Capturing Business Model Innovation Driven by the Emergence of New Technologies in Established Firms

A Case Study at Siemens Healthineers
Abstract

Background: It is argued that the emergence of new technologies and the digitalization can improve the healthcare, make it more efficient, personalized and available for everyone. The healthcare has already begun to become more digitized and there is no doubt that this trend will continue. Moreover, it is argued that AI will have a major impact on the MedTech and healthcare industry.

Problem discussion: To stay competitive it has been concluded that firms must update and rethink their business models constantly thus, to undertake business model innovation. This applies specially to established firms that have been successful with the same business model for a long time. Despite the fact that the existing literature addresses the importance of business model innovation, very little attention has been drawn to how to actually achieve this change.

Purpose: The purpose of this study is to explore how business models in established firms within the MedTech industry develops over time due to the emergence of new technologies. More specifically, we focus on how artificial intelligence is influencing and will influence the business models in the MedTech industry.

Methodology: This study has been performed through a single case study at Siemens Healthineers. The primary data has been gathered through four meetings with people with expertise in the field of artificial intelligence as well as the MedTech and healthcare industry. Further, through 14 interviews with employees at Siemens Healthineers in Sweden as well as through four verifying interviews with other actors within the MedTech industry. In addition, secondary data from the period 1998-2017 has been gathered through 20 annual reports from Siemens AG, 10 annual reports from Siemens AB, 9 documents found on Siemens Healthineers’s website and 46 different websites.

Findings: Several events have been identified which have contributed to business model innovation at Siemens Healthineers. Thus, 19 events have been identified between 1960-2000 and 21 events have been identified between 2000-2018. Further, three business models at Siemens Healthineers from the past, the present and the future is presented to visualize the business model innovation process. The trustworthiness of the findings is ensured by four verifying interviews with other actors within the MedTech and healthcare industry.

Conclusion: Business model innovation at Siemens Healthineers has been a process of incremental changes over time. Further, it can be concluded that the firm has used both a planned and an emergent approach of change to achieve business model innovation.

Keywords: Business models, business model innovation, process, events, new technologies, established firms, medtech, healthcare
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Halmstad, June 2018
Emma Bäckman and Josefin Ellmarker
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>3D</td>
<td>Three-dimensional</td>
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<tr>
<td>AGI</td>
<td>Artificial General Intelligence</td>
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<td>AI</td>
<td>Artificial Intelligence</td>
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<td>BMC</td>
<td>Business Model Canvas</td>
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<td>BMI</td>
<td>Business Model Innovation</td>
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<td>C$</td>
<td>Cost Structure</td>
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<td>CH</td>
<td>Channels</td>
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<td>CR</td>
<td>Customer Relationships</td>
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<td>CS</td>
<td>Customer Segments</td>
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<td>CT</td>
<td>Computer Tomography</td>
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<td>DL</td>
<td>Deep Learning</td>
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<td>GDPR</td>
<td>General Data Protection Regulation</td>
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<td>ICT</td>
<td>Information and Communication Technology</td>
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<td>IoT</td>
<td>Internet of Things</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>KA</td>
<td>Key Activities</td>
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<td>KP</td>
<td>Key Partners</td>
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<td>KR</td>
<td>Key Resources</td>
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<tr>
<td>MedTech</td>
<td>Medical Technology</td>
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<td>ML</td>
<td>Machine Learning</td>
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<tr>
<td>MRI</td>
<td>Magnetic Resonance Imaging</td>
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<td>O</td>
<td>Outcome Events</td>
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<td>OR</td>
<td>Operating Room</td>
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<td>R$</td>
<td>Revenue Streams</td>
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<td>R&amp;D</td>
<td>Research and Development</td>
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<td>VP</td>
<td>Value Proposition</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<td>X-Ray</td>
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1. Introduction
The digitalization in today’s society has an enormous effect on how firms are doing business. It has resulted in a faster pace of how firms handle innovation and develop new products and services (Rothwell, 1994). In turn, this means that the acceleration of how innovation happens forces firms to update their business model(s) to be able to adapt to the changes in the external environment. To survive in the digital economy today, firms need to look for emerging technologies that can help create competitive advantage, generate value and enable transformational business models (Gartner, 2017).

One industry that is facing several challenges today is the healthcare industry. Populations around the world are aging rapidly which puts a high pressure on the medical technology (MedTech) firms to offer new products and services to the healthcare industry to be able to meet these new demands (World Health Organization, 2018). As it is right now, the healthcare industry is struggling with inefficient and consumer unfriendly treatments (Herzlinger, 2006). Thus, this results in that patients are not treated on an individual level.

On the contrary, several researchers indicate that there are opportunities to offer higher value to the patients through a more cost-efficient and personalized care (Royston, 2009; Schartinger et al., 2015; Van Eenoo et al., 2018). It is argued that the emergence of new technologies such as the internet of things (IoT), information and communication technologies (ICT) and artificial intelligence (AI) integrated in products and services can disrupt the healthcare industry while at the same time, give the patients more freedom to choose when and where the care can be located (Michel, 2012; Piette et al., 2015; Schwamm, 2014). This advancement is especially beneficial for elderly people and/or people with other obstacles due to limited mobility and/or geographical locations. Thus, the World Health Organization (WHO) states in their world report on aging and health that “…eHealth, will be a critical tool for transforming health systems and services to deliver person-centred and integrated care that is appropriate to older people and aligned with the Healthy Ageing agenda” (World Health Organization, 2015, p. 109).

Thus, the emergence of new technologies forces firms that operate within the MedTech industry to relocate their resources and rethink their business model(s). Cavalcante (2014, p. 499) argues that: “the emergence of a new technology in the market makes it important for established companies—even those with successful business models—to carefully analyse its commercial potential and change their business models accordingly, since there are many examples of leading companies, with successful business models, that have failed in the emergence of new technologies”. Several researchers argue that changing the business model(s) is essential to stay competitive in the market. Therefore, it is important for established firms to analyze the external environment to identify coming trends and changes within the industry (Atun, Shah & Bosanquet, 2002; Lee & Meuter, 2010).

One particular technology that is emerging rapidly within industries today is AI. AI is a term associated with a machine that can solve problems usually performed by humans (Russell &
Norvig, 2010). Essentially, what is used in many of our modern applications today is machine learning (ML). Thus, ML are statistical methods that are used to make predictions and see patterns out of lots of data. For example, it is possible to convert speech to text, identify images and match posts or products with users’ interest (LeCun, Bengio & Hinton, 2015). There has been a lot of assumptions regarding how AI will affect the healthcare industry, some researchers argue that AI will take over the role of humans while some argue that it should be seen as a complement (Bloss, 2011; Haine et al., 2017; Noor, 2007; Rozzano, 2017). It is argued that the implementation of AI in products and services that are offered to the healthcare industry by the MedTech firms, can result in a more patient-centered and flexible care. Further, that AI will disrupt industries and if conducted right, it can drive competitive advantage: “an alliance between humans and machines will usher in a new era of work and drive competitive advantage. The full promise of AI depends on humans and machines working together to develop differentiated customer experiences and to create entirely new products, services and markets. That is the real opportunity of AI” (Shook & Knichrehm, 2018, p. 3). In a study performed by the firm Accenture, it was estimated that if companies invest in AI and in human-machine collaboration, their revenues could be boosted by as much as 50% in the health sector between 2018 and 2022 (Accenture, 2018). Thus, there is a lot of arguments pointing towards an implementation of AI in a greater extent in the healthcare industry.

Altogether, the increased attention towards the challenges in the healthcare industry combined with the emergence of new technologies such as AI forces firms that operate within the MedTech industry to rethink and update their business model(s). This, to be able to meet the new needs due to the aging population around the world and thus, to be able to offer products and services to the healthcare industry: “to meet the needs of ageing populations, significant changes are required in the way health systems are structured and health care is delivered. In many places, particularly in low- and middle-income countries, access and affordability are key barriers to care. New services and approaches will need to be developed in these settings” (World Health Organization, 2015, p. 114).

1.1 Problem discussion

Adapting to and adopting new technologies is critical for the survival of established firms in their industries (Cavalcante, 2014). However, it is also acknowledged that technologies by themselves have seldom much of a value unless they are integrated and delivered through the firm’s business model (Chesbrough, 2010). Unfortunately, the history shows that it is common that firms fail to commercialize great technology achievements because too little attention has been drawn to the development of a suitable business model to go with those (Teece, 2010).

Furthermore, business models is a research field, which has had a growing interest since its breakthrough in 1990 (Klang, Wallnöfer & Hacklin, 2014; Zott et al., 2011). One reason for this might be that a well-structured business model gives organizations an understanding of the whole business system (Teece, 2010). Moreover, it is ensured that developing a business model with activities that are interrelated and support the customer value will result in a
competitive advantage. However, interrelated activities in a business model are not enough to succeed over time. To stay competitive, it has been concluded that organizations must update and rethink their business models constantly (Casadesus-Masanell & Zhu, 2013; Ghezzi, 2014; Wirtz, Göttel & Daiser, 2016). This applies specially to established firms that have been successful for a long time. If they continue doing what they have always done, without updating their business model due to changes in the external environment they might go bankrupt (Achtenhagen, Melin & Naldi, 2013). Moreover, the history shows that even if a new technology is discovered, it is difficult for established firms to respond effectively to this technological change (Tripsas & Gavetti, 2000). Further, it is argued that firms within the MedTech industry have started to encounter a transformation since the emergence of new technologies enable products and services to be more digitized.

Even though it has been stated that updating the business models is important for established firms in order to survive Cavalcante (2014), very little research has been published on business model innovation (BMI) in comparison to business models (Foss & Saebi, 2017). A literature review on BMI based on articles from 2000 to 2015 indicates that there is a need for more research on BMI (Foss & Saebi, 2017). However, from the existing literature on BMI, it can be concluded that much of the research has focused on developing the concept itself or focused on the consequences of BMI. Moreover, the literature emphasizes that BMI has either an outcome or process perspective. The outcome perspective discusses the result of BMI, for example, a new type of business model for a specific firm or industry, while the process perspective highlights the stages of a successful BMI process (Foss & Saebi, 2017). Despite the fact that the literature addresses the importance of BMI, very little attention has been drawn to how to actually achieve this change (Johnson, Christensen & Kagermann, 2008). Thus, there is a need for more process studies on BMI to get a better understanding of how organizations develop and change their business models over time (Achtenhagen et al., 2013; Foss & Saebi, 2017; Van De Ven, 2007).

As mentioned, the emergence of new technologies often forces firms to reconsider their current business model Chesbrough (2010), since new technologies can upgrade the products and services that are delivered to the customer (Teece, 2010). AI is the technology that is listed as the most disruptive during the ten coming years (Gartner, 2017). Moreover, it is argued that to survive in the digital world today, firms that want to be in the front edge need to jump on this new wave of technology (Gartner, 2017). Over time, it has been shown that firms within the MedTech industry have improved products for the healthcare industry repeatedly due to the emergence of new technologies. But the question of how these firms have achieved this change has not received enough attention.

Thus, the purpose of this study is to explore how business models in established firms within the MedTech industry develops over time due to the emergence of new technologies. More specifically, we focus on how artificial intelligence is influencing and will influence the business models in the MedTech industry. The following two research questions have been stated based on the purpose of the study:
1. How do established firms within the MedTech industry change their business models over time, to adapt to the emergence of new technologies in general and in the case of artificial intelligence in particular?

2. Which key events have contributed to this change?

To answer the research questions, a single case study is performed at Siemens Healthineers. Siemens Healthineers is an established firm that has operated 120 years within the MedTech industry in Sweden, which makes it an extreme and suitable case for studying how business models in established firms develop over time. Firms within the MedTech industry has started to encounter a transformation since the emergence of new technologies enable products and services to be more digitized.

The primary data has been gathered through four meetings with people with expertise with the field of AI as well as the MedTech and healthcare industry. Further, 14 interviews with employees at Siemens Healthineers in Sweden has been performed as well as four verifying interviews with other actors within the MedTech industry to validate the results. In addition, secondary data from the period 1998 to 2017 has been gathered through 20 annual reports from Siemens AG, 10 annual reports from Siemens AB, 9 documents found on Siemens Healthineers’s website and 46 different websites.

1.2 Thesis layout

In this section, the eight chapters that are included in this thesis is briefly presented. Thus, the aim is to provide an overview of the content to ease the understanding for the reader.

In chapter 1 (Introduction): The background of the study as well as the problem discussion and the research questions are presented. Further, this leads to the purpose of the study and how the stated research questions are answered.

In chapter 2 (Theoretical frame of references): The framework that this thesis builds upon is presented. Thus, business models and BMI are concepts that are presented. Further, the BMC is presented since it has built the foundation for the interview manuscript and the findings.

In chapter 3 (Methodology): The research process and the methodological choices that have been made such as the research approach and the research strategy is presented. Further, how the quality of the study has been ensured is also presented.

In chapter 4 (Setting the context): The technology (AI) is presented since it has been used as a driving factor to analyze BMI within industries today.

In chapter 5 (Siemens Healthineers): The empirical data that has been gathered is presented. Thus, the section is structured with regard to two time periods and includes the primary data that has been gathered from the interviews, as well as secondary data from sources such as annual reports.
In chapter 6 (Analysis): The findings and the events that have triggered BMI at Siemens Healthineers is presented. The findings of the thesis are discussed with regard to the existing literature and the answers received from the verifying interviews with actors in the MedTech and healthcare industry. Further, three business models at Siemens Healthineers that visualize the past, the present and the future are presented.

In chapter 7 (Conclusion): The thesis ends with a conclusion where the main findings, as well as an answer to the stated research questions, is presented. In addition, limitations and suggestions for future research is presented.
2. Theoretical frame of references
This section describes the theoretical frame of references that this study is based upon. The focus of this study is on business models and there are two perspectives that can be used when performing a study on this topic: (1) outcome- and (2) process-perspective (Foss & Saebi, 2017). The section starts with an introduction to the concept of business models, which has an outcome-perspective. It is followed by an introduction to the concept of BMI, which has a process-perspective. Lastly, the section ends with an explanation and discussion of the chosen study approach.

2.1 Business models
The term “business model” was presented for the first time in an academic article in 1957 (Bellman, Clark, Malcolm, Craft & Ricciardi, 1957). However, it was not until the late 1990s that the term started to be used in greater extent (Osterwalder, Pigneur & Tucci, 2005). In turn, this match with the findings from Zott et al., (2011) that concluded that most of the literature on business models emerged from the mid-1990. Already from the breakthrough, the concept has gained a lot of attention from both managers and academia. However, there is still little clarity around the actual meaning of what a business model is, which in turn can be one reason to why there is a growing interest for the concept (Bertels, Koen & Elsum, 2015).

2.1.1 Definitions
As mentioned, it has been hard to define business models over time and more often business models are described as a multi-dimensional concept (Li, 2018). In 2005, Osterwalder et al., (2005) stressed the need for a clear definition. Around ten years later several researchers concluded the same, which indicates that it is difficult to agree upon one single definition (Ghezzi, 2014; Klang et al., 2014; Markides, 2015). Even Zott et al., (2011) argues that the literature on business models tend to be without any explicit definition and in some academic articles, the concept is not defined at all. However, in articles where the concept is defined, the definition often refers to the elements of a business model. Moreover, it also happens that the concept is defined by using definitions stated in previous research. In turn, the definitions tend to overlap which leads to a number of different understandings of a business model. Thus, different definitions are presented in Table 2-1.
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Definition of a business model</th>
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<tr>
<td>Chesbrough and Rosenbloom (2002, p. 529)</td>
<td>“A successful business model creates a heuristic logic that connects technical potential with the realization of economic value”</td>
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<td>Magretta (2002, p. 4)</td>
<td>“…Who is the customer? And what does the customer value? It also answers 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?”</td>
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<td>Morris et al., (2005, p. 727)</td>
<td>“A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets”</td>
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<tr>
<td>Johnson et al., (2008, p. 60)</td>
<td>“A business model, from our point of view, consists of four interlocking elements that, taken together, create and deliver value”</td>
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<tr>
<td>Osterwalder and Pignuer (2010, p. 14)</td>
<td>“A business model describes the rationale of how an organization creates, delivers, and captures value”</td>
</tr>
<tr>
<td>Teece (2010, p. 179)</td>
<td>“A business model articulates the logic, the data, and other evidence that support a value proposition for the customer, and a viable structure of revenues and costs for the enterprise delivering that value”</td>
</tr>
<tr>
<td>Baden-Fuller and Mangematin (2013, p. 419)</td>
<td>“…a stripped-down characterization that captures the essence of the cause–effect relationships between customers, the organization and money. Hence, a business model is a special example of a configuration”</td>
</tr>
<tr>
<td>Li (2018, p. 3)</td>
<td>“…business model is defined as a firm's rationale and logic for value sensing, creation, distribution and capture. It explains how a firm makes money now and in the future, and a good business model can create sustainable competitive advantages”</td>
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*Table 2-1: Definitions of a business model from a historical perspective*
Furthermore, the meaning of a business model depends on people's previous experience. Osterwalder et al., (2005) claim that there is a significant difference between business- and technology-oriented people. Business-oriented people tend to think of a definition in words of a more value/customer-oriented definition, while technology-oriented people argue about an activity/role-oriented definition. As a consequence of the unclear definition, several authors point out that the term business model can be hard to separate from other concepts, and especially the concept of strategy (Markides, 2015; Osterwalder et al., 2005; Zott et al., 2011). Thus, business models and strategy are often used as synonyms (Markides, 2015; Osterwalder et al., 2005). In turn, this might be the result due to the lack of a clear definition. Instead of being seen as substitutes, Zott et al., (2011) claim that business models and strategy should be seen as complements. A business model can be explained as a detailed description of a strategy and its focus on how interrelated activities can support the demand (Markides, 2015). Thus, the two concepts have different focuses. Furthermore, business models also push for an outside-in perspective which results in that market changes can be discovered quickly (McGrath, 2010). In Table 2-1, several definitions of business models are presented.

Based on existing literature, the definitions of business models often include how a firm works, who the customer is and how the firm makes money (Magretta, 2002). Despite this, definitions of business models have had different focus over time which can be seen in Table 2-1. The first definition presented by Chesbrough and Rosenblom (2002) focuses on how to make money on technical potential and mention the connection between these factors as a heuristic logic. Both, Magretta (2002) and Johnson et al., (2008) tries to answer the question “what is a business model?” by emphasizing its different elements. Furthermore, the definition presented by Morris, Schindehutte and Allen (2005) has a clear outcome focus since it describes a business model as interrelated activities that are addressed to create competitive advantage. Even though it is not literally expressed, Teece (2010) also touches upon the importance of interrelated activities by arguing that a business model articulate everything needed to support the firms offering. In similar, Baden-Fuller and Mangematin (2013) means that the activities in a business model have a cause-and-effect relationship. Further argued, it seems like many of the newer definitions of business models builds on the classics but has a future perspective included. Based on previous research, Li (2018) has developed a definition that is aligned with the digital transformation of business models. As many other definitions, this one includes how the firm creates, distributes and captures value and that a suitable business model can result in a competitive advantage. However, what differentiates this newer definition from the older ones is that it also emphasizes that a plan of how the firm should work in the future is required.

Among the definitions discussed above, the one presented by Osterwalder and Pignuer (2010) is the most general. In comparison to the definitions presented by Magretta (2002) and Johnson et al., (2008), it doesn't give an explicit picture of the elements of the business model. However, the definition by Osterwalder and Pignuer (2010) includes three highly relevant parameters, how an organization create, capture and deliver value. All these parameters are affected by the emergence of new technologies and therefore, this definition is adopted in this thesis.
Altogether, what characterizes almost all definitions for business models is that all its elements must be interrelated and support each other. This has also been ensured by Markides (2015) who studied how definitions for business models have changed over time. Moreover, it can be concluded that the greater part of the definitions on business models include what a firm offers, and the activities needed to deliver that offering. In addition, most of the definitions also include the economic aspect and that the value should be delivered at a reasonable cost.

2.1.2 Elements and tools
A business model consists of different elements but exactly what elements that are included in a successful business model differ among scholars. However, it has been concluded that the elements in a business model can range from 4 to more than 20 (Täuscher & Abdelkafi, 2017). Thus, there are many different ways to describe a firm's business logic. Moreover, it is often hard for managers to mediate the business logic to the rest of the organization and especially if there is a new one that should be presented (Täuscher & Abdelkafi, 2017). New ways of doing things often result in cognitive challenges. However, it has been concluded that visualization as a tool as well as storytelling, where the business model is put in a context and explained by the help of post-it notes, are ways reach the audience and minimize this challenge (Osterwalder et al., 2005; Täuscher & Abdelkafi, 2017).

According to Täuscher and Abdelkafi (2017), a business model can be categorized into three different views: (1) element view, (2) casual view and (3) transactional view. In turn, it has been concluded that each view of a business model is often presented with a visual tool with certain characteristics.

Element view
Tools for the element view visually show a number of predefined elements and the user must fill out textual information for each element, which exemplifies the firm’s business model (Täuscher & Abdelkafi, 2017). The business model canvas (BMC) consisting of nine building blocks is one example for this category of visual tools, where the nine building blocks represent the elements in a business model (Osterwalder & Pignuer, 2010). In turn, Johnson et al., (2008) present another visual tool with four different elements: (1) customer value proposition, (2) profit formula, (3) key resources and (4) key processes, which must be filled out with textual information. When discussing the elements in a business model, it seems like scholars agree upon the content, but use different words to describe it. According to Magretta (2002) and in similar to what Johnson et al., (2008) presents, a business model should include elements which describe customer value, revenue streams and the economic logic of how the business model can deliver value. Furthermore, Chesbrough (2010) argues that a business model must communicate a value proposition, have a structure and value chain to deliver the offering as well as a clear revenue model.
Casual view

In opposition to the element view which has its focus on the elements, tools for the casual view often use arrows to relate and connect to different elements. In comparison to the element view, the tools for the casual view does not give any suggestions or subtitles of what the elements should include. One clear example of this is presented by Kiani, Gholamian, Hamzeheiand and Hosseini (2009) where arrows in different colors create loops to show the interaction between the elements in the business model. Further argued, many tools combine several views and a combination of the element view and the causal view is the most common (Täuscher & Abdelkafi, 2017). In these types of visual tools, the elements are clearly described with suggestions of what the elements should include. In addition, the relationships between the elements are described by arrows which are typical for the casual view but non-existent in the element view (Linder & Cantrell, 2000).

Transactional view

The tools for the transactional view of business models are often illustrated by boxed objects which includes the actors in the business model, and arrows show how these actors are related to each other (Täuscher & Abdelkafi, 2017). The work presented by Velu and Stiles (2013) is one example of this, where the relationships between the buyer, a digital platform and the seller are described.

Lastly, one more interesting point that Täuscher and Abdelkafi (2017) showed with their research is that visual tools used by managers are seldom the ones developed by academia. It has been concluded that the element view is the most common way to describe a business model and tools for this view are also those which are most describing and easy to understand. Although well-developed tools are out there, several managers continue to make their own visual models. However, even if tools developed by the academia or managers themselves are used, it is beneficial when designing and communicating a business model.

2.1.3 Business model canvas

As discussed in the section above, it is helpful to have a tool to visualize and communicate a business model (Osterwalder et al., 2005). Bertels et al., (2015) and Täuscher and Abdelkafi (2017) argues that the BMC is the most popular framework for describing and developing business models. Based on the Ph.D. thesis by Alexander Osterwalder, it was first introduced in 2004 and in 2010 it expanded when the book Business Model Generation was released. The BMC can be seen as a complementary tool to the definition of business models presented by Osterwalder and Pignuer (2010), which has been chosen for this thesis. The BMC explains the elements of the business model and how it is possible to create, capture and deliver value. The elements which describe the business logic are according to Osterwalder and Pignuer (2010) explained in nine building blocks and are presented in Figure 2-1.
1. Customer segments (CS) refers to the different groups of customers that the firm chooses to target. Firms need to group customers with regard to their needs, behaviors and other characteristics. No firm can serve all CS at the same time. Instead, firms need to conclude on their most important customer and also discuss if this also might be the most profitable customer (Osterwalder & Pignuer, 2010).

2. Value proposition (VP) describes and communicates how a product or service can solve a problem. It also tells what the customer can benefit from using the product or service. Last but not least, it states why the customer should buy from you instead of competitors (Osterwalder & Pignuer, 2010). What also is important is that the VP is easy to understand, if the firm can’t communicate the VP, it does not matter how good the product is.

3. Channels (CH) describes how the firm reach its customer and thus, communicate the VP to its CS. The choice of channels plays a big role in how the customer experience the firm and the VP (Osterwalder & Pignuer, 2010).

4. Customer relationships (CR) explains what type of relationships the firm creates with its different customers. It is also important to remember that different customers might require different types of relationships. The relationships can be created through personal assistance, dedicated personal service, self-service, automated service and co-creation. Furthermore, it is worth to remember that different types of relationships can overlap and co-exist (Osterwalder & Pignuer, 2010).
5. Revenue streams (R$) refers to the money that a firm generates from its CS. The firm must ask questions as “what are the customers willing to pay?” and “how would they prefer to pay?”. A business model can generate money from two types of R$, either from one-time payment or from ongoing payment. The pricing mechanism can also be based on two types of strategies, the price can be based on static variables or on market conditions. Moreover, firms can generate money by different types of R$ such as asset sales, usage fees, subscription fees, leasing, licensing, brokerage fees or advertising (Osterwalder & Pignuer, 2010).

6. Key resources (KR) refers to the assets that are needed to be able to run the business. Resources are needed to create the VP, reach and maintain the relationship with the customer and other partners. It is also used to earn money. There are different types of resources, physical, financial, intellectual and human resources and which one that is the most important differ depending on what kind of business model the firm has (Osterwalder & Pignuer, 2010).

7. Key activities (KA) explains the most important activities that a firm must undertake to be able to run the business successfully. In similar to KR, the KA are required to create the value proposition, reach and maintain the relationship with the customer and other partners. It is also needed for earning money. Moreover, KA can be divided into three categories, production, problem-solving and platform/network. It is important to remember that the KA might also differ depending on what kind of business model the firm use (Osterwalder & Pignuer, 2010).

8. Key partners (KP) describes the network of suppliers and other partners that are required to run the business successfully. In many cases, partnerships are an important part of the business since it is possible to reduce risks, acquire resources, create alliances and thus, optimize the business model. Moreover, four types of partnerships exist, strategic alliances between non-competitors, strategic partnerships between competitors, joint ventures and buyer-supplier relationships (Osterwalder & Pignuer, 2010).

9. Cost structure (C$) refers to the costs that arise to run the business model. Two types of costs structures exist but more often, firms apply a combination of both structures. The first structure is value-driven and the main focus is on value creation. The second structure is cost-driven and focuses on minimizing costs. Other structures that can be applied are fixed costs, variable costs, economies of scales and economies of scope (Osterwalder & Pignuer, 2010).

In this thesis, the BMC has been used for several things. It has been used to design the manuscript for the interviews, worked as a support under the interviews to communicate the elements of a business model and also as a tool to visualize how the business model as Siemens Healthineers has changed over time. Moreover, it has been used since it is a tool for describing the element view, which is the most common way to describe a business model.
2.2 BMI as a process
The concept of business models has been a common term to use when describing an organization’s business since the late 1990s (Osterwalder et al., 2005). In recent years, there has been an acknowledgement to the fact that established firms need to update, rethink or change their business model to stay competitive in the market (Casadesus-Masanell & Zhu, 2013; Ghezzi, 2014; Wirtz et al., 2016). This concept is called BMI.

2.2.1 Definitions
The concept of BMI and its functionality has gained a lot of attention during the past years. BMI is briefly described the change of one or more elements of the existing business model (Frankenberger, Weiblen, Csik & Gassmann, 2013). Although the concept has gained a lot of attention in recent years, there is no denying that it is relatively new (Spieth, Schneckenberg & Ricart, 2014). Foss and Saebi (2017) argue that a lot of the definitions of BMI in the existing literature are lacking clarity and specificity. Moreover, there is a lack of research on how to achieve this change over time (Achtenhagen et al., 2013). Euchner and Ganguly (2014) argue that the concept of BMI is vaguely defined which makes it hard to study and thus, changing the business model involves a lot of risks. Further argued by Wirtz et al., (2016, p. 2): “…extant literature on BMI draws a quite heterogeneous picture, which lacks conceptual clarity and clear-cut practical advice”. In Table 2-2, several definitions of BMI are presented.
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Definition of business model innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malhotra (2000, p. 9)</td>
<td>“…business model innovations represent ‘paradigm shifts’ that characterize not transformation at the level of business processes and process workflows, but radical rethinking of the business as well as the dividing lines between organizations and industries”</td>
</tr>
<tr>
<td>Markides (2006, p. 20)</td>
<td>“Business-model innovation is the discovery of a fundamentally different business model in an existing business”</td>
</tr>
<tr>
<td>Casadesus-Masanell and Zhu (2013, p. 464)</td>
<td>“…business model innovation refers to the search for new logics of the firm, new ways to create and capture value for its stakeholders, and focuses primarily on finding new ways to generate revenues and define value propositions for customers, suppliers, and partners”</td>
</tr>
<tr>
<td>Frankenberger et al., (2013, p. 253)</td>
<td>“…a business model innovation can be defined as a novel way of how to create and capture value, which is achieved through a change of one or multiple components in the business model”</td>
</tr>
<tr>
<td>Guo et al., (2013, p. 451)</td>
<td>“…the creation or reinvention of existing business models by proposing new value propositions, designing novel value-creation systems, and building original value-capturing mechanisms”</td>
</tr>
<tr>
<td>Euchner and Ganguly (2014, p. 33)</td>
<td>“…is any innovation that creates a new market or disrupts the competitive advantage of key competitors”</td>
</tr>
<tr>
<td>Stiilur (2018, p. 191)</td>
<td>“BMI is the introduction of a business model that is new to the industry of the focal firm – that is, there is no known precedent in that space”</td>
</tr>
</tbody>
</table>

**Table 2-2: Definitions of BMI from a historical perspective**
As seen in Table 2-2, a lot of the definitions presented arose from research from the previous years. The reason behind this might be the criticism towards the concept resulting in that several authors have tried to contribute to the field. The first definition presented by Malhotra (2000) is written in a rather general way, thus discussing BMI from a macro perspective. The definitions presented by Markides (2006) and Zott and Amit (2007) is also formulated in a rather general way, but they discuss BMI as a new way to do business.

In comparison, the definitions suggested after 2010 and presented by Casadesus-Masanell and Zhu (2013), Frankenberger et al., (2013) and Guo, Zhao and Tang (2013) are mostly focusing on the value that is captured and delivered through this process and they provide a more detailed explanation of how to achieve this. Moreover, the definition presented in Euchner and Ganguly (2014) has a more outcome-focus, thus what an organization can achieve through BMI. Lastly, Snihur (2018) discuss BMI from a macro perspective and refer to it as a business model which deliver something totally new to the industry. Furthermore, the definition presented in Frankenberger et al., (2013) has been chosen for this thesis since it aligns with the chosen definition of a business model.

2.2.2 Types of changes

The reason why established firms choose to change or update their business model is many. Cavalcante, Kesting and Ulhøi (2011) argue that only changes that affect the core standard repeated processes are considered as a BMI. It is further argued that BMI is harder for established firms than startup firms since they have to rethink their current business model to be able to offer value in the future (Zott & Amit, 2010). Thus, it is common that established firms are struggling to overcome the current business logic and think outside the box, since they are used to the current business model and its way of work (Frankenberger et al., 2013).

There are several publications that discuss and present how to address BMI. Cavalcante et al., (2011) present four types of business model change in their research: (1) business model creation, (2) business model extension, (3) business model revision and (4) business model termination. The first type, business model creation, focus on the materialization of a business idea into a new venture. The second type, business model extension, focus on improving the business model by adding new processes. The third type, business model revision, focus on intervening with the existing core processes and replacing with a new one(s). The fourth type, business model termination, focus on removing the core processes. In comparison to the previous framework which focus on types of business model change, Girotra and Nessesseine (2014) has a more decision-making focus in their framework, where changes to the decisions of: (1) what your offerings will be, (2) when decisions are made, (3) who makes them and (4) why, is argued to improve the firm’s revenues, costs and risks. The first change, what your offerings will be, focus on changing the mix of products or services to avoid risks such as uncertain demands. The second change, when decisions are made, focus on how to improve business models by changing the timing of the decision making. This, to avoid making decisions when there is not enough information. The third change, who makes them, focus on replacing the decision makers to improve the decision making in the value chain. The fourth
change, why, focus on how decision makers collaborate to create value and pursue their private objectives without damaging the value chain.

Altogether, the majority of the frameworks regarding BMI has been developed during the previous years, this due to the lack of comprehensive frameworks in prior research within the field.

### 2.2.3 Approaches and stages of BMI

Several authors discuss experimentation and trial-and-error as activities that are critical to perform in the BMI process (Achtenhagen et al., 2013; Cavalcante, 2014; Chesbrough, 2010; Euchner & Ganguly, 2014; McGrath, 2010; Wrigley & Straker, 2016). Moreover, this way of work is called an emergent approach (Bamford & Forrester, 2003). For example, Cavalcante (2014) has discovered a pre-stage in the BMI process. Whereas experimentation and learning, which means dealing with new ideas and practices, are challenges that are needed to overcome to be able to proceed and promote BMI. In similar, McGrath (2010) argues that experimentation is needed to discover new business models. Moreover, that experimentation can be seen as a source of competitive differentiation since it can result in that a firm can build better and more suitable business models for the industry and market, faster than its competitors. Wrigley and Straker (2016) further argue that experimentation and learning help testing different ideas to find the most suitable solution. Moreover, Euchner and Ganguly (2014) state that business experiments such as prototypes, trials and user experiences are the heart of the BMI process. Similarly, Achtenhagen et al., (2013) developed in their research a framework which shows distinctly that experimentation, a balanced use of resources and the right culture and leadership within the organization will lead to successful value creation.

Another approach to BMI is presented in Eurich, Weiblen and Breitenmoser (2014), where the focus in on a six-step approach that is based on network thinking. This framework, in comparison to the activities presented previously such as experimentation and trial-and-error, is a more planned process of how to approach BMI. Further, the framework presents how to structure the design process of a new business model. Thus, it includes the following six steps: (1) determination of the mission and business environment, (2) analysis of interdependencies, (3) determination and analysis of design alternatives, (4) creation of business model design alternatives, (5) selection of one BMI and (6) test and realization of the business model. The first step, determination of the mission and business environment, focus on identifying assumptions and constraints that can have an impact on the business model. The second step, analysis of interdependencies, focus on determine business assumptions, their consequences and potential connections to understand the organization’s situation and facilitate communication between involved stakeholders. The third step, determination and analysis of design alternatives, focus on evaluating the consequences of the business assumptions and decision options. The fourth step, creation of business model design alternatives, focus on drafting different alternatives of the business model. It is suggested to use different conceptual tools. The fifth step, selection of one BMI, focus on the evaluation of the alternatives from the previous step. The last step, test and realization of the business
model, focus on testing the assumptions regarding the selected business model via for example a test market.

Another framework that has a more planned approach to BMI is presented in (Frankenberger et al., 2013). This framework is called “4I” and it consists of four BMI process phases: (1) initiation, (2) ideation, (3) integration and (4) implementation. The first phase, initiation, focus on the ecosystem of the innovating firm, which means customers, competitors, suppliers, universities and others that influence the operations of the firm. The second phase, ideation, focus on how to transform discovered opportunities into concrete ideas for new business models. The third phase, integration, focus on developing a new business model from the ideas that were presented in the previous phase. The fourth phase, implementation, focus on how to implement the new business model.

2.2.4 Barriers and challenges
One of the main barriers for established firms when performing BMI is that many firms have a hard time thinking outside the current business logic (Frankenberger et al., 2013). It is argued that: “it is so difficult to break out of the dominant logic of the company and of the industry when you have been working within this company for many years, which is the case for most of our managers” (Frankenberger et al., 2013, p. 259). Thus, this shows the importance of managers in the BMI process, which is discussed in several articles. It is argued that managers can be a barrier in BMI if they don’t allocate resources properly (Chesbrough, 2010; Guo et al., 2013). Guo et al., (2013) argues that strong managerial skills can help managers allocate resources properly, and therefore it is recommended that they engage in activities that prosper this type of skills. Further argued, managers need to understand that innovation is not only innovative products or services but also involves the business model (Cavalcante, 2014). Therefore, it is also important that managers respond quickly to new business opportunities before it is too late.

Moreover, it is stated that a strong organizational culture and employee commitment, as well as a clear leadership, is key to a successful business change. Although, strong cultures can become destructive if not handled properly. Achtenhagen et al., (2013, p. 437) argues that: “...achieving a positive impact of a strong culture implies shared norms and values that allow, and even encourage, employees to question current ways of generating revenue, to experiment with new ideas, and to dare to change ways of doing things”. Thus, it is important to have an open attitude towards change among both the employees and managers to succeed with BMI.

2.3 A process approach to study BMI
The purpose of this study is to explore how business models in established firms within the MedTech industry develops over time due to the emergence of new technologies. More specifically, we focus on how artificial intelligence is influencing and will influence the business models in the MedTech industry. In the words of Van de Ven and Poole (1995), this purpose can be explained as studying a process of organizational change. The question is though, what is a “process” and what is “organizational change”? A process can be explained
as interrelated activities that systematically together change something (Rescher, 1996). Interestingly, this explanation has striking similarities to the chosen definition of BMI:

“… a business model can be defined as a novel way of how to create and capture value, which is achieved through a change of one or multiple components in the business model” (Frankenberger et al., 2013, p. 253). In this definition, the elements of the business model are the interrelated activities as explained in the description of a process (Rescher, 1996). Furthermore, Rescher (1996) argues that a process “change something”, which in the definition presented by Frankenberger et al., (2013) is the elements of the business model. Altogether, BMI is a process where interrelated elements constantly change to be able to create and capture value over time. Furthermore, organizational change can be defined as: “…a difference in form, quality, or state over time in an organizational entity” (Van de Ven & Poole, 1995, p. 512). Moreover, Van de Ven and Poole (1995) argue that the entity can be several things. It can be an individual’s job, a product, or an overall organization, but in the entity of this thesis, it is defined as the business model.

When making process studies, there are two types of theories with complementary definitions that are frequently used for this area of interest. It can be explained by either a “variance theory” or a “process theory”. A “variance theory” is defined as: “a category of concepts or variables that pertain to actions and activities” (Van de Ven, 2007, p. 196). It results in an outcome-focused approach and the researcher study “what causes what”. The other way to study organizational change is through “process theory” which is defined as “a narrative describing how things develop and change” (Van de Ven, 2007, p. 196). This perspective results in an event-driven approach and harmonizes with the purpose of this study, since it includes a historical perspective where activities, stages and structures of incidents are studied over time.

To explain a process of change, Van de Ven and Poole (1995) has formed four different theories: (1) life cycle, (2) teleology, (3) dialectical and (4) evolution, which all have different views on what drives change. Moreover, the theories have occurred from two different dimensions, which is illustrated in Figure 2-2. The first dimension, unit of change, refers to if the change addresses a single entity or is an interface between several entities. The second dimension refers to if the sequences of change will be prescribed or more towards a constructive change.
The evolutionary theory builds on the concepts, variation, selection and retention, based on the biological theory of evolution. When using this view from a business model perspective, it means that a business model develops because of cumulative change. The selection phase drives change forward, and it occurs through a competition of resources, and the business model that best suits the environment survives. Instead of selection, the dialectical theory states that change and development occur due to tensions between two or more business models that compete for domination and authority (Van de Ven & Poole, 1995). Moreover, tensions start because of internal and external pressures that either puts the different elements of the business models in conflict with each other or put different business models to compete about priority. In turn, this means that change happens because of competing goals and interest, which changes the status quo of the business model (Van de Ven & Poole, 1995).

When using the life cycle perspective applied on business models it means that a specific logic, program or code regulates the development and in turn, change the business model. Thus, the business model evolves gradually. External events influence the development, but it is always the specific logic, program or code that controls the development in the end. The life cycle perspective also emphasizes that change occurs because of historical events. Moreover, it is argued that: “each stage of development is seen as a necessary precursor of succeeding stages” (Van de Ven & Poole, 1995, p. 515).

The teleology perspective argues about the importance of having a final state or goal to achieve change in a business model. Moreover, Van de Ven & Poole (1995, p. 516) claim that: “proponents of this theory view development as a repetitive sequence of goal formulation, implementation, evaluation, and modification of goals based on what was learned or intended by the entity”. In turn, this theory enables creativity since the goal needs to be stated by the entity itself, which in this context is the people involved in the process of
BMI. In opposite to the life-cycle perspective, the teleology does not propose for a specific logic or a set of stages to perform change (Van de Ven & Poole, 1995). However, it agrees that change is influenced by external factors. In this theory, it means that, even though a goal is achieved, the development will not stagnate because it is influenced by the external environment and imbalance within the organization. Altogether, the organization's resources and external environment determine the way it is possible to change the business model (Van de Ven & Poole, 1995).

It is important to remember that change happens because of many different factors and there is seldom one motor for change. Therefore, the four theories should be seen as four general theories of process which also can overlap with each other (Van de Ven & Poole, 1995). When performing process studies, some researchers argue that it is beneficial to include more than one process theory to be able to analyze the differences between them. In opposite, others argue about having one theory in mind since it makes it easier to have a clear focus when collecting the data and making the analysis (Van de Ven, 2007). Although, we argue that all the theories have some parts that are relevant when studying BMI, we have chosen to analyze the development and change out of the life cycle perspective since it matches the literature on BMI.

Business model innovation is a process of constant change and when choosing a process perspective of a research, Van de Ven (2007) promotes that change should be analyzed out of selected events. Even though a research area has been chosen, it is impossible to study everything at the same time and therefore it is advantageous to have specific events to rely on that makes the analysis more distinct. According to Van de Ven (2007, p. 217), events are explained as: “…abstract concepts of bracketed or coded set of incidents”. In turn, incidents are explained as “…operational empirical observations” (Van de Ven, 2007, p. 217). Altogether, this means that the incidents shape the events. However, identifying events are not an easy task as Poole, Van de Ven, Dooley and Holmes (2000, p. 92) argue: “events are generally not simply “there”; the research must engage in the interpretation of raw data such as interviews or historical records to recognize relevant events”.

2.3.1 Five categories of events
The five categories of events as defined by Poole et al., (2000, pp. 106-108) and that have been used to analyze the empirical data are presented down below.

1. Idea events occur when there is a change in the ideas that are deemed to be significant to the overall development of the business model by the involved individuals. Change in the business model ideas is classified into those that pertain to core or related events. In turn, core ideas are those that relate to the central technology, product, program, or service that makes up the essence of the business model. Related ideas are those that support the development of the business model, but do not constitute a change in the core embodiment of it.

2. People events occur when there is a change in the staffing (turnover) or assignments (roles) of the people holding key positions in the business model.
3. Transaction events occur when there is a change in the legal or social contrasts associated with the business model. This may relate to key transactions between different business models or sectors in the firm but also transactions between the people related to the business model. The effort to exchange or modify existing transactions may also receive this code. For example, when the firm initiates efforts to create a new contact or relationship involving the business model, it is coded as a transaction event. Furthermore, a resource controller intervention is one form of transaction that can be tracked over time. These people can be venture capitalists, top managers, or board members who have invested capital in parts or the whole business model.

4. Context events is an external event that is related to the business model but occurred beyond the control of the team. It may involve an environmental change in technology, structure, or market that affects the business model. In turn, context events are subdivided into organization and external context. For this study, it has been concluded that organizational context refers to all organizational elements and events that occur internally, while all environmental changes are included under the external context.

5. Outcome events occur when a change happens in the criteria or values of criteria used to judge the progress or outcomes of the business model. Moreover, the outcome can be both tangible or intangible. It can for example be the product or service that is delivered through the business model as well as a judgment by the resource controllers or involved managers about the success or failure of the business model. Outcomes are further coded as representing either: (1) positive (good news or successful accomplishments), (2) negative (bad news or instances of failures or mistakes) or (3) mixed (neutral or ambiguous news or results indicating elements of both success and failure) outcomes.

2.4 Summary of the theoretical frame of references
The theoretical frame of references that this thesis builds upon are: the concept of a business model, the business model canvas, business model innovation and the process- and life cycle perspective. Thus, the chosen definition of a business model is presented in Osterwalder and Pigneur (2010) which discuss how an organization create, capture and deliver value. All these parameters are affected by the emergence of new technologies and therefore, this definition is adopted in this thesis. Further, the chosen definition of BMI presented in Frankenberger et al., (2013) is aligned with the previously chosen definition since it has a distinct focus on the value that is created and captured in the organization. To visualize the business model innovation process, the business model canvas presented by Osterwalder and Pigneur (2010) was chosen to explain how the business model at Siemens Healthineers have changed over time. Thus, to study this phenomenon the process- and life cycle perspective has been used (Van de Ven & Poole, 1995).
3. Methodology

It is important to have a clear structure of the process and the design of the research to get the best outcome (Bryman & Bell, 2011). In this section, a description of the research process is presented. Moreover, it is followed by the methodological choices we have made and how we designed our research to answer our stated research questions.

3.1 Research process

It is important to have a clear structure of the process and the design of the research to get the best outcome (Bryman & Bell, 2011). In this section, a description of the research process is presented. Moreover, it is followed by the methodological choices we have made and how we designed our research to answer our stated research questions.

![Figure 3-1: Illustrating the iterative research process](image)

3.1.1 Initiation

The first phase of our research process was the initiation phase. Thus, this phase focused on finding a research topic and finding a firm to use for our case study. When deciding on a research topic, there is a lot to choose from. Although, due to the focus of our program and therefore certain limitations, we decided rather early in the process that we wanted to focus on business models and specifically BMI. Further, we have always been fascinated by the emergence of new technologies and how organizations are affected by these. Thus, we wanted to analyze BMI and use technologies as a driving factor when analyzing this change.

First and foremost, we performed a literature review to see the state of the art and to see what type of technologies that are discussed in the existing literature. The purpose of this was to identify a relevant research topic and to be able to contribute to the field. We searched for literature in the databases “ABI Inform”, “Scopus” and “Web of Science”, provided by Halmstad University and we also used Google Scholar. To systematically read and gather data, we divided the articles that we found in the databases among us. After each read article, we wrote a summary containing an abstract, the research question(s), the main findings and the conclusion. This to be able to discuss the articles better with each other but also to be able to go back and see what is relevant for each of the sections of the thesis. When we decided for on research topic, we wanted to gather as much knowledge about the subject of business models and AI as possible. Thus, to get a broad knowledge from different actors within the field, we attended lectures at Halmstad University where the purpose was to listen to experts and to gather more knowledge within the subject of AI. We also had meetings with doctors to gather knowledge within the healthcare industry as well as meetings with experts to get valuable advice and foremost contacts. A presentation of the meetings that were held can be seen in Table 3-1 on the following page.
Table 3-1: The number of meetings that were conducted as a part of the initiation phase

<table>
<thead>
<tr>
<th>Date</th>
<th>Meeting nr.</th>
<th>Title</th>
<th>Location</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>05-feb-18</td>
<td>Meeting nr. 1</td>
<td>Professor of Informatics</td>
<td>Halmstad University</td>
<td>30 min</td>
</tr>
<tr>
<td>08-feb-18</td>
<td>Meeting nr. 2</td>
<td>Area and Investment Manager ICT</td>
<td>Clarion Hotel Post, Gothenburg</td>
<td>45 min</td>
</tr>
<tr>
<td>15-feb-18</td>
<td>Meeting nr. 3</td>
<td>Area Manager, Chief Physician</td>
<td>Hallands Hospital Halmstad</td>
<td>90 min</td>
</tr>
<tr>
<td>19-feb-18</td>
<td>Meeting nr. 4</td>
<td>Teamleader, Data Digital and AI</td>
<td>Siemens Healthineers, Malmö</td>
<td>70 min</td>
</tr>
</tbody>
</table>

When we felt that we had a general knowledge about the subject we started our search for an appropriate firm to perform a case study on. The first search focused on established firms, where three criteria were stated which the chosen firm should fulfill. Those were: (1) An organization within the MedTech/healthcare industry that have changed or are changing their business model with regard to AI, (2) the firm should have circa 30 employees and (3) it should be located in Sweden. We identified 14 firms and analyzed them with regard to the criteria presented above and sorted out the firms that fulfilled those. In total, we found that nine of the 14 firms matched our stated criteria, so we contacted them via telephone.

After the first search, we concluded that many of the relevant firms for this thesis were startups. Therefore, we decided to have two options for our thesis, either to analyze an established firm or to analyze a startup firm. For our second search, we stated two new criteria which the chosen firm should fulfill. Those were: (1) An organization within the healthcare/medTech industry that has AI integrated into their business model and (2) it should be located in Sweden. In total, we found five firms which matched our stated criteria which we also contacted via telephone. A presentation of the firms found in both the first and second search can be seen in Appendix 1.

One of the companies we found in our first search of established firms were Siemens Healthineers. When we contacted them, they were very open-minded towards us conducting interviews with their employees for our thesis, so we booked a meeting with them the 19th of February to discuss these opportunities. When we finalized the meeting, both of us had a great feeling about Siemens Healthineers and we decided rather quickly to perform our case study at their firm. The four crucial meetings we had in our initiation phase, which later led us to a case study at Siemens Healthineers, are presented above in Table 3-1.

3.1.2 Execution

The second phase of our research process was the execution phase. Thus, this phase focused on gathering empirical and secondary data. At first, we wanted to gather the empirical data through one workshop and around five interviews. Although, we discovered that several of the employees were very busy and did not have time to participate in a half-day workshop. Thus, we decided to only focus on interviews and to conduct at least 10 interviews in total. In addition, we wanted to support our empirical data with secondary data, since we could not perform the workshop and to get as broad process-perspective as possible. Further, we wanted
to interview people from different divisions from the firm.

To get in contact with potential participants for our research, different methods have been used. Four initial contacts were given from our contact person. Despite this and to get in contact with more people at Siemens Healthineers, we contacted the headquarters’ reception in Solna. In addition, we used LinkedIn to find employees with relevant job-titles at Siemens Healthineers that could be possible participants for our interviews (LinkedIn, 2018). When potential interviewees were called, we asked if they were willing to share contact information to their colleagues that they thought could be relevant for us. By this way of work, even more employees at Siemens Healthineers were contacted and booked for interviews. Moreover, the attitude towards participating in our study was positive and the majority of the interviews was booked at once. We also sent information about which date and at what time the interview would take place to all the employees that confirmed an interview. A deeper description of what main areas that the interview would include as well as the structure of the interview was sent to some of the employees who wanted to be extra prepared. The time for each interview was presented as taking 45 minutes. However, we constructed the schedule with possibilities to extend the interviews.

The majority of the interviews took place at Siemens Healthineers office in Solna. Thus, they were held in a conference room which we had access to via the firm. We stayed in Stockholm for two days and during these days we had eight interviews with employees working at the office in Solna. Moreover, we have had interviews over the phone as well as face-to-face interviews in Falköping and Gothenburg. In total, we conducted 14 interviews, whereby five (36%) of the interviews were conducted over the telephone. We knew that the transcription and the analysis of the data would take a lot of time and therefore, we were very pleased with 14 interviews. A description of when and where the interviews took place as well as the title of the interviewees can be seen under the subtitle “3.2.5 Data collection techniques” in Table 3.2.

To gather our secondary data, we used and read annual reports as well as documents about the firm and their offerings, which we found on their website. Further, we included secondary data from 46 other websites as well. The purpose of the secondary data was to analyze it and being able to discuss it with the results from the empirical data. In total, we read about the healthcare sector in 20 annual reports from Siemens AG, 10 annual reports from Siemens AB and 9 documents found on Siemens Healthineers website. A description of the secondary data can be found under the subtitle “3.2.5 Data collection techniques” in Table 3.2.

3.1.3 Examination

The third phase of our research process was the examination phase. This phase focused on transcribing the interviews as well as categorizing the different events and stating our findings. We started to transcribe the first 10 interviews while waiting to conduct the last four interviews since they were scheduled a week later than the majority. We searched for a reliable and suitable program for us to use for this purpose on the internet, but when we tested them we noticed that several words were missed due to us and the interviewee speaking fast,
as well as using slang words. Thus, we decided that even though it would be time-consuming, we felt like we got a more reliable result if we would do the transcribing ourselves. When the last four interviews were conducted, we transcribed these as well.

When the transcribing was completed, we started to think of how to structure and organize the data with regard to the five categories of events presented in (Poole et al., 2000). We went through all of the transcribed interviews together, to be able to map out the events suitable for each category. When we were done, we had eight pages filled with text related to the events which we analyzed and used in our analysis and findings.

3.1.4 Finalization
The fourth and final phase of our research process was the finalization phase. This phase focused on finalizing the thesis and ensuring trustworthiness. Thus, we attended the exhibition Vitalis in Gothenburg the 26th of April, which is the largest eHealth event in Scandinavia (Vitalis, 2018). During the exhibition, we conducted four verifying interviews with other actors in the MedTech and healthcare industry. The purpose was to find out if the findings of our thesis were aligned with other actor’s perception of the transformation that has and will happen in the MedTech and healthcare industry.

Further, we finalized our thesis by writing the discussion and conclusion parts. To clarify how business models at Siemens Healthineers has changed over time, 3 business models from the past, the present and the future was developed. Moreover, we discussed our findings with regard to the literature presented in the theoretical frame of references as well as the result from the exhibition Vitalis. Lastly, we did some adjustments on the thesis in general and finalized the document before it was sent to the supervisors and the opposition group.

3.2 Methodological choices
This section describes the methodological choices that have been made during the process of our thesis will be explained with regard to the “research onion” presented by (Saunders, Lewis & Thornhill, 2009). We have used an inductive approach, thus contributed with new knowledge. We have done this by performing an exploratory study, where we collected the empirical data through a single case study which is also an extreme case. We gathered our primary data through semi-structured interviews which have been conducted face-to-face as well as via telephone. We have also used secondary data to lay the foundation for our analysis. A more detailed description of the methodological choices we have made is presented down below. Each subtitle includes the theory that is relevant for the specific purpose as well as a motivation to why we have chosen as we have.

3.2.1 Research approach
In general, there are two types of research methodologies, deductive and inductive. In the deductive approach, a theoretical or conceptual framework is developed from previous literature and thereafter, hypotheses are stated and tested by using empirical data. In the inductive approach, empirical data is collected and thereafter, a theory is developed as the result of the analysis. Altogether, a deductive approach can be explained as testing a theory, while an inductive approach can be described as building a theory (Saunders et al., 2009).
Furthermore, the deductive approach is more associated with quantitative research while the inductive approach is linked to qualitative research (Bryman & Bell, 2011).

To understand the relationship between theory and research, it is important to know the difference between the two methodologies, deductive and inductive. However, it is better to think of the approaches as guidelines of how to achieve the work rather than hard and fast distinctions of how the work should be done (Bryman & Bell, 2011). More often, deductive approaches include elements from the inductive process and vice versa (Bryman & Bell, 2011).

In this thesis, we explore how business models in established firms develop over time due to emerging technologies. We wanted to contribute with new knowledge to a rather nascent field and therefore a more inductive research approach has been used. Even though we have had a clear plan for the steps in our research, the whole research process has been pervaded by flexibility. To be able to formulate suitable research questions and get a better understanding for our research topic, we had as mentioned in “3.1 Research process”, meetings with doctors and experts in the field at the beginning of the process. Thereafter, we developed the theoretical framework in parallel with the empirical data. Altogether, we have worked back and forth to build our findings.

3.2.2 Research purpose
Depending on what research question(s) that are chosen for the study, there are different research purposes that are suitable: descriptive, explanatory or exploratory (Saunders et al., 2009). To be noted, a study can have multiple purposes (e.g., be both descriptive and explanatory). Robson (2002) as cited in Saunders et al., (2009, p. 139) states that an exploratory study is used to find out: “…what is happening; to seek new insights; to ask questions and to assess phenomena in a new light”. Robson (2002) as cited in Saunders et al., (2009, p. 140) further argues that a descriptive study is used: “...to portray an accurate profile of persons, events or situations”. Lastly, an explanatory study is used to analyze a situation or problem and explain the relationships between the variables. Thus, we argue that this study is an exploratory study since we collected our empirical data through a case study. This, by conducting interviews in the organization and also by having meetings with people with great expertise within the field of artificial intelligence and the healthcare industry.

3.2.3 Research strategy and research choice
There are different types of research strategies, some are more suited to use with a deductive approach while some are more suited to use with an inductive approach. Research strategies should explain how the research question(s) should be answered, this can be done through surveys, action research, case studies and experiments to mention a few (Saunders et al., 2009). For this study, we have used a case study approach. Thus, a case study can be described as a method used to explore or describe a phenomenon in context by using several data sources (Baxter & Jack, 2008). Similarly, it is argued that a case study is a research strategy which has its focus on understanding dynamics within single settings (Eisenhardt, 1989; Yin, 1981). Further, it allows the researcher(s) to explore organizations or individuals in an easy way through communities, interventions, relationships or programs (Yin, 2003).
A case study usually involves different data collection methods, in forms of for example interviews, questionnaires or workshops. The outcome of the data collection might be quantitative and/or qualitative (Eisenhardt, 1989; Saunders et al., 2009; Yin, 1981). Further, Saunders et al., (2009) argues that a case study is said to be appropriate for explanatory and exploratory studies and when: “…a "how" or "why" question is being asked about a contemporary set of events over which the investigator has little or no control” (Yin, 2003, p. 9). Thus, for this thesis we have explored this phenomenon, how and why Siemens Healthineers have changed over time. This change is analyzed with regard to the emergence of new technologies, forcing firms that operate within the industry to update or rethink their business models.

A case study can include both single- and multiple case studies, (Yin, 2003). A single case study is often used when it is a critical, extreme or unique case. Multiple case study can be used when for example analyzing if the findings from a first case occur in other cases, and thereafter generalize these findings. Further, there are dimensions of the unit of analysis. If the case study only involves an organization, it is called a holistic case study. Thus, if there is an interest in using other departments of the organization in the case study as well, this is called an embedded case study. Further, an embedded case study is suitable when performing process studies, where the purpose is to have a long-term perspective and thus, it is also favorable to include multiple sources. Moreover, we have gathered the empirical data through interviews with employees from different divisions within the organization at Siemens Healthineers. Thus, we argue that this is an embedded case study.

Furthermore, there are different types of analysis, micro-, meso- and macro-levels of analysis. These are often used to describe the scale, size or location of a research target. The micro-level of analysis has the focus on an individual or small group. Thus, it can be a person, citizen, household or marriage. The meso-level of analysis has the focus on population sizes and/or connections between the micro- and macro-level of analysis. Thus, it can be a community, village, clan or organization. The macro-level of analysis has the focus on the outcomes of interactions over a large population. Thus, it can be a nation, civilization, society or international. This level of analysis is also called the global level (Markus & Robey, 1988). Further, our study explores how Siemens Healthineers have changed their business model with regard to AI. Thus, the focus of this study is on a meso-level of analysis. Although, it is affected by AI which is seen from a macro-level of analysis perspective.

Case selection

To get a good result out of a case study, the selection of cases is highly important since it will define the limits for the generalizing of the findings. Moreover, the aim is to find a case which can reflect and can extend the theory (Eisenhardt, 1989). To be able to answer our stated research questions and fulfill the purpose of this thesis, we wanted an established firm within the healthcare industry for our study. Based on our criteria that we formulated at the beginning of our research, which also can be seen under the title “3.1 Research process”, it was concluded that Siemens Healthineers were the most suitable firm for us to perform a case study on. The firm work in a dynamic industry which is crucial and beneficial when looking...
at how new technologies affect the business model. Moreover, it was chosen as an interesting case since the firm work in a dynamic industry and at the same time are affected by strong regulations since they deliver products and services to the healthcare industry.

Pettigrew (1990) stress that when a single case is studied, it is often preferable to choose an extreme situation, where the entity can be transparently observed. Siemens Healthineers is one of the leaders in its industry, meaning that studying Siemens Healthineers as an extreme case could give valuable insights into the field. Eisenhardt (1989) also argue about the importance of choosing an entity with the right population since the actions and reflections of these individuals are what the empirical data will be built on. Moreover, it is also important that both researchers and the selected population is active and have an interest in the study to get a good result (Van de Ven, 2007). For this thesis, we explore how business models develop over time and therefore we needed participants with different focus areas to get a fair picture of the organizations business model. Moreover, we selected participants carefully and focused on getting interviews with the most relevant people for our focus but that also had a high interest in our research.

To ensure the findings of our study, four verifying interviews were conducted at the exhibition Vitalis in Gothenburg. In section “6.3 Business model innovation driven by new technologies”, we have chosen to refer to them as: actor (1), which is one of the main competitors to Siemens Healthineers, that has been in the industry for many years. Actor (2), which is a relatively new firm that has been in the industry since 2004 and won multiple prices. Actor (3), which is an organization that together with organizations within Halland, work to stimulate innovation and drive projects within healthcare. Lastly, actor (4), which is a firm that provides a digital service where it is possible to have doctor’s appointments via the telephone. This, since all of the organizations wanted to be anonymous.

Case organization
Siemens Healthineers is a firm with 48,000 employees and has a 120-year long history within the healthcare industry. It is one of the world’s largest suppliers to the healthcare industry and a leader within diagnostic imaging and laboratory diagnostics and their solutions reach around five million patients every day (Siemens Healthineers, 2018). The firm offers products and services along the whole continuum of care, from the early stages of detection of diagnosis to follow-up care (Siemens AG, 2014; 2016; 2017). Moreover, Siemens Healthineers argue that they: “…enable healthcare providers to increase value by expanding precision medicine, transforming care delivery, improving patient experience, and digitalizing healthcare” (Siemens Healthineers, 2018).

The firm has built its success on engineering excellence and pioneering technologies: “healthcare providers around the world have long relied upon our engineering excellence – leading-edge, high-quality medical technology across a broad portfolio. Our solutions touch an estimated five million patients globally every day and help hospitals to continuously improve their clinical, operational, and financial outcomes” (Siemens Healthineers, 2018).
In 2014, the firm stated in their annual report that they expected fundamental changes and that the business models for the healthcare industry will change (Siemens AG, 2014). As a response to this coming change, Siemens Healthineers became a subsidiarity to Siemens AG in 2016 to be able to better meet the changes (Siemens AG, 2016). The world’s population is increasing and by the year of 2050, it is estimated to be nine billion people on the earth compared to seven billion today (Siemens AG, 2011). It has been concluded that people live longer which also puts higher pressure on the healthcare systems and the medical solutions that are provided (Siemens AG, 2013). Moreover, firms within this industry are strictly dependent on public policies and regulations (Siemens AG, 2017). To meet the changes and the new challenges in the healthcare industry, Siemens Healthineers constantly work to upgrade their product portfolio to meet the future needs of their customers (Siemens AG, 2013). They argue that data is nowadays the heart of what they do and that this is what is moving the healthcare forward right now (Siemens Healthineers, 2018).

In this thesis, we refer to Siemens Healthineers throughout. Although, we are well aware of that they were a division to Siemens AG until 2016. We argue that the text is easier to follow and does not cause as much as confusion as if we write Siemens instead of Siemens Healthineers.

3.2.4 Time horizons

According to Saunders et al., (2009) two types of studies exist, cross-sectional and longitudinal, and which one that is applied depends on the time horizon. Depending on how much time that is allocated, a research can have different focuses. The research question has, of course, a major impact on how the research will be designed, but the time allocated must also be taken into consideration since it will affect what methods that is doable for the study. Cross-sectional studies can be seen as “snapshots” and focus on a specific phenomenon during a particular time. Usually, when there is little time, it is most likely that the research ends up being a cross-sectional study. Furthermore, qualitative methods are often used when the time is relatively limited. In opposite, a research tends to be longitudinal when studying change and development over a period of time. When the time horizon is more open-ended, it is possible to do measurements over a long time, for example every second year during a ten-year period. Even though longitudinal studies yield a lot of data, it is an approach that requires a lot of work since relationships need to be built between the researchers and the people to the entity being studied (Poole et al., 2000; Van de Ven, 2007). The data can be collected from: “…either historical archival files or from a real-time field Study of a change process” (Van de Ven, 2007, p. 195).

For this thesis, we have had a process focus and we study development and change of business models which stress for a longitudinal study. Although we were time constrained, a longitudinal study was chosen since it is possible to perform these kinds of studies retrospectively (Van de Ven, 2007). Moreover, we also explore how Siemens Healthineers achieve BMI over time which interpreted for a longitudinal study in its two dimensions, both historical and real time.
3.2.5 Data collection techniques

For this thesis, we have used a case study approach which is: “…a research strategy which focuses on understanding the dynamics present within single settings” (Eisenhardt, 1989, p. 534). It is common that case studies involve different methods to collect data such as interviews, focus groups and surveys. This allows a research to not only be explored through one lens: “…rather a variety of lenses which allows for multiple facets of the phenomenon to be revealed and understood” (Baxter & Jack, 2008, p. 544). The different methods we have collected data through is the primary data via four meetings during the initiation phase and 14 interviews at Siemens Healthineers during the execution phase. Further, it has been collected via four verifying interviews with other actors in the MedTech and healthcare industry during the finalization phase, as well as secondary data via for example annual reports. A description of how the data was gathered is presented down below in Table 3-2, as well as more detailed explanations in the following sections. To be noted is that in all the documents and reports that we have read, we have only focused on the sections that discussed the healthcare sector. In addition, we have also read sections related to innovation and new trends.

<table>
<thead>
<tr>
<th>Meetings</th>
<th>Interviews (Siemens Healthineers)</th>
<th>Interviews (Other actors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>14</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 3-2: The primary data

<table>
<thead>
<tr>
<th>Annual reports (Siemens AG)</th>
<th>Annual reports (Siemens AB)</th>
<th>Documents (Siemens Healthineers)</th>
<th>Websites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pages: 4476</td>
<td>Pages: 242</td>
<td>Pages: 154</td>
<td></td>
</tr>
</tbody>
</table>

Table 3-3: The secondary data

**Primary data**

For this thesis, we have chosen to collect our primary data through semi-structured interviews. Thus, it is argued that: “primary data are data that are collected for the specific research problem at hand, using procedures that fit the research problem best” (Hox & Boeije, 2005, p. 593). Therefore, it has been important for us to narrow down our research focus, otherwise, it is easy to become overwhelmed by the amount of data (Eisenhardt, 1989). In the following sections, an explanation of the respective activities will be presented.

**Interviews**

When collecting data, there are different types of methods to use. One method is to collect data via interviews with employees within the organization. Generally, there are three types of interviews: (1) structured interviews, (2) semi-structured interviews and (3) unstructured or in-depth interviews (Saunders et al., 2009). Structured interviews usually involve a questionnaire where the interviews are strictly structured, and the interviewer should use the same tone and voice for every interviewee. Semi-structured interviews on the other hand are
not as strictly structured, whereby the order of questions might vary with every interview. Further, there is also room for additional questions. Unstructured interviews are informal where there is no predetermined set of questions to be asked, thus the interviewer and interviewee discuss freely (Saunders et al., 2009).

For this thesis, we have conducted semi-structured interviews. This because we wanted to have prepared questions to ask but also being able to discuss issues that the interviewee felt was important (Longhurst, 2003). For two days, the 4th and 5th of April 2018 we had most of our face-to-face interviews scheduled at Siemens Healthineers in Solna. Moreover, we have had face-to-face interviews in Falköping and in Gothenburg. Except for face-to-face interviews, we have also conducted telephone interviews. Due to time limitation and that we wanted to gather as much empirical data as possible, we decided to be flexible and conduct some of the interviews over the telephone. This because some of the employees were not present at the office when we were in Stockholm.

The benefits of telephone interviews are that there is a greater access, it is faster than face-to-face interviews and it has a lower cost (Saunders et al., 2009). Thus, this approach is beneficial when there is a long distance or other hinders that prevents conducting a face-to-face interview. However, one disadvantage of this approach is that the interviewer cannot see the interviewees’ responses to the asked questions. Furthermore, when asking sensitive questions, trust is especially important, and this might be difficult to achieve via the telephone (Saunders et al., 2009). Therefore, it is recommended to conduct telephone interviews when there is a need for a follow-up or when there is a long distance, as in our case. Although, to be noted is that only 36% of the interviews were conducted via telephone, thus we are very pleased with the number of interviews we had face-to-face. The total number of interviews and how many that were conducted via telephone is seen in Table 3-4.
The manuscript for the interviews which can be seen in Appendix 2 and 3, was designed with regard to the BMC to cover questions for every block in the business model (Osterwalder & Pignuer, 2010). Furthermore, we wanted to have questions that gave us distinct answers but at the same time, we did not want to have too closed questions. Therefore, we worked back and forth with the manuscript to get the best possible layout. If the interviewee didn’t understand the question, a deeper explanation that could give them ideas of what they could answer had been prepared in advance. It was also used as a help for us to not lose the focus during the interview. The process-perspective was kept in mind when designing the questions to get answers to how the firm had changed over time. Furthermore, to get a suitable flow in the interviews the manuscript was divided into different blocks with questions regarding: (1) job-position and daily job assignments, (2) the organization and (3) technologies and the future. In addition, customized questions were designed since some of the interviewees worked with areas that were of particular interest to cover all the blocks in the BMC (Osterwalder & Pignuer, 2010).

Table 3-4: The number of interviews that were conducted to gather the empirical data

<table>
<thead>
<tr>
<th>Date</th>
<th>Interview nr.</th>
<th>Title</th>
<th>Location</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>04-apr-18</td>
<td>Interview nr. 1</td>
<td>Business Analyst</td>
<td>Siemens Healthineers, Solna</td>
<td>30 min</td>
</tr>
<tr>
<td>04-apr-18</td>
<td>Interview nr. 2</td>
<td>Services Manager</td>
<td>Siemens Healthineers, Solna</td>
<td>50 min</td>
</tr>
<tr>
<td>04-apr-18</td>
<td>Interview nr. 3</td>
<td>Account Manager</td>
<td>Siemens Healthineers, Solna</td>
<td>50 min</td>
</tr>
<tr>
<td>04-apr-18</td>
<td>Interview nr. 4</td>
<td>Marketing Communication Manager</td>
<td>Siemens Healthineers, Solna</td>
<td>35 min</td>
</tr>
<tr>
<td>05-apr-18</td>
<td>Interview nr. 5</td>
<td>CT Product Manager</td>
<td>Telephone</td>
<td>50 min</td>
</tr>
<tr>
<td>05-apr-18</td>
<td>Interview nr. 6</td>
<td>Sales Operations Excellence Manager</td>
<td>Siemens Healthineers, Solna</td>
<td>40 min</td>
</tr>
<tr>
<td>05-apr-18</td>
<td>Interview nr. 7</td>
<td>Sales Director</td>
<td>Siemens Healthineers, Solna</td>
<td>45 min</td>
</tr>
<tr>
<td>05-apr-18</td>
<td>Interview nr. 8</td>
<td>SAP Support</td>
<td>Siemens Healthineers, Solna</td>
<td>20 min</td>
</tr>
<tr>
<td>06-apr-18</td>
<td>Interview nr. 9</td>
<td>Product Manager</td>
<td>Kurorten, Falköping</td>
<td>60 min</td>
</tr>
<tr>
<td>10-apr-18</td>
<td>Interview nr. 10</td>
<td>Account Manager</td>
<td>Caffé Ritzizza, Gothenburg</td>
<td>60 min</td>
</tr>
<tr>
<td>12-apr-18</td>
<td>Interview nr. 11</td>
<td>Collaboration Officer Nordic</td>
<td>Telephone</td>
<td>60 min</td>
</tr>
<tr>
<td>16-apr-18</td>
<td>Interview nr. 12</td>
<td>Business Development Manager, Teamplay</td>
<td>Telephone</td>
<td>65 min</td>
</tr>
<tr>
<td>20-apr-18</td>
<td>Interview nr. 13</td>
<td>Business Manager XP</td>
<td>Telephone</td>
<td>40 min</td>
</tr>
<tr>
<td>02-may-18</td>
<td>Interview nr. 14</td>
<td>Teamleader, Data Digital and AI</td>
<td>Telephone</td>
<td>55 min</td>
</tr>
</tbody>
</table>
The initial questions had two purposes, it was supposed to give a better understanding of the interviewee’s background and daily work. Further, the aim was to create a relaxed atmosphere by starting with questions that the interviewee could answer easily. The organizational questions were designed to cover how the organization works, what key resources and key activities they have had over time as well as how they work to adopt new trends. The technology related questions raised discussion around old and new technologies and how they have had and will change the value that the firm delivers to their customer. It is argued that AI is a technology that is relevant to the industry, and therefore it was used as an example when discussing the future perspective.

In total, the manuscript included 5 initial questions, 12 organizational questions and 8 technology and future related questions. In addition to this, 14 customized questions were developed and divided among nine of the interviewees. The standard questions for the interviews can be seen in Appendix 2 and the customized questions can be seen in Appendix 3. Moreover, to make it easier both for us and for the interviewee, it was decided that one of us asked the questions while the other person wrote down notes. Follow-up questions were asked from both of us, but one had the overall responsibility for keeping the interview going.

Despite the interviews with the employees at Siemens Healthineers, four verifying interviews with different actors within the MedTech and healthcare industry were conducted at the exhibition Vitalis in Gothenburg. The list of exhibitors was studied before the visit to conclude what actors that were relevant and of interest to interview. Even for these four actors, semi-structured interviews were conducted and therefore a manuscript was prepared. The questions were customized and the number of questions for each actor varied from two to four and can be seen in Appendix 4. In turn, the manuscript was designed based on the findings to ensure a higher degree of trustworthiness of our study. The same interview structure was used for the verifying interviews as for those with the employees at Siemens Healthineers. One of us asked the questions and follow-up questions were asked from both of us.

Secondary data
Secondary data is: “data originally collected for a different purpose and reused for another research question” (Hox & Boeije, 2005, p. 593). Moreover, secondary data can be categorized into three groups: (1) documentary data, (2) survey-based data and (3) data compiled from multiple sources (Saunders et al., 2009). Documentary data includes both written and non-written materials, such as emails, letters, voice recordings and video recordings. Survey-based data includes censuses, continuous, regular and ad hoc surveys. Examples of these are governments’ censuses, organizations’ surveys, academic surveys and employee attitude surveys. Lastly, data compiled from multiple sources can include both area-based and time-series based data. Examples of these are industry reports, government publications and journals (Saunders et al., 2009).

For this thesis, we have used data compiled from multiple sources. Thus, we have gathered secondary data via the firm such as annual reports and documents found on their website. We have also gathered data from multiple websites such as the firm’s own website and others.
concerning for example laws. Further, secondary data from Siemens AG is included in the thesis, since Siemens AG is the majority shareholder of Siemens Healthineers. Further, since Siemens Healthineers have only been an own firm for two years and thus, they have been a division of Siemens AG the years before. Moreover, secondary data from Siemens AB is also included since it concerns the local market which Siemens Healthineers operates in. In total, we have read and gone through 20 annual reports from Siemens AG, 10 annual reports from Siemens AB, 9 documents found on Siemens Healthineers’s website and 46 different websites. As mentioned in “3.2.5 Data collection techniques”, all the documents and reports that we have read, we have only focused on the sections that discussed the healthcare sector. In addition, we have also read sections related to innovation and new trends.

3.2.6 Data analysis procedures

The purpose of this study is to explore how business models in established firms within the MedTech industry develops over time due to the emergence of new technologies. Thus, this has been explored from a process-perspective and performed through an extreme case study at Siemens Healthineers. Moreover, we have used empirical data gathered from interviews as well as secondary data to lay the foundation for our analysis. This, to make it possible to identify events that have triggered BMI over time. As argued by Poole et al., (2000) argues, it is not an easy task to identify events, and a lot of data must therefore be studied.

Further, to determine what events that have contributed to change for Siemens Healthineers over time, five categories of events were chosen for this study: (1) ideas, (2) people, (3) transactions, (4) context and (5) outcomes (Poole et al., 2000). Moreover, it helped us to analyze our empirical data and get a more clear and precise result, which otherwise can be very challenging in process studies (Van de Ven, 2007). The five categories have been used before in a study of innovation development (Poole et al., 2000). However, we argue that it can be applied to this thesis since it is a related field. Moreover, it has been concluded that BMI can be referred to as one type of innovation (Teece, 2010). Thus, the five categories of events are highly relevant for our research purpose since we explore how business models develop over time. The five original definitions of the five events presented by Poole et al., (2000) refer to innovation development but in this thesis, we have therefore chosen to refer to the concept business model instead. Moreover, the definitions can be found in section “2.3.1 Five categories of events”. To discover the main events that have triggered BMI at Siemens Healthineers, we have carefully gone through the transcription from every interview together. Further, every quotation used in the analysis has been translated and looked through by both of us to ensure the trustworthiness. Moreover, Table 3-5, presents the guidelines that were used to find events for each of the five categories. Further, illustrative quotes of coded events are presented to give examples of how events were identified from the raw data.
<table>
<thead>
<tr>
<th>Type of events</th>
<th>Guidelines to find the events</th>
<th>Illustrative quotes of coded events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea events</td>
<td>- Approaches to the BMI process - Changes in strategies - Investments in technologies</td>
<td>&quot;...the business model needs to be tweaked, changed all the time. Do small changes, test something else and stuff like that&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;...it is the employees that build the organization and that helps the healthcare industry forward. And &quot;Healthiners&quot; is a combination of engineering, pioneering and healthcare&quot;</td>
</tr>
<tr>
<td>People events</td>
<td>- Reorganizations and how it affects the employees - The attitude towards change - How the firm locate their human resources</td>
<td>&quot;...there is a need for another type of employee and perhaps another type of competence&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;...the software is suddenly really important and then you understand that is it a disadvantage for us since we are a very engineering-heavy firm. It is hard to reorganize. But we have understood that it needs to be done and therefore we are building divisions named digital health services to improve our skills within that area&quot;</td>
</tr>
<tr>
<td>Transaction events</td>
<td>- Different partnerships - People or organizations that have an impact on the firm</td>
<td>&quot;Partnerships with university hospitals have increased heavily&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;...we need and will be more flexible, especially with the stock market introduction since it will put pressure on us to make faster decisions and to take action into what we should do and not do&quot;</td>
</tr>
<tr>
<td>Context events</td>
<td>- Market and technology changes - Internal changes within the organization - How the firm analyze the external environment</td>
<td>&quot;I have a partner whom I have a business deal with, who scans what is happening online on the internet, so I know what is going on in discussion forums and what new trends that are coming&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;The personal data act regulates how we are allowed to handle patient data&quot;</td>
</tr>
<tr>
<td>Outcome events</td>
<td>- Actions which have a particular effect on the business model - If investments in different technologies have a successful or a less positive impact on the outcome</td>
<td>&quot;We were a part of a research project... which resulted in a new way of producing pictures for mammography which was revolutionary&quot;</td>
</tr>
</tbody>
</table>

Table 3-5: Identification of events from the raw data

### 3.3 Trustworthiness

To deliver a high-quality study, researchers strive to reduce the possibilities to get the wrong answer and thus, a good research design is very important (Saunders et al., 2009). In similar, Bryman and Bell (2011) argue about the importance of building trustworthiness to ensure the quality of the research.
According to Bryman and Bell (2011), trustworthiness can be explained by reliability, replication and validity. Furthermore, Lincoln and Guba (1985) as cited in Bryman and Bell (2011, p. 43) present four criteria: (1) credibility, (2) transferability, (3) dependability and (4) confirmability that should be addressed to increase the trustworthiness of a qualitative research. Thus, these criteria have been chosen for this study and are presented in the coming sections.

### 3.3.1 Credibility

Credibility refers to: “...whether or not there is a good match between researchers’ observations and the theoretical ideas they develop” (Bryman & Bell, 2011, p. 395).

Moreover, Krefting (1991) argue about the positive power of using triangulation to enhance the credibility and thus, the quality of the research. The idea of triangulation is to combine multiple methods and sources when gathering literature and empirical data to ensure that different perspectives have been covered. Further, Patton (1999) also argues about the importance of using multiple sources when collecting data and also choosing methods that are suitable for answering the research questions.

For this case study, semi-structured interviews have been used to gather reliable data. Moreover, employees at different divisions and with different responsibilities in the firm were interviewed to get a broader perspective and more trustworthy data. The primary data in terms of interviews has also been supported by secondary data conducted from the firm’s and other websites, annual reports from Siemens AG and Siemens AB as well as documents from their website. Further argued, Krefting (1991, p. 220) claims that: “credibility can also be enhanced within the interviewing process. The reframing of questions, repetition of questions, or expansion of questions on different occasions are ways in which to increase credibility”. A lot of time has therefore been spent to design a good manuscript for the interviews.

The questions were designed based on the BMC to ensure that we covered questions for every block of the business models. Moreover, the BMC was used as a support during the interviews to easier communicate the concept of business models and BMI. A lot of secondary data was studied before we started to design the manuscript to be able to ask relevant and distinct questions and get as much as possible out of the meetings. As mentioned, we decided to interview people with different job titles. This also resulted in that we designed a manuscript with questions for all the interviewee but also a customized manuscript with questions dedicated to specific interviewees. Moreover, we also interviewed people with the same job titles to be able to repeat the questions. Furthermore, the employees at Siemens Healthineers that was interviewed was from Sweden and therefore Swedish was used during the interview. The idea of using Swedish instead of for example English was to make the interviewee more comfortable as well as minimize confusion and misunderstandings due to the language and thus, get a more reliable data.

Furthermore, we are two people that have performed this case study, meaning that the literature, the empirical data and the results have been reviewed by more than two eyes. Krefting (1991, p. 218) state that: “a study's credibility is threatened by errors in which...”
research subjects respond with what they think is the preferred social response”. Moreover, Krefting (1991) also argue that if the informants trust the researchers, it is more likely that the researcher can get access to valuable information. Developing trust between the researchers and the people involved in the entity being studied often takes time. However, if the research question is relevant and developed to suit all the parties in the study it is more likely to enhance the trust and perform a study with high quality (Van de Ven, 2007).

To ensure a high level of credibility, the aim has been to have an open conversation with Siemens Healthineers during the whole process. Discussions regarding the research questions and the purpose of the study have also been done together with Siemens Healthineers to ensure that all parties are satisfied. The thesis was also sent to the firm before the final submission to ensure that they felt the thesis gave a correct picture of their organization.

3.3.2 Transferability
Transferability can be explained as the applicability of the research (Krefting, 1991). Moreover, it has been argued that: “…as long as the original researcher presents sufficient descriptive data to allow comparison, he or she has addressed the problem of applicability” (Krefting, 1991, p. 216).

The objective with a qualitative research is to study a specific phenomenon and thus, transferability refers to the possibility to put the research result in another context, or in the same context at another time (Bryman & Bell, 2011). Moreover, it refers to: “…the ability to generalize from the findings to larger populations” (Krefting, 1991, p. 216). The difficulties with qualitative research are that the findings might not be transferable since it has emerged from one unique case (Krefting, 1991).

Moreover, qualitative researchers should aim for what Geertz (1973) argues, as cited in Bryman and Bell (2011, p. 398) and refers to as a thick description to ensure high transferability. Moreover, Guba and Lincoln (1985) as cited in Bryman and Bell (2011, p. 398): “…argue that a thick description provides others with what they refer to as a database for making judgments about the possible transferability of findings to other milieux”. By collecting data from both primary and secondary sources, we have worked for a thick description for this case study. In addition, the visit at the exhibition Vitalis gave another dimension to our work and contributed to a higher degree of transferability.

3.3.3 Dependability
Researchers can adopt an “auditing” research approach since it results in better trustworthiness. This means that all the steps in the research process such as problem formulation, selection of research participants, fieldwork notes, transcripts and methodological decisions should be documented (Bryman & Bell, 2011). For this case study, an “auditing” approach has been followed meaning that meetings and the interviews have been recorded. The possibility to listen twice on a session has made it possible to separate the interviewees’ statements to be influenced by our personal values and beliefs. Notes from the different sessions have also been saved and available to us and our supervisor. During the whole research process, a logbook has also been used to document everything that we have
worked with. With this document, we have been able to keep track of all our activities and what we have done. At the beginning of our research, we developed a long-term plan, but the logbook ensured that we did not miss important steps in our research process and also forced us to constantly plan for the coming working day.

3.3.4 Confirmability
Confirmability refers to neutrality (Krefting, 1991). Moreover, it discusses the risk for the result to be affected by the researchers’ personal values (Bryman & Bell, 2011). The recorded sessions helped to ensure a high degree of confirmability where the personal belief could be held out of the interviewees’ answers. Furthermore, the recorded interviews were transcribed by ourselves to get familiar with the material. In turn, it meant that we had to listen and write down the words of the interviewee which strengthened the degree of confirmability. To code the events that have triggered BMI at Siemens Healthineers over time, we analyzed the transcribed material together to ensure that the statements from each interview were coded as the right events.

During the exhibition Vitalis, we conducted four verifying interviews with other actors in the MedTech and healthcare industry. We discussed our findings with a relatively new firm that has been in the industry since 2004. In turn, this firm has had a great success during the recent years and has won different prices. Moreover, we discussed our findings with a firm that provides a digital service where it is possible to have doctor’s appointments via the telephone. In addition, we also talked to an organization which together with organizations within Halland, work to stimulate innovation and drive projects within healthcare. Lastly, we discussed our findings with one of the main competitors to Siemens Healthineers that has been in the industry for many years. By this way of work, we could ensure that our findings were relevant and in line with the changes that the industry has and are facing right now. Even though we made a single case study, this also gave us an opportunity to discuss BMI with other firms and actors other than Siemens Healthineers.

3.4 Research ethics
When making business studies, it is important to be aware of ethical aspects since it will guide the conduct of the empirical data (Bryman & Bell, 2011). To make all the participants of our research feel comfortable, we have followed four main areas regarding ethics in business studies. Diener and Crandall (1978) as cited in Bryman and Bell (2011), has developed these four main areas, which focuses on: (1) harm to participants, (2) lack of informed consent, (3) invasion of privacy and (4) whether deception is involved.

With regard to the four main areas of research ethics, it is essential that the researchers consider how to get access to the empirical data before the research starts. Moreover, they need to consider how the research project should be presented to the people that the data will be collected from (Bryman & Bell, 2011). Already from the start when we had our first contact with Siemens Healthineers we explained what we expected from them, and also that our thesis was going to be published. Furthermore, Pettigrew (1990, p. 285) emphasize ethical considerations for process studies and state that “these ethical considerations relate particular to the front end of the research – how expectations and contracts are set between the grant
awarding body, among researchers and between researchers and respondents”.

When we called our interviewees for the first time, we informed them about our research topic and we explained what role they would have in our thesis. We have learned from before that the concept business models is not something that everyone is familiar with. Thus, when we talked to our interviewee the first time, we used a more common language to describe our research topic.

Three days in advance, a reminder was sent via email to the interviewees about the meeting and also that the interview should take place in one of the conference rooms at the office. When the interviews started, both face-to-face and via telephone, a short presentation about ourselves and our educational background was given. Moreover, an explanation of our research topic and how the interview was going to be structured was mentioned. To minimize misunderstandings, it was clarified before the interview started that the result of our thesis had to be published. This was intended to be as a reminder so that the interviewee did not say anything inappropriate that should not be published. Furthermore, we asked about their permission to record the interview to able to concentrate on the interviewee and the answers that we received, as well as being able to re-listen to the interview afterward (Saunders et al., 2009). In the end, we asked every interviewee if we could call or email them if we wanted to ask more questions or to ensure what was said during the interview. Almost the same procedure was used during the four verifying interviews at the exhibition Vitalis in Gothenburg. We introduced ourselves, informed about our research topic and explained what role they would have in our thesis. Altogether, we have aimed to inform all the participants about our requirements and expectations for this study to be doable.
4. Setting the context
This section presents the first definition of AI and the evolution of the technology. Thus, the purpose of this section is to present AI, which in this thesis have been used as a driving factor for BMI. AI is one of the latest research fields in science and engineering and is a hot topic in many industries today. The birth of AI is often associated with the year of 1956. In this year, John McCarthy, who is one of the pioneers within the field, and other influential researchers performed a two-month study of AI, during the summer at Dartmouth College in Hanover, New Hampshire (Russell & Norvig, 2010). In 1955, they presented their research proposal for the study and through this proposal, the term AI was defined for the first time. In their proposal, they outlined the following:

“...every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves” (McCarthy, Mikinsky, Rochester & Shannon, 2006, p. 12).

As the quote indicates, AI can be described as machines that solve problems that otherwise would have been performed by humans. Although the first definition of AI was outlined more than sixty years ago, the interest for the technology has accelerated during the previous years. As a consequence of the development of the technology, AI has been categorized into weak AI and strong AI during the recent years (Russell & Norvig, 2010). However, most of today’s AI goes under the first mentioned category, weak AI and refers to computer programs that demonstrate intelligence in a special area, for example medical diagnosis or automobile driving (Goertzel, 2007). In opposite, strong AI refers to a computer program that thinks and acts as if it was a human (Russell & Norvig, 2010). More often, strong AI is also called artificial general intelligence (AGI) and is more associated with over natural behavior (Bostrom, 2014).

For the commonality, AI might be a rather nascent subject but in the industry, many high-tech firms have seen the potential in AI and have started to invest more and more in the powerful technology. As Bower & Christensen (1995) argues, it is important for firms to be aware of new disruptive technologies since it will create turbulence on the market. To survive in the digital world today, firms and its business leaders need to constantly search for and consider disruptive technologies since it can generate value, competitive advantage, reduce operating costs and transform business models (Gartner, 2017). There is no doubt that AI is a disruptive technology that already has and will have an impact on many firms and its industries.

In the latest published report of the “Hype Cycle of Emerging Technologies, 2017” there was three trends that were distinctive: AI Everywhere, Transparently Immersive Experiences & Digital Platforms. From these three emerging trends, AI technologies (machine learning and deep learning) have been listed as the trend that will be the most disruptive one over the next ten years (Gartner, 2017). The hype cycle is presented down below in Figure 4-1. One reason
for the fast acceleration of AI is the amount of data that now are available through the IoT, where data can be gathered in the cloud (Gubbi, Buyya, Marusic & Palaniswami, 2013). Moreover, IoT and AI are technologies that support each other. IoT will improve AI technologies since it requires a lot of data and when AI technologies advances, there will also be a higher pressure on the IoT since more data are required and need to be stored.

![Image of Hype Cycle of Emerging Technologies 2017](image)

*Figure 4.1: The Hype Cycle of Emerging Technologies 2017 (Gartner, 2017)*

As published in the report, AI technologies include both ML and deep learning (DL), which are methods to parse data. ML is explained as a statistical method where a computer learns from data and then make predictions based on what it has learned from the data. Moreover, if a prediction turns out to be wrong, adjustments must be done by a programmer to correct the mistake. In turn, ML techniques are used in many of our modern applications today and through the technology, it is possible to convert speech to text, identify images and match posts or products with users’ interest (LeCun et al., 2015). Further, DL is a subcategory of ML and in general, the two methods are rather similar, but its capabilities are different. In comparison to ML, DL methods can learn by themselves and it is possible to mimic the biological network of the human brain to greater extent (LeCun et al., 2015). If predictions turn out to be wrong, DL methods adjust these mistakes by themselves and a programmer do
not need to tell what is right or wrong. Moreover, it is possible to detect relationships with DL methods that ML methods sometimes miss (Siemens Healthineers, 2018). Altogether, it is argued that AI technologies will play a big role in our everyday life in a near future (Gartner, 2017). It is already integrated in product and services today, but it will be even more integrated in a greater extent.
5. Siemens Healthineers

This section explores how Siemens Healthineers has changed over time. It is based on the empirical data from the 14 interviews and the secondary data from both Siemens AG and Siemens Healthineers. The section is structured in two time periods for the years between 1960-2018. The structure is developed with regard to the years included in the timeline which is presented on the firm’s website (Siemens Healthineers, 2018). The first time period concerns the years between 1960-2000, when the firm had a strong focus on R&D, developed the world’s first real-time ultrasound and started to use digital imaging instead of analog imaging. The second time period concerns the years between 2000-2018, when the products became more connected to software programs and the number of partnerships increased. To be noted is that only a sample of the products and services Siemens Healthineers have offered over time is mentioned in the following sections. We have chosen to include the ones that we argue reflects what the firm offered during the respective time periods.

5.1 1960–2000

Business models within the MedTech industry during the first time period mostly focused on the development of new tangible products. Siemens Healthineers has for many years been in the front edge of the industry by delivering innovative and premium products and services to the market. One of the reasons for the firm’s success was the focus of finding competent people with engineering knowledge, which had a positive influence on the firm’s culture. At the beginning of this time period, more specifically in 1965, the firm invested a lot of money in the construction of the research center in Erlangen, which is the headquarter for R&D today. The investment resulted in better opportunities for R&D and laid the foundation for many of the firm’s innovations in healthcare. Further, during the mid-1960s, research and development (R&D) activities were characterized by technology push and the firm believed that a strong focus on R&D would result in a successful outcome (Rothwell, 1994). Thus, in 1967 the firm developed the world’s first real-time ultrasound which might have been a result of the distinct R&D focus (Siemens Healthineers, 2018). The real-time ultrasound made it possible to observe changes in the body and visualize it on a screen (Siemens Healthineers, 2018).

During this time period, the firm was also affected by external factors that influenced the R&D of new products and services. In 1973, the trade organization Swedish Medtech was founded (Swedish Medtech, 2018). The organization offered guidelines to firms that operated in the MedTech industry and thus, since Siemens Healthineers became a member of this trade organization they were affected by the guidelines provided. Moreover, the population in the world increased during this time period. This put a pressure on the firm to develop innovative products that could help to meet the challenges with an increased population. Thus, this is illustrated in Table 5-1 and as seen, the population increased rapidly during this time period compared to the years before (Population Reference Bureau, 2018).
Thereafter, in 1975, the firm launched their first computer tomography (CT) which could take pictures of the human brain and at the time it took less than six minutes: “the X-ray tube and a detector unit scan the skull from various directions, and an image of absorption distribution in the brain is generated in the computer” (Siemens Healthineers, 2018). According to the interviewees, the X-radiation (X-ray) technology is one example that laid the foundation for the firm and thereafter new discoveries within radiology moved the firm’s offerings forward. Thus, the firm also invested in competence within radiology during this time period.

Several of the interviewees argued that the development of data capacity had a major impact on the firm and led to product advancements: “what has been really determined is the improvements of data capacity and the possibilities to make smaller processors that produce more. This gives possibilities to a huge software development. All of our systems are more and more controlled by software and this is a revolution that started 20 years back”. In 1983, the firm launched their first magnetic resonance imaging (MRI) system. With the help of magnetic fields, the scanner could produce cross-sectional images with high quality without using radiation. This made it possible to observe tissues and organs more clearly compared to before (Siemens Healthineers, 2018). Further, in 1990 the firm invested in AI technologies. Since the firm worked in this area already during this time period, they were well-prepared for the digitalization and the AI revolution that would create changes in the industry (Stanford medicine, 2017). During the same year, in 1990 the CE marking was introduced. This resulted in that the firm had to follow certain directions which their products should fulfill regarding health, environment and safety (Swedish Standards Institute, 2018).

Further, during the 1990s, ICT became more significant when for example, computers became a standard in every household. Further, the term is explained as followed: “ICTs include well known telecom services such as telephony, mobile telephony and fax. Telecom services used together with computer hardware and software form the basis for a range of other services, including email, the transfer of files from one computer to another, and, in particular, the Internet, which potentially allows all computers to be connected, thereby giving access to sources of knowledge and information stored on computers worldwide” (European Commission, 2001, p. 3)
In 1991, the world wide web was introduced to the public (The Next Web, 2011). Thus, this resulted in that the firm tried to adapt to this transformation by for example converting their medical imaging from analog to digital. The firm’s products during this time period focused on diagnostic imaging and laboratory diagnostics and thus, the shift between analog and digital imaging had a major impact on the firm's value proposition. Even if it is not explicitly expressed, it can be seen as the starting point of the digitalization of the healthcare at Siemens Healthineers. When analog imaging was used it took a long time to produce pictures since they had to be sent by physical mail between doctors. When digital imaging was introduced, it became even more efficient. Images could be seen directly on the computer screen and sent between doctors in a second by email or special software programs. As a result of the digitalization, the quantity of patient data started to increase which in turn led to both opportunities and challenges. It meant that it would be possible to make the care more specific and effective but only if all the data could be analyzed properly with the right techniques.

In 1994, another law was introduced, more specifically the law of public procurement (Regeringskansliet, 2018). This law regulated the sales-process of the firm: “public procurement refers to the process by which public authorities, such as government departments or local authorities, purchase work, goods or services from companies” (European Commission, 2018). Before the law of public procurement, it was accepted that firms for example paid for their customers business trips. Although, when the law was introduced, the firm had to stop with all types of invitations. Altogether, there were many regulations to take into consideration since the products needed to have a high-quality standard but also because the majority of the customers were large public organizations and thus, there were a lot of regulations and laws that needed to be followed.

Altogether, the firm was affected by several new technologies during this time period such as digital imaging and data capacity which resulted in product improvements. The investment in AI already in 1990 resulted in that the firm was well prepared to the transformation the industry would face during the later years. Due to the emergence of new technologies and data capacity, the personal data act was also introduced the 29th of April in 1998 (Sveriges Riksdag, 2018). During the same time period, in 1999, Siemens Healthineers also offered their first intuitive medical IT platform: “…the image processing software syngo facilitates medical examinations by providing a single user interface for a large number of imaging systems, like X-ray devices or magnetic resonance imaging (MRI) scanners” (Siemens Healthineers, 2018). Thus, the platform was used to generate and post-process images.

To summarize, the products that were developed during this time period were mostly tangible products. Thus, several were developed with regard to the emergence of new technologies. Further, during this time period several new laws emerged which controlled the R&D process within the firm through guidelines and directions.
5.2 2000–2018

Business models within the MedTech industry in the present time period focused on both products and services. During this time period, several industries transformed in pace with the digitalization: “the markets in which our businesses operate experience rapid and significant changes due to the introduction of innovative and disruptive technologies. In the fields of digitalization (e.g. internet of things, web of systems, cloud offerings, Industry 4.0), there are risks of new competitors, substitutions of existing products/solutions/services, niche players, new business models…” (Siemens AG, 2017, p. 29). Analyzing the external environment and the changes and new technologies that emerged was crucial for firms to ensure their competitiveness (Bower & Christensen, 1995; Twiss, 1992). Thus, continuously working with BMI to adapt to these changes proved to be significant during this time period and also something that several of the interviewees discussed: "I have as a goal that I do not want to be predictable, that is what I am aiming for. It is really important, and therefore the business model needs to be tweaked, changed all the time. Do small changes, test something else and stuff like that”.

Moreover, Siemens AG was successful regarding patents during this time period which is illustrated in Table 5-1. Even if the number of patents does not tell everything about how the firm adopted new trends and responded to changes, it is an indication. The increased number of patents indicates that the firm constantly worked to update their technology products and services which indirectly means that they made changes in the business model(s) to be aligned with the industry changes.

<table>
<thead>
<tr>
<th>Year</th>
<th>Nr. of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>63,000</td>
</tr>
<tr>
<td>2016</td>
<td>59,800</td>
</tr>
<tr>
<td>2015</td>
<td>56,200</td>
</tr>
<tr>
<td>2014</td>
<td>56,100</td>
</tr>
<tr>
<td>2013</td>
<td>56,000</td>
</tr>
<tr>
<td>2012</td>
<td>57,000</td>
</tr>
<tr>
<td>2011</td>
<td>53,300</td>
</tr>
<tr>
<td>2010</td>
<td>51,400</td>
</tr>
<tr>
<td>2009</td>
<td>56,000</td>
</tr>
<tr>
<td>2008</td>
<td>55,000</td>
</tr>
</tbody>
</table>


During this time period, Siemens Healthineers also had different partnerships but during the recent years, the interviewees argued that partnerships with universities and university-hospitals exploded. Moreover, the firm started to cooperate with: “…one of the world’s foremost research institutes: the Harvard University School of Medicine” in 2003 (Siemens AG, 2003, p. 32). Two years later, in 2005, the firm developed the world’s first dual source CT scanner that had two X-ray sources and detectors in one system: “with twice the scanning
power, we set new standards in image quality, scan speed, and spectral imaging” (Siemens Healthineers, 2018).

In pace with the digitalization and the shift towards more service-related offerings, it was argued that new competence, for example within software was needed to answer to these changes. In the annual report from 2007, the firm stated that they introduced programs to strengthen the qualifications of software engineers. Through internal training at the firm, a software architect could for example after nine months be qualified as a senior software architect (Siemens AG, 2007). Moreover, the firm also invested in application specialist since they were the ones who taught the customers how the firm’s products and services functioned. Further, in 2008, the firm launched a robotic-assisted angiography system. It allowed for imaging in all surgical positions and brought faster workflows to the operating room (OR). Further, it enabled three-dimensional (3D) images for larger volumes (Siemens Healthineers, 2018).

During this time period, the firm was also affected by several external factors such as laws and regulations. The law of public procurement, as mentioned in the first time period, regulated how the firm must act in the sales-process. The law was reformulated in 2008, although the interaction with the customers was still very regulated. However, it was accepted for firms to invite their customers to a lunch if it was in connection with a meeting: “for more than 10 years ago, it was common that we had dinner with our customers and we paid their business trips and hotel rooms and everything. But that is not allowed anymore, and I think that is great. It is not the firm that bribes the most that should win, rather the firm that can deliver the best”. In addition, the firm was a part of the trade organization Swedish Medtech, which together with the Swedish Association of Local Authorities and Regions also regulated how the contact with the customers had to be handled (Swedish Association of Local Authorities & Regions, 2018; Swedish Medtech, 2018).

In 2013, the firm stated in their annual report that their solutions and systems helped to improve and make the care more efficient: “software solutions and imaging systems from Siemens are helping make outstanding healthcare affordable by ensuring the efficiency of our workflows” (Siemens AG, 2013, p. 22). In 2014, the firm launched their cloud-based network: “the cloud-based solution with its apps monitors quantities such as imaging throughput or dose levels, utilization of staff, rooms and resources of the whole department down to every device and procedure, showing our customers where workflows need adjustments” (Siemens Healthineers, 2018). This product might have been developed to better meet the new needs and demands of the customers, thus for example to make the customers workflows even more effective.

The same year, in 2014, Siemens AG presented that they anticipated that fundamental changes in technologies and markets for the healthcare would come (Siemens AG, 2014). To better meet these changes, the healthcare division became a subsidiarity to Siemens AG: “the Swedish healthcare organization was sold to the wholly-owned subsidiary Siemens
Healthcare AB per 2015-10-01” (Siemens AB, 2016, p. 6). This transformation was completed in 2016 and the aim was to faster respond to the fundamental changes.

As a consequence of the reorganization, the healthcare division in Sweden became one of the local offices, owned by the international subsidiarity. The legal name of the subsidiarity was Siemens Healthcare, but as a part of the transformation in being an own firm, the public name was changed to Siemens Healthineers the 4th of May 2016 (Siemens Healthineers, 2018). The reason behind the new name, specifically “Healthineers” was related to the employees working in the organization: “it is basically about putting the focus on that it is the employees that build the organization and that helps the healthcare industry forward. And “Healthineers” is a combination of engineering, pioneering and healthcare”.

Partnerships with subcontractors are something that the firm had during this time period. However, it became even more significant to have clear directives for this type of partnership. To be able to include larger subcontractors, the firm made a change in their sale-model in 2015. The firm ended up in an unusual affair where they had a subcontractor with larger order value than themselves. However, the customer wanted to buy from Siemens Healthineers even if the subcontractor had a higher order value. This made the situation very unsure and risky and therefore it was decided to do changes regarding partnerships with subcontractors. This, to be able to accomplish similar businesses in the future but with a higher financial security. The following year, in 2017, the law of public procurement was once again reformulated (Regeringskansliet, 2018). This meant that the firm had new or updated directions to follow regarding the sales-process. Moreover, the new law aimed to encourage innovation within the MedTech industry (MedTech Magazine, 2017). Further argued, it was concluded that startups within the MedTech industry occurred in a greater extent during this time period which resulted in that the firm discussed how they could integrate these types of partnerships in their business models.

Moreover, the firm implemented a startup approach in 2016 and in line with this new approach the incubator Next47 was founded by the firm. This, to be able to collaborate with startups to a greater extent (Siemens AG, 2016). Further, to develop and spread knowledge about the products as well as develop deep relationships with the customers, the firm opened an experience center in 2017 (Siemens Healthineers, 2018). At this place, the customers could observe the products in their real environment and received a hint about how the products could be implemented in their working environment. The customer could test by themselves and understand what products they could buy. In 2018, the firm also introduced Next47 in Sweden (MedTech Magazine, 2018; Next47, 2018). Moreover, Next47 aimed to generate new ideas and accelerate the development of new and disruptive technologies. The name “Next47” referred to the year when Siemens AG was founded and was a startup. In turn, the number 47 was a symbol for the entrepreneurial spirit which the firm had in its early years when it was founded which the firm wanted to carry on to the “next” generation of revolutionary innovations. Furthermore, partnerships with university-hospitals also increased during this period to get a better understanding of the customers working environment.
The firm was introduced on the Frankfurt stock market the 16th of March 2018 (Deutsche Börse Group, 2018). One of the interviewees formulated it as followed: “we are not a division to Siemens, rather an own firm but with Siemens AG as majority shareholder”. Siemens AG owns the majority of the stocks but besides this, private shareholders can invest in the firm too. Further, several of the interviewees argued that: “…we need and will be more flexible, especially with the stock market introduction since it will put pressure on us to make faster decisions and to take action into what we should do and not do”. Further, one of the interviewees argued that there will be a greater focus towards profitability since the firm is public now and therefore they need to work smarter and better.

During this time period, the attention towards patient security and how data was handled increased, both from the firm’s perspective but foremost from the customer’s perspective. Thus, the 25th of May 2018 is the enforcement date for the new General Data Protection Regulation (GDPR), which the firm and their customers need to take into consideration. The new law aims to strengthen the fundamental rights of citizens in the digital age and also simplify the rules for firms in the digital market (European Commission, 2018). Thus, one of the interviewees argued that: “we have a new data protection law that we must adapt to and the hospitals must do the same. The issues regarding patient data is tough but right now we have good control over it, but I believe we can be better but then a lot of work is needed on the IT-side to get it as good as possible with high security”.

To summarize, during this time period the firm focused on both physical products and services. It was important for the firm to be aware of the external environment and there are several external factors which had an impact on Siemens Healthineers business. The law of public procurement is only one example of a law that changed and thus, had an impact on how the firm was allowed to handle their businesses during this time period. Further, new partnerships were initiated during this time period and the relations and conditions for existing partnerships changed. Corporations with universities and university-hospitals became even more prioritized and it became essential to establish deep relationships with the customers.

5.3 Comparison of the two time periods

From a historical perspective, the firm has a long tradition of engineering. In turn, this resulted in that the firm was associated with high quality. The investments in engineering knowledge that was done when the firm was founded sat the standard and had a positive effect during both time periods. Moreover, the firm had a wide product range and many of the products were premium products, meaning that knowledge within engineering still was important and drove the firm forward. The products that were developed during the first time period were mostly tangible products. In comparison, what was offered during the second time period were a mix of products and services, which is presented in Figure 5-1.
During the first time period, external factors such as new laws and regulations emerged that the firm needed to take into consideration. This, since the laws and regulations controlled how the sales-process was handled and further, they provided different criteria that the products should fulfill. During the second time period, the firm was still taking the previously mentioned laws and regulations into consideration, although external factors such as changes in the industry due to the digitalization affected the firm to a greater extent. Further, the digitalization contributed to that Siemens Healthineers worked to establish long-term relationships with their customers, thus many new partnerships were initiated with for example university-hospitals. Further, to better meet the changes in the industry during the second time period, Siemens Healthineers became an own firm and also changed their name.

To summarize, many of the technologies that had an impact on the firm emerged during the first time period. However, they affected the firm and their business models to a greater extent during the second time period. Thus, this was mirrored in what the firm offered during both time periods since the technologies were integrated to a greater extent during the latter time period. Altogether, the firm was associated with high quality during both time periods and developed, for example, the world’s first real-time ultrasound in 1967 and the world’s first dual source CT scanner in 2003.
6. Analysis

This section starts with mapping Siemens Healthineers business models during different time periods with the help of the BMC. Furthermore, it presents the key events that have triggered BMI at Siemens Healthineers over time. This is structured accordingly to the two time periods described in the previous section. Furthermore, for each time period the identified key events are presented and categorized with the help of the five categories of events presented in Poole et al., (2000) which are: (1) Idea events, (2) People events, (3) Transaction events, (4) Context events and (5) Outcome events. The definition of each category of events can be seen in section “2.3.1 Five categories of events”. The section ends with a discussion of how Siemens Healthineers changed its business model driven by new technologies over time.

6.1 Business models over time

This section presents business models at Siemens Healthineers over time. Thus, the section includes three business models, one for each of the time periods: 1960-2000, 2000-2018 and 2018-the future. Moreover, the additions in the respective BMC are marked in bold to clarify the changes. To be noted is that during the first time period 1960-2000, Siemens Healthineers have probably changed their business model several times since the time period is for 40 years. However, we have chosen to create a “general” business model for that time period, thus it is not reflecting on the minor incremental adaptations rather the main events.

6.1.1 The past, 1960–2000

Firms that operated in the MedTech industry during this time period faced new laws that had to be considered in the sales- and R&D process. In addition, the emergence of new technologies resulted in new product advancements such as the world’s first real-time ultrasound.

Figure 6-1: The business model at Siemens Healthineers in the past
During this time period, Siemens Healthineers were driven by a strong engineering focus and it resulted in a VP that offered high-quality products which obtained a high status on the market. Due to the digitalization, new technologies occurred which resulted in product advancements which also resulted in a modified VP. The firm’s products were developed for usage in the hospitals and since these are regulated by the public sector in Sweden, the public sector was one of the CS. In addition, a few private actors were also one of the CS. Based on the data available, it is not clear what CH the firm used to reach their customers during this time period, but it can be assumed that it was through personal communication. Further, it is also assumed that market communication was characterized by printed material in terms of flyers and brochures but as the years passed, market communication became more digital.

The CR was driven by a strong personal contact during this time period: “during all the years, it has been important with a close relationship to the customers”. (Per-Anders). Although, the contact was strictly controlled during the sales-process, due to the introduction of the law of public procurement. In addition, personal customer service was important to create a long-term relationship with the customers: “we have had a really good service organization during all the years and we have behaved very well”.

Many of the investments and also the partnerships aimed to support the firm itself during this time period. The firm initiated a partnership with the trade organization Swedish medtech which also became a KP that supported and guided the firm. Moreover, university-hospitals was a KP, but these partnerships were not common: “in the past, a few partnerships with University-hospitals existed, but these were more rarities”. Furthermore, the adoption of new technologies and the investments within AI indicates that R&D was one of the main KA during this time period. There was a strong focus on constantly improving the VP. The firm invested a lot of money in the construction of the new research center to achieve better product development. Thus, it also became a new KR for the firm. Along with the new research center, the employees were an important KR. The emergence of new technologies also resulted in that the firm invested in their employees which in turn, strengthened the workforce and the firm as a whole.

For the C$, the firm used a mix of both a value-driven and cost-driven structure. However, in the early years, it was a strong focus on the value-driven structure but when it showed that the products had potential and entered the market with success, the fixed costs were divided on a larger volume of products and in that way a more cost-driven structure was automatically introduced. Moreover, the R$ was characterized by one-time payments.

6.1.2 The present, 2000–2018

Firms that operated in the MedTech industry during this time period faced several changes and new technologies that emerged. Thus, BMI was essential to be able to meet the new demands of the industry. As any other firm that operated in the industry, Siemens AG stated in their annual report from 2017 that their challenge was: “the global healthcare market served by Healthineers is transforming, putting healthcare providers under pressure for better outcomes at lower cost. Drivers of this transformation include increasing societal resistance to
healthcare costs, payers becoming more professional, a shift to value-based reimbursement, chronic disease burdens, and rapid scientific progress” (Siemens AG, 2017, p. 4).

Figure 6-2: The business model at Siemens Healthineers in the present

The digitalization during this time period contributed to several new technologies that emerged and thus, new demands in the industry. Even though Siemens Healthineers gladly adopted the new technologies, several of the interviewees argued that they struggled with communicating the VP since there was a challenge to get the customer to feel comfortable with the new technologies and to see the value in them: “…our experience is that there is a higher quality and the customer’s experience is that it is new and unfamiliar and would rather have it the way it used to be. So there is a challenge in communicating new technologies, it is”.

The CS during this time period remained the same, thus mostly the public sector but also some private actors: “what is unique with this market is that we have the same customers every year. You don’t find any new customers and this means that the sales and marketing that I am working with is relationship marketing”. Thus, due to the challenges in communicating the VP, the communication and through which CH the firm communicated with their customers proved to be very important during this time period. The firm attended conferences and exhibitions where their customers participated. This, to get a better understanding of the customers and their future plans. In turn, this helped the firm to develop products that the customers wanted.

Moreover, the firm worked a lot with their CR during this time period. As indicated in the quote above, the firm aimed to develop close and long-term relationships to their customers which the majority of the interviewees argued were an important part of the business model: “one part of the business model is to establish a deep partnership with the customer. If we initiate an affair with a new customer, it should feel natural for them to continue the work
with us”. Although, the CR and the sales-process varied depending on the CS. The private actors had a strong focus on investment, what the products and services would generate in the long run: “the private actors think of the investment and amortization over time”. Furthermore, the public sector did not consider the long-term investment as much as the private actors, the public sector was: “… totally budget driven and they are allowed to buy a CT scanner for 10 million and they buy it, and then they don’t think of it anymore”.

As a result of the digitalization it became possible to follow the installed products and services online and thus, the CR regarding services and support became more digital: “during the years, we have had a competent service-organization but now when we have the possibilities to connect our systems to us and send data about the status we can predict problems which are fantastic”. By this way of work, the service-engineers at Siemens Healthineers could know exactly when for example an X-ray tube needed to be changed. In turn, it resulted in a more effective healthcare since the products never stood still.

One of the KP during this time period were partnerships with university-hospitals which allowed the firm to get a better understanding of their customers working environment. Indirectly, this meant that the firm could predict and better plan their upcoming work compared to before. Further argued, this also meant that risks regarding product development were minimized in that sense that the firm understood what products and services that would meet the specific customer’s needs. Interestingly, it was often the customer who pushed for these partnerships. Furthermore, partnerships with other actors, for example, firms that analyzed the external environment or supported the product development were also significant for this time period. Due to the importance of KP with the customers during this time period, one of the KA for the business model was according to several of the interviewees, the meetings with the customers: “…having continuous meetings is what I have with our customers, where we go through what their needs are, both with the machine that they have today but also their needs in the future, and if they should invest and how to think etcetera”.

Moreover, one of the KR for the business model during this time period were the employees. Siemens Healthineers became an own firm in 2015 and the firm also changed their name in 2016. This, to put more focus towards that it was the employees of the firm that drove the healthcare forward. Moreover, the firm still had a strong engineering focus during this time period as well, something they were proud of. The C$ of the business model during this time period was a mix of both value-driven and cost-driven structure. Thus, the firm worked a lot with communicating and delivering the value to the customers, while at the same time there is always a need to minimize costs. Further, the R$ contained mostly one-time payments as well as a change to the sales-model of the firm in 2015. In addition, the firm also signed agreements on service and education to ensure the R$: “We sign contracts for service and also agreements regarding education”.
6.1.3 The future

Firms that operate in the MedTech industry will face changes in the future. It is argued that what is requested in the industry will move towards more intangible products and services. During the previous time periods, there was a distinct focus on tangible products from both the customers and the firms. Although, several of the interviewees argued that they see a more distinct focus towards services in the future: “…it is now product-driven to a great amount, but I believe that there will be a shift, that the services will control what products you have. The services will come first”. Thus, there is an indication that the VP in future business models will be more related to intangible products and services.

Figure 6-3: The business model at Siemens Healthineers in the future

Further, it is argued that AI will be implemented in the business models to a greater extent. Thus, AI was discussed in Siemens AB’s annual report from 2017 as a new technology that can solve some of the challenges in the society: “new innovation areas that distributed energy systems, AI, autonomous machines, online e-mobility and blockchain techniques can contribute to the solution of some of our times biggest societal-challenges” (Siemens AB, 2017). The majority of the interviewees agreed and stated that AI can change the way of work in for example hospitals and also contribute to more precise diagnoses for the patients: “…it will improve the care and opportunities to give the right diagnose, at the right time, for the specific patient”. Thus, it can be concluded that one of the biggest modifications will be in the VP in the future since the value will shift and the offerings will be more focused on intangible products and solutions.

The CS for the future business models will most likely remain the same as during the previous time periods, thus the public sector and some private actors. The communication with the customers will most likely also remain the same, through CH as for example meetings and exhibitions. Further, due to the emergence of new technologies and that the firm is facing
challenges with communicating the value of new technologies already today, there will probably be a continuous work with the CR and establishing a close and long-term relationship to the customers in the future. The customer service and support are predicted to be even more digital: “we work with medical systems and maintaining these is critical. They cannot malfunction”. Further, it is argued that AI implemented in products and services can result in possibilities for real-time updates regarding the products and services status and thus, can result in a more efficient maintenance of the installed products.

Regarding KP for the future, some of the interviewees argued that third-party suppliers will be involved in the business to a greater extent compared to today. Smaller or startup firms often have smart ideas but usually, the product or service must be connected or integrated to the offerings by the larger actors, such as Siemens Healthineers. Thus, there are possibilities for the firm to work even more with other actors to develop innovative products and services in the future and therefore one of the KA will be to work with R&D. In turn, it was argued by one of the interviewees that there is a need to reorganize to be able to meet the new demands in the industry, which will focus more on intangible products and services. Thus, this will be another KA for the future; “everything is controlled by digital devices. The software is suddenly really important and then you understand that is it a disadvantage for us since we are a very engineering-heavy firm. It is hard to reorganize. But we have understood that it needs to be done and therefore we are building divisions named digital health services to improve our skills within this area”. Further, if the organization and the divisions within the firm will expand to keep up with the digitalization, there will be a need for new competence. Thus, one of the KR for the business models in the future will be new human resources, thus new competence: “…there is a need for another type of employees and perhaps another type of competence”.

The C$ in the future will most likely be more value-driven since the industry overall has a distinct focus on how the new products, services and the emergence of new technologies can benefit the patients that is receiving the care: “more and more people talk about value-based healthcare. That means, that you no longer get paid for 100 scans. You get rather paid for how many of these 100 scans that will return to the hospitals. Thus, if you have not cured a person then you might not get paid for it either”. The R$ in the future is argued to be more related to the usage of the product or service, thus that the customers pay-per-use. One of the interviewees stated the following: “in the future it will be more specific, that you pay-per-use. You pay for what you use. Since everything becomes even more controlled by software, it opens up for this kind of opportunities”. However, using new ways of payment methods can result in new challenges that need to be confronted: “…pay-per-use is a really interesting business model, but it requires that you have incentives for it”. In Sweden, the majority of the healthcare is within the public sector and earning money is not the most significant, which also questions if pay-per-use is the right revenue model. However, the fact that the firm is discussing in these terms demonstrates that they are open towards new R$ and aware of that the revenue model can change.
6.2 Events that have triggered BMI

This section presents the events that have triggered BMI at Siemens Healthineers over time. The section is structured with regard to the two time periods which has been used to describe Siemens Healthineers over time. In turn, each time period is structured with regard to the five categories of events presented in Poole et al., (2000). The definition of each category of events can be seen in section “2.3.1 Five categories of events”.

6.2.1 Events that have triggered BMI, 1960–2000

During this time period, 19 primary events could be confirmed and divided on: 2 idea events (I), 1 people event (P), 1 transaction events (T), 7 context events (C) and 8 outcome events (O). The primary events are presented from a historical perspective in Table 6-2. Further, in Table 6-2, the primary and secondary events as well, as the affected elements of the business model, are presented.

<table>
<thead>
<tr>
<th></th>
<th>1.1</th>
<th>1.5</th>
<th>1.12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea (I)</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>People (P)</td>
<td></td>
<td></td>
<td>1.12</td>
</tr>
<tr>
<td>Transaction (T)</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context (C)</td>
<td>1.6</td>
<td>1.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Outcome (O)</td>
<td>1.2</td>
<td>1.1</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Table 6-1: The primary events during the first time period, 1960-2000

1. Idea events during this time period were mostly characterized by several investments. In 1965, a lot of money was invested in the construction of the research center in Erlangen, which is the headquarter for R&D today. The investment resulted in better opportunities for R&D and laid the foundation for many of the firm’s innovations in healthcare. In 1990, the firm invested in AI technologies and this resulted in discussions regarding how this technology could be used in a near future and implemented in the firm’s products and services.

2. People events were not many during this time period. At the beginning of this time period, the firm invested in knowledge within radiology and it resulted in a workforce with additional competence within the field.

3. Transaction events that occurred during this time period concerned partnership that focused on supporting the firm itself. Moreover, the trade organization Swedish Medtech was founded in 1973 and the firm became a member which resulted in better support and guidance.

4. Context events during this time period occurred due to demographic and technology changes and because of new sets of regulations. Moreover, the population increased which resulted in a higher pressure on the firm to develop innovative products and services that could contribute to a healthcare that could handle the growing population. Despite this, the digitalization started, and ICT emerged in greater extent. This resulted in that firm tried to adapt to these technological advancements. The firm started to convert their medical imaging from analog to digital and also integrate ICTs in their existing products. It also resulted in discussions of how it could create new product opportunities. At the end of this time period,
three new regulations were also introduced which had an impact on the firm. In 1990, the CE marking was introduced and in 1994, the law of public procurement was introduced in Sweden. Further, the 29th April in 1998, the personal data act was introduced as well. This resulted in more restrictions to follow when developing products as well as a more rigorous sales-process.

5. Outcome events during this time period were characterized by having positive effects on the firm's business model. Many of the firms’ revolutionary products were launched and the response from the market was positive. The launch of the world’s first ultrasound and the firms first CT resulted in positive publicity for the firm. Moreover, the transformation from analog to digital imaging resulted and a faster production and faster distribution of images and thus, it improved the products. At the beginning of this time period, the firm had also a strong focus on engineering knowledge and it resulted in that the firm became associated with high quality during the rest of the years. Focusing on premium products and supreme services appeared to be prosperous and it resulted in that the sales of rest of the product range accelerated. At the end of this time period, the increased amount of patient data resulted in both opportunities and challenges. It could be possible to make the care more specific and effective but the question of how all the data should be analyzed still remained. However, it was shown that the investments within AI in 1990 was well-invested money. It resulted in that the firm was in the front edge regarding implementation of the technology. Thus, when the products started to generate a lot of patient data, the firm was well-aware of how AI technologies could be used to analyze the data existed, although it was not fully developed.
<table>
<thead>
<tr>
<th>Primary events</th>
<th>Secondary events</th>
<th>Change in BM component(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 (I)</td>
<td>In 1965, the firm invested in the construction of the research center in Erlangen</td>
<td>1.1.1 This resulted in better opportunities for R&amp;D and laid the foundation for many of the firm’s innovations within healthcare</td>
</tr>
<tr>
<td>1.2 (O)</td>
<td>In 1967, the firm launched the world’s first real-time ultrasound</td>
<td>1.2.1 This resulted in positive publicity for the firm and a revolutionary step for the healthcare industry. It was possible to observe changes in the body and visualize it on a screen</td>
</tr>
<tr>
<td>1.3 (I)</td>
<td>In 1973, the trade organization Swedish Medtech was founded</td>
<td>1.3.1 This resulted in that the firm became a member of the trade organization and in turn, the firm could get better support and guidance</td>
</tr>
<tr>
<td>1.4 (O)</td>
<td>In 1975, the firm launched their first CT</td>
<td>1.4.1 This resulted in positive publicity for the firm and improved healthcare. It was possible to take pictures of the human brain</td>
</tr>
<tr>
<td>1.5 (I)</td>
<td>In 1990, the firm invested in AI technologies</td>
<td>1.5.1 This resulted in a discussion regarding how this technology could be used in a new future and implemented in the firm’s products and services</td>
</tr>
<tr>
<td>1.6 (C)</td>
<td>In 1990, the CE marking was introduced in Sweden</td>
<td>1.6.1 The firm needed to fulfill the health-, environmental-, and safety requirements provided when developing products</td>
</tr>
<tr>
<td>1.7 (O)</td>
<td>In 1990, the firm invested in AI technologies</td>
<td>1.7.1 This resulted in that the firm were in the front edge regarding the implementation of AI, thus the investment was successful</td>
</tr>
<tr>
<td>1.8 (C)</td>
<td>In 1991, the world wide web was introduced</td>
<td>1.8.1 The digitalization started and this resulted in that the firm tried to adapt to this transformation by for example converting their medical imaging from analog to digital</td>
</tr>
<tr>
<td>1.9 (C)</td>
<td>In 1994, the law of public procurement was introduced in Sweden</td>
<td>1.9.1 This resulted in that the sales-process became more rigorous</td>
</tr>
</tbody>
</table>
6.2.2 Events that have triggered BMI, 2000–2018

During this time period, 21 primary events could be confirmed and divided on: 5 idea event (I), 3 people event (P), 5 transaction events (T), 6 context events (C) and 2 outcome events (O). The primary events are presented from a historical perspective in Table 6-3. Further, in Table 6-4, the primary and secondary events, as well as the affected elements of the business model, are presented.

Table 6-2: The events that have triggered BMI during the first time period, 1960-2000

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
<th>Impact</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.10 (C)</td>
<td>The 29th of April 1998. The Personal Data Act was introduced in Sweden</td>
<td>This resulted in directions for the firm on how they could develop their products and services</td>
<td>CH, CR, KA,</td>
</tr>
<tr>
<td>1.11 (O)</td>
<td>In 1999, the firm launched their first intuitive medical IT platform</td>
<td>This resulted in positive publicity for the firm and improved healthcare. It was possible to facilitate medical examinations by providing a single user interface for a large number of imaging systems</td>
<td>VP</td>
</tr>
<tr>
<td>1.12 (P)</td>
<td>The firm invested in competence within radiology</td>
<td>This resulted in a workforce with additional competence within the field</td>
<td>KR</td>
</tr>
<tr>
<td>1.13 (C)</td>
<td>The development of data capacity accelerated</td>
<td>This resulted in possibilities to improve the software and possibilities for product improvements</td>
<td>VP</td>
</tr>
<tr>
<td>1.14 (C)</td>
<td>Information and communication technologies emerged in a greater extent</td>
<td>This resulted in the firm started to integrate these technologies in their existing products as well as started to discuss new product opportunities</td>
<td>KA, VP</td>
</tr>
<tr>
<td>1.15 (C)</td>
<td>The population increased</td>
<td>This resulted in a higher pressure on the firm to develop innovative products that could help to meet the challenges with an increased population</td>
<td>KA</td>
</tr>
<tr>
<td>1.16 (O)</td>
<td>The firm focused on engineering knowledge</td>
<td>This resulted in that the firm was associated with high quality</td>
<td>KR</td>
</tr>
<tr>
<td>1.17 (O)</td>
<td>The firm focused on premium products and services</td>
<td>This resulted in a good reputation which affected the rest of the sales</td>
<td>KA, VP</td>
</tr>
<tr>
<td>1.18 (O)</td>
<td>The shift between analog to digital imaging</td>
<td>This resulted in a faster production and faster distribution of images, thus product improvements</td>
<td>KA, VP</td>
</tr>
<tr>
<td>1.19 (O)</td>
<td>The quantity of patient data increased due to the digitization</td>
<td>This resulted in that it was possible to make the care more effective but only if all the data could be analyzed properly</td>
<td>KA</td>
</tr>
</tbody>
</table>

Table 6-3: The primary events during the second time period, 2000-2018

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
<th>Impact</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>2.3</td>
<td>2.7</td>
<td>2.9</td>
</tr>
<tr>
<td>People (P)</td>
<td>2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transaction (T)</td>
<td>2.1</td>
<td></td>
<td>2.13</td>
</tr>
<tr>
<td>Context (C)</td>
<td>2.4</td>
<td></td>
<td>2.8</td>
</tr>
<tr>
<td>Outcome (O)</td>
<td>2.2</td>
<td>2.6</td>
<td></td>
</tr>
</tbody>
</table>
1. Idea events that occurred during this time period had a crucial impact on the firm’s business model. In 2014, the firm presented to the stakeholders and the society that they expected fundamental changes in the industry. Moreover, they argued that new business models in the healthcare industry would come. This announcement to the public resulted in that stakeholders was informed about that a change in the industry would come. Due to the fact that the firm ended up in an unusual affair with a subcontractor during this time period, the firm made a change in their sales-model in 2015. This resulted in a sale-model with stronger directives and better conditions with higher financial security when making businesses together with subcontractors.

2. People events during this time period were characterized by new competence. The firm invested in their employees since it was concluded that both expertise in software, as well as application specialists, was required in greater extend to reach the coming demands. This resulted in that the firm introduced internal programs to strengthen the qualifications of software engineers. Through internal training at the firm, a software architect could for example after nine months be qualified as a senior software architect. The investment of application specialist resulted in a larger workforce with great expertise that could teach the customers how the firm's products and services worked. In addition, the firm’s introduction at the Frankfurt stock market the 16th of March in 2018 resulted in a higher pressure on the employees to take faster decisions and consider what projects and research initiatives to concentrate on and vice versa.

Moreover, the firm implemented a new innovation strategy with a startup approach during this time period. This resulted in that the incubator next47 was founded in 2016 by the firm itself, with the aim to accelerate the development of disruptive innovations and create a deeper relation to startups. In 2018, next47 was introduced in Sweden. As a part of the transformation of being an own firm, the public name of the firm was changed in 2016. The legal name of the subsidiarity is Siemens Healthcare, but the public name was changed to Siemens Healthineers. Furthermore, the name had a purpose and resulted in a new identity for the firm. In turn, it is through engineering-knowledge and pioneering technologies that the “Healthineers”, the employees, push the healthcare forward. During this time period, it also became a higher pressure on profitability because Siemens Healthineers became an own firm. This resulted in a stronger focus on business excellence which concerned activities related to productivity improvements.

3. The transaction events during this time period indicated that it became even more important with all kinds of partnerships and interestingly, the interest for new partnerships came from the external environment. The interest from University-hospitals to collaborate with Siemens Healthineers increased during this time period. This resulted in that the firm could get a better understanding of their customers working environment and challenges ahead. Further argued, it also meant that the firm could minimize risks regarding product development compared to before since they got a deeper understanding of the customers’ requirements. Indirectly, it also meant that the firm could predict and better plan their upcoming work compared to before. Furthermore, a partnership with Harvard University School of Medicine was initiated.
and resulted in better possibilities to get updates from the latest research from academia. In July 2017, Siemens Healthineers Experience Center was opened. This resulted in that the customer could visit this place to get inspired and thus observe the products before the purchase and understand what products that were suitable for their working environment. The 16th of March 2018, Siemens Healthineers were introduced on the on the Frankfurt stock market, and it resulted in new owner conditions. Besides Siemens AG, which owns the majority of the stocks, private shareholders had now the possibility to invest in the firm too. This became a big change and a new situation for the firm. It also resulted in a higher pressure on the firm’s future plans.

4. Context events that occurred during this time period concerned mostly technology and market changes, but an internal reorganization also had a major effect on the firm. Thus, the Swedish healthcare organization was sold to the wholly-owned subsidiary Siemens Healthcare AB in 2015, and this reorganization was completed in 2016. Moreover, this reorganization made it easier for the firm to meet the fundamental changes in the industry since the firm were not forced to consider Siemens as a whole anymore. It resulted in faster decision making as well as a more flexible organization. It also resulted in that all the resources could be dedicated to Siemens Healthineers and not the other divisions. Laws and a new set of regulations were also factors that contributed to change during this time period. The law of public procurement was modernized two times, in 2008 and in 2017. This resulted in that the sales-process became less strict compared to when the law was introduced in 1994, but it was still many restrictions to consider. However, the sales-process and how the customer contact was controlled became more humane. During this time period, the Swedish Association of Local Authorities and Regions was also founded. This resulted in additional restrictions on how the contact with the customer was allowed to be handled.

Another context event that occurred during this time period was the development of data capacity that accelerated and for the firm, it resulted in possibilities to improve the products and services. As a consequence of the advancements in data capacity, it became even more important to regulate all data that was generated through the firms’ devices. The firm knew that the new GDPR law would be introduced the 25th of May in 2018 and this resulted in that the firm started to consider how it would change the development of their products and services. In addition, the customers started to pay more and more attention towards patient security during this time period. This resulted in an even higher pressure on how the firm handled all the data that their products and services generated. Moreover, startups occurred in greater extent within the MedTech industry and as a result, the firm started to discuss how startups could be integrated into the firm’s business model.

5. Outcome events during this time period were characterized by successful products launches which resulted in improvements in healthcare. The firm launched the world’s first dual source CT scanner which created new standards within image quality, scan speed, and spectral imaging.
<table>
<thead>
<tr>
<th>Primary events</th>
<th>Secondary events</th>
<th>Change in IBM component(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 (T) In 2003, the firm initiated a partnership with Harvard University School of Medicine</td>
<td>2.1.1 This resulted in better possibilities to get the latest research from academics</td>
<td>KP, KR</td>
</tr>
<tr>
<td>2.2 (O) In 2005, the firm launched the world's first dual source CT scanner</td>
<td>2.2.1 This resulted in positive publicity for the firm and a revolutionary step for the healthcare industry. New standards were set in terms of speed, contrast, and spectral imaging.</td>
<td>VP</td>
</tr>
<tr>
<td>2.3 (P) In 2007, the firm invested in software engineers</td>
<td>2.3.1 This resulted in that the firm introduced internal programs to strengthen the workforce and the qualifications of software engineers</td>
<td>KR</td>
</tr>
<tr>
<td>2.4 (C) In 2008, the law of public procurement was reformulated</td>
<td>2.4.1 This resulted in that the sales process became less strict compared to when it was introduced in 1994</td>
<td>CH, CR, KA</td>
</tr>
<tr>
<td>2.5 (I) In 2014, the firm presented that they expected fundamental changes in the industry</td>
<td>2.5.1 This resulted in that the stakeholders were informed that a change in the industry would come</td>
<td>KP, VP</td>
</tr>
<tr>
<td>2.6 (O) In 2014, the firm launched a cloud-based network</td>
<td>2.6.1 This resulted in positive publicity for the firm and improved healthcare. With apps it was possible to monitor quantities such as imaging throughput or dose levels to know where the workflows needed adjustments</td>
<td>VP</td>
</tr>
<tr>
<td>2.7 (I) In 2015, the firm changed their sales model</td>
<td>2.7.1 This resulted in clear directives of how the partnerships between subcontractors and the firm should be handled</td>
<td>CH, KP, RS</td>
</tr>
<tr>
<td>2.8 (I) In 2015, the Swedish healthcare organization was sold to the subsidiary Siemens Healthcare AB</td>
<td>2.8.1 This resulted in a higher pressure on profitability and a stronger focus on business excellence</td>
<td>CS, KA</td>
</tr>
<tr>
<td>2.9 (C) In 2015, the Swedish healthcare organization was sold to the subsidiary Siemens Healthcare AB</td>
<td>2.9.1 This resulted in that it was easier for the firm to meet the fundamental changes in the industry. It resulted in faster decision making as well as a more flexible organization</td>
<td>KA, KP, KR</td>
</tr>
<tr>
<td>2.10 (I) The 4th of May 2016, the firm changed their legal name</td>
<td>2.10.1 This was a part of the transformation in being an own entity and it resulted in a new identity for the firm</td>
<td>KA, VP</td>
</tr>
</tbody>
</table>
6.2.3 The emergence of new technologies, events and business model elements

Between 1960-2018, 40 events were found in total. Over time, idea events showed a gradual curve upwards. The emergence of new technologies forced the firm to new investments within fields that were related to the technologies and it also resulted in that new strategies had to be implemented to suit the new technology conditions. Moreover, this category of events had an impact on the overall business model and thus, many of the elements were affected. However, the KA, KP, KR, and VP were the elements that were mainly affected in the business model. As a consequence of the investment in new technologies, the firm educated the employees to stay in line with the technology development that happened externally. This resulted in new competence and it strengthened the KR for the firm and therefore, KR was also the element in the business model that was affected the most by the people events.
Looking at the emergence of new technologies and the transaction events, it was shown that the transaction events increased when technologies became more advanced. The firm had a tradition of making everything by themselves, but as technologies became sophisticated the firm understood that different partnerships were needed for the firm to survive. Thus, this resulted in that partnerships increased at Siemens Healthineers during the second time period. Despite the fact that the transaction events mainly affected the KP, many of the initiated partnerships resulted in new resources for the firm and therefore KR was also one of the elements that were mainly affected by transaction events.

Context events had a major impact on Siemens Healthineers over time and several of the context events were related to the emergence of new technologies, especially during the first time period. During the second time period, context events occurred due to market changes and they were characterized by updated laws and regulations regarding how to handle the advanced technologies for the MedTech and healthcare industry. Thus, the context events mainly affected the KA and the VP in the business model.

As a consequence of the adoption of new technologies, many positive outcome events were also found and related to successful product launches, which in most of the cases had an impact on the VP in the business model. Altogether, KA, KP, KR and the VP are the elements that have been mainly affected over time. However, several of the events have also had an impact on other elements too and it is therefore suggested to look at table 6-2 and table 6-4 which illustrate all the changes in business model elements.

6.3 BMI driven by new technologies
This section discuss how BMI has been achieved over time at Siemens Healthineers, due to the emergence of new technologies. Thus, the first section is named BMI process and discuss how this process has changed over time, as well as how the firm work to discover market and technology changes today. It is followed by a section which describes factors that can make the BMI process easier to achieve, thus it is named facilitating factors for BMI. Lastly, it is argued that the MedTech industry will face fundamental changes in a near future and therefore the section ends with a discussion around the key characteristics of future business models driven by AI. Moreover, the findings are discussed with regard to the literature presented in the section “2. Theoretical frame of references”. The answers from the verifying interviews are also included in the discussion to ensure trustworthiness.

6.3.1 Characteristics of the BMI process at Siemens Healthineers
The emergence of new technologies and more specifically digital technologies have made drastic changes for several industries during the last years. This has also been the case for Siemens Healthineers, but it has mostly resulted in changes in the VP in their business models. In contrast with companies such as Amazon and Uber, two firms that made radical changes in their business models due to the emergence of digital technologies according to Girotra and Nessesine (2014), Siemens Healthineers has not made any radical changes in their overall business model. The firm operates in one of the most regulated and complex industries, and this is one reason for the incremental changes in their business model over
time. Radical changes within this industry have not yet occurred but it is argued that it will happen (Stanford medicine, 2017). This is also aligned with what the employees at Siemens Healthineers believe: ”compared to many other industries, healthcare have not been exposed to big changes. I think the healthcare stands in front of its big change right now”.

To update the business model, it can be concluded that BMI at Siemens Healthineers has been driven by a specific logic (Van de Ven & Poole, 1995). However, this analysis indicates that the BMI process was more planned at the beginning of the first time period and it followed certain steps (Van de Ven & Poole, 1995). It was a strong focus on R&D and the firm used the knowledge in-house and thus, the firm had an inside-out perspective when developing their products and business model (McGrath, 2010). Further, it became more significant with an emergent approach during the later years of the first time period, when ICT technologies emerged in greater extent. It was clear that external events influenced the development of the business model (Van de Ven & Poole, 1995). Thus, the firm included and focused more on an outside-in perspective (McGrath, 2010). Further, a combination of a planned and an emergent approach became the new way to achieve BMI during the second time period since the emergence of new technologies made the industry environment hard to predict. Moreover, the interviewees argued that AI is the technology that will have a major impact on the MedTech and the healthcare industry in a near future. Thus, it is assumed that an emergent approach to BMI will be even more significant in the future. New ideas need to be tested and reworked to develop potential business models and especially if the business model includes a technology that the market is unfamiliar with. Presented down below in Figure 6-4 is a visualization of the BMI process at Siemens Healthineers during the two time periods.

![Figure 6-4: A comparison of the BMI process at Siemens Healthineers during the two time periods](image-url)
When the interviewees were asked if certain models or steps were used in order to update the business model, the majority of the interviewees referred to that it is something that is controlled by the top management. However, the employee seems to be a part of these steps without reflecting on it. It has been concluded that analyzing the external environment is essential to know what factors that might influence the operations of the firm (Frankenberger et al., 2013). Moreover, this analysis is performed in two ways at Siemens Healthineers today: (1) through the internal organization working with competitive intelligence and trend analysis and (2) through interaction with the customer. At the headquarter in Germany, a group of people works systematically with identifying and following all kind of trends and changes in the industry. They also obtain the newest information via collaborations with consultants working with trend analysis. Despite the newest research from academia, this group also analyze which equipment that is sold the most and what customers buy from competitors. Moreover, the global economy is analyzed to understand how the firm should invest and what they should prioritize to move forward. In turn, all information about coming trends is spread to the organization in Sweden via the daily dialogue and through general meetings and conferences.

Despite the competitive intelligence analysis performed at the headquarter, employees are allowed to take own initiatives regarding trend analysis on the local markets. An example of how this can look like was described by one of the interviewees: “I have a partner whom I have a business deal with, who scans what is happening online on the internet, so I know what is going on in discussion forums and what new trends that are coming”. Altogether, it can be concluded that the firm discovers trends from the external environment from different levels. In addition, a lot of information about market trends are also absorbed by the people who have close contact with the customer: “We salesmen are a bit like antennas and intercept trends and then we discuss and send it forward to the product specialists”. Presented down below in Figure 6-5 is a visualization of how the firm analyze the external environment.

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**Figure 6-5: The system of how Siemens Healthineers analyze their external environment**
Moreover, discovered opportunities from the external environment must be transformed to concrete ideas, in order for them to result in new business models (Frankenberger et al., 2013). A lot of the daily work for the employees at Siemens Healthineers, concentrate on this transformation. Coming trends and its long-sightedness as well as how to respond to new trends is discussed in the daily work. In turn, new ideas that are discussed are sent to the headquarter for further discussion on a higher level. To know if the new ideas will result in potential business models, the firm discusses and test the ideas together with the customer. It is a constant process of experimentation and trial-and-error (Achtenhagen et al., 2013; Cavalcante, 2014; Chesbrough, 2010; Euchner & Ganguly, 2014; McGrath, 2010; Wrigley & Straker, 2016). The interviewees argued that it is important to listen to the customer to understand their working environment and thus, their product requirements. In turn, the customer's perspectives are important to take into consideration to be able to develop business models that will suit their needs and wants. However, the customers do not always know what requirements they have and their needs and wants might also change when the industry changes, which makes it essential with a close customer contact: “…having continuous meetings is what I have with our customers, where we go through what their needs are, both with the machines that they have today but also their needs in the future, and if they should invest and how to think etcetera”.

Moreover, the overall impression from the interviews was that the firm have an open mind towards change and sees change and development as a necessity to survive. Similarly, actor (1) from the verifying interviews said that: ”we need to be open-minded if we want to be an actor that is on the front edge”. Despite the fact that Siemens Healthineers is a large organization, the attitude towards the implementation of new business models has been positive over time, which otherwise is the most challenging part because people often tend to be reluctant to change (Frankenberger et al., 2013). The fact that the firm work with experimentation and trial-and-error in their daily work, also minimize this challenge which otherwise occurs during the implementation (Frankenberger et al., 2013). By making small and constant changes, new business models have gradually been implemented over time. As mentioned, the firm have an open attitude towards change and the challenge is rather to get the customer to understand how new technologies and new business models can be valuable for them. Similarly, actor (3) from the verifying interviews argued that people should: “see the opportunities instead of the problems, don’t be afraid of the technology. See what it can help us with, to do our society better”.

Even though there is a challenge in getting the customers to understand the value of the technology, several of the interviewees argued that in a near future, the firm will face a shift since the younger population is more open towards the digitalization and disgorging personal data. Thus, this might contribute to that the firm’s future customers might have a more open-minded attitude towards the emergence of new technologies. In addition, this might open up opportunities for a faster implementation of new technologies in the business model, thus achieving BMI. Similarly, actor (3) from the verifying interviews argued that: “I think it is a norm. I don’t think that you adopt, rather that you assume that this is the way it is. We are used to apps, it is a norm, it is nothing that you choose, you rather assume that this is the way
it is”. Further, when being asked if the generation-shift will affect how well new technologies are accepted, actor (3) said: “absolutely, that is my perception”. Moreover, actor (4) from the verifying interviews argued that: "we humans change our consumer behavior. We want faster access, we are used to it via the internet. And then we expect that from all other types of services, even healthcare“. Thus, it indicates that it might be easier to implement new technologies and thus, to achieve BMI.

### 6.3.2 Facilitating factors for BMI

There are several factors that can facilitate the BMI process. Thus, one of them being the managers since they have an important role in allocating the resources the right way (Chesbrough, 2010; Guo et al., 2013). Managers at Siemens Healthineers control and push the employees in certain directions, but during the later years it has been appreciated and accepted for the employees to take own initiatives regarding their field of work. Further, decision making regarding product adjustments for the local market is done by the product managers and the customers together, since it is the product managers who have the best information and expertise about the products. This means that the top managers are not involved in these decisions at all and that the person that is: “…the most informed person…” has the decision rights (Girotra & Nessesine, 2014, p. 7).

A lot of the partnerships that the firm have established over time aims to result in new knowledge and expertise, since: “the best-informed people aren’t always in the firm” (Girotra & Nessesine, 2014, p. 7). During the first time period, the firm had few partnerships overall, as argued by one of the interviewees: “we have a tradition within Siemens to do things ourselves”. In comparison, the second time period is characterized by an increased number of partnerships, for example, research projects with university-hospitals where knowledge is exchanged. From the firm’s perspective, these types of projects aim to generate results that can be valuable for the development of innovative products and services. However, this is not always controlled by the firm to the fullest. The research participants from the university-hospitals are involved in the decision making or even make the critical decisions by themselves since they have more knowledge within the field that is studied. Moreover, it has been ensured that these types of partnerships have increased during the recent years to better meet the changes and new trends in the industry. One scenario is that Siemens Healthineers sell equipment which is used for research projects and thus, they can take part of the result. Similarly, actor (2) from the verifying interviews stated that they have similar partnerships where the partner uses the firm's products: “…for their study, where they bring up a lot of feedback on what they would want that is not integrated right now or how something could be changed to the better. Of course, we take this into consideration”.

Altogether, partnerships have been a critical factor for Siemens Healthineers to be able to meet the demands in the industry today but also in the future: “leveraging AI and Big Data into digital innovations that support actionable insights can’t be done alone – partnerships are key” (Montag, 2018). Further, partnerships are beneficial for the firm since knowledge is exchanged and thus, risks are reduced, resources are acquired, alliances are created and thus, the business model is optimized (Osterwalder & Pignuer, 2010).
6.3.3 The key characteristics of future business models driven by AI

Siemens Healthineers have constantly worked with BMI to improve their products and services to be able to adapt to the emergence of new technologies. This has resulted in product improvements with new features and characteristics and thus, business model extension has been achieved (Cavalcante et al., 2011). In a near future, the firm expects fundamental changes in the industry due to the emergence of new technologies such as AI, which means that the business models will be modified. Thus, a revision of the business models will most likely happen which is often characterized by uncertainty since it is hard to predict the future. Further, there is often a lack of knowledge and skills to be able to succeed with this modification (Cavalcante et al., 2011).

However, Siemens Healthineers have always prioritized the employees within the firm by for example offering several internal programs. This, to strengthen the competence both within the existing working areas but also the coming working areas that will occur due to the emergence of new technologies. In that way, the risks are minimized. Similarly, it was argued by several of the interviewees at Siemens Healthineers that new competence is often needed when the firm needs to update and rethink their business models. This, to be able to meet the new demands of the industry. Similarly, actor (1) from the verifying interviews stated: “of course, if the industries are changing that means that what we do changes as well. And if our products, services and solutions change, we need to adapt thereafter. Thus, it is very likely that new competence is needed that can handle the new business models”. Further, actor (3) from the verifying interviews agreed and stated that: “I think that is very important to be able to keep up with what is happening and changing”.

Moreover, the interviewees at Siemens Healthineers argued that knowledge within AI will be essential in a near future. Several of them claimed that AI technologies will be revolutionary for the MedTech and healthcare industry and one of the interviewees argued that it will improve the possibilities to: “… deliver more care for less money or the same money”. Moreover, it was argued that human errors can affect diagnoses today but with the support from AI technologies one of the interviewees argued that: “…the quality of the care will be improved, and the lowest-level will enhance”. On the other hand, it is important that doctors and nurses that work with systems with AI integrated, do not lose their common sense and trust the technology to the fullest level. In turn, all the interviewees claimed that AI will, therefore work as a decision support rather than replacing the humans. Thus, it is argued that:

“AI will not by any means replace radiologists – rather it will provide them with tools to meet the rising demand for diagnostic imaging and actively shape the transformation of radiology into a data-driven research discipline. AI algorithms are expected to help speed up clinical workflows, prevent diagnostic errors and reduce missed billing opportunities, thus enabling sustained productivity increases. Above all, methods of artificial intelligence could lead to more precise results and more meaningful prognostic risk scores and integrate diagnostic radiology even more into outcome-oriented clinical decision-making” (Siemens Healthineers, 2017, p. 3).
Altogether, the future is digitized and working with BMI and how business models will look like in the future is essential to be able to meet the changes that new technologies such as AI will contribute to. This to be able to stay competitive in a market and a world that is becoming more and more digitized: “The future is electrical, automated and online. Huge amounts of data are created every day and if used properly, this data can create huge values and benefits. The digitalization changes how people change their lives, how companies handle their systems and processes as well as how cities and our everyday life functions. In the year of 2020 there will be 3 times as many online units as people on this earth” (Siemens AB, 2017).
7. Conclusion

The purpose of this study has been to explore how business models in established firms within the MedTech industry develop over time due to the emergence of new technologies. Further, the purpose was also to identify key events that contributed to this change. More specifically, it focused on how artificial intelligence is influencing and will influence the business models in the MedTech industry.

Our study showed that business models at Siemens Healthineers followed a planned approach during the first time period, compared to the second time period when the firm had a combination of a planned and an emergent approach. The change of approach was a result of the context events such as the emergence of new technologies, which led to that the firm needed to be more flexible and thus, work with experiments and trial-and-error activities. It can be concluded that the emergence of ICT is one of the most critical context events for the firm since it enabled new product opportunities. Thus, this was the start for more intangible products. Moreover, context events such as laws and regulations have had a major impact on Siemens Healthineers over time since they are operating in an industry that is complex and strictly controlled. Additionally, being an early adopter of new technologies and having several partnerships have been vital to the BMI process.

It can be concluded that the BMI process at Siemens Healthineers has been a process of incremental changes between the years 1960-2018. The overall process of how the firm has discovered new technologies and implemented it in the business model has followed a certain structure, which can be connected to the 4I framework and the life cycle perspective of organizational change (Frankenberger et al., 2013; Van de Ven & Poole, 1995). Further, the strong focus on engineering did not only generate high-quality products, it also resulted in a planned BMI process. However, the industry environment has always been relatively unpredictable and uncertain, which has forced the firm to work dynamically. Further, analyzing the market and having a close relation to the customers has been of high importance for the firm to be able to test new business models.

Moreover, Siemens Healthineers have always been an early adopter of new technologies which is ensured by looking at their successful products throughout the years. In turn, a well-established system of how the firm has analyzed the external environment is one of the answers to their success. The firm has had an internal group of people working with competitive intelligence and trend analysis. In addition, the employees have also had their own partnerships with other companies that update them regarding trends and market changes. In turn, interaction with the customers is vital to understand what is happening in the external environment. A visualization of this system can be seen in Figure 6-5.

It can also be concluded that several partnerships have been essential for BMI at Siemens Healthineers over time. Collaborations with university-hospitals are, for example, one partnership that has resulted in that the firm could get a better understanding of their customer and thus, develop business models that has suited the market demands. Moreover, there has
been a clear relationship between the emergence of new technologies and the increased number of partnerships. When technologies became more advanced throughout the years, the number and types of partnerships increased. In addition, the BMI process at Siemens Healthineers have always been driven by a clear purpose and today, the firm claims that they are: “shaping the future of healthcare” (Siemens Healthineers, 2018). Working with products and services that can contribute to a healthier population have always been and is still a driving factor and motivation for BMI.

Lastly, it is argued that AI is the technology that will shape the future of healthcare. In a near future, there will be a significant shift in the MedTech and healthcare industry and this will occur due to the implementation of this technology. A critical event for Siemens Healthineers was the investment in AI already during the first time period. This indicates that they have good conditions in meeting the new changes in the industry that this technology will contribute to. Further, it is argued that the implementation of AI will result in possibilities to make use of and analyze all the data that is generated through devices used for healthcare. In turn, it is argued that the emergence of new technologies and more specifically AI will improve the care, make it more efficient and more personalized. To be concluded, it is with a lot of excitement that we look forward to the future to be able to conclude if our predictions about coming business models for the MedTech industry were correct.

7.1 Implications
The implications of this study are relevant for firms that want to learn about the importance of BMI as well as understand what it takes to succeed with this process. First, our study provides a holistic view of how BMI can improve a firm's offerings and the ability to adapt to external changes. Second, it also discusses how AI will disrupt the MedTech and healthcare industry in a near future and thus, this study is relevant for all kinds of actors within these industries. Third, our study visualizes how the business model elements are affected by the emergence of new technologies via three BMC’s. Fourth, it indicates that BMI does not need to be either a planned or an emergent process. If both approaches are used in a combination, it can result in a well-structured BMI process, which at the same time can adapt and respond to market changes. Thus, it is important that managers understand that a combined approach is possible. Fifth, an open-minded and flexible organization is needed to achieve this change.

7.2 Limitations and suggestions for future research
While this study has offered valuable insights of how established firms can achieve BMI driven by new technologies and also succeed with this process, the study is based on only one in-depth case study in a single industry. Therefore, the findings of this study cannot be generalized to all actors in the MedTech industry even though some of the findings might be transferable to some. Thus, future research can further validate the findings from this study by using them as a starting point to investigate other actors’ perceptions of BMI. It would be interesting to know if other established firms within the MedTech industry have similar or other processes to achieve BMI compared to Siemens Healthineers.
In addition, it would also be interesting to get a deeper understanding of how startups and small and medium firms achieve BMI and if their way of work is different compared to established firms within the MedTech industry.

Second, this is a single case study and it has been performed at an established firm that operates globally, but the primary data have been gathered through interviews with employees in the Swedish organization. It would therefore be interesting to apply our methodological choices and do the same study but include primary data from other organizations around the world.

Third, since this thesis has a process perspective, business models at Siemens Healthineers have been analyzed over time. Although, it was not a desirable access to secondary data before the year 2000 and thus, this limited the gathered data for the time period between 1960-2000. Further, there has probably been several business models at Siemens Healthineers during this time period, but we have not reflected on the minor incremental adaptations. It is suggested that future research can focus on studying the first time period more detailed, to get an extended description of BMI at Siemens Healthineers in its early years. Moreover, process studies are needed to a greater extent within the MedTech industry since it is argued that AI will contribute to new business models in a near future.
References


Foss, N. J., & Saebi, T. (2017). Fifteen years of research on business model innovation: how far have we come, and where should we go?. *Journal of Management, 43*(1), 200-227.


Appendices
Appendix 1: Market search
Appendix 2: Manuscript interviews, standard questions
Appendix 3: Manuscript interviews, customized questions
Appendix 4: Manuscript interviews, Vitalis
Appendix 1: Market search
The table presented down below illustrates the two searches that were performed to find an appropriate firm for the case study. The first search focused on established firms while the second search focused on startups. To be noted is that the firms marked in red were not contacted due to not fulfilling the stated criteria.

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<td><strong>Total: 9 (14)</strong></td>
<td><strong>Total: 5</strong></td>
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Appendix 2: Manuscript interviews, standard questions

Initial questions:

1. What is your position in the firm?

2. What does your daily work look like?

3. How long have you worked at Siemens?

4. Have you had any other positions at Siemens?

5. How long have you worked within this industry (MedTech) and have you worked at other firms?

Organizational questions:

1. We have read about Siemens overall goals and visions and understand that you strive to be the leader in everything you do. As we understand it, you want to enter new markets and adopt new technologies to enhance the firm's value. Can you tell us about the goals and visions that you are working with at Siemens Healthineers?

2. How do you analyze the external environment to discover trends? Such as new technologies, digital trends (e.g. apps as a result of the digitalization), what the customer wants etcetera.
   Follow-up question/explanation: Do you have any models/special way of work that you follow?

   Follow-up question/explanation: Which departments are responsible for this? Is there any specific working group or are there several departments working with this?

3. How do you adopt new trends in your business after they have been discovered?
   Follow-up question/explanation: Do you add a project team who continues the work with this?

   Follow-up question/explanation: Do you have any models/steps that you follow?

   Follow-up question/explanation: Who is the decision maker for this?
4. **How is the attitude towards change?**  
   **Follow-up question/explanation:** That is, if it is clear that a new technology will dominate the market and change how the majority of the actors deliver value. How easy is it then to change the way of work in your organization to adopt to this change?

   **Follow-up question/explanation:** In general, do you think that you are an organization that is flexible and works agile?

   **Follow-up question/explanation:** Has there been any drastic changes at Siemens Healthineers during the last 5-10 years? If yes, can you give an example?

5. **Do you use the concept business model in your organization? And what is your significant role?**

6. **What makes your business model unique?**

7. **Whom are your stakeholders?**  
   **Follow-up question/explanation:** How do you take these stakeholders into consideration when there is changes in the organization?

8. **Whom are your customers? Do you only sell via business-to-business or do you sell to private persons too?**  
   **Follow-up question/explanation:** We know that you sell CT products to hospitals, but how does it work with for example apps, which are on the market today and are sold direct to private persons. Are you in this business?

9. **What are your key activities for delivering products/services of high quality to the healthcare industry?**

10. **What are your key resources for delivering products/services of high quality to the healthcare industry?**

11. **Despite your own development department, do you collaborate with other partners to develop your products?**

12. **How do you deliver value today and how do you think you will deliver value to your customers in the future?**  
   **Follow-up question/explanation:** What determines if the customers choose you and not your competitors at the moment?

   **Follow-up question/explanation:** What will determine if your customer choose you and not your competitors in the future?
Follow-up question/explanation: Are you working actively with this right now? Long-term plans etcetera, is there are strategy for this?

Technology and future-related questions:

1. How do you adopt to the digitalization in today’s society, when you are operating in an industry that contain sensitive patient data?
   Follow-up question/explanation: There are a lot of new apps for example, how do you as a firm work with safety for all actors?

2. Is there any technology that will be especially relevant for your organization in your future work? How long have you come in the adoption of this?

3. A new technology that is a hot topic right now is AI. How do you think AI will affect your products/services? In what way?

4. How do you think that new technologies such as AI will improve the healthcare industry from an organizational perspective? In what way?

5. How can the digitalization in today’s society contribute to a more beneficial care from a patient perspective?

6. How do you think the healthcare industry looked earlier compared to now, when there are a lot of new technologies implemented in services/products?

7. Which general technologies have been especially relevant over time and what product improvements have they contributed to at Siemens Healthineers?
   Follow-up question/explanation: The discovery of X-ray emanation has for example been very relevant for your firm, but which technologies have then improved your products? Has for example the expansion of the internet or ICT contributed to improvements?

8. Lastly, we would like to ask what you think will be the biggest challenge in the implementation of new technologies in your organization?
Appendix 3: Manuscript interviews, customized questions

1. How and through which channels do you communicate the value that is offered through your products/services to your customers?

2. How do you build and nourish your customer relationships? How has that changed over time?

3. What does your sales-process look like? How has that changed over time?
   Follow-up question/explanation: How do you sell your products? Do you follow any specific steps?

4. In what ways are your customers able to pay for your products/services today? How will it look like in the future?
   Follow-up question/explanation: Will your customers pay for something else than physical products?

5. What does your process look like when you develop new products? How has that changed over time?

6. Whom are your key partners? What are their tasks?

7. Have you had different key partners over time?
   Follow-up question/explanation: Since the industry is changing and there is a need for new knowledge and expertise, how does it affect the partnerships you have/have had?

8. How do you create awareness concerning new technologies that is implemented in your products?

9. What is the attitude among your customers when new technologies such as AI is implemented in your products?

10. What are the challenges and the biggest differences regarding marketing to the public sector compared to the private sector?

11. Can you tell us about the digital ecosystem and how it has changed over time?

12. How much does Siemens Healthineers invest into their employees? Both for personal development but also for activities that can contribute to a better working climate.
   Follow-up question/explanation: Can you give any examples of these activities?
Appendix 4: Manuscript interviews, Vitalis

Firm 1:
1. Do you think there will be a shift in what you are delivering to your customers today vs. in the future?  
Follow-up question/explanation: For a long time, companies have delivered physical products, is it moving towards delivering more services in the future?

2. What do you think the digitalization will contribute to from a patient perspective?

3. Do you think that flexibility is an important part of an organization to be able to adapt to trends and changes in the industry?

4. Is partnership an essential part in the development of products and services?

Firm 2:
1. What is forcing companies that operates in the MedTech industry to change their business models?  
Follow-up question/explanation: AI is a hot topic, is this something that forces companies to update their business models?

2. Will the MedTech industry shift focus in a near future? Will companies deliver more services in the future?

Firm 3:
1. What is the reason behind that more and more individuals use digital services as the ones your firm provide?

2. Do you think that more and more firms that delivers mostly physical products today, will enter the digital market in the future?  
Follow-up question/explanation: Thus, offer services like for example apps

3. Are partnerships an important part of the development of products and services?

Firm 4:
1. Do you think there will be a shift in what you are delivering to your customers today vs. in the future?  
Follow-up question/explanation: For a long time, companies have delivered physical products, is it moving towards delivering more services in the future?

2. Do you think that the digitalization will contribute to that you have to update your business models?
3. Do you think that there will be a need for new competence in forms of employees, to be able to meet the changes in the industry?

4. What do you think the digitalization will contribute to from a patient perspective?
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