis are the firms who stand to gain the most from IoT use. Company C has had access to their sensor data for more than 15 years, but until recently that data was not used to its full potential. "*Our problem has been that only a small percentage of those products we monitor connect to the actual sale of the product."* To address this problem CC has been hiring people with analytical skills to figure out what data should be monitored, and what actions should be taken as a result of the data. Data analysis has become a core of CA's business. As IA states, analyzing data is about "*... having a good base of knowledge to make better* *decisions"*. CB has not had a need for analytical capabilities until recently when they launched their new IoT based applications, so the company has now hired a professor to assist them with big data analytics. All three case companies are trending towards more analytical capabilities, motivated by the need to draw use of the data generated by IoT.

As the analytical capabilities of the firm grow, so too grows the abilities of the firm to transform data into valuable insights (Jernigan, Kiron and Ransbotham, 2016); thus, data will become more valuable to firms with highly developed analytical capabilities. CA, which is continuously developing their analytical capabilities and is currently very analytically capable compared to competitors, brings up the ambition to gather more data, stating that "*We want to gain access. We know this data exists out there, weather data for instance."* CB in contrast has not had much analytical capabilities historically, and as such have not emphasized the collection of data, however, with the recent hire of staff dedicated to big-data analysis, CB is now focusing more on analytics and the gathering of data than they have previously. With CC's new focus on using their existing data to create value for different parts of their organization, they have begun to also look outside their own company for sources of new data to further improve their performance, *"We have a partnership with an industrial control company with a huge installed base. We can measure temperature and vibration, whereas they can measure for example pressure. When separate, we can't correlate that data, but by combining our data we create huge value."* This difference in the current analytical capabilities of the case companies is likely due to them acting in very different industries. A company like CA is based on software, and as such will have an easier time acquiring the necessary analytical capabilities as opposed to a company like CB that has focused on the manufacture of physical products.

With data becoming more valuable for firms with analytical capabilities, the sources of data in turn also becomes more valuable. One such source of data is data-sharing, which is strongly associated with creation of business value from IoT (Jernigan, Kiron and Ransbotham, 2016). Data-sharing has been used extensively by CA and CC, with CB not using data-sharing to the same extent. IB explains a situation where CB prioritized owning and keeping their own data as opposed to sharing it: *"In the united states there was a company that wanted our system on all of its wheelchairs, but we had to decline the offer… It is a complex ecosystem with a lot of actors wanting the data, for instance relatives who want to know where the patient is at all times. Insurance companies also want the data to help combat insurance fraud through the use of GPS data. Our data is valuable and we know it."* In contrast CA has the ambition of giving out their data to customers as completely open data, in *"some sort of data warehouse so it is open to analysis."* CC currently shares data with their customers, as the customers often owns the data in question. IC explains that CC *"does not care if [they] don't own it, but we want to have the right to do certain things with it and act responsibly with that data."*

The case companies studied in this thesis all recognize the value of acquiring analytical capabilities and the value of acquiring relevant data, but not all of them implement data-sharing, despite the possible benefits outlined previously. To understand this disparity one can make use of institutional theory. Institutions are the rules of the game in a society (Scott, 1995) and can be divided into formal and informal institutions (North, 1990), where formal institutions include laws, regulations and rules and Informal institutions which include norms, cultures and ethics. The data CB handles concerning its users is often governed by strict patient confidentiality laws, backed up by regulative force through the legal system. CB thus cannot simply share its data openly as that would risk legal action. There also exist informal institutional barriers for CB, as well as for CA and CC in the form of organizational norms. For instance, CB wants to sell their bed sore prevention application in Sweden, but the Swedish industry they operate in is conservative, resisting their efforts to provide a new innovative product. For CA and CC the problem is often that potential data-sharing partners can be siloed, meaning that information is contained within the company, either through ignorance or through a data protectionist attitude. As IA states: *The two biggest reasons we haven't done this already is data protectionism and that often the infrastructure owners do not themselves fully understand their own systems."* IC adds that "*If customers decide to stay isolated, we're fine with that, but it will decrease the possible performance we can provide, and we make them aware of that."* All three case companies have also experienced problems with company norms and culture stifling business model innovation, for instance by insisting on payment through a lump sum instead of using value based pricing enabled by IoT, as was the case for CA.

Going for open data is not always straightforward. In the case of CA: *"... some of our data is vital for national security, and in those cases, you need special contracts and agreements."* These formal institutional boundaries can have catastrophic consequences if they are not followed. Sharing data between organizations also brings into question issues with data integrity. As organizations cooperate they become reliant on each other's security systems. If hackers access and manipulate data in one organization, that data could spread to many others through data-sharing protocols (Jernigan, Kiron and Ransbotham, 2016). During interviews with the case companies, security was only emphasized for CA, as they handle vital infrastructure, but security breaches for CB and CC would likely also have large negative consequences. Downplaying or being simply unaware of the major security concerns is common in many organizations today (McKinsey Global Institute, 2015).

The sharing of data between organizations forges new relationships and deepens existing ones (Jernigan, Kiron and Ransbotham, 2016). These relationships can develop with customers and suppliers, but also competitors and governments, depending on the ecosystem that the organization is in. Relationships and interconnectedness between organizations is a prevalent trend in the literature regarding the effects of IoT on businesses (Arnold, Kiel and Voigt 2016). This trend is evident in the case companies studied in this thesis. As IC explains, *"Before it was more difficult to have partners, but we had some. I never felt that it actually did anything, it was more just a press release than anything else. Today partnerships matter a lot more."* CA has the ambition to develop new partnerships, but this change is slowed by data protectionism and ignorance to the effects of data-sharing from potential partners. CB developed a deep partnership with their supplier of electronics, insuring that CB would have full access to the data produced by these electronics.

Tuten and Urban (2001) describes three key factors for a successful partnership: improved communication, trust/honesty/fairness and satisfactory performance indicators. The issue of trust and honesty is of great importance when data-sharing is involved, as fraudulent or incomplete data could have serious negative consequences for the company receiving the data. CC is seemingly aware of this issue through their partner selection process, "*We give information to our partners, and we choose our partners in a way that there is no conflict of interest.*" This is a clear way of minimizing the incentives for dishonest behavior, which in turn helps strengthen the relationship between them.

Entering a new partnership may entail a significant change in corporate culture (Tuten and Urban, 2001), putting pressure on management to develop the skills necessary for joint participation and openness (Mohr and Spekman 1994). CB had long discussions with their suppliers to make sure that CB gets full access to the data generated through the electronics the suppliers provided. "*We integrated our own processor into their stuff, so we do not want them to sell what we are developing to other parties, and they have been very positive towards this agreement.*" These issues of data ownership are common problems for IoT projects (Porter and Heppelmann 2015) and are key issues to deal with during partnership formation.

The movement from discrete products to product systems consisting of closely related products, to systems of systems that link an array of product systems together is a trend described by Porter and Heppelmann (2014). This trend is seen in CC as they have gone from selling discrete products to also selling complementary products and services, including bundled sensors and recently also analytics based on the data generated by the sensors. CB has traditionally sold discrete products - their electronic wheelchairs - but are now shifting towards value based health care with services and solutions complementing their products. CA has been selling their traffic management system since the company was founded, providing "a *reliable operation of trains",* but they are in the process of developing their analytical skills and data gathering even further to be able to provide a complete optimization of their clients' operations through data analysis. The continued progress towards systems of systems is not evident in the case companies studied in this thesis, although CC can be argued to be moving in that direction in their cooperation with an industrial control company that supplements their existing product system. This trend, or rather lack thereof, may be because of several factors, including company size, age and the industry they operate in; generalizing as to the cause is unwise when limited to three case companies of different size, age and industry.

Discussion

As seen in literature and cases, IoT influences firms and industries. The question is therefore not about *if* but rather *how* it affects firms and industries. In our analysis, we saw different factors of IoT connect both to firms and industries. These new possibilities that IoT brings could be used in different ways, either by using them internally to improve the company, or by generating data that can be commercialized, either through new products and services, or by partnerships in an ecosystem.

The theoretical frameworks used in this thesis contains both micro and macro-level aspects. To answer the question of what companies need to consider when adapting their business models for IoT, it is helpful to look at the research question in a way that captures both the micro- and macro-level aspects. We therefore divide this chapter into IoT’s effect on the firm, including micro-level effects, and beyond the firm, including macro- and meso-level analysis. This approach will hopefully give the reader a better understanding of what type of value IoT can bring, in different perspectives, and how that value can be leveraged.

IoT’s impact on business models

There is no question that IoT affects firms’ business models. When studying IoT and business models, there are no simple conclusions; just like the nature of the firm, every case is unique and brings new dimensions to the issue. There are some trends however that have been identified; Dijkman et al. (2015) and Arnold, Kiel and Voigt (2016) have done research on business models and IoT and found that some areas tend to change more than others, and that some specific changes are more prevalent than others. Our findings support these conclusions to a large extent, however, we have found instances where the effect of IoT depends more on the firm's earlier context. Furthermore, there are instances where different areas of the business model have a profound effect on others, a finding that is discussed by Osterwalder and Pigneur (2009), but not explicitly in the context of IoT.

In the analysis, we argued that software companies for example do not tend to change as much as other companies when introducing IoT, this shows that the context of the firm is important as it sets the foundation of where the company is, and IoT’s entrance might show where the company is going. Digitalization trends that are visible today are, for example, servitization, new value based revenue models and industry 4.0. The important thing to remember is that the discrepancy between where the firm is, and where it is going indicates the effect on the firm when IoT is introduced. As an example, company C initiated servitization back in the 1990s’ and engaged in sensor driven analytics without or with limited connectivity before IoT was introduced. Furthermore, company C has a value proposition that has not changed radically over the last century, producing high quality products with high performance, which IoT hasn’t changed, but rather just improved. The history of company C explains why IoT has not had a profound effect in regards to these areas in the company. The same goes for company A; a software company in its core does not seem to change as much as other firms, since most of their activities already is digital and data driven. However, IoT can have other implications, such as networks and data-sharing that goes beyond the firm and unlocks new revenue models. In the case of company B, the earlier context is not as aligned with IoT development, and they work with data gathering and analytics to eventually change their revenue model for IoT. There is unfortunately no easy way of defining how much and what in a company's business model will change, but an indication could be to follow general IoT trends, such as servitization and industry 4.0 and see how firms relate to them.

When business models change, there is often not just a single factor that changes. Osterwalder and Pigneur (2009) describe the business model canvas and its parts as connected to each other. We have found this to be true and have seen in all cases that IoT might increase this connection in certain directions. The IoT technology is a tool like all other technologies, and should be seen as such when companies think about possibilities with this new technology. When firms look to change their value proposition, it is often done by increased data analysis that increases value for the customer. The operation of analyzing is an activity that gains increased importance due to IoT. Furthermore, all companies do not have the possibilities to analyze data or enter the digital world in the same way as an IT-company, and therefore rely on partners. Our findings show that key resources, key activities and key partners heavily depend on each other, and they relate strongly to a changed value proposition. As a direct effect of a firm's activities, the cost structure of the firm changes. In the case of IoT, costs tend to be lowered in certain areas as productivity rises, especially with industry 4.0 initiatives, but rises in areas related to increased activities, such as analytics and software development. The connection between different areas of the business model is important for firms to acknowledge, and the general trend with IoT indicates the acquisition of new activities, either in-house or with partners, and is necessary to be able to change other areas of the business model.

Beyond the firm

As discussed in the analysis chapter, there exists a trend of industry boundaries expanding due to the use of IoT products, such as CC moving from providing discrete products to providing product systems with complementary parts, diagnostics and service. However, this trend towards integrated systems of systems does not have to occur within a single firm, but can instead occur through the development of partnerships from firms providing neighboring product systems. In the case of CC, they developed a partnership with an industrial control company to share and correlate data to improve performance in an area where they were both suppliers of parts. It is possible for a single company to provide both parts and provide the same value, indeed this may be where many organizations are heading, but it is important to realize that this is not a necessity. The value obtained through analyzing data throughout the entire product ecosystem can be acquired through the analysis of a single company, or through the collaborative data-sharing and analysis of several partnering companies.

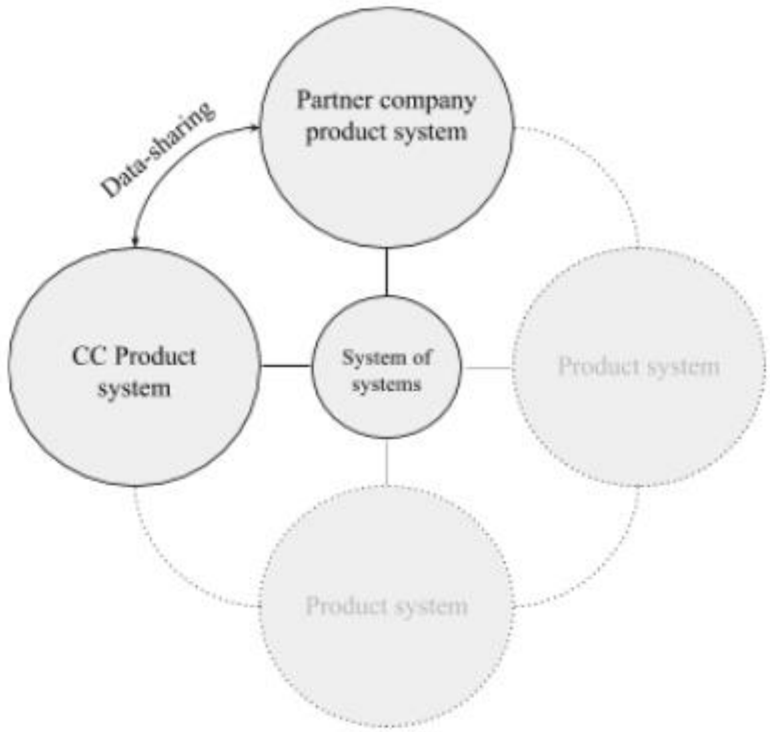

Figure 6: Company C's data-sharing partnership expands the IoT ecosystem.

When discussing the implications of data-sharing with partners it is important to note that it is not a zero-sum game; If company A shares data with company B, leading to an addition of new value to company B, that does not in itself detract any value from company A. In that sense, it is often a win-win proposition, each company can gain without necessarily negatively impacting the other partner. Note that the ability for the firm to maximize the value from data-sharing partnerships will depend on the firm's analytical capabilities. As seen in the case studies, the developing of new partnerships and the implementation of data-sharing can have substantial benefits for firms using IoT, as they are sources of new and useful data. However, when the data in question contains sensitive information - either from a legal perspective or a trade secret perspective - there can be negative consequences to sharing resulting from either regulative actions or a loss in competitive edge due to dissemination of trade secrets throughout the industry. The choice of data-sharing versus data-protectionism depends on the unique situation of the company in question, and one does well to remember that blindly following simple advice such as "Always share data" can be dangerous, there are no quick fixes.

The potential benefits of IoT have been talked about for years, and the hype has convinced the boards of many companies that IoT is an area worth investing in (McKinsey Digital, 2016). Despite this there exists many companies who have difficulties in getting value out of their IoT investments (Jernigan, Kiron and Ransbotham, 2016). The cases in this study are all in the process of developing their IoT and analytical proficiencies, and the problems they encounter can serve to caution and inform other companies who are heading down the same road. Institutional problems have been a recurring theme for the cases studied in this thesis, both formal and informal institutions. CA and CB does business through public procurement, meaning they are required to provide an offering to an exact list of pre-made specifications. This puts an artificial restriction on the business models of these companies; Changing from lump sum to a value based subscription model is difficult when dealing with public procurement. Public procurement evens out the competition, but, as IA put it: "*Public procurement is a double-edged sword in that regard, you even out the competition but you also limit the incentive to innovate."* There are other institutional obstacles that companies face, such as data-protectionism and ignorance for CC, patient confidentiality laws for CB and national security issues for CA. Institutional issues like these have the potential to seriously halt the progress of any company trying to create value from IoT based projects, and often there is little a company can do to combat it. For formal institutions, such as laws and regulations one can attempt to lobby the governing bodies to change the laws or regulations to benefit the company, but this is a long and difficult ordeal. For informal institutions, such as norms, cultures and habits, there is potential for change; Purchasing habits can be changed if one is persuasive enough, and new norms can be introduced in its place. Even though each firm differs on a micro-level, they all experience institutional effects on a macro level. Firms often handle these institutional effects in different ways, stemming from their micro-level differences. Any company working with an IoT related project would do well to closely consider the formal and informal institutions in their ecosystem when discussing possible business model changes.

Conclusion

In this chapter the findings are presented, followed by a discussion on the credibility of the findings, the academic contributions of the thesis, as well as implications for future research.

Findings

The findings of this thesis are detailed below and answers the research question: What do firms need to consider when adapting their business models for IoT?

Within the firm one needs to consider that areas in the business model are interconnected and that firms need to be able to act nimbly and carefully when adapting their business models.

- Changes to a company's business model due to IoT depends on the earlier context of the firm
- Firms need to be able to adapt their activities to reap the benefits of IoT based business models
- Information infrastructure must be in place and allow the right data to be used by the right person to be able to generate value from data collected through IoT
- The 'Key Partnerships' section of the BMC is likely to change as IoT is implemented in the firm

Beyond the firm one needs to consider the effects of partnerships, data-sharing, IoT ecosystems and institutional obstacles.

- Firms with analytical capabilities, acquired internally or through partnerships, can benefit from data-sharing with partners
- Identifying the firm's place in an IoT ecosystem enables the firm to find new and valuable partnerships
- Formal and informal institutions can prevent successful data-sharing due to issues with security, confidentiality, integrity, ignorance and data-protectionism

In summary, in the process of business model transformation, firms need to consider the environment, including institutions, and their positions in their eco systems to address IoT in the best way, understanding that it is through partnerships and the sharing of information that there is the largest potential for companies to adapt their business models for the future.

Credibility

In this thesis, measures have been taken to secure its credibility. The methods used in this thesis is commonly used and widely accepted, and precautions have been taken during the process to ensure the reports quality. There are however, some areas that could be addressed to further enhance the report's credibility.

Internet of Things is quite a new area and research is still being published. Most of the research has been done over the past few years, and we have tried to constantly update and look for new information available to better follow up on changes in the field. Despite this, there may exist new studies that we have not accounted for in this thesis.

In this thesis, three cases were chosen with the help of Acando. Three cases do not paint the picture of all companies working with IoT, nor do they explain every possible factor that could be considered for firms entering the field of IoT. Furthermore, the companies interviewed could be considered as proficient in their use of IoT and have documented knowledge in the area. The main reason for this is that these companies are customers to Acando, that specializes in IT.

When interviewing the companies, precautions have been taken by formulating questions per academic norms and critically interpret interviewee’s answers to identify attempts to alter information that might benefit the firm. No interview is without bias however, and as such this thesis is ultimately colored by the experiences and inherent biases of the authors. For instance, we are both positive towards the use of IoT and digitalization in firms, which could have played a role in our interpretation of the results.

Academic contribution

IoT and its effect on business models is a new area of research. There exist many studies on the technological side of IoT, detailing the architecture and protocols needed to set up and IoT based system, but few studies examining the issue from the viewpoint of the individual company. There also exist few studies using an ecosystem-based view of IoT.

This thesis contributes to the literature by examining three cases where IoT has had an impact on the firm’s business model and detailing important managerial considerations for firms intending to implement IoT into their business model. More specifically this thesis contributes to the area of IoT based business model changes, focusing on partnerships, ecosystems and data-sharing. The results indicate that, regardless of industry, firms will need to utilize partnerships to make the most of their IoT investments. The results also show the value of utilizing IoT ecosystems, as well as knowing ones position within that ecosystem. The thesis also contributes to institutional theory by giving empirical examples of institutional obstacles and their impact on different firms.

Future research

This thesis has studied three case companies and the effect of IoT on their business models. All three companies are based in Sweden and are relatively proficient in IoT. It would be interesting to study additional companies to see if the same trends are apparent across different industries, countries and levels of IoT proficiency.

Research on IoT ecosystems and the practical implications of data-ownership, strategic positioning and lock-in effects would be interesting and beneficial for companies who aim to compete through the use of ecosystems.

With more and more data being generated, there are also concerns about personal integrity and how data generated from IoT affects our personal lives. Our lives become more and more mapped out every day, from grocery store behavior to interaction on social media. This data might not only be used for good purposes, leading to questions on IoT related to society and morality.

The area of public procurement and the problems inherent in the system is apparent in the cases studied in this thesis. Future work could study this closer and give recommendations regarding how firms can accomplish business model changes while still utilizing public procurement as their main source of customer acquisition channel.

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Appendix

Interview form (Swedish)

A, Din bakgrund

- Innan vi kör igång intervjun skulle det vara intressant att höra lite mer om dig? (Avdramatiserande - ofarliga frågor, leder in på historieberättande)
- Hur länge har du varit på detta företag och i din nuvarande roll?
- Vad gjorde du innan, vad har du för utbildning?
- Vad gjorde att du valde att bli (nuvarande roll)?

B, Deras bolag

- När startades bolaget?
- Hur många anställda har ni?
- **Hur ser er affärsmodell ut?**
- Vilken intäktsmodell och prissättningsstrategi har ni?
- Vilka försäljningskanaler använder ni?
- Hur ser kundstrukturen ut? Små/stora bolag, privatpersoner, återkommande kunder?
- Vilka är era huvudsakliga konkurrenter? Vilka svagheter eller styrkor har de jämfört med er?
- Har ni någon internationell verksamhet? Ser verksamheten och affärsmodellen likadan ut utomlands som i Sverige?

C, IoT

(Så fort du ställer en fråga, följ upp med varför, hur och exempel, hur gick det till, hur initierades detta, vilka involverades, möjligheter, svårigheter.)

- **Vad innebär begreppet IoT för er? (se till att man jobbar med samma definition)**
- **När började ert företag att prata om IoT?**
    - Hur var synsättet kring IoT hos er då?
    - Har ni förändrat ert synsätt sen dess?
    - När var ert första IoT projekt?
    - Vad är det viktigaste ni lärt er om IoT sen dess?

- **Vad har ni för IoT lösningar i företaget idag? (Se om vi kan locka fram att prata om specifika projekt)**
    - Monitor: samlar ni in information? Hur samlas denna in?
    - Control: kan ni kontrollera/styra med hjälp av tidigare datainsamling?
    - Optimize: Används kontrollerande och insamlande funktioner för optimera produkt eller produktion?
    - Autonomy: Hur autonoma är produkterna / produktionen

- Hur har ert bolag anpassat er för IoT?
- Har ni några aktiva IoT projekt? Berätta!
- Har ni några IoT projekt ni nyligen slutfört?
- Har ni några kommande IoT projekt ni kan berätta om?
- Analyserar ni själva datan för sensorerna?

- Delar ni med er av datan till era kunder?

D, Processen

- **Kan du berätta om ert senaste IoT relaterade projekt, hur processen tillväga? (pilotstudier, marknadsundersökning, förändringsarbetet)**
- När ett nytt IoT projekt utvecklas, använder ni den befintliga tekniken eller ett nytt koncept (värdeerbjudande) som bas?
- Hur stor del spelar datainsamling via befintlig IoT i er utvecklingsprocess?
- Hur stor del har era kundrelationer i er utvecklingsprocess?
- Har ni produktutveckling med IoT i fokus inriktat mot nya kundgrupper?
- Hur ser er innovationsprocess ut i bolaget?
- Har ni gjort någon förändring i er innovationsprocess pga IoT?
- Hur ser era utvecklingsteam ut?
- Hur koordineras affärsmodellsutvecklingen med produktutvecklingen?
- Hur sker koordineringen ut mellan nya produkter och utformandet av värdeerbjudandet?
- Har företaget ändrat struktur på grund av IoT
- Har företaget ändrat sina aktiviteter på grund av IoT
- Finns det inneboende motkrafter i företaget som hindrar utveckling av affärsmodellen?

E, Affärsmodellen

- **Har ni förändrat er affärsmodell till följd av IoT?**
- **Hur anser ni att värdeerbjudandet har påverkats av er användning av IoT?**
- **Vilka delar av affärsmodellen anser ni har förändrats? (visa BMC)**
- Ser ni en kopplingen mellan graden av IoT implementation och affärsmodellens förändring?
- Har ni ingått några nya partnerskap genom era satsningar inom IoT?
- Har ni funnit nya kanaler via IoT produkter?
- Har ni kunnat sänka era kostnader för produktion på grund av IoT?
- **Anser du att ni tjänat på era IoT investeringar? Isåfall hur?**
- Har ni fått ett ändrat resursbehov på grund av era IoT produkter?
- Hur har era kundrelationer förändrats tack vare IoT?

F, Frågor kring specifik fallstudie

- Finns det något intressant projekt inom IoT som sker nu under våren som vi kan följa?