



**CHALMERS**  
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# **Industrial transformation of the compressor industry**

## A case study at Atlas Copco Compressor Technique

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

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## **Abstract**

This master's thesis has been conducted in cooperation with Atlas Copco Compressor Technique in Sweden. Atlas Copco Compressor Technique is a large incumbent within the compressor market and the company is investigating how the organization can adapt to digitalization. The purpose of the thesis is to study how the focal company can change its business model to facilitate value creation and increase efficiency, given digitalization.

During this thesis, a literature study of industrial digitalization and technologies served both as basis for the analysis and also as background information to gain an understanding of the situation of Atlas Copco Compressor Technique. To ensure an offer that is appealing to customers, the analysis was also based on empirical findings from case studies of the focal firm and nine customers within five different industries to understand the customer needs. The study was focused on the current situation and the internal operations, while the purpose of the customer study was to identify current and future needs, application of the products and future development. The analysis was primarily based on the Business Model Canvas framework developed by Osterwalder and Pigneur (2010) which consists of eight building blocks that represent the business model of a company. Each building block was studied separately with regards to the information found on industrial digitalization and the case studies in order to obtain a structured approach on the analysis.

From the analysis, three business opportunities were derived which are presented in this report as three Business Model Canvases. These opportunities were considered, when combined, to facilitate a sustainable business. The first business model creates value for the customer by offering energy efficiency, which was found to be an increasingly important factor for customers buying compressors in the future. The same business model increases efficiency for the focal firm in the sense that the products are easily upgraded wirelessly. The second business model is directed towards customers that already owns a compressor and is thus preferably used following to the first business model. The second business model is characterized by efficient maintenance of the tangible products and the value for the customers is derived from the efficient service operations and increased dependability of the products. The last business model is developed to be used in situations when the customers are in need of a new machine. The main value to be gained for the focal firm is to find opportunities for upsell and to gain deeper customer relations, internal efficiency will be increased by automating the back office operations related to sales. By allowing software to analyze real time data of the condition of customers' machines, Atlas Copco Compressor Technique can predict the life of their products and approach the customers with new offerings at the right time.

In order for Atlas Copco to adopt these three business models containing digital elements, a five step action plan is proposed for the adoption process. It has been concluded that the change must be driven from within the company, the organization must therefore facilitate two way communication, provide leadership for digitization and create a shared vision throughout the organization. In addition to these business models, an alternative customer segmentation was proposed. For all three business models, it is in this report proposed that the customers will be targeted according to their digital potential and adoption rate. The customers with high adoption rate are preferably targeted first when introducing new innovative products, followed by the other adopters as they have been influenced by the early adopters.

Keywords: digitalization, incumbent firm, business opportunities, value propositions, customer segmentation



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# 1. Introduction

*This section will introduce the background, problem formulation, purpose of the thesis and limitations of the thesis. Furthermore, a disposition of the thesis will be presented.*

## 1.1 Background

Automation and digitization is transforming the modern economy (Weinelt, 2016). Today, we live in a digitalized age where technologies such as social medias, analytics tools and mobile phones are predominating the market (Westerman et al., 2012). In the year of 2016, there were over 2.6 billion smartphones users around the world (Piejko, 2016). The same year, internet usage reached a penetration rate of 50,1% which is approximately 3,7 billion internet users around the world (Internet World Stats, 2017). The spread of internet into people's homes and mobile phones has given companies the opportunity to reach their customers around the clock. (Wessel et al., 2016).

A concept that has arisen along with digitalization is the Industrialist Dilemma (Wessel et al. 2016). The powerhouses of the 20th century have had a difficult time to adapt to the new data-driven world (ibid). Incumbent firms' responses to change are often rigid and tedious which victimizes them when new technologies disrupt their industries (Bradley & O'Toole, 2016). By the end of this year, 20 % of today's market leaders will have lost their leading position to the 21st century corporations due their leading edge of working with new technologies (Nordström, 2015). Not even in a dominant market position, adapting and transforming to the digital age is inevitable (Hendersen, 2016). Doz and Kosonen (2010) argue that it is especially important for companies that have had success for a long period of time to transform their way of doing things and adapt their business model to the competitive situation. Otherwise, there is a possible risk of failing (Doz & Kosonen, 2010). The way of working that used to be right does not necessarily have to be right today. (ibid) Firms must innovate continuously and embrace new digital technology in order to stay competitive (Baller et al., 2016). In a study made by Massachusetts University of Technology together with Capgemini Consulting indicates that 81% of the respondents have seen a substantial impact in both performance and competitive advantage, mainly, due to digital transformation has been recognized (Fitzgerald et al., 2013).

Embracing digital technology should involve transforming every part of a company from marketing channels to a company's value proposition of what kind of products and services to be offered (Hendersen, 2016). A transformation involves investing in technology, R&D and human capital, all at once (Hendersen, 2016). There has been a shift from transforming how we do technology to transforming the way we do business and altering the entire business model (King, 2013). As Amit and Zott (2012) argue, a new innovative business model does not only allow improvements in revenue, costs and risks, it can also create new opportunities on existing markets as well as new markets.

## 1.2 Problem formulation

Compressed air is used both in industry and in the homes of private consumers because of the wide range of applications (Air Compressor Guide, 2016a). Compressed air is often taken for granted, both in industry and in our everyday life and few reflect on where the air is derived from (Air Compressor Guide, 2016). As for the private consumers, compressors are found in hair dryers, cars, radios and loudspeakers (Egy, 2016). In the industry, compressed air is used for instance as an energy carrier where only 7,5% of the energy can be used for the intended purpose (Air Compressor Guide, 2016b). Furthermore, 75% of the cost of owning a compressor is related to energy consumption (Nanda, 2017). Beyond the use as an energy carrier, compressors are also used in power tools and cylinders for cooling, cleaning and transportation of material among others (BIAB tryckluft, 2011).

In many industries, digitization has become a natural strategic move, as when digital platforms began to replace paper magazines (World Economic Forum, 2016). In other industries, as for manufacturing companies, the digital transformation is less obvious (Westerman et al. 2014). Atlas Copco Compressor Technique, hereafter referred to as ACCT, is one out of four business areas within Atlas Copco Group. ACCT has come to realize that the digital transformation has already hit the compressor industry and that the only way of surviving the change is to conform. Studies show that the majority of the actors within the compressor industry are highly aware of the fact that digital technology can be very beneficial for their companies, both in terms of products and services in order to enhance the company's performance (Schulte, 2016). The question many companies are asking themselves, including ACCT, is what they should do and how to do it? A study made by Deloitte (2015) shows that companies in many industries have difficulties with prioritizing digital initiatives and know where to begin. The focal company's problem lies in the lack of knowledge and ACCT does not know how to respond to this prevailing rapid change.

ACCT has experienced a rapid digitization of their high-end customers. Their production facilities are becoming more digitally adapted and ACCT knows that if they, as the supplier of compressed air, are not able to offer what the customer is demanding, someone else on the market will. ACCT is unsure how their value proposition will be affected by digitalization and how digital technology can affect their business model and their way of working. Research shows that a business model needs to be changed overtime to create sustainable value in the company (Achtenhagen et al., 2013). This is often forgotten, especially by companies that have been successful for a long time, like ACCT. Such companies tend to forget the importance of adapting to market demand and competitive situation (Achtenhagen et al., 2013).

In the case of ACCT, the problem can be seen as twofold. Today, they compete with innovative and technically superior products and services. Nevertheless, actors are starting to catch up using digital technology. ACCT does not know how to respond to this rapid digital change and they are unaware of how the digital change will affect their business model and their way of working. So in order to maintain its position and competitiveness, ACCT must adapt to the new and forthcoming conditions to avoid being ousted by new entrants or substitutes.

## 1.3 Purpose

The purpose of this thesis is to analyze how Atlas Copco Compressor Technique can innovate its business model in order to increase efficiency and profitability, given digitalization.

In fulfilling the purpose, the main intention of this thesis is to provide recommendations on business model content that will create added value for the customer and increase the competitiveness of Atlas Copco's business unit Compressor Technique in Sweden within the coming five years. In doing so, the following questions will be asked:

- How could the Swedish air-compressor industry be affected by digitalization within the next five years?
- What opportunities and threats will digitalization imply for Atlas Copco Compressor Technique in terms of products, processes and people?
- How should Atlas Copco Compressor Technique develop their business model within five years by employing digitalization in order to expand their business through new revenue streams?

## 1.4 Scope and delimitations

The thesis only focus on ACCT's offer and the scope of the thesis is to study the Swedish market of compressor technology. All empirical data is gathered from actors that operates on the Swedish market and all conclusions are based on this data. Thereby, the study is only applicable for the Swedish market. While offices in other countries can be compared to the Swedish, it is important to be aware of the fact that there are differences in terms of culture and regulations. Due to the fact that the study only apply for one case, the generalizability for other companies is rather low.

The process of business model innovation consists of many phases. This research is limited to the early phase of business model innovation which means that the latter phases such as change management and implementation methods will not be subjected in detail.

The interviews were conducted with only large successful customers on their respective markets to get a representative picture of the surrounding environment of ACCT. This selection is not assumed to affect the outcome due to the fact that the majority of the external actors that influences ACCT are precisely large successful companies. The study only concerned the relationship between ACCT and their customers. Relationships in the previous steps of supply chain was not studied.

## 1.5 Disposition of thesis

*Chapter 2* presents a description of industrial digitalization, related concepts and technologies and its business implications. This section provides the basic knowledge needed for further understanding of the thesis.

*Chapter 3* presents the theoretical models that will be used in the analysis. The chapter presents the concept of a business model, the Business Model Canvas and the theory of diffusion of innovation followed by a more specific description of digital adoption.

*Chapter 4* presents the chosen methodology of the study that touch upon the design, the chosen method and the process of the study. This chapter also addresses the validity, the generalizability and reliability of the study.

*Chapter 5* presents the results given from the performed interviews. This chapter is divided into two sections, one that consists of the interviews performed at the focal company and one part that presents the result of the externally performed studies with customer and competitors to the focal company.

*Chapter 6* presents the analytical section where the theoretical frameworks are applied to the empirical results combined with facts from the digitization review. In addition, change proposals are presented and discussed.

*Chapter 7* presents the conclusion of the thesis where the purpose of the thesis is answered and further discussed.

*Chapter 8* presents a general discussion of future recommendations to the focal company.

## 2. Industrial digitalization

*This section provides an overview of industrial digitalization and the aspects of the subject that was touched upon during this thesis. The section presents the concept of Industrie 4.0, internet of things and simulation to shed light on the meaning of these concepts. In addition, the environmental perspective on industrial digitalization will be discussed. Digital transformation is touched upon in a broad sense before the section is finalized with a presentation of three companies that have adapted successfully to digital technology.*

### 2.1 Industrie 4.0

German industrial companies have been seen as industrial leaders for decades (Kautzsch, 2016). Today, they are also in the forefront of digitalizing the manufacturing industry (ibid). The German government presented their industrial development strategy 2011 called Industrie 4.0, a name that refers to the fourth industrial revolution (Germany Trade & Invest, 2017). The purpose of Industrie 4.0 is to make Germany a leading market for advanced manufacturing by adapting the industrial sector to the new global trends of connectivity and digitalization (Germany Trade & Invest, 2017). The German chancellor Angela Merkel stresses the need for the European Union to develop at a higher pace in order to maintain competitiveness against growing economies in Asia and USA (Bundesregierung, 2015). Industrie 4.0 is said to include the following: internet of things, big data analysis, cyber-physical systems (enabled by sensors etc.) and finally, an infrastructure for digital communication (Carreiro, 2015). Fettke et al. (2014) also add a few concepts not directly related to production but still associated with Industrie 4.0: personalized distribution and procurement, systems for personalized product and service development and corporate social responsibility. The new generation of manufacturing which Industrie 4.0 has resulted in will increase efficiency in every process, from R&D and product planning to supply chain management and pricing (ibid). Kautzsch (2016) means that German manufacturing companies are currently rewriting the rules by using big data to forecast demand, using various analytic tools to analyze supplier information, customer behavior and competitor information and developing the use of 3D printing to improve maintenance and equipment performance of the factories.

Marr (2016) wrote an article in Forbes magazine regarding Industrie 4.0, saying that a firm needs four components in order to call itself a Industrie 4.0 system. These components are *interoperability, information transparency, technical assistance and decentralized decision making*.

- *Interoperability*: Communication between people, machines and apparatus.
- *Information transparency*: A digital copy of the real system is created to process all information.
- *Technical assistance*: The ability for the technical parts of the system to support people in both decision making and when performing physical operations.
- *Decentralized decision making*: Needed to support the other three components and is originated in organizational culture.

According to Baur and Wee (2015), Industrie 4.0 has been made possible because of four so called disruptions: the rapid increase in data volume due to higher computational power (the development of communication and networks are also included in this category), business

intelligence and analytics, new forms of human machine interactions and the increased ability to transfer digital information to the physical world.

The drivers for Industrie 4.0 are market forces both in the form of application pull and technology push forces (Fettke et al., 2014). Firms must find their unique way of competing for the customers in a rapidly changing technological environment (ibid). Fettke et al. (2014) especially highlights five market pull and three technology push trends that fuels the need for firms to adapt to Industrie 4.0:

#### Market pull

- *Decreased time to market*: The speed that new products and technologies are introduced on the market are increasing continuously, rendering old technology obsolete.
- *Batch size one*: The demand for personalized offerings increase and firms thus need to produce smaller and personalized batches.
- *Flexibility*: Flexibility in both product development and production is needed to continuously deliver unique and new innovative products for each customer.
- *Decentralization*: Is needed to be able to make decisions rapidly in order to maintain flexibility and speed. Fettke et al. (2014) recommends flat organizations.
- *Resource efficiency*: Because of the anticipated rise in raw material prices and increased focus on sustainability, resource efficiency is needed to cut costs of producing products and for goodwill purposes.

#### Technology push

- *Mechanization and automation*: To support physical labour and increase efficiency in production.
- *Digitalization and networking*: To support control and analysis of the production.
- *Miniaturization*: Refers to computer hardware needed to store and process information. New improved technology has enabled storage of large amount of data at minimal physical space.

Baur and Wee (2015) mean that firms adapting to Industrie 4.0 should consider three actions starting with gathering data. Value will be created when the gathered data is used in a proper way, which has proven to be a common challenge for adapters (Bar-Joseph, 2013). To guide firms in allocating resources to a suitable development program for Industrie 4.0, Baur and Wee (2015) have developed a “digital compass”. The “digital compass” shows what value is related to Industrie 4.0 levers, see table 2.1.

<i>Value drivers</i>	<i>Industry 4.0 levers</i>
Asset utilization	<ul style="list-style-type: none"> <li>• Routing flexibility</li> <li>• Machine flexibility</li> <li>• Remote monitoring and control</li> <li>• Predictive maintenance</li> <li>• Augmented reality for MRO</li> </ul>
Labor	<ul style="list-style-type: none"> <li>• Human-robot collaboration</li> <li>• Remote monitoring and control</li> <li>• Digital performance management</li> <li>• Automation of knowledge work</li> </ul>
Inventories	<ul style="list-style-type: none"> <li>• In situation 3D printing</li> <li>• Real time supply chain optimization</li> <li>• Batch size</li> </ul>
Quality	<ul style="list-style-type: none"> <li>• Statistical process control</li> <li>• Advanced process control</li> <li>• Digital quality management</li> </ul>
Supply/Demand	<ul style="list-style-type: none"> <li>• Data-driven demand prediction</li> <li>• Data-driven design to value</li> </ul>
Time to market	<ul style="list-style-type: none"> <li>• Customer co creation/open innovation</li> <li>• Concurrent engineering</li> <li>• Rapid experimentation and simulation</li> </ul>
Service/Aftersales	<ul style="list-style-type: none"> <li>• Predictive maintenance</li> <li>• Remote maintenance</li> <li>• Virtually guided self service</li> </ul>
Resources/process	<ul style="list-style-type: none"> <li>• Smart energy consumption</li> <li>• Intelligent lots</li> <li>• Real time yield optimization</li> </ul>

*Table 2.1. Industry 4.0 levers (Baur & Wee, 2015)*

The second action according to Baur and Wee (2015) relates Industrie 4.0 to the long term strategy in order to capture the full potential of the transformation. Industrie 4.0 unlocks possibilities for new business models, which has to be noted by manufacturers in order to understand their competitive environment (Baur & Wee, 2015). Baur and Wee (2015) list the following examples:

- *Platforms*: Since customers require increasingly customized products, manufacturers need to gain a profound understanding of the overall customer need in order to offer customers complete solutions instead of only a product (Geissbauer et al., 2015). In order to gain such information manufacturers must “own” the relation with the end customer, who pulls the demand, according to Geissbauer et al. (2015). The platforms link all actors in the value chain to the customer, providing all actors with that “ownership” (ibid). Geissbauer et al. (2015) also state that first movers gain a

competitive advantage by establishing such platforms, especially if the platform enables them to gain a closer end customer relation.

- *Pay by use*: Enables manufacturers to lower the barriers for new customers by relieving the customers from investments in equipment and total ownership of products (Tukker, 2004). Since the customer demand is automatically monitored a close relation between customer and supplier is implied, enabling the supplier to create customized offers to customers (ibid). Manufacturing firms provide services and products combined in order to create multiple revenue streams and increase profit, since offering products alone is a case of diminishing returns (Bates et al., 2003). Services can also be a mean of differentiation towards competitors and thus avoid price competition (ibid).
- *Licensing intellectual property*: In cases where there is a prevailing knowledge asymmetry between the customer and manufacturer regarding the product, consultancy services can be offered (Baur & Wee, 2015). Consultancy services implies that the supplier provides the customer with guidance of how to use the product efficiently in a broad sense (Tukker, 2004). Like pay by use offers licensing intellectual property is a way for manufacturers to create additional revenue streams, but by creating value utilizing in house knowledge (Bates et al., 2003; Tukker, 2004).
- *Monetizing data*: There are three ways of monetizing data according to Ross and Wixom (2017) which are improving internal processes, adding information to products and selling data. Using data to facilitate rational decision making and improving processes has proven to be an efficient way of increasing profitability (Ross & Wixom, 2017). By using data and analytics tools manufacturers can provide customers with additional information to the product which implies an additional revenue stream, but such offerings also implies risks (ibid). If the data is not managed and controlled properly, quality deficiencies may be detected by customers and the manufacturer may lose its credibility as supplier (ibid). Selling data is considered by Ross and Wixom (2017) to be the most difficult way of monetizing data, mainly because it requires firms to adopt completely new business models.

The third action to be considered when adapting to Industrie 4.0 described by Baur and Wee (2015) is preparation. Manufacturers must prepare in order to facilitate good conditions for the changes, implied by the transformation, and these preparations mainly includes recruiting “digital talents” and planning for restructuring the organization (Baur & Wee, 2015). The most critical obstacles that firms encounter is how to manage the data and cyber security according to Baur and Wee (2015).

## **2.2 Internet of things (IoT)**

*The concept internet of things (here by referred to as IoT) refers to the connectivity of manufacturing equipment and products among others and is enabled by systems of systems, wireless communication and big data analysis which will be further explained separately below (Bossen & Ingemansson, 2016). The IoT systems enable equipment to interpret and communicate digitally with its surroundings (Internet of things Sverige, 2017). Notable for such systems is that they should be implemented with care to ensure integrity and safety (Bossen & Ingemansson, 2016).*

### **2.2.1 Systems of systems**

The concept systems of systems is many independent smaller systems that are interconnected in a larger, holistic system which enables interoperability and thus a more efficient use of all systems and a more flexible system as a whole (Bossen & Ingemansson, 2016). The systems together perform complex tasks by communicating with each other (Rouse, 2012). The communication is enabled by suitable interfaces between the smaller subsystems (ibid). By the use of a system controller, sub optimization of the systems are avoided (ibid). In order to create a proper system controller, knowledge of how each subsystem works, how they interoperate over time and how the larger entity works and evolves has to be gained (ibid). The subsystems are often characterized by different fabricate, different lifecycles and different owners (Bossen & Ingemansson, 2016).

Systems of systems is a prerequisite for initiatives such as Industrie 4.0 and IoT (Bossen & Ingemansson, 2016). Wee et al. (2015) state in their report that in order to create a robust flow of information, common standards is the key to handle data from various sources. To ensure flexibility Wee et al. (2015) stress the need for transparency and sharing information throughout the whole value chain, both within the firm and outside with suppliers and customers.

### **2.2.2 Wireless communication**

Wireless connection has enabled new innovative business models for firms, providing streaming and navigation services, social media, taxi services etc. (Bossen & Ingemansson, 2016). In the movement towards Internet of things, wireless communication must provide units with low energy consumption, low unit prices and long battery time and at the same time support the increased amount of data (ibid). In industry, wireless communication is used for connecting sensors added to manufacturing equipment and for security reasons (Shen, Wang & Zhan, 2013). One reason for using wireless sensors in production is the need for reduced amount of cables on moving equipment, so that the equipment can move with higher degrees of freedom (Bossen & Ingemansson, 2016). Wireless communication may also impact overall energy savings by providing synchronized production in central plants and smaller production facilities in the periphery, to optimize production and distribution (ibid).

### **2.2.3 Big data analysis**

Big data analysis refers to the ability to handle extremely large amounts of data of various quality (Bossen & Ingemansson, 2016). By developing advanced algorithms, patterns, correlations, trends and other kinds of useful information can be extracted from the ledge flow of information in order to support decision making (Rouse, 2017). Big data analysis is made possible by the combined use of certain technological tools which are described in table 2.2.

Data Management	A repeatable process to make data readable by maintaining a quality standard in the data
Data mining	Finds patterns in the incoming data
Hadoop	Stores large amounts of data on commodity hardware
In memory analytics	Enables immediate analysis and thus insight from the data by analyzing stored data from the system's memory
Predictive analytics	Uses statistical analysis to determine the likelihood of different outcomes by analyzing historical data
Text mining	Uses machine learning and language processing technologies to analyze written texts

Table 2.2. Big data analysis tools (Davenport & Dyché, 2013).

Big data analysis is not only used for fast and rational decision making, big data analysis has proven to reduce costs because of the cost advantages provided by the new storage abilities due to Hadoop and cloud-based analytics (Davenport & Dyché, 2013). Increased value for customers can also be created by using big data analysis in order to better process customer information and thus generate a deeper understanding for the customer needs (Davenport & Dyché, 2013). Big data analysis in manufacturing has proven to raise productivity when used to analyze and improve supply chains according to Gaitho (2015). Companies like SKF and Sandvik have adopted big data analysis in order to gather information of their products after they have been sold in order to for example predict damage due to wear and help their customers use their products more effectively (Bossen & Ingemansson, 2016). Volvo Cars is another manufacturer embracing big data analysis techniques, developing technologies to predict the probability of engine failure (Bossen & Ingemansson, 2016).

There are many areas of application for big data analysis and the most influential ones are according to LaRiviere et. al (2016) predicted demands, predictive maintenance, improving pricing and for developing radically new applications. The information below is derived from LaRiviere et al. (2016) reasoning.

- *Predicted demand*: By using all the above mentioned digital technologies, especially text mining (see table 2.2), web search data can be analyzed to detect customer demands and needs. Such information can also be found by studying which customer segment are visiting certain websites, for example based on location.
- *Predictive maintenance*: The IoT can provide a large stream of real time data which can be analyzed and interpreted in order to in advance predict machine failure. By using data mining and predictive analytics, predictions of the life of the machine and its components can be made. The advantage of making such predictions is that the dependability of the machine increases, since failure can be prevented in advance based on the actual condition of the equipment.
- *Improving pricing*: The use of data mining, in combination with the other technologies mentioned in table 2.2 enables firms to relate price responsiveness and preferences to algorithmically generated customer segments. Such application of big data analysis

may also be used to match advertisers to customers, which has proven to increase revenue on online advertising.

*Radically new applications:* Big data analysis may not only be used to improve existing processes, it can also disrupt them. By finding patterns in large amounts of data that have not been accessible before, new conclusions can be made which unlocks new opportunities. For example, ways of curing diseases and ensure local electricity distribution on demand.

## **2.3 Simulation**

Simulation refers to the ability to create a virtual copy of the real world in order to simulate different scenarios during for example product development and production planning (Lindström, 2016). Simulation, or virtual reality (VR) as it is also referred as, is defined by Onyesolu and Felista (2009) as “A highly interactive, computer-based multimedia environment in which the user becomes the participant in a computer-generated world”. VR simulation is a way of using and interact with complex and large amounts of data and is made possible with today's computing and digital technology (Onyesolu & Felista, 2009).

Using simulation during the product development phase decreases the time to market and development costs because of the reduced amount of labor and reduced need for physical testing (Pease & Zistl, 2014; Bossen & Ingemansson, 2016). The earlier in the product development stage mistakes are made, the less costly they are (Nigel & Slack, 2015) and according to Reality technologies (2016), the company Gabler has increased their profits by 15% since the introduction of the system. Gabler's virtual manufacturing factory also allows for virtual inspection of the equipment sold by experts, something that in real life is difficult because of the logistics of physically moving people but can be done more easily and frequently due to the VR technology (Reality technologies, 2016). The purpose of such activities is to ensure a steady and reliable production for the client, by monitoring and inspection of the product and its performance (Reality technologies, 2016). VR simulation can also preferably be used to simulate manufacturing of a product in order to develop an effective and reliable manufacturing process (Andersson, 2015).

## **2.4 Technology and environment**

The way humanity consumes our planet's resources is not sustainable and the consequences are severe (Globalportalen, 2017). The greenhouse gas emissions due to the combustion of fossil fuels are among the largest causes for the climate changes, causing the global middle temperature to rise and thus affects all living beings on our planet (WWF, 2017). In order to slow the negative spiral of climate change down, measures have to be taken on a global level and industry has a key role in the process (Globalportalen, 2017). The industry is responsible for one third of the emissions due to energy consuming production and transportation (ibid). Production must become more energy efficient and the use of renewable sources must increase (WWF, 2017). In September 2015 Agenda 2030 was created at the UN summit in New York, containing 17 goals for sustainable development (FN, 2017). The meaning with Agenda 2030 is that environment will no longer be considered separate from development (FN, 2017). Agenda 2030 constitutes of the global sustainability and environment goals which applie (FN, 2017). Diplomacy Edu (2017) states that standards are the key to reach the 17 sustainable development goals. For example the ISO 50000 series touch upon energy efficiency aspects (related to goal 9 regarding industry sustainability, innovation and

infrastructure), but also international standards for trade (goal 17) may contribute to a streamlined international trading system (Diplomacy Edu, 2017).

The Swedish government aims to become world leading in sustainable development and has taken measures to alter the society into being modern and ecofriendly (Equalclimate, 2017). Decreased emissions does not necessarily exclude growth and economic gains according to Porter and van der Linde (1995). By investing in new technology and energy saving initiatives, companies can increase profit by increasing efficiency (Porter & van der Linde, 1995). Also, since Sweden is moving towards a fossil fuel free and more energy efficient society, profitability may even decline if not investing in the previously mentioned changes (Equalclimate, 2017).

## **2.5 Digital transformation**

*In order to become a digitalized actor within the manufacturing industry, the process of transforming needs to be considered. In the section below the concept digital maturity will be explained followed by a motivation of why firms should engage in the transformation. In addition, characteristics of successful digitalized industries will also be presented.*

### **2.5.1 Digital maturity**

Digital maturity, or “Digirati” denotes both digital innovative products and the force of driving transformation and movement forward (Westerman et al., 2012). Recent studies show that digitally mature companies have higher revenue, profitability and shareholder value than less-digital companies (Heaslip, 2015). In a study made by Massachusetts Institute of Technology (MIT) together with Deloitte Consulting, strategy was identified as the key driver of becoming a digitally mature company (Kane et al., 2015). The study also shows that less digital companies often focus on individual technologies, instead of focusing of the overall strategy with its scope and objectives. There are two kinds of dimensions of digital maturity; digital intensity and transformation management intensity (ibid). Digital intensity dimension contains the company’s technological operations in terms of customer engagement, internal processes and business models. Transformation management intensity denote the creation of the necessary capabilities a leader should have to be able to drive digital transformation (ibid). For both dimensions, digital innovation and digital culture are equally important when transforming a company to a digital business (Heaslip, 2015). Heaslip (2015) believes that any company, startup or large traditional company, can transform.

### **2.5.2 Digital industries**

The degree of digitalization does vary between industries (Gandhi et al., 2016). Studies show that the leading companies are 13 times more digital than average companies in less digitalized industries (ibid). Gandhi et al. (2016) underline the digital difference in the economy by writing that “some parts are playing in an entirely different league”. Over the past 15 years, company's digital assets have been doubled, not only in terms of pure IT but also within the physical assets of the company (ibid). There has been an increased usage of different forms of transactions, customer and supplier interactions and the internal processes of a business such as activities at back office has become more digitalized (ibid). Gandhi et al. (2016) distinguish between sectors and their potential for digitalizing their processes, see table 2.3.

SECTOR	KNOWLEDGE INTENSIVE	CAPITAL INTENSIVE	SERVICE	B2B SECTOR	LABOR INTENSIVE	QUASI-PUBLIC
INFORMATION & COMMUNICATION MEDIA	X					
PROFESSIONAL SERVICES	X					
FINANCE & INSURANCE	X					
WHOLESALE TRADE				X		
ADVANCED MANUFACTURING				X		
OIL & GAS		X		X		
UTILITIES		X		X		
CHEMICALS & PHARMACEUTICALS		X		X		
BASIC GOODS MANUFACTURING		X		X	X	
MINING		X		X	X	
REAL ESTATE		X		X	X	
TRANSPORTATION & WAREHOUSING		X	X		X	
EDUCATION			X		X	
ENTERTAINMENT & RECREATION			X		X	
PERSONAL & LOCAL SERVICES			X		X	
GOVERNMENT			X		X	X
HEALTH CARE			X		X	X
HOSPITALITY			X		X	X
CONSTRUCTION			X		X	X
AGRICULTURE & HUNTING			X		X	X

Table 2.3. Presentation of different sectors digital potential.

Gandhi et al. (2016) mean that companies can increase their digital ability in many ways, for example in how they integrate digital tools in their everyday activities but also in the way of working with customers and suppliers. The research performed by Gandhi et al. (2016) have identified key attributes of digital leaders that can be used as a framework for other companies. These attributes have been divided into three categories; digital assets, digital usage and digital workers (Gandhi et al., 2016).

- *Digital assets* is a measure of how much a company invests in digitizing their assets, such as hardware, software, data and IT services (Gandhi et al., 2016). It can be smart buildings, smart vehicles, big data or IOT systems to increase the performance of equipment and supply chains (ibid)
- *Digital usage* means which extent a company involve their customers digitally (Gandhi et al., 2016). It may concern digital payments, digital marketing or usage of e-commerce platforms (ibid). Companies with a high digital usage often manage back office with different software applications (ibid).
- *Digital workers* involves the extent of which employers use digital tools in their daily work to increase productivity (Gandhi et al., 2016). Within this category, there is a

huge gap between the best and the inferior in the economy (ibid). The study also shows that companies priorities digitizing different processes, for instance health care organizations possess high technological tools while their payment process are very manual, less than 20 % of the payments are done digitally (ibid).

## **2.6 Digital technology adopters**

*In this section, three firms adopting digital technology are reviewed as illustrations of how firms may use digital technology in a successful way. Siemens is considered to be a conservative, product based firm that due to a pro-innovation culture are successful in adopting new technology (Littlefield, 2015). As an illustration of firms using digital technology to increase efficiency, SAPs application for supporting service technicians is presented (Oswald & Schreckling, 2015). Finally, a description of how Volvo Cars is using digital technology to change the performance of their cars is presented.*

### **2.6.1 Siemens – Combining high tech products with services**

Siemens has recognized the need for proactive maintenance on industrial products, since their customers' production plants are developing into being more complex and refined (Ratkovic, 2013). The firm is incorporating sensor technology and intelligent information processing technology into their technically advanced products to enable individually tailored service contracts offers (ibid).

The sensors and digital technology enables Siemens to wirelessly connect to the machines to gather and process the continuous flow of real time data (Ratkovic, 2013). By harvesting information from all connected machines worldwide, Siemens create a bank of information from which the value for the customer is extracted (ibid). In utilizing big data analysis to process information from all active units, Siemens can predict the life of single parts and thus offer predictive maintenance services (ibid).

In addition to predictive maintenance services, Siemens is developing an online platform for spare parts (Ratkovic, 2013). The vision is that by 2025, an application would be developed that recognizes components material numbers from pictures (ibid). When a predictive maintenance system discovers that a component is about to break a service technician gets noticed (ibid). The service technician would then photograph the component and use the visual recognition application to send the information to the service center who organizes delivery of the right parts at the right time (ibid).

If a spare part is not available Siemens are hoping to, by using additive manufacturing technology, decrease lead times on components and thus ensure just in time delivery (Ratkovic, 2013). Ratkovic's vision is to install replacing components within 24h after the customer has recognized a defect (ibid).

To inspect a problem, a service technician would use a device such as glasses or template to study a machine virtually (Ratkovic, 2013). Augmented reality will in the future enable Siemens technicians to easily inspect the highlighted problem by having the ability to see through the machine (ibid). Such systems would also hold information regarding service history and notes from other technicians who have previously examined the product (ibid).

### **2.6.2 SAP – Augmented reality apps and wearable technologies**

Customers are using smart gadgets daily but not in workplaces (Powell, 2016). Smart Gadgets are described by Powell (2016) as smartphones, smart glasses, smart watches and even smart t-shirts. SAP is developing ways for enterprises to incorporate smart technology and augmented reality to enhance business performance (ibid). SAP has recognized an increased demand for not only the use of smartphones but also for other smart gadgets such as glasses, clocks and even t-shirts (ibid). When developing augmented reality applications SAP has chosen to focus on smart glasses and mainly the Vuzix M100 glasses that are considered to be the most rigid ones on the market (ibid).

SAP has developed and announced the release of two augmented reality apps, the “SAP AR warehouse picker” and the “SAP AR Service technician” (Powell, 2016). In developing successful augmented reality applications, SAP has recognized that only relevant information at the time should be displayed in front of the user's actual reality (ibid). The user interaction is minimal and data is gathered from many different kinds of wirelessly connected sensors (ibid).

#### **Service technician scenario**

A common problem for service technicians recognized by SAP is the lack of information when arriving to a site (Powell, 2016). It is common that technicians is not able to perform the job when arriving to a site and thus has to return to the service station before returning with more information (ibid). Such activities are expensive and if avoided, costs can be cut and the technician would become more efficient (ibid).

The SAP application would provide the technician with hands free access to instructions and models of the equipment (Fargel, 2014). Complete with a recording device and voice recognition for interaction, the technician could record notes to create a digital knowledge base (ibid). In the case of a technician needing further guidance or support, SAP is introducing “expert calling” (ibid). The concept implies that support can be brought directly to the site by calling an expert who can see the situation through a live stream (ibid). The livestream would be provided by the camera incorporated in the smart glasses (ibid).

### **2.6.3 Volvo Cars – Polestar optimization and drive modes**

Volvo Cars is using digital technology in their products, enabling the company to offer a service called polestar which is a service for increased performance (Volvo cars, 2014). The service entails changes in the software that controls the operations without affecting the hardware (ibid). This creates value for the service customer at minimal effort (ibid). In addition Volvo Cars is offering cars with various drive modes, enabling the customer to choose the characteristics of the car's control system depending on situation (Volvo cars, 2015). The drive modes is standardized packages of software (modules), all ensuring a pleasant driving experience for the customer (ibid). Modular products refers to a product which is constituted of a number of standardized building blocks (Golfman & Lammers, 2015). The individuality of each product lies in the combination of these standardized building blocks, which may also be referred to as modules (ibid). Another advantageous feature of modular products is the ability to rearrange the modules meaning that the character of the product may be changed over time (ibid). Modular programing can be used in order to create modularized products (Technopedia, 2017). The modular program has an executable setup, consisting of one main module upon which auxiliary modules (executable files) are added which creates value for the customer digitally (ibid).

### 3. Frame of reference

*This section will present the methods that will be used to interpret the empirical results in section 5. Initially, the concept 'business model' will be presented and thereafter the Business Model Canvas, theory of diffusion of innovation and digital adoption theories will be explained.*

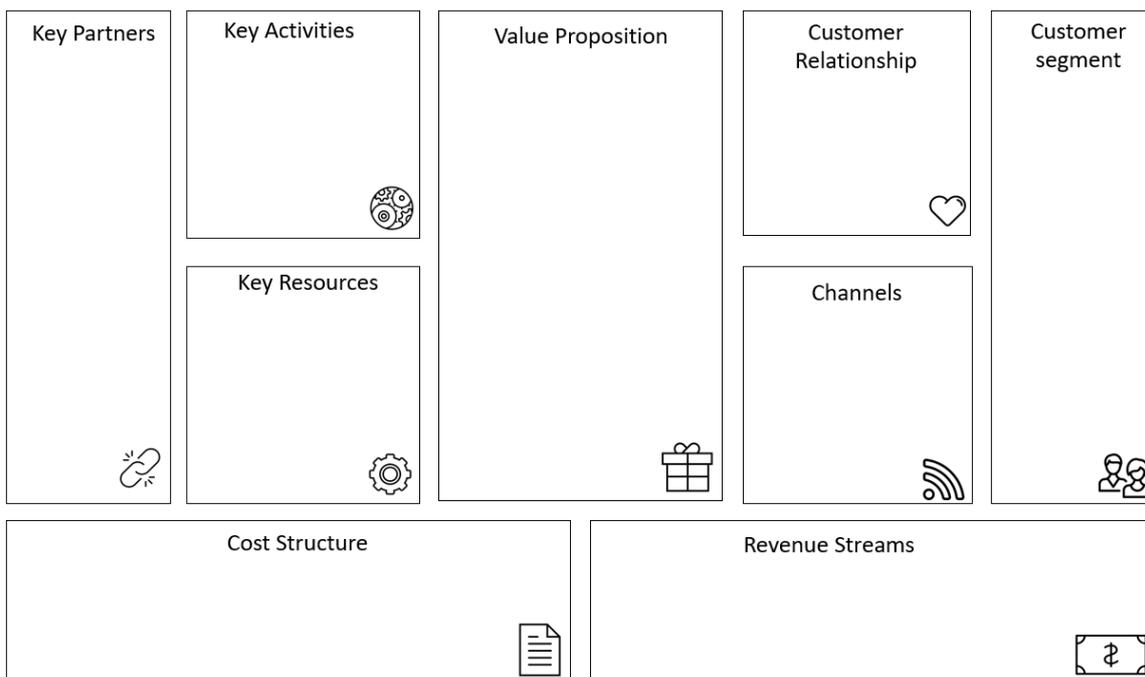
#### 3.1 Business models

A business model is a method that describes a company's way of intercept value into the business (Financial times lexicon, 2017). A business model includes many different aspects such as advertisement, prices, sources of revenue and product description (ibid). The model provides a link between internal and external sources and activities which are essential to a company's strategy (ibid).

Research has shown that a business model needs to be changed overtime to create sustainable value in the company (Achtenhagen et al., 2013). This is often forgotten, especially by companies that have been successful for a long time (ibid). They tend to forget the importance of adapting to market demand and competitive situation (ibid). A business model is a framework for making money, something companies need to be reminded of, argue Achtenhagen et al. (2013).

##### 3.1.1 Business Model Canvas

A Business Model Canvas visualize a company's way of creating, deliver and capture value (Osterwalder & Pigneur 2010). The model consists of nine building blocks, see figure 3.1, which can be further divided into four main areas; customers, offers, infrastructures and the finances. The information presented below are derived from Osterwalder and Pigneur (2010) if nothing else is mentioned.



*Figure 3.1. The Business Model Canvas by Osterwalder and Pigneur (2010).*

### **Customer segments**

The first building block involves the groups of people the business is aiming for. Different groups of people can create different customer segments, either if they have different need and requirements or if they ask for different relationships or distribution channels.

### **Value propositions**

The proposed value is the products or services that are requested by the customers. The products and services that create value for the customer. It can either be a offer that is similar to the existing offer but with more value added or it could be a offer that can disrupt the industry. Each customer segment has a corresponding value proposition.

### **Channels**

This building block forms a bridge between customer segments and value propositions and describes the communication and how the customers want to be reached. The chosen channels are of importance as it is one of two touch points between the company and its customers.

### **Customer relationships**

This building block describes the relationships that a company would like to establish with the customers. The customer relationships can either be personal or automated. The form of relationship can depend on the following; customer acquisition and retention or/and in the order to increase sales.

### **Revenue streams**

The revenue building block consists of the different streams of cash generated within the company. Each customer segment has a corresponding stream of revenue. Revenue streams comes in two forms, either from one-time customers or from continuous payments by a specific customer segment.

### **Key resources**

This building block describes the assets that are of importance for the company to work. The key resources are the resources required to be able to create a value proposition to the chosen customer segments. These resources can either be of physical or intellectual character or be financial or human factors. The employers of a business are said to be among the most important resources while they are at the same time also perceived as the most disregarded resource (Cleverism, 2015).

### **Key Activities**

The key activities denote the activities that are essential for a business model. In line with above reasoning of key resources, the key activities are required to create a value proposition. Key activities can either be software development for a software company or supply chain management for a manufacturing company.

### **Key Partnerships**

The Key partnership building block constitute the network of partners and suppliers that are required to deliver the value proposed. Osterwalder and Pigneur (2010) distinguishes between the following four partnerships:

- Strategic alliances: cooperation between actors that are not competitors
- Cooperation: cooperation between competitors
- Joint ventures: actors that creates new businesses

- Buyer-supplier: relationship between buyer and supplier ensure delivery

### Cost structure

This building block describes the costs a company incur. Every activity that the business model performs, every partnership it creates, costs occurs. The importance of cost structure vary among companies. Some companies are more cost driven while others choose a more value driven cost structure.

## 3.2 Digital adoption

*In this section the theory of diffusion of innovation and theories of how digital technologies are adopted are presented. In order to adopt digital technologies, it is important to understand how companies' are affected by new technologies. It is also important to understand the difficulties with adopting new technologies and how a company can overcome these difficulties in order to become a digital master.*

### 3.2.1 Diffusion of innovation

The diffusion of innovation theory describes the social process of the distribution of an innovation. The most frequently used theory describes the way an innovation is communicated by individuals which are members of a social system over time (Sahin, 2006). The spread of an innovation is epidemic and follows a so called s-curve. Illustrated in figure 3.2, the distribution of the innovation in the early stages of its lifecycle are low (Dearing, 2009). The curve also illustrates that the spread increases exponentially until it reaches a certain point where the penetration of the market has reached a maximum (Rafinejad, 2007). To what extent an innovation is distributed and accepted among the members of the system depends on many factors. The spread depends on the uncertainties and obstacles that are connected to the transformation into the new innovation, the availability to the communication channels such as mass media, interpersonal communication, and the composition of the social system (Sahin, 2006).

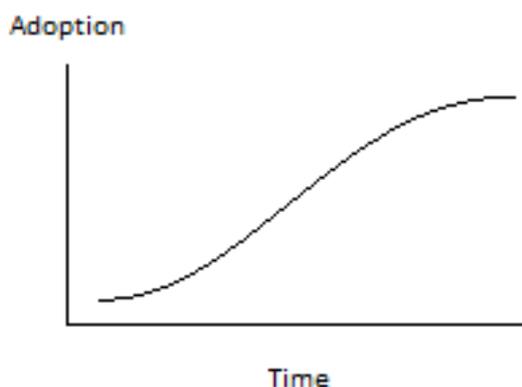


Figure 3.2. The adoption curve freely interpreted from Dearing (2009)

The individuals in the social system can be categorized into five groups, the innovators, the early adopters, the early majority, the late majority and the laggards (see figure 3.3.). The innovators are the ones that bring the innovations into the system from the outside. These individuals are not respected by the rest of the members in the system, which often is due to a common unwillingness to accept changes (Sahin, 2006). The early adopters on the other hand often hold leadership roles which means that other individuals approach to the early adopter to receive information and advice on the innovation. (Light, 1998) The information spread by the early adopters are their subjective evaluation of the innovation and they “put their

personal stamp of approval on a new idea by adopting it” (Rogers, 2003). The difference between the early and the late majority is mainly that the early majority are deliberately adapting to the innovation when the late majority are led to adapt to the new innovation by peer pressure or economic aspects. The category that last adapts to the change are the laggards. The laggards often has a limited interpersonal network which makes them less knowledgeable about the innovation and thus do not adapt until members of the other categories has ensured that the innovation works in a satisfying way. The rate of information about the innovation is an important factor that affect the adaption-time to a new innovation and Rogers describes the innovation-diffusion process as “an uncertainty reduction process”. To decrease uncertainties Rogers proposes five attributes to the innovation, relative advantage, compatibility, complexity and trialability. To which extent the innovation possesses any of these attributes depends on the personal perception of the individual in the network.

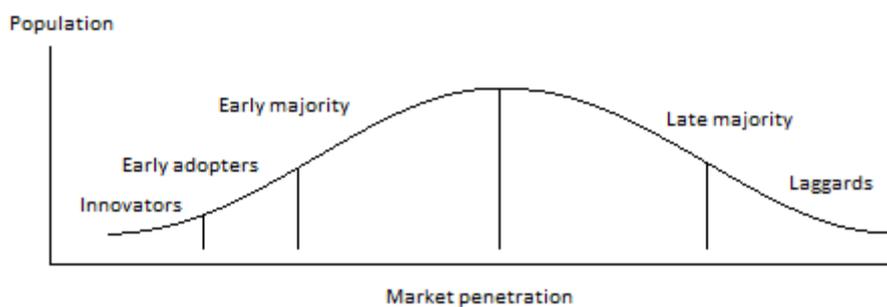


Figure 3.3. The diffusion of innovation curve, freely interpreted from Rafinejad (2007)

### 3.2.2 Barriers for digital transformation

A transformation to digitalization involve challenges and problems (Fitzgerald et al., 2013). There is not one single solution to the problems that arise during a digital transformation, which is why it is important to be aware of the barriers to transform, mean Fitzgerald et al. (2013).

The main barrier that was recognized by Fitzgerald et al. (2013) was leadership. In some cases, a lack of alignment among senior managers can be the cause of the problem (Fitzgerald et al., 2013). In other cases, the alignment between managers is not shared with the rest of the organization which appear to be equally as problematic according to Fitzgerald et al. (2013). The second barrier to transformation is related to the creation of suitable business and financial cases (ibid). Many companies have, according to Fitzgerald et al. (2013), had clear struggles with the return on investment of digitization programs due to uncertainties of where the impact of the transformation is taking place and its quantity (ibid). The third identified barrier is governance (ibid). The study made by Fitzgerald et al. (2013) show that 40 percent of the companies participating in the study had no formal governance model in place to run the transformation properly. It was also revealed that only 26 % percent of the respondents had formal KPIs to measure the progress of the transformation (ibid). Hence, the lack of formal governance models and PKI's constitutes the governance barrier. The last barrier of transformation is culture (ibid). A transformation of this kind entails change in work practices which can cause resistance (ibid). The capability aspect relates to the lack of skills that was experienced by the participants in Fitzgerald et al.'s (2013) study as a major problem in digital transformation (ibid). This study showed that the barriers to transform a company lies in governance, measurement and vision. Fitzgerald et al., (2013) argue for the importance of reviewing the process regularly to understand what prevents the transformation to become successful.

### **3.2.3 Become a digital master**

Companies need to move at the speed of the customers, otherwise someone else will, argues Heaslip (2016). He continues stating that companies often understand why they should move at the speed of the society, the shortcomings, however often lies in knowing what to do and how. In order to become a digital master, Gandhi et al. (2016) stresses the importance of external focus. To be able to increase the external focus, it is important to understand the external surroundings and how it is digitizing as well as understand the changes in customer's expectations (Gandhi et al., 2016). It is also important to understand which companies that will meet these expectations, both from the industry itself but also from other external actors (ibid). Once a company has an external focus, strategies can be designed in order to intensify their use of digital tools (Gandhi et al., 2016). In addition, Bilefield (2016) believes that it is important to transform through the whole organization to make the digital transformation successful.

Westerman et al. (2014) have identified two critical dimensions when transforming digitally; digital capabilities and digital leadership. They aim to answer what companies should do in order to digitally transform and how they should do it. Digital capabilities aims to understand how the company master its technological aspect (Westerman et al., 2014). To become digital mature, a company needs to change the way business are done (ibid). Customer relations can be technological improved as well as internal operations and business models, according to Westerman et al. (2014). A company can increase efficiency at work and get closer to customers using new tools as social medias and analytics (Westerman et al., 2014). Digital leadership is the bridge from technology to the actual transformation (ibid). Research have shown that bottom up leadership have not given any successful transformations (ibid). Clear directions, goals and structure from top management is important to master a transformation (ibid).

In addition to these dimensions, Heaslip (2016) emphasizes the importance of working in small teams. He argues that even if the team in question risks everything, the total risk for the company will be reduced. Small teams can experiment, fail, retest and fail again without disrupting the whole company, says Heaslip (2016).

#### **Libert's steps**

All organizations are different and thereby, there are various ways to transform one. Libert et al. (2016) argue for a five-step process called pivot, a model that they are using when working with clients. The steps below are derived from the framework of Libert et al. (2016).

##### *Step 1 - Pinpoint.*

The first step in a transformation of a company is to clarify the starting point. By identifying today's business model and assets and understand its strengths, weaknesses and long term habits, a starting point can be clarified.

##### *Step 2 - Inventory.*

The second step involves creating a list of the company's assets, both tangible as plants and equipment and intangible as skills and intellectual properties.

### *Step 3- Visualize.*

The third step deals with visualization of what the future will bring for the digitalized network. The aim is to investigate how the network can create value from new investors, competitors and distributors, both in term of own assets and others’.

### *Step 4 - Operate.*

The fourth step involves doing a pilot where small amounts of time, talent and money are spent. This step’s aim is to learn and change fast.

### *Step 5 - Track.*

In the last step, new metrics should be reported such as sales and number of active network partners. Common metrics such as revenue and profitability are also important but is often perceived as difficult to use in the transformational stage since it usually take time for models to create value for organizations.

## **Maxwell’s steps**

In a Harvard Business webinar with Maxwell Wessel (2017), the complexity of a digital transformation was discussed with focus on legacy and the Industrialist Dilemma. During the session, he presented a five step framework of what a company should do to manage the process of change successfully. The summarized steps below are based on Wessel’s (2017) discussion regarding the complexity of digital transformation.

The first step is according to Wessel (2017) also the most important; admit reality. Things that were success factors last century does not necessarily mean that they will make companies great this century (Wessel, 2017). The next step in his process is to recall what you do. Companies often fool themselves to think that customers buy what they sell. Contrariwise, a customer rarely buys what a company sells. Wessel (2017) says that companies often miss the point which is to understand what job a customer want to do. “People do not want to buy a quarter-inch drill. They want a quarter-inch hole!”, quoted by Christensen, Cook and Hall (2006). The third step is called “north star” and means establishing and agree on long term goals for the company. This will decrease the pressure and allow short term failures in larger extent. The fourth step involves decisions regarding further transformation. Wessel (2017) means that it could be very difficult to persuading all partners to transform. It is important to realize that different people have different incentives and only some partners or organizations may be necessary to continue with (Wessel, 2017). VISA performed this step successfully when they divided its organization and created a part that focused on the future round the clock (ibid). In the last step, organizations and partners are established and it is now time to enlarge the pie, i.e. creating new economic opportunities and create value in the ecosystem (ibid). Wessel (2017) says that a company does not need to own every asset, enlarge the pie and use companies in the ecosystem.

In addition to the above mentioned processes, Hammer et al. (2016) present four aspects of what differs a digital master with a non-digital master. The first aspect entail the importance of focus (ibid). The second aspect presents the use of agile strategy and the importance of gradually build the transformation to succeed (ibid). As the third aspect, Hammer et al. (2016) resemble capturing digital opportunities with a team sport. The fourth and last aspect emphasize the human involvement and Hammer et al. (2016) mean that the real challenge of a transformation is the transformation of the employees.

## 4. Methodology

*This section will present the chosen methodology of the thesis which consists of the design of the research, an outline of the working process and the methodology behind data collection and data analysis. Furthermore, generalizability, validity and reliability of the study will also be discussed.*

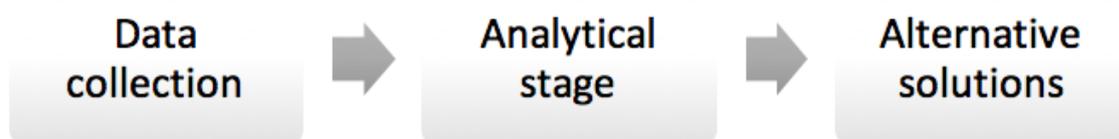
### 4.1 Research design

Easterby-Smith et al. (2015) believe that a study of qualitative character is useful for researchers that are trying to understand particular issues within a specific area. Aligned with that reasoning, this study was performed as a qualitative study due to its definition and character. A case study research design was selected because of the choice to investigate a single organization and its real-life context in depth (Easterby-Smith et al. 2015). The research design aimed to support the process of addressing the research questions, which implied a consistency in the activities performed during the project (Easterby-Smith et al. 2015).

A case study research design involves large amount of data and some believe that the result of a case study research is non generalizable and thereby, cannot represent an entire population (Easterby-Smith et al. 2015). Others discuss whether a case study research is subjective or objective (Easterby-Smith et al. 2015). To counteract these risks, one should use multiple sources of evidence in order to triangulate the information (ibid). Easterby-Smith et al. (2015) also emphasize the importance of having a distinct research design with specified research questions and decisions how the data should be interpreted before the data collection starts. In line with that reasoning, triangulation was used throughout the process of the thesis project in order to increase the strength of the study. Using different perspectives and complementary information from secondary data increases the validity and generalizability of the study (Easterby-Smith et al. 2015).

The replicability of this specific thesis will depend on the character of the environment and the company in question. Although, it can be argued that the analytical framework can be used in other contexts with companies from similar industries henceforth.

### 4.2 Research process



*Figure 4.1. The research process of the study.*

The research process was divided into three stages; a section of data collection where a study of the topic and an empirical study was performed, an analytical section and a discussion of alternative solutions, see figure 4.1. During the first part of the research, the data collection,

an iterative literature study was performed where repeating rounds of literature reading was performed. The initial stage of the study was also served as base for the following stages of the thesis. In order to gain a better understanding the compressor industry and the underlying concepts of digitalization, the following topics was studied: Industrie 4.0, IoT, simulation, digital transformation and digital technology adopters. In addition, environmental aspects have been relevant throughout the process. Complementary literature concerning theoretical frameworks applicable for the analysis was also studied in order to gain a better understanding of the case which this study was focused on and further support the analysis. The literature was gathered using written sources such as Harvard Business Review and by participating in a web based seminars at Harvard Business School.

The initial stage also included an empirical study, consisted of primary and secondary data. Interviews with the focal company was performed as well as interviews with customers. In addition to the literature review and the empirical study, a theoretical framework was also created in order to understand how the focal company could digitalize their business model to stay competitive.

The second step in the research process was of an analytical character. In order to answer the designated research questions and fulfill the purpose, this step was essential for the study. The analytical framework was applied on relevant empirical data and background information. A business model analysis was performed where each building block of the business model was discussed. In the last step of the process, based on the analysis performed, suggestions for alternative business models were created and presented. A discussion of each proposition was performed and the step was finalized with a recommendation of how a successful digital transformation can be pursued.

### **4.3 Data collection**

The collected data was gathered from both primary and secondary sources and was of both quantitative and qualitative character. The data has been collected continuously throughout the research process.

The data collection used both purposive sampling and snowball sampling. Easterby-Smith et al. (2015) argue that purposive sampling should be used when the researcher has a clear idea of what kind of data is needed, which goes in line with the purpose of the study. The selected data was large successful customers to the focal company. In addition to purposive sampling, snowball sampling was also used during the study. This method is useful when knowledgeable individuals are difficult to identify (Easterby-Smith et al., 2015). The selection of the focal company's employees was performed using snowball sampling, starting with the supervisor which further recommended suitable employees.

#### **4.3.1 Secondary data collection**

Secondary data was collected throughout the research process, both as complementary data to other data gatherings and also as standalone information. The data was constituted of information from competitors and customer to the focal company. The purpose of the secondary data collection was to get a macro perspective of the head organization and the remaining actors that were interviewed during the study. As preparation for the interviews, the current company was studied in order to minimize the risk of asking for information that could be found at the relevant websites or in other written sources. This increased the quality of the interviews.

### **4.3.2 Primary data collection**

The interviews were divided into interviews with employees at the focal company and interviews with customers to the focal company. All interviews were of semi structured character where questions were predetermined with a flexible nature. Semi structured interviews provides a flexibility and it allows the interviewers to deviate if that is needed (Easterby-Smith et al. 2015). A semi structured interview is a successful method when the interviewer need a range of insights on a specific topic (ibid). The method encourage a two way communication which in turn can give more in-depth answers where not only the answers to the questions are given, but also the reasons (ibid).

#### **External interviews with customers**

The external interviews was comprised of interviews with customers to ACCT. There were nine different companies interviewed and in total 12 interviewees. The average length for the interviews were approximately one hour. The customer respondents were actors from industries such as Paper mill, Petro chemistry, Heavy automotive, Beverage and pharmaceutical that use compressor technology from ACCT. The size of the companies varied, from micro companies to small and middle sized ones. The interviewees were of different characters where managers at different levels were asked as well as automation and operating engineers and maintenances administrators. The purpose was to give as a comprehensive picture of the customer environment as possible. The questions asked aimed to understand the customer's' total demand and their use of compressed air. Factors influencing the choice of supplier were also discussed as well as thoughts and experiences concerning digitization. The factors used were chosen based on information about the compressor industry, presented in the literature chapter. All factors were considered to be important for the customer in the decision making.

The competitive respondents consisted of main actors within compressor industry, namely ACCT main competitors. The purpose of that information collection was to map what other actors are doing and how they are doing it in order to identify what the next step should be.

#### **Internal interviews at ACCT**

The internal interviews consisted of interviews with four employees at ACCT. The respondents were a general manager, a vice president of operations, a process manager and a lead generation manager. These interviews had an average time interval of one and a half hours. The interviews covered the following topics; vision and mission, various offerings, customer demands, application areas, business models and digitalization.

### **4.3.3 Interview setup**

All interview questions were sent in advance in order to prepare the interviewee and ensure a comfortable environment. It can be difficult to obtain trust during an interview so Easterby-Smith et al. (2015) recommend keeping the interviewees well informed before and during the interview.

The interviews were primarily held at the interviewees' offices but Skype was used when necessary. The choice of locations is in line with Easterby-Smith et al. (2015) reasoning that locations are essential for the interview outcome and it should be at a location where the interviewees feel comfortable. The interviews always started with a short presentation of the thesis and an outline of the purpose and structure with the interview, this to make the interviewees comfortable in what to expect.

All interviews were recorded in order to avoid misinterpretations. Easterby-Smith et al. (2015) believe that recorded interviews makes it possible to listen again and avoid misinterpretations but it is also essential if the interviews are to be transcribed. In addition, notes were taken during the interviews, primarily to make the interviewee feel appreciated but also to help the researcher come up with follow up questions. Both researchers participated in all interviews, this to avoid biased answers.

## 4.4 Data analysis

The qualitative data that was collected and summarized has been further explained and interpreted in a qualitative analysis. The analysis began with open ended questions and moved towards more precise answers, characteristic of a qualitative analysis (Easterby-Smith et al. 2015). The data analysis consisted of circular and nonlinear reasonings and it was iterative and progressive.

A deductive approach was used (Easterby-Smith et al. 2015). A deductive approach begins by using various frameworks to group the gathered data and then look for relationships in those frameworks. This approach is used when the qualitative research is the main design in the study which is the case in this research (Easterby-Smith et al. 2015). The analysis has been structured in the following way, see figure 4.2.

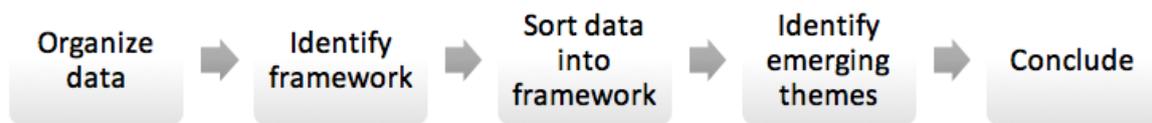


Figure 4.2. The process of the analytical work.

The first step in the data analysis was to transcribe the collected data, namely all interviews performed. To facilitate the analytical work further, the data was structured into internal and external data and was further divided into several themes that was labelled with today's organization, future developments, thoughts around digitalization among others. The next step of the data analysis was to identify which framework that would be most suitable for the analysis. The identification started with a discussion of potential closures of the study. By identifying that a number of business models were desired for the analysis, it became easier to understand which tools that were needed to deliver the desired result. The framework consisted of a Business Model Canvas analysis together with the diffusion of innovation theory that was later applied at the respondent customers. The purpose was to investigate how the empirical findings, together with the industry and digitalization facts, could be used in ACCT's advantage. After the data was organized and the framework was selected, the empirical results, both external and internal findings, was distributed into the chosen framework together with the background review of digitalization and industry facts. The analytical work continued by identifying emerging themes in the framework that were based on a combination of customer needs and academic findings of the digital surroundings. Further, the emerging themes were organized so the result could be displayed, that is in a number of different business models.

## 5. Empirical results

The empirical results have been divided into two sections including internal interviews and external interviews. The internal interviews consist of gathered information from key employees at ACCT along with information from company-specific material. The empirical results external to the focal company touches upon customers and competitors to ACCT. The chosen customers are players that are considered relevant for ACCT's future development and work. The competitive overview consists of a brief description of three large and inspiring compressor actors containing their competitive strategy and digital orientation.

### 5.1 Internal environment

The internal environment are based solely on performed interviews at ACCT. The following employees constitute the empirical evidence below:

- General Manager
- Vice President of Operations
- Lead Manager
- Business Process Manager

Compressed air is a prime energy source for many industries, to either a smaller or a larger extent. As a supplier of compressed air, ACCT is no exception and is present in multiple industries. The business area Compressor Technique delivers a range of products to their customers, from industrial, gas and process compressors to miscellaneous equipment related to compressed air. Each business area is also divided into a variety of divisions, see figure 5.1.

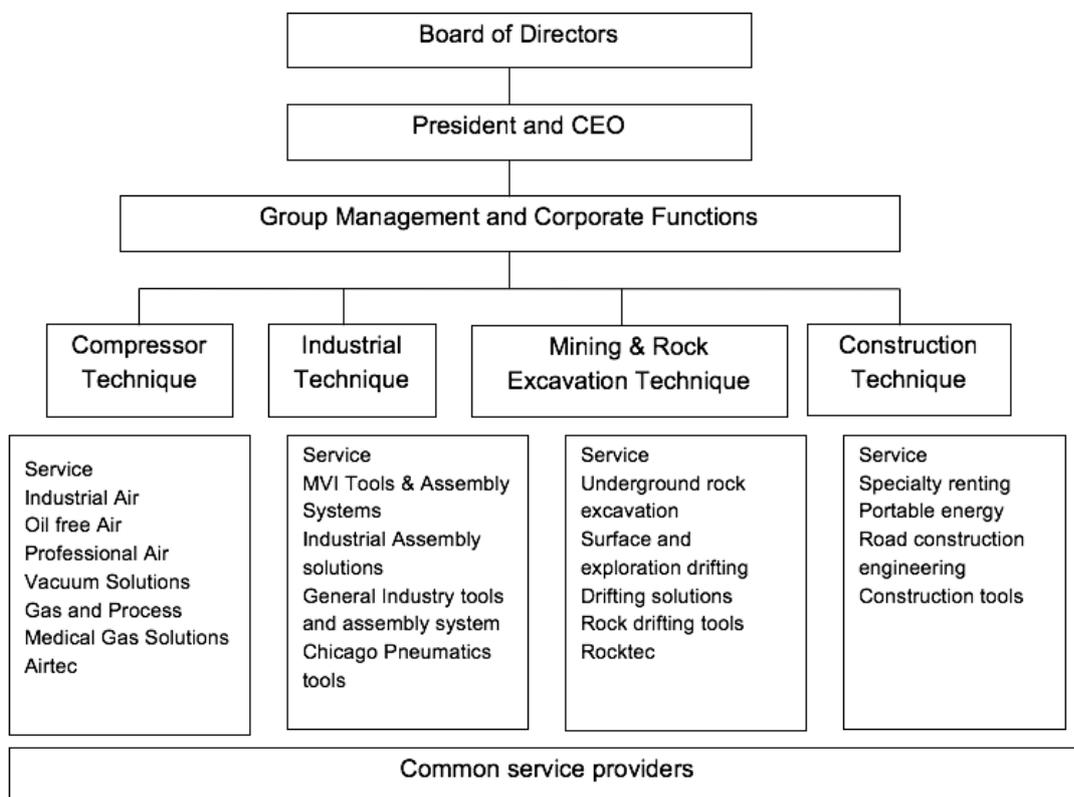


Figure 5.1. The structure of the Atlas Copco Group

Atlas Copco is a *product driven customer focused* company which means that the products are produced by Atlas Copco in-house. They offer standardized products that is available for the larger extent of the customer base, thereby the product driven customer focused approach.

ACCT has recognized many business opportunities in the near future on an otherwise mature industrial market. There are pending investments for compressor technology in large industries such as paper, food, pharmaceutical and heavy automotive industry. Although, that does not necessarily mean growth, according to the General Manager (GM). ACCT is continuously getting opportunities to replace equipment that can be up to 20-25 years old. ACCT strives to be at the right place at the right time to catch opportunities for further investments. ACCT's highest generated value is found in high end customers that owns more than one compressor.

### **5.1.1 ACCT's vision**

The vision of ACCT is that each division should be first in mind and first in choice. ACCT should be the number one brand, according to themselves. The Atlas Copco group's vision is yet more complex due to the possession of multi-brands. At that level, the vision is that the Atlas Copco brand should be number one and the multi brands should be number two. The strategy of ACCT is to offer top class products. A parable that the GM addresses is the car industry with Skoda and Audi. He means that some actors compete with price and their strategy is to be the cheapest actor on the market. ACCT compete within the premium segment, where top class products is the essential and price comes as secondary.

In order for ACCT to sell more advanced premium products, there is a need towards the customer to be able to explain the value and the reason why the customer should buy an ACCT product. Part of ACCT's strategy is to have a coordinated salesforce, an extensive aftermarket and a service divisions that can demonstrate that value. Another strategic choice of ACCT is to develop and produce the majority of the core products in house. The advantage of developing and producing in house is, according to the GM, that ACCT owns their intellectual property and there is no risk of information and knowledge leakage. He continues by saying that there is always a discussion of ownership when it comes to co-development. Therefore, ACCT does not think they would benefit from co-developments.

*"We started earlier. We had a head start, let's not make them smart."*

- Vice President Operations

*What gets measured gets done.* The foregoing is a well-used proverb at ACCT. The GM says that the challenge with measurement is to actually use all that information. He has worked for Atlas Copco for over 35 years and at the start, there were much less measurements than it is today. The measuring tools were simply not there, he says. Today, we measure a lot but just within a few years, I am sure that there will be even more measurements, says the GM.

### **5.1.2 Core competences**

ACCT presented four core competencies within the area; product development, standardized production process, distribution and sales and services.

#### **Product development**

ACCT is constantly striving to be at the forefront of research and development while continuously produce innovative products. Their visions is to offer the best solutions to all customers and to produce products that are most beneficial for the customers. In terms of total cost of ownership, ACCT also tries to satisfy customers in best way possible. Safety and energy saving are two factors that always have been are highly prioritized at the company.

#### **Standardized production process**

ACCT is said to be good at selling grey boxes. A standardized and good production process is essential to obtain high class production and cost leadership. A combination of producing high quality products and having lowest production costs because of a standardized production process brings health margins in the industry, says GM.

#### **Distribution**

The majority of the machines are sold through direct channels, so called direct sales. There are physical customer centers in 80 out of 190 countries. ACCT puts a lot of effort of sales and has an extensive network of sales force.

#### **Sales and Service**

ACCT has dedicated trained operations for both sales and services. In ACCT, more than 50% of the employees are related to service.

### **5.1.3 Current digital transformation**

ACCT is in the process of transformation. The Vice President of Operations (VPO) estimates that only 30-40% of the company is digitalized today. There is a long way to go, he says. ACCT presents two rules of thumb concerning digitalization, see below.

Two rules of thumb:

- Do not digitalize for the sake of it. A digitization initiative should solve a problem. It is only then a company will benefit of doing something in a digital way.
- One should not wait until the final product is complete. It is better with smaller steps and the product does not necessarily have to be perfect in the beginning.

ACCT considers that at least part of their organization is already digitalized. According to the VPO, it is fair to say that ACCT is still ahead of competition concerning their connected machines that they are offering and the website's offer. Nevertheless, there is a fear that the competitors will catch up soon, says the GM. He continues by explaining that all of today's major actors offer connected solutions, energy saving solutions and extended websites where the customer can go in and study the behavior of a particular machine. He ends the discussion by stating that these solutions are becoming more commoditized.

ACCT is working on predicted maintenance solutions where the machines can predict with exact precision when the machine needs service. ACCT is not where they want to be yet, it is rather an ongoing process of work today, says the VPO. The website is also in a development

stage where the software is not entirely integrated yet. Today, it is rather standalone. The vision is to provide one portal where all information can be found, from the machine's behavior to technical information and administration tasks such as invoices sent. This implies less personal interaction that will allow the back office to do more value added activities instead, says the GM. The purpose is to create one digital consolidated contact point at ACCT.

The service division has the vision of having every machine above 30 kilowatts connected in order to push data to an IoT platform. This in order to learn internally and benefit from data that subsequently will offer the customer transparency in terms of the information they will be able to see on the IoT platform. An example of a large digital initiative performed by ACCT is the initiative of going digital at the service department with the service technicians. The characteristics of the technicians were 40-50 year old men which have not grown up in a digital world. The initiative of a digital mobile solution took ACCT ten years to finish. The mobile initiative started 2007 and in March this year, ten years after the start, ACCT finally rolled out the final mobile phones to the three remaining countries in world. Today, every service technician knows how to use a mobile phone in the daily work. Now, there is a need to change the software in the mobile device and the same exercise with the technicians will be done once again but this time, the initiative will be performed in seven months. A clear demonstration of how fast the speed of digitalization is, says VPO.



Figure 5.2. How overall changes are performed at ACCT.

The overall changes at ACCT is performed in smaller project with a learning phase, see figure 5.2. It is only after the learning phase they can evaluate and see how the company can mature further. Finally, the last stage in their process is implementing on larger scale. It is a challenge to find the perfect package that will fit everyone, says GM. The latest SAP implementation is one example of that. All of the respondents agreed that difficulties arose both during and after this particular project due to lack of culture cohesion, leadership, information and knowledge.

*“The world hates changes but it is the only thing that has brought progress.”*  
 - General Manager

**5.1.4 Business model**

A component that has been a part of both yesterday’s business model and today’s is the direct sales. ACCT has emphasized the importance of having direct contact with the customer to the greatest extent for years. The interviewees do not think that direct sales management will change in the future.

The GM says that the content of the business model has changed the last the last ten years. Yesterday’s business model covered among other things, traditional sales management. The customer called the sales engineer and asked for a meeting. The sales engineer visited the customer and had a presentation of the different options of compressors. In short terms, the sales management was characterized by human interaction. The maintenance work aimed

primarily to help when a compressor broke down. Preventive and corrective maintenance characterized ACCT’s service management.

Today’s business model is characterized, in addition to what's mentioned above, by a sales management where the customer uses the website in a larger extent. The customer contacts the service engineer and explain what they have found on the website and what he/she is interested in. It has become clear that the customers are more informed today on the ground of digitalization. The use of online stores has gained importance and ACCT has realized that they must adapt to that. It has also been realized that there is a market for second hand machines in addition to the newly produced machines. This is part of today’s business model. As mentioned above, machines are more compatible with the internet today than it was ten years ago. Many in-house processes have become more digital such as the channels between customer and ACCT. For example, the website is used in a larger extent today as a channel of communication.

**5.2 External environment**

The external environment of ACCT constitutes a selection of customers and competitors that are presumed to be representable. This section will present the customer's compressor use of today and in the future and it will also present their own production development and their view on digitalization.

The customers which constitute the empirical evidence are presented in table 5.1. Each interviewee will hereby represent the company for which they are employed and the company are being named after industry and size. In those cases where two interviews have been performed at the same company, they will together represent the company in the analysis below. In addition, companies from the same sector with the same size have been named (1) and (2).

<i>Sector</i>	<i>Size of company</i>	<i>Interviewee</i>
Paper mill	Large	Automation engineer Strategic purchaser
Paper mill	Medium	Purchase manager
Petrochemical	Medium	Procurement coordinator Procurement specialist
Petrochemical (1)	Small	Operating engineer
Petrochemical (2)	Small	Operating engineer
Pharmaceuticals	Large	Accountable engineer
Beverages	Micro	Process manager
Heavy automotive (1)	Large	Maintenance administrator
Heavy Automotive (2)	Large	Plant maintenance manager Maintenance engineer

Table 5.1. The respondent customers.

### **5.2.1 Compressor application**

In the following section a description of what kind of equipment that is used to produce compressed air and how that air is used in different industries are presented.

#### **Paper mill**

The two paper mill companies use, regardless of the difference in company size, compressors in similar ways. Both companies have a number of large machines of which one or two are frequency controlled <sup>1</sup>and a few of them are considered to be very old. The compressors are grouped together to form a compressor station that provides the production facility with compressed air. The machines produce a constant but varied flow of air around the clock, depending on the need for the production. Normally, these compressors are operating on 60-70% of their total capacity. The air is used to operate control valves for the control systems and in the packing lines.

The large paper mill company has a service agreement with their compressor provider ACCT, which is the main provider. The agreement implies that ACCTs service technicians perform maintenance on the machines based on operating hours which are not wirelessly connected to ACCT.

#### **Petrochemical**

Like the companies operating in the paper mill industry, the interviewees' firms operating in this industry use compressors in similar ways, despite the differences in size. All three companies have a number of large compressors in their compressor station. The small petrochemical company (1) though, also uses one large specially made machine as part of the core production. The level of automation and remote control varies between the machines and none of them are connected to ACCT. All companies have service agreements with both ACCT and a rival supplier. The service technicians' share maintenance reports which is used as basis for ordering spare parts to keep in store in-house preventively.

#### **Pharmaceutical**

The large pharmaceutical company use ACCT compressors in 95% of all the cases, some frequency controlled and others not. They use compressed air to operate controlling valves, ventilation and for fume hoods. Compressed air is also used as power source in "explosive areas" certified areas of the production plant. They have had a collaboration with ACCT who offered a service for energy efficiency. The air losses due to leakages decreased from 34% to 4% after the service was performed.

#### **Beverage**

One micro beverage was studied that used two non-frequency controlled compressors. The second compressor was recently bought from Blocket.se, which is a trading site for used items. Both compressors are made by ACCT but they only have a service agreement for the older compressor. The service agreement on the newly purchased used machine is with a third party not related to ACCT. Compressed air is used as an energy source in every step of the manufacturing process, both in the brewery and in the tapping activity.

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<sup>1</sup> Allows for changing the load on the machine, it may also be referred to as variable speed control (VFDs, 2017)

## **Heavy automotive**

The way compressors are used at the two studied heavy automotive companies do not differ in general. Both companies are of the same size and use 10-15 compressors at their facilities of which about half constitutes for their compressor stations where none are frequency controlled and most are old, which implies expensive renovations.

The production process is organized as a fishbone and is only operational during daytime. A fishbone process constitutes of a main assembly line to which smaller kitting stations and even smaller lines are attached along the line, according to the heavy automotive company (2). The production is dependent on the compressors since they power all “power-tools” used along the lines.

The heavy automotive company (1) has a service agreement with ACCT, where the technician gets a sms when it is time for service. To control the machines efficiently, the heavy automotive company (1) has made their own superior control system for all compressors to achieve interoperability. The purpose of the control system is to integrate the operations of the machines to run them more efficiently. Currently, negotiations are pursued with ACCT to lease a new unit for such system.

### **5.2.2 Ownership**

Three forms of ownerships were discussed during the interviews when interviewees was asked about what form of ownership they have and prefer; full ownership by the customer, leasing contracts and buying air per use. All interviewees have self-owned compressors while one of the respondent also has chosen to lease one machine. Buying air per use was a concept only discussed in theory since none of the respondents are currently buying air per use.

Both paper mill companies have a policy of funding all investments with their own money. One respondent at the medium sized petro chemistry company explained that when the company is performing well, binding capital in equipment is preferred.

#### **Leasing**

The small petrochemical company (1) is leasing one of their compressors. The reason for leasing is the inability to invest in new equipment at the time and thus leasing became a valid option. The experience of leasing the machine has been positive overall but the interviewee mentioned difficulties in integrating the control systems to achieve interoperability, due to limited access to the machines control unit.

The possibility of leasing machines was also brought up during the discussions with other companies in the petrochemical and paper mill industries. The large paper mill company concluded that it would be unfavorable for them since costs are difficult to estimate and the owner of the machine controls the equipment. Even though the interviewee at the company experiences an increased transparency in the relation between buyer and supplier, having a supplier controlling part of their machinery is today out of question. The reason for that is, according to the interviewee, the lack of control over equipment connected to their own processes.

#### **Buying air per use**

During the interviews, buying air was discussed by the small (1) and medium petrochemical as an alternative ownership. Both companies brought up the option during the discussion regarding forms of ownership. The small petrochemical company (1) reasoned that the

advantage would be that someone else would take care of the maintenance, otherwise the interviewee was unsure about the advantages. The interviewee at the company concludes that buying air per use is not considered possible today but possibilities may appear in the future.

The medium petrochemical company made the connection between their own situation, being located at the Swedish petrochemical cluster, and large industry complexes in Germany. In those large complexes, it was said that all companies are provided with air by an external actor. However, according to the interviewees, buying air per use is not considered favorable today compared to owning machines due to the company's prevailing economic situation. However, it may be relevant in the future.

### **5.2.3 Buyer-supplier relationship**

During discussions about the relationship with ACCT as a supplier, our respondents described the purchase process as being similar to a collaboration characterized by a high level of transparency. One of the four respondents, the large company operating in the paper mill industry argued that relations with all suppliers are of high importance. The company is expecting their suppliers not only to fulfill a need but to engage in improving the overall performance by using expertise that cannot be found in house. Another respondent, also in the paper mill industry mentioned that ACCT, by their own initiative had offered a service for measuring and increasing efficiency on the air compressors. The service was considered to be a collaboration to help the company improving their efficiency. The pharmaceutical company stated that, in general, a close relation with suppliers are preferred in order to maintain high quality on the product by gaining access to service. The interviewee continued arguing that it is preferred to use one supplier for all machines since they are known and accepted by the staff working close to them daily.

Interviewees at the medium size petrochemical company and the large paper mill company stated that they have had relations with ACCT for over 40 years. The interviewees are thus confident in knowing that ACCT obtain technological competence. Regardless of the long relationship though, both companies have chosen other suppliers as well during that time when the price has been favorable. The reason for that is that ACCT's products are expensive, but when estimating total life cost, the price is competitive according to one interviewee at the medium sized petrochemical company. This is a statement that is shared by the small sized petrochemical company (1). A competitor was able to offer a suitable solution compatible with certain documentation requirements for the medium sized petrochemical company. One interviewee at the company stated that the same competitor had difficulties in delivering an attractive price on service, and thus rejected the offer. The reason for the competitors' high service prices was according to the interviewee related to low availability and high execution time.

When describing the perception of ACCT as a company, all interviewees stated that ACCT has a strong brand and is a dependable Swedish supplier who provides high quality services and products. The impression that the service technicians are at the right place at the right time is shared by the large paper mill company, the micro beverage and the medium petrochemical company. All companies state that ACCT has a technical advantage and a wide range of products. The overall experience from the small petrochemical (1) company is that ACCT is putting effort into developing a suitable product and at the same time are open with their own abilities and limitations.

There are different benefits with different suppliers according to the medium size paper mill company, stating that some prefer one brand while others another. Even if that is the case though, the interviewee finds guarantees and installation most important when choosing a supplier. At the time when the small petrochemical company (1) chose ACCT as supplier for their newest compressor investment, the product design which enabled easy installation was one of the determining factors.

#### **5.2.4 The purchase process**

A majority of the interviewees stated that many interests have to be taken into account when buying a large compressor. Both of the heavy automotive companies stated that the purchase process is initiated with a list of product specifications, such as desired capacity, energy efficiency and standards that are sent to the supplier before the negotiations begin.

Buying a large machine is by the interviewees considered to be a large investment and companies are thus executing the purchase process in project form with a team of people with various expertise. One interviewee at the medium petrochemical company referred to a compressor purchase as one of the larger purchases they do. The respondent continued stating that people from technology, operations, maintenance and purchase departments have to be involved in such purchase process. The interviewee also explained that both site managers and the Vice President had to be involved in the decision making because of the size of the investment. Commodity managers are the front figures and the steering group of the project makes the decisions, based on suggestions from the purchase and technology experts, the interviewee concludes. At the other two petrochemical companies and the two paper mill companies interviewed, the purchaser's role is similar to one another. The purchaser's role in those companies is to lay out various financially healthy alternatives and monitor the discussions to ensure a rational process is maintained. In the case of all interviewed companies, if the company is part of a larger group large investments are often coordinated on a central level and for example compressors for the sites are bought at the same time.

#### **5.2.5 Purchase factors – Present classification**

During the interviews factors regarding desired characteristics of today's compressor offerings were discussed. The factors were price, quality, service, delivery precision, lead time and energy efficiency, see figure 5.3. The interviewees stated the relative importance of these factors, as well as motivating their choices and clarified their perception of each factor and how they are related. Factors classified as highly important are represented with a high score in figure 5.3.

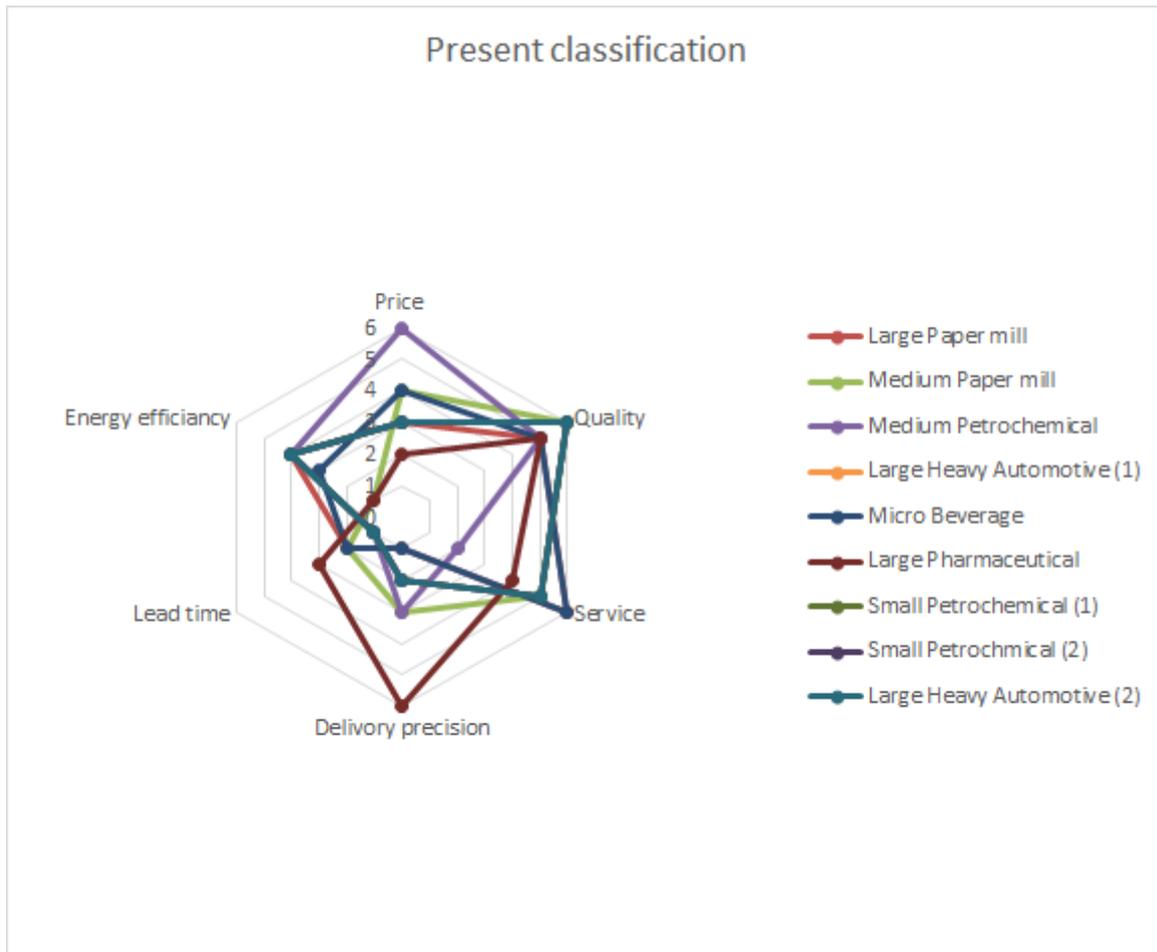


Figure 5.3. Illustration of the relative importance of the purchase factors.

During the discussion of the importance of price and its impact on the purchase decision, a lifecycle perspective on investments was discussed with representatives from the large paper mill company, the medium petrochemical company and both heavy automotive companies. Both the large paper mill company and the medium petrochemical company stated that compressors have a long life, which is why the initial cost of purchasing the machine only represent part of the total cost of buying a compressor. Both continued their reasoning by saying that both energy efficiency and quality affects the total cost of the investment, and thus becomes a matter of price. A low quality product might have a shorter life cycle, it may also imply increased costs for service and maintenance, cost of disturbance in the core production and higher operations cost according to all interviewees. As shown in figure 5.3, the large paper mill, medium and small (2) petrochemical companies consider price to be important since they consider it to be related to quality. A high quality product imply lower costs throughout the life of the product because of reduced maintenance costs and a longer product life. The interviewee motivates the choice by stating that the final decisions are based on total cost analyses.

The interviewee representing the small petrochemical company (1) mentioned that the negotiations process begins with price but in the end technological superiority exceeds price. The micro beverage representative agrees with the reasoning and said during the interview that price is important, but not on the expense of high quality and dependability. Dependability is described by uptime by the interviewee, who stresses that the production

relies on the compressors. One interviewee at the large paper mill company stated that price only affects the deal if the price is so high that they cannot afford it.

Even though one of the representatives at the medium size petrochemical company stated that price was the most important factor, he still expressed the need for high quality. It was also stated by a representative at the medium petrochemical company that if they have good experiences with a supplier and know that they will get good service, price and delivery time are less important. The interviewee continued saying that price is always negotiable. Interviewees at the small petrochemical company (1), the micro beverage, the medium paper mill company, the heavy automotive company (2) and the large paper mill company all considered quality and service as the most important factors. It was stated at the medium paper mill and pharmaceutical company that quality and service is closely related to dependability and lifespan of the product. The pharmaceutical company thus consider dependability to be of highest importance, followed by quality and service which together constitutes for dependability.

During discussions regarding service, the large paper mill and the micro beverage companies stated that they considered it to be most important. Interviewees at both companies stress the importance of dependability of the product performance and relates this to service offerings, since their production is relying on the compressors inter alia. Service was considered most important when buying a compressor by many interviewees and good service, as perceived by all interviewees, is related to availability and it is appreciated that technicians can be in place at the right time. Delivery precision is not as important for product delivery and spare parts, since they keep them on stock, according at the large paper mill and medium petrochemical company. It was also mentioned by the interviewee at the medium sized petrochemical company that if the delivery precision is good, lead time becomes less important.

In the discussions about energy efficiency, there were different opinions. Energy efficiency was by the small petrochemical company (2) considered most important while interviewees at the pharmaceutical and both paper mill companies considered it least important. One interviewee at the medium petrochemical company argued that energy efficiency is only considered during the call for tender, since it is based on theoretical values and calculations. The interviewee then continued, saying that the company is committed to use energy efficient engines. It was stated by the micro beverage that energy consumption is not one of their largest costs and is thus not prioritized. The interviewee at the pharmaceutical company stated that compressors are, by definition, consuming large amounts of energy. Energy efficiency is thereby related to the operations of the machines.

### **5.2.6 Purchase factors – Future classification**

The future desired characteristics of compressor offerings were structured based on the same six factors as presented in figure 5.4. The interviewees stated how they perceive the relative importance within 5-10 years with a motivation to their opinions. Discussions of how the customers are likely to develop their business in general followed since it was considered by the interviewees that such development might have an impact on the use of air compressors.

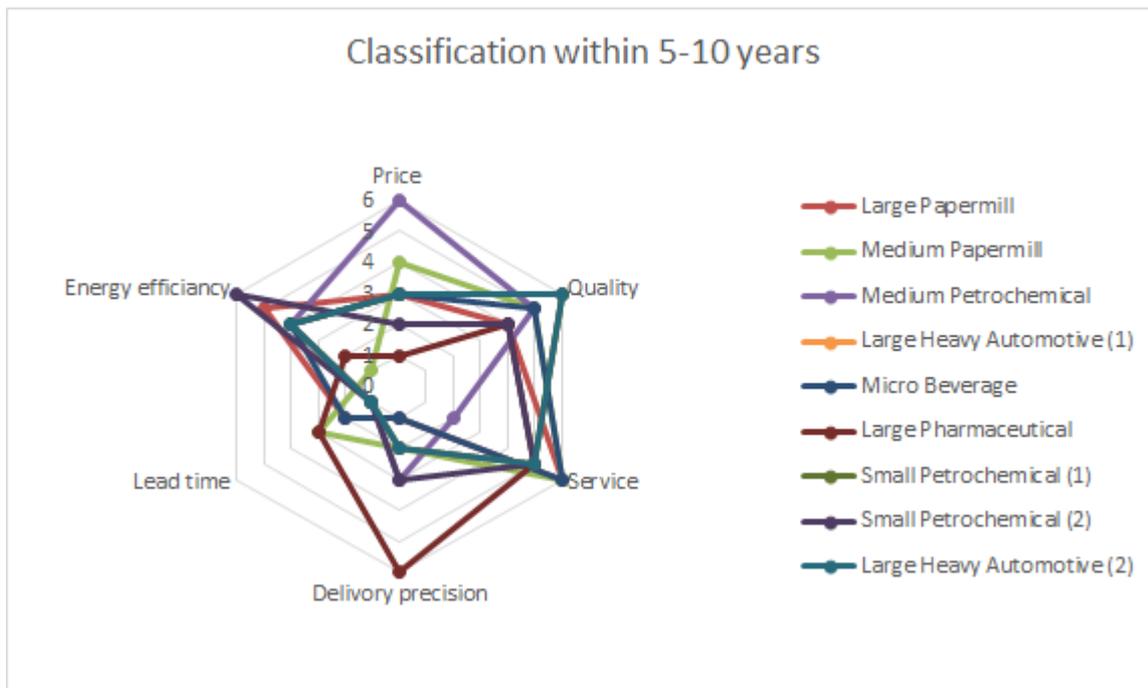


Figure 5.4. Illustration of the relative importance of the purchase factors within the next 5-10 years

During the discussion of how the customers' needs would change within the coming 5-10 years, five out of nine interviewees discussed energy consumption (see figure 5.4). Neither interviewees at the medium petrochemical nor the small petrochemical company (1) believe that energy efficiency will become of higher importance compared to the other factors in the future. One interviewee at the small petrochemical company (1) argued that they would move on to renewable energy sources and start reuse and recycle their waste to become more energy efficient. Both the medium and small sized petrochemical companies had the same thoughts but discussed further the possibilities of altering the production process into using renewable raw materials such as bio oil instead of naphtha. Both also stated that compressed air is something that they would avoid using from an energy perspective. Compressed air requires a lot of energy, which is getting more expensive, according to one interviewee at the small petrochemical company (1). Interviewees at the large paper mill company would also prefer not using compressed air, if it could be avoided.

Discussing energy efficiency, representatives for the large paper mill company and the micro beverage believed it to be of greater importance in relation to the other factors. The reason for that choice is that the production process will be developed more in the future and therefore the energy consumption will have an increased impact on the business. The micro beverage would be likely to invest in water cooled compressors in the future, to recycle the heat and reuse it in their production. Interviewees at the large paper mill company on the other hand made a connection between energy efficiency and quality of the products. The interviewee further expressed an interest in updated control units for more efficient use of the machines. Interviewees at the heavy automotive company (1), the pharmaceutical company and the small petrochemical company (1) also desire upgraded control units on the compressors to increase energy efficiency and matching the air production with the need. Both the large paper mill company and the large pharmaceutical company specifically desire upgraded frequency controlled machines but also superior control units. According to the interviewees, the superior control unit facilitates interoperability by regulating all compressors based on air consumption. The heavy automotive company (1) discussed installing such control units in the near future and are in the process of hiring one from ACCT.

When asked to describe how the perception on service is likely to change, three out of nine respondents considered that service offerings would be increasingly important onwards. The ability for the supplier to wirelessly be connected to the machines, to monitor their performance and to store information was also discussed. Both paper mill companies had a positive attitude to ACCT in both cases, monitoring and communicate with the machines. According to the medium paper mill company an intelligent communication system would facilitate maintenance and decrease lead time, since the physical inspection in many cases may default. One interviewee at the medium petrochemical company on the other hand was skeptical to the concept of ACCT communicating with the machines in real time. All maintenance has to be scheduled since the machines operate around the clock providing air for the production. Therefore would a communication system be useless according to the interviewee. The interviewee continued saying that a system for surveillance and diagnosis of the machines would be of greater interest since it would give an indication of possible failures in advance.

In addition to the discussions regarding the factors, one interviewee at the medium paper mill company speculated that compressor suppliers might start using a similar system as Siemens. The interviewee stated that customers charge for placing orders, instead of the customer doing it themselves using a catalogue. The interviewee continued saying that to simplify the purchase of spare parts, suppliers could synchronize the product names by using different standards valid for different industries. Respondents at both the medium and the small petrochemical company (2) are having a negative viewpoint on decreased personal contact due to digitalization. The argument was that both during the purchase process and when contacting service center for maintenance, human interaction is desired.

### **Customers' business development**

The micro beverage, both small petrochemical companies, the medium petrochemical company and the heavy automotive companies will increase capacity in their production and at the same time increase efficiency by doing more with less effort. Possibilities for increasing automation to decrease manual labour in the production process has been recognized at the micro beverage, while both heavy automotive companies and the small paper mill company are adapting into using digital tools. The small paper mill company is developing towards incorporating IoT into their production system, allowing producing units to communicate directly with each other. The benefits of such advanced and highly automated system is the decreased dependence on individual's competence, according to one interviewee at the small paper mill company. When the production process are becoming increasingly sophisticated at the heavy automotive companies the need for properly trained staff increases, resulting in longer training periods. To reduce the risk of "the human factor" a pick to light system is used to ensure the kitting operations are performed correctly. The next step in digitizing the production for the company is starting to use digital supporting documents, related to each product.

Five out of nine respondents expressed that when increasing capacity, the air consumption will increase. The cost per cubic meter produced air is of great interest at the medium petrochemical company. It was mentioned at interviews with both the medium petrochemical company and heavy automotive company (1) that there are difficulties in measuring energy efficiency and air consumption. One interviewee at heavy automotive company (1) argued that installing measurement equipment would itself affect the consumption negatively, since

the equipment would disturb the airflow. One company that have chosen to start measuring air consumption is the large paper mill company.

### 5.2.7 Competitors

The global air compression industry is characterized by a few large players with strong brands that frequently acquire smaller companies and engage in strategic alliances (Technavio, 2015). The rate of know-how is typically high and companies competing globally spend a lot of resources on development and innovation (Technavio, 2015). Three companies was selected for the study, Ingersoll Rand represents a large incumbent while Kaeser and ELGI represent aspiring smaller companies (Technavio, 2015).

Kaeser has recognized the customer need of compressed air rather than the compressor itself, now developing network solutions for customers to buy compressed air by use (Schulete, 2016). In addition, Kaeser is also developing predictive maintenance systems for their compressors and are planning to create paperless factories where all information is digital (ibid). Ingersoll Rand on the other hand has chosen a different approach, but still based on customer needs (Szefur, 2016). The company uses its expertise in different industries to identify the part their compressors is taking in a larger system, to ensure that the compressor is contributing to an optimized system overall and thereby create customer value (ibid). ELGI has recognized the industrial trend of IoT and Industrie 4.0 but are currently mainly focusing on expanding its business globally (Nanda, 2017).

In the following table, the competitors are presented by their value proposal, digital development focus and competitive strategy, see table 5.2.

<i>Company</i>	<i>Value proposal</i>	<i>Digital development focus</i>	<i>Competitive strategy</i>
<b>Ingersoll Rand</b> <sup>2,3</sup>	Embrace sustainability and emphasize energy efficiency	Energy efficient systems  More customized solutions with use of data driven insights and analytics	Energy efficient solutions Deliver data driven end-to-end systems assessments
<b>Kaeser</b> <sup>4,5</sup>	Emphasize both their own and customers CO2 consumption	Predictive maintenance system	Low life cycle cost Energy efficient solutions by superior compressor technology  Offering various financial alternatives to increase availability
<b>ELGI</b> <sup>6</sup>	Offer products to give continuous uptime  Ensuring energy efficiency at customers	Predictive analytics  Energy efficient services	Forecasts to become the best at energy efficiency to give value for the money to the customer

*Table 5.2. A summary of the focal company's competition.*

<sup>2</sup> Company Ingersoll Rand (2017)

<sup>3</sup> Szefur (2017)

<sup>4</sup> Kaeser kompressoren SE (2017)

<sup>5</sup> Kaeser (2017)

<sup>6</sup> Nanda (2017)

## 6. Analysis

*In the following section, the nine different building blocks of a Business Model Canvas will be analyzed with the studied company, ACCT, as starting point. From the Business Model Canvas analysis, three proposed business models will be presented, explained and motivated. The proposed business models are thereafter discussed with regards to efficiency and profitability in mind. The section will be concluded with an action plan of how to transform successfully.*

### 6.1 Business Model Canvas analysis

The Business Model Canvas analysis aims to investigate each of the nine building blocks that Osterwalder and Pigneur (2010) present in their Business Model Canvas. In line with their division of the nine building blocks mentioned in section 3, Frame of reference, the analysis below will be divided into the following parts; customer, offer, infrastructure and finances.

From the internal empirical results, it has become clear that ACCT is well aware of the technological changes to which they are exposed to. As written in the same section, ACCT is continually working on adopting new technologies that can be advantageous for their competitiveness. The difficulty lies rather in the adoption of the technological change which goes in line with Wessel et al. (2016) discussion of the 20th century powerhouses. Both Westerman et al. (2014) and Heaslip (2015) discuss the two dimensions of a successful transformation; the digital technologies and the culture and leadership skills. In the case of ACCT, the bridge between digital technologies and a successful transformation seems to lack. The empirical results highlights the fact that ACCT struggle with a lack of digital knowledge and cultural aspects, such as willingness to transform.

#### 6.1.1 Customers

*As mentioned in the section 3, Frame of reference, the customer category involves the following three building blocks; customer, channels and customer relationships. These building blocks will be analyzed separately.*

##### **Customer**

In order to define customer segments and understand the differences between them, one need to understand their customers' behavior and characteristics (Osterwalder & Pigneur, 2010). In the analysis below, the following tools will be used to investigate ACCT's customers; the perception of technological adoption and the level of digital potential each sector possess. The aim is to investigate which groupings of customer segments that are compatible with a potential digital transformed value proposition. In the analysis below, conclusions about industries will be drawn solely based the interviews that have been performed with the represented companies.

Based on the customer's production needs, their latest developments and their digital standpoint, see section 5, Empirical results, the respondent companies have been categorized with reference to Rogers' theory of how new technology are adopted.

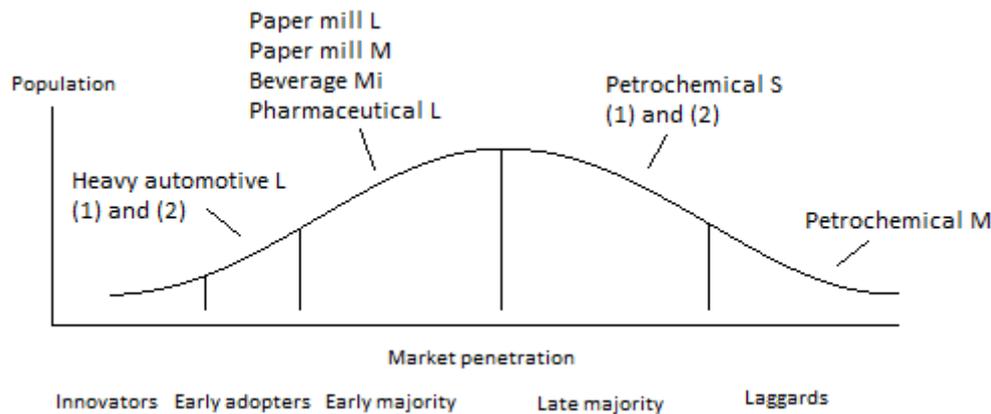


Figure 6.1. The customers in Roger's diffusion of innovation curve.

As seen in figure 6.1, there are no innovators categorized among the respondents. Based on the empirical results, all the respondents operates within mature industries with little space and incentives to innovate. The leftmost group are the early adopters where the heavy automotive companies can be found. These respondents can be compared to opinion leaders because of their self-powered innovative way of working, both physically in terms of production process and mentally in their way of working. The two paper mill companies are categorized as early majority together with the pharmaceutical and the micro beverage company. Given the information in section 5, *Empirical results*, the companies are perceived as innovative in the sense that they seem open-minded to adopt a new product after they seen it useful by the early adopters. For example, the micro beverage company has seen how beneficial it is to have automated production processes and therefore wish to have a more automated production themselves.

All three petrochemical companies are placed on the right side of the curve. All three actors represented more or less a sceptic mindset towards change and the prevailing digital transformation. In some contexts, the medium sized petrochemical company also demonstrated a resistance towards new innovative solutions and that they preferred living in the past with traditional communication, which can be seen in the discussion where they showed a skeptical mindset towards machine communication and automatization of various in house activities. This particular respondent could be compared with Roger's definition of laggards.

SECTOR	KNOWLEDGE INTENSIVE	CAPITAL INTENSIVE	SERVICE	B2B SECTOR	LABOR INTENSIVE	QUASI-PUBLIC
CHEMICALS & PHARMACEUTICALS		X		X		
BASIC GOODS MANUFACTURING		X		X	X	

Table 6.1. The studied industries' digital potential.

In addition to the diffusion of innovation theory, a research made by Gandhi et al. (2016), presented in section 2, *Industrial digitalization*, shows what process the industries have digital potential within, see table 6.1. This classification is used as a tool when determining customers' potential to digitally transform. Among the industries mentioned by Gandhi et. al (2016), three of them are aligned with the respondents; chemicals, pharmaceuticals, and basic

goods manufacturing. All three sectors, pharmaceuticals, chemicals and basic good manufacturing are classified by Gandhi et al. (2016) as capital intensive sectors with the potential to further digitalize their physical assets. In addition, these sectors can also be designated as business to business sectors with the potential to digitally engage and interact with their customers (Gandhi et al., 2016). For basic goods manufacturing solely, Gandhi et al. (2016) also characterize it as a labor intensive sector with potential to provide digital tools to its workforce.

As seen from the above analysis, the result of the customer segmentation by Rogers (2003) theory and Gandhi’s (2016) classification of digital potential among different sectors correlates. Therefore, Roger’s (2003) and Gandhi’s (2016) theories will be used as a combination in the analysis below. Table 6.2 presents the segmentation that is based on the correlated theories mentioned.

Companies	Roger’s theory	Digital potential
Heavy automotive L	Early adopter	Physical assets Customer interaction Workforce
Heavy automotive L	Early adopter	Physical assets Customer interaction Workforce
Paper mill L	Early majority	Physical assets Customer interaction Workforce
Paper mill M	Early majority	Physical assets Customer interaction Workforce
Beverages Mi	Early majority	Physical assets Customer interaction Workforce
Pharmaceutical	Early majority	Physical assets Customer interaction
Petrochemical S	Late majority	Physical assets Customer interaction
Petrochemical S	Late majority	Physical assets Customer interaction
Petrochemical M	Laggards	Physical assets Customer interaction

Table 6.2. Summary of the customer segmentation.

As seen in table 6.2, there are various levels of adoption rates as well as digital potential. As for the companies that operates within the petrochemical sector, Gandhi et al. (2016) means that there is potential for digital transformation in terms of physical assets and customer interactions. However, they seem to lack the potential and will of providing digital tools to the company's workforce, which goes in line with the observations that have been found during the empirical studies. According to Gandhi et al. (2016), the basic goods manufacturing sector, namely heavy automotive, beverage and paper mill companies, have potential within workforce, customer interaction and physical assets. Aligned with observations from the external empirical results, found in section 5, these customers are receptive to transformation. In line with Hammer et al. (2016), to reach a successful transformation it is important to gradually change with an agile strategy. By targeting the actors with high digital potential, Hammer et al. (2016) mean that the more hesitant parties can be reached after it has generated understanding and excitement.

### **Customer relationship**

Osterwalder and Pigneur (2010) distinguish between three customer relationships but in the analysis below, only the relationships regarding current customers will be considered. As the external empirical results indicates, the current customers value personal contact, while the development goes towards a more automated ones (Wessel et al., 2016). Judging from the empirical discussions, the customers think that an improved digital contact will damage the close relationship to the focal company. Two of the petrochemical companies oppose a more digital customer contact, both in terms of purchase process and service requests. Other respondents are more attentive to a potential change, see empirical results.

The use of big data analysis can facilitate a more automated relationship with the customer (Techtarget, 2017). By gathering information about the customer, ACCT can customize its relationship and make them more personal. The information gathered can also be used to proactively offer customers new personalized value propositions, a statement that is recognized by the customers in the empirical results. In addition to a more customized response, a more automated customer relationship would facilitate for ACCT in their operations. As the General Manager said during the interview, less personal interactions in some activities would create more value added in other activities.

### **Channels**

From the empirical results, it becomes clear that the current customers want to be reached in a rather traditional way, such as telecommunication and personal meetings. Although, there are some respondents that are more open towards digitalization and its advantages than others. In line with Wessel et al. (2016) argumentation that internet is found everywhere today, in people's phones and homes, ACCT should take advantage of the opportunity that can enable them to reach customers around the clock. As stated in the empirical results, section 5, ACCT is currently working on a website where they can reach out to their customers in a more digital way and use online communication as a complement to the personal communication activities. This provides a foundation for further digitalization. In some industries, such as fashion industry, social media channels are considered to be useful when delivering value propositions to the customers (Westerman, 2014). Although, with the empirical results in mind, both ACCT and the customers agrees on the fact that the compressor industry deliver products and services for industrial customers and not for private individuals that are the main users of social media channels. However, it can be discussed if social media channels could become a successful channel in the future.

### 6.1.2 Offers

*Opportunities for value creation have been defined by the customer demands and industry trends from section 2, Industrial digitalization. In the creation of value propositions, Dave McClure's elevator ride template of what, how and why. The proposed offers will be presented below.*

*Offer the right spare part at the right time to decrease inventory costs*

Customers have indicated an interest in lowering the inventory costs related to spare parts. The reason why customers store large amount of spare parts is originated in skepticism towards the delivery precision of those parts, because of the high need for dependability. By using sensor technology, wireless communication and big data analysis, the life of spare parts can be predicted which results in right spare part arriving at the right time, not at the expense of dependability.

*Offer right product at the right time to increase dependability*

The customers have shown an increased interest in suppliers that are dedicated to the overall use of compressed air. By predicting the life of the machines and mapping the customers demand for compressed air, the focal company can approach the customer proactively with offerings for additional compressors, in the case of an increasing demand for air and also offer new updated machines to replace old ones.

*Offer right service at the right time to increase the machine's dependability*

Customers press the importance of dependability of a machine due to the fact that their production depends on compressors' functioning. In line with these observations, other actors have also recognized the need of proactive maintenance due to more complex and sophisticated production plants. The machines condition and use are analyzed to predict the life of the machine and its components in order to provide tailored service execution.

*Offer more time-efficient services performed by technicians to decrease service costs*

In the empirical results it has been shown that customers have opted out options because of high service costs and is thereby an influencing factor when choosing supplier. More efficient services can be performed by technicians geared with the information and knowledge needed to perform the job. In order to be prepared, the service technicians could be more connected, have better access to information and real time data and communicate online.

*Offer energy efficient operations to decrease total cost of ownership of the machine*

The empirical result indicates an increased importance of energy efficiency within five years with the argument that the consumption is increasing and energy is getting more expensive. By modular programming, flexibility is achieved which will ensure efficient operations of all machines and decrease the cost of use and thus of long term ownership. In addition to a decrease in total cost of ownership, the value proposition may also demonstrate environmental responsibility externally.

*Offer air as a service where customers pay by use which in turn decrease costs*

In the empirical results, alternative ways of getting compressed air have been discussed. Offering air as a service has been seen as a requested option as the customer then only pay by use, cost per cubic meter, and thereby escapes the fixed cost for a compressor and the associated costs for maintenance. In line with the customer request, traditional product-based companies are now moving towards servitization.

### *Offer cheaper products by improving product and process development*

The empirical results demonstrate the importance of price when choosing compressor supplier. In those cases when the focal company has been deselected, it has been due to price. With transparency, use of today's technology, the development can be streamlined and decrease the cost of producing a unit. By using visualization tools and digital communication, the customer can be involved early in the process, regardless of time and place.

### **6.1.3 Infrastructures**

*In the following section the infrastructures that are required to provide the suggested proposals are presented. The area of infrastructure includes the following building blocks; key activities, key resources and key partners.*

#### **Key activities**

The key activities presented in this section correlates with the presented value propositions in the above section. The activities required for product and process development, efficiency and availability of maintenance and service, energy efficiency, predicted maintenance and air as service will be presented.

#### *Product and process development*

Judging from the discussion presented in section 5, *Empirical results*, many customers base the purchase decision on the total cost of owning the machine including the initial cost of the product. A consequence of a streamlined development process is, according to Ratkovic (2013), decreased product cost which may be reflected in the offered initial price. In streamlining the development process, adopting VR technology has been proven to be particularly suitable according to Pease and Zistl (2014). By using VR tools during the early stages of development for simulating testing instead of performing physical ones, costs of labor and hardware can be decreased, as described in section 2, *Industrial digitalization*. The ability to perform tests early in the process increases the probability of detecting problems early in the process which will make them less costly (Nigel & Slack, 2015). Another way of ensuring that problems are handled early in the process is engaging customers in the concept development phase of the process according to Baur and Wee (2015).

#### *Efficiency and availability of maintenance and service*

Service has proven to be one of the most important purchase factors for customers (see section 5, *Empirical result*) and the lead time on services is in many cases a key for assuring dependability (Ratkovic, 2013). It has been noted in the Empirical results that the physical availability of a service technician lowers the cost of the service, which is a desired feature for customers as well. Even though the service technician is physically available Powell (2016) has recognized a lack in efficiency due to missing knowledge, requiring technicians to travel back and forth from the site. In order for ACCT to avoid such issues, providing service technicians with information and communication devices such as smart gadgets will streamline the service activities (Powell, 2016). With proper use of the gadget, the technician can perform a high quality service efficiently on site and thus increase dependability on the machine while decreasing the costs of the service (Powell, 2016)

#### *Predictive maintenance, spare parts*

According to customers, spare parts are bought and stored in order to ensure dependability of the machine (see section 5, *Empirical results*). By digitally analyzing the life of the machine and its components, precise indications will be provided on when a certain component needs to be exchanged in advance and when a certain service needs to be provided (Siemens, 2013).

The information can further be used by service technicians both to schedule services when needed and order spare parts which arrives right on time (Siemens, 2013). In providing such offering which is referred to as predictive maintenance, the dependability of the machine will increase and at the same time, customers and ACCT's cost of spare part storage will decrease (Siemens, 2013). Predictive maintenance is made possible by the combined use of sensor technology, wireless communication and big data analysis to transmit, gather and analyze information in an IoT system (Bossen & Ingemansson, 2016).

#### *Predictive maintenance, proactive sales*

The ability of suppliers to support the use of compressed air is being requested by customers (see section 5, *Empirical results*). Such ability will be provided by the combined use of sensor technology, wireless communication and big data analysis. The system will enable analysis of the life of the machine and the demand for compressed air over time (Techtarget, 2017). In understanding the condition of the machines and changes in compressed air demand, customers can proactively be approached with customized offerings for compressor exchanges, upgrades and new products (Techtarget, 2017). In the case of ACCT, the sales department needs to be able to understand the data received.

#### *Energy efficiency*

Energy efficiency was considered to become an important purchase factor in the future (see section 5, *Empirical results*) and because of the policy changes towards sustainability (see section 2, *Industrial digitalization*) ACCT will provide energy efficient solutions. Since customers also expressed a need for personalized offerings ACCT will, by utilizing modular programming in combination with technical superiority and efficient operations, meet both demands. According to Golfman and Lammers (2015) modular programming implies easy updates of the system controllers' software on request. Modularized software enables ACCT to offer customers standard products, differentiated by the software modules. The modules will differ from each other in the level of complexity and thus the ability to provide energy efficient operations. The modules can easily be changed since the machines are wirelessly accessed by ACCT. In order to successfully implement modular programs, the right competence is needed.

#### *Air as service*

Customers has expressed a possible future interest in pay by use solutions for compressed air and personalized solutions (see section 5, *Empirical results*). In addition, Baur and Wee (2015) have recognized business models characterized by pay by use offers to be favorable. In order for ACCT to estimate the amount of air the customer have used, the demand for air has to be measured by ACCT themselves. This activity requires both knowledge, time and resources in order to reach a desired result. In addition, as the value proposal change in terms of ownership of the machine, service agreements with customers will be diminished. Instead, a pay by use agreement will be established with the customers and ACCT will be responsible for the machine and its maintenance.

## **Key resources**

According to Osterwalder and Pigneur (2010), key activities can either be of physical, intellectual, financial or human character. In the below analysis, only the physical and human resources will be discussed due to the chosen scope of the thesis.

### *Physical resources*

To meet the increasing demand for energy efficiency expressed by the customers, ACCT offer system controllers for efficient operations of their machines by interoperability (see section 5, *Empirical result*). To ensure that the systems are robust and reliable, in accordance with Wee et al. (2015), ACCT can use standardized systems for all sub control units. By offering robust and reliable operations systems, ACCT also creates customer value in the form of dependability. Dependability was described by the customers in section 5, *Empirical results*, as superior to quality, service and lead time of service. The one customer using leasing contracts expressed difficulties in integrating control systems, especially in the case where the machines had different owners (section 5, *Empirical results*). Efficient control of the machines is related to energy efficiency according to the customers and will be increasingly influential in the future (see section 5, *Empirical results*). As described in section 2, *Industrial digitalization*, flexible systems may be achieved by transparency between all owners of the software and machines (Wee et al., 2015). As transparency is a characteristic desired by the customers (see section 5, *Empirical results*) ACCT do not only provide customers with increased energy efficiency, such customer value also reinforces the relation.

Using common standards on control units facilitates larger wirelessly connected systems of systems which constitutes for internet of things, as described in section 2, *Industrial digitalization*. Having machines wirelessly connected to ACCT, continuously transmitting information of use and condition requires resources and tools to handle the incoming data (Davenport & Dyché, 2013). To successfully manage the data and utilize the information, resources for data management to ensure high quality data, data mining to recognize patterns in the flow of information, Hadoop to store data, in memory analytics for immediate analysis, predictive analytics to statistically predict likelihoods of outcomes and text mining to by machine learning analyze written texts are required. The combination of these resources and robust systems, the focal company can predict the life of components and demand and thus proactively offer solutions and dependable machines (Ratkovic, 2013). Such offerings are expected to be appreciated since customers have expressed a particular interest in suppliers proactively offers additional value based on knowledge (see section 5, *Empirical results*).

Another prerequisite for successful use of big data analysis regards the components transmitting the information wirelessly as discussed in section 2, *Industrial digitalization*. Since customers demand energy efficiency and low lifecycle cost, see section 5, *Empirical results*, these components must align with this need as well. In order to maintain a low price on the product during its life, the components must be low priced but still be of high quality, have a long battery life and low energy consumption (Bossen & Ingemansson, 2016).

The use of such gadgets implies large amounts of background activities. The smart gadgets themselves are only meant to provide the user with relevant information for the task and abilities for limited interaction (Powell, 2016). In offering predictive maintenance services, technicians would be provided with real time information wirelessly transmitted by the machines sensors through a internet of things (Ratkovic, 2013). Information are shown

visually to the user by the gadget and for interaction, the gadget may contain a recording device with voice recognition, a camera or scanner (Ratkovic, 2013). The gadget will contribute to the value creation for customers by simplify and streamline the tasks performed by the user (Ratkovic, 2013).

*Human resources*

In addition to the physical resources ACCT needs to possess in order to deliver a value proposition to the customers, human resources are as important in a successful transformation as physical resources (Osterwalder & Pigneur 2010). Human resources have a tendency to even be forgotten sometimes (Cleverism, 2015). In the empirical results, section 5, personnel and human interaction are emphasized in every stage of the customer relationship, both by ACCT and the respondent customers. Regardless of value proposition, human resources are of great importance to ACCT. As stated in the empirical results, the customer is not only buying a compressor, they are buying the ACCT’s experience.

In order to reshape a value proposition to one with digital character, the employees need to conform. Since previous digital projects, such as the implementation of SAP see section 5, *Empirical results*, resulted in a longer learning curve than expected, the human resources are of even greater importance to ACCT this time.

As discussed by Westerman et al. (2014) in section 3, *Frame of reference*, the barriers to transform often involves lack of leadership, governance, culture and financial cases. This reasoning corresponds with the empirical case where ACCT describes an earlier digital implementation with the same transformational barriers. As written in section 3, Westerman et al. (2014) discuss the following four element how to succeed with a digital transformation: possess a common vision, an engaged organization, an improved governance and good leadership. In the case of ACCT and in line with Westerman et al. (2014) suggestions, the following resources and activities, regardless of value proposition, are recommended in table 6.3.

	<b>Resource</b>	<b>Activity</b>
<b>Vision</b>	Software engineers	Familiarize ACCT with the proposed technologies by using workshops
<b>Engagement</b>	Project managers	Create solutions together with employees by using crowdsourcing
<b>Governance</b>	CEO	Put someone in charge for transformation
<b>Leadership</b>	Knowledge pool	Build up the right digital skill

*Table 6.3. A presentation of the suggested human resources and corresponding activities.*

### **Key partners – Partner networks**

In order to deliver a value proposition, Osterwalder and Pigneur (2010) believe in partner networks. As discussed in section 3, *Frame of reference*, there are different types of relationships which can be applied at the ACCT case. In the empirical results, the employees at ACCT explain that they are skeptical towards partnerships. However, from the external point of view, the customer side, it is preferably desired. The customers emphasize a total demand that can be met by one supplier, as discussed in section 5, *Empirical results*. To achieve this, partnerships are required. As understood, a collision occurs between ACCT's mindset and the customers' demand.

As mentioned above, Osterwalder and Pigneur (2010) discuss four different types of partnerships, one of them is strategic alliances where companies can benefit from others' core competences. Wessel et.al (2016) discuss the Industrialist dilemma and its difficulties to change well established internal systems and they mean that the powerhouses of 20th century that still operates today have a difficult time adapting to this new data driven world. In line with the above reasoning, the Industrialists could benefit from strategic alliances with companies that possess digitalization as their core competencies. It can give better access of knowledge and increase effectiveness by producing better products and services (Wessel et al. 2016). In the case of ACCT, partnerships with software developers, customers and technology vendors could enhance their competitiveness due to additional knowledge.

The remaining two partnerships; Coopetition (cooperation between competitors) and joint venture, actors that creates new businesses will not be discussed due to ACCT's core values.

### **6.1.4 Finances**

*The section consists of the two building blocks: cost structure and revenue stream. In the analysis below, these two will be further discussed with regards to the suggested value propositions.*

#### **Cost structure**

When adopting digital technology initial costs related to implementation and adoption appears (Bossen & Ingemansson, 2016). Costs of investing in new equipment and installation appear at the moment of purchase but there are also other following costs (ibid). Implementing new technologies require education in the use of the new technology, in order for the users to make the initial investment worth it. (ibid). Automation of activities that would otherwise been performed by individuals, labor costs decreases and remaining personnel can focus on value adding activities (Nigel & Slack, 2015). In the case of ACCT, this create a reduction in labor costs.

Implementing digital technology in the product development and production planning process will include costs of implementation, adaptation and adoption (Bossen & Ingemansson, 2016). The cost of producing products will decrease when the new technology is installed (ibid). The product cost will decrease since the new technology will imply shortened development time and thus less development costs, which are imbedded in the total cost of producing the product (Nigel & Slack, 2015). By adopting digital technology during the production planning stage the trial time for producing the new product and including it in the production logistics decreases which implies a smooth implementation and thus decreased costs (Bossen & Ingemansson, 2016).

Since a majority of the people employed is related to service, service operations have a large effect on the overall cost of ACCT's business (see section 5, *Empirical results*). It has been recognized by Powell (2016) that service technicians often lack time efficiency. More time-efficient service technicians imply more tasks performed on the same amount of time and thus the cost of labor for each task will be lowered Powell (2016).

### **Revenue stream**

As specified in section 1, Introduction, ACCT aims to increase the company's profitability and one way to do that is to increase the company's turnover/revenue stream. Osterwalder and Pigneur (2010) distinguish between one-time customers and continuous payments from a customer segment. In the following analysis, continuous payment will only be discussed due to the formation of customer segments that is solely based on the current customer base. The chosen value propositions will create a variety of revenue streams. Initially, a differentiated offer will create a totally new revenue stream for ACCT and thereby incur revenue. In addition, recurring revenues occurs in conjunction with those value proposals that are likely to continue in the future, such as the service based value proposals. The service based proposals also include value added services in terms of more activities performed in less time. ACCT will also be able to charge more for those value added services. In line with the discussion above of a potential website development, advertising in a greater extent could be a possible revenue stream for ACCT. An extended website will attract companies that want to pay to be visible at their website and therefore create a revenue stream from advertisement.

## **6.2 Proposed business models**

From the above analysis, three potential business models have been developed with the grounds that those offers are assessed to be relevant for ACCT. The purpose of these business models is to create added value for the customers and increase ACCT's competitiveness on the market. The offers that were rejected are not considered to be sufficiently demanded by the customers nor a competitive mean in the compressor industry, based on the empirical results and the findings on industrial digitalization. All offers can be found in section 6.1.2 Offers and the ones that was chosen to be part of the business models was "Offer energy efficient operations to decrease total cost of ownership of the machine" which is found in Proposal 1, "Offer right service at the right time to increase the machine's dependability" and "Offer more time-efficient services performed by technicians to decrease service costs" which are both found in Proposal 2 and finally "Offer right product at the right time to increase dependability" which is found in Proposal 3. These offers were each chosen since they were the ones that are directed towards the main customer demands that were found during the customer study (see section 5, *Empirical results*): dependability and energy efficiency. Dependability was considered to be one of the two customer needs to focus resources on since it is related to the three purchase factors that was considered to be of highest importance today: quality, service and price. Energy efficiency was chosen since it was the one factor that was considered to become of higher importance for the interviewed customers in the future. The "Offer the right spare part at the right time to decrease inventory costs" offer was rejected since it was not considered to affect the dependability of the products compared to the offers that was directed towards service. The reason why the offers named "Offer air as a service where customers pay by use which in turn decrease costs" and "Offer cheaper products by improving product and process development" were rejected were the lack of interest amongst customers in both offers. Customers was willing to accept a high price for products of high quality and the interest in buying air by use was currently not considered to be high enough.

The customers have been segmented based on Roger’s diffusion of innovation theory and Gandhi et al. (2016) discussion of industries’ digital conditions. As presented above, the analysis touch upon four out of five consumer groups which correlates with the categorization of digital potential and thereby, the segments will only be refereed as the four adoption groups as continued, see table 6.4. As discussed in section 3, Frame of reference, it is useful to target one group of customers and then gradually progress to others. In this case, in line with Roger’s (2003) reasoning, it is recommended to begin with the early adopters due to their technological adoption rate and digital potential, and gradually continue to early majority when the product or service has been proven to be successful. As a result of this, it is recommended to keep the old business models until the new ones are well-functioning for all customer segments.

Early adopter	Early majority	Late majority	Laggards
Heavy automotive L	Paper mill L	Petrochemical S	Petrochemical M
Heavy automotive L	Paper mill L	Petrochemical S	
	Beverages Mi		
	Pharmaceuticals L		

Table 6.4 Customers segmentation based on Rogers’ (2003) and Gandhi’s (2016) theories.

**Proposal 1: Energy efficiency**

From the given proposals, it has been understood that energy efficiency is, in addition to a customer demand, a potential competitive mean. As seen in section 5, *Empirical results*, energy efficiency has increased in importance for compressor companies around the globe. By offering an energy efficient solution, the customers could reduce cost for energy consumption at the same time as ACCT could gain value added sales, due to the new value offered to the customers of measuring energy efficiency. From the empirical results, section 5, it has been recognized that ACCT currently offers a parsimonious service for measuring energy efficiency. This will probably facilitate the acceptance of the new offer. In addition, this proposal can be seen from an environmental point of view. As mentioned in section 2, *Industrial digitalization*, the demand for environmentally friendly products have increased in conjunction with Agenda 2030 where development and environment are considered jointly. The proposal can thus be seen as both advantageous from a cost and environmental point of view, in line with Porter and van der Linde (1995).

The energy efficiency proposal involves an agile solution where the customer is able to scale up and scale down the consumption digitally. Through modularization, together with system controllers and wireless communication, the customer gives the possibility to add and remove software functions. This simplifies programming updates in that sense that changes can be done with as little effort as possible as discussed in section 2, *Industrial digitalization*. In the prevailing industrial climate, actors need to be agile and modular to thrive in today's rapidly changing environment (Fettke et al., 2014). With regards to that reasoning, a modular proposal can increase ACCT’s competitiveness. The developed Business Model Canvas is presented below, see figure 6.2.

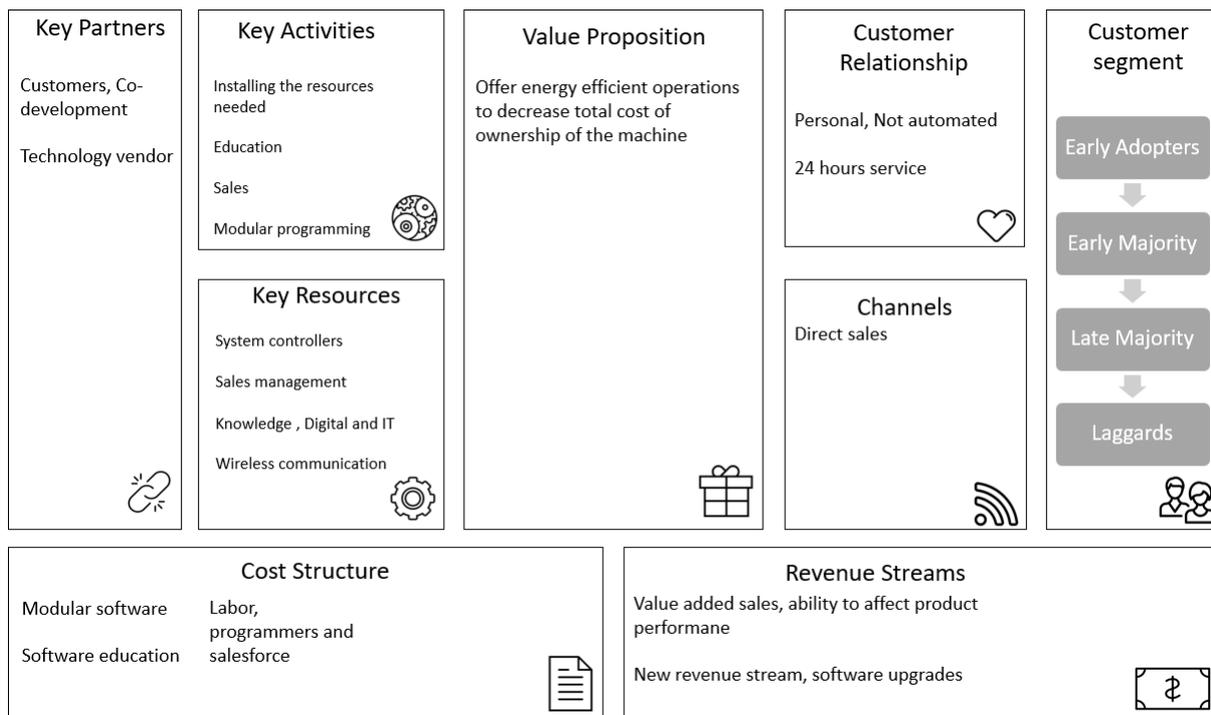


Figure 6.2. Illustrates the business model of “Energy efficiency”

To deliver a differentiated value proposition, close and personal communication between supplier and customer is desired by the customer, see Empirical results section 5. Direct sales is thereby a useful channel to communicate the provided value to the customer segment. In addition, 24 hours service is a necessity to support customers with the new delivery. To deliver a new value proposition which entails a new revenue stream, efficient sales management becomes a key activity. The sales engineers need to know what they are selling and to whom.

As explained above, new technological sets up also require human resources. To be able to perform good sales activities, a well-established sales management is essential. There is also a need for IT/software knowledge that can execute the software installment needed. To be able to use the system controller, standardization of all units are also needed (Wee et al., 2015). To make this business model effective, it is also recommended to have partnership, see figure 6.2, in order to support the more continuous relationships. Also, the customers are perceived as a partner in this particular case as they will become co-developers.

### Proposal 2: Offer efficient services at the right time

After a product has been sold, the opportunity to maintain it arises (See section 5, *Empirical results*). It has also been proved that customers consider service as one of the highest valued features when buying a compressor, which have been demonstrated by rejection of inefficient services. In order to capture those business opportunities it is concluded from the customer interviews that the right service needs to be offered at the right time. The opportunities does not appear exclusively for ACCT but for competitors as well and customers choose the most beneficial offer (see section 5, *Empirical results*). To provide customers with a superior offer a proactive and efficient approach is proposed. In line with this reasoning the two value propositions shown in figure 6.3 were combined to form the basis for this business model. By combining the two value propositions (offer more time efficient services performed by technicians and offer the right service at the right) both dependability and cost reductions can be offered to the customer. In order for technicians to gain access to the right information, the

use of smart gadgets are proposed. The purpose of the gadget would be the interaction, to serve as a user interface (Powell, 2016). The information accessed by the gadget would originate from the predictive maintenance system, to further utilize it for more efficient services. By providing more efficient services, revenues from services will increase since technicians will have the ability of generating more value for the customers with the same amount of effort (Powell, 2016). This business model also implies increasing automation in the back office, minimizing the human interaction which leads to lower labor costs and the dependence on the single person's competence at the focal company (Pease and Zistl, 2014). In offering proper services on products increases the life of the product, ensures a stable and prolonged revenue stream from service.

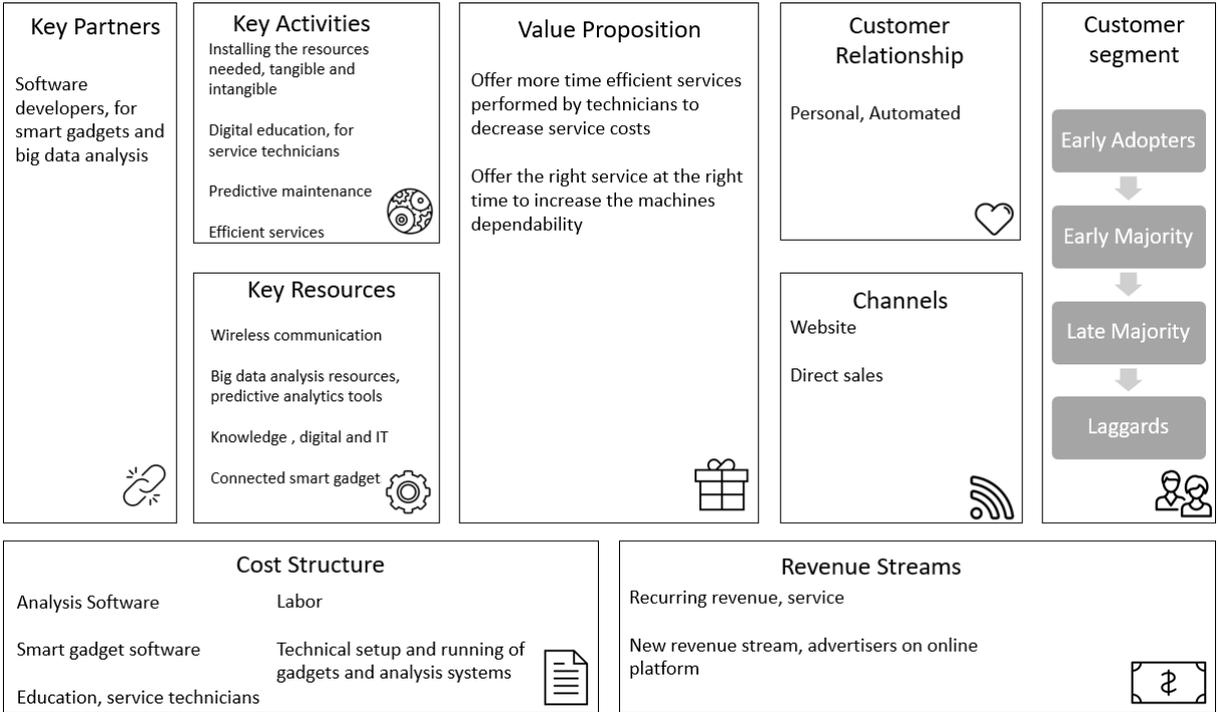


Figure 6.3. Illustrates the business model of “Offer efficient service at the right time”

As figure 6.3 presents, the business model is characterized by big data analysis and the use of smart gadgets. As big data analysis enables an extended interface between the human and machine, see section 2, *Industrial digitalization*, the customer relationship will be almost completely automated. The channel would be direct sales in order to still maintain a close, yet still automatic, customer relation (see figure 6.3). Since the service opportunity will be automatically predicted, the customer can gain access to that information automatically and get the opportunity to order the service in advance via an online platform. The digital platform on the company's website would contain a customer and a service technician interface. Both parts would be able to log into the website and thereby gain access to schedules and relevant information regarding the service operation. By having a trafficked website, the possibility for revenue from advertisers marketing themselves on the website appears. To increase revenue from advertising, the concept of improved pricing can be used match advertisers with customers (LaRiviere et. al (2016). By accessing the real time stream of digital customer information using wireless connections and big data analytics, ACCT can gain objective information about the customers (ibid). In order for the service technicians to handle gadgets needed to perform the service efficiently they need to be trained. The education’s aim is to make the service technicians adopt the technology.

### Proposal 3: Offer right product at the right time

Given the rapid transformation of the industry sector, ACCT needs to proactively capture business opportunities to increase revenue. With access to a flow of real time data of the machine, ACCT can approach customers with a new offer when their current machines is close to collapse. Proactive sales management can be achieved with the use of predictive analytics to predict the demand (Davenport & Dyché, 2013). In addition, the use of wireless communication reduces the cost of devaluing data due to less human work and decreased labor costs.

In addition, wireless communication is often used to reduce cost to devalue data. As described in Proposal 1, in order to succeed with proactive sales offers, good leadership is important at the focal company. By measuring the condition of the machines, the sales engineers can recognize a need even before the need has arisen at the customer. Since the customer is approached before the need is realized, competitive offerings can be blocked in advance, preventing competitors to increase their business. The sales engineer can be at the right place at the right time. This value proposition will create more opportunities for ACCT which in turn can be transformed to sales and further increased revenue. The customer will gain a continuous flow of products and reduce the risk of potential breakdowns, namely an increased level of dependability.

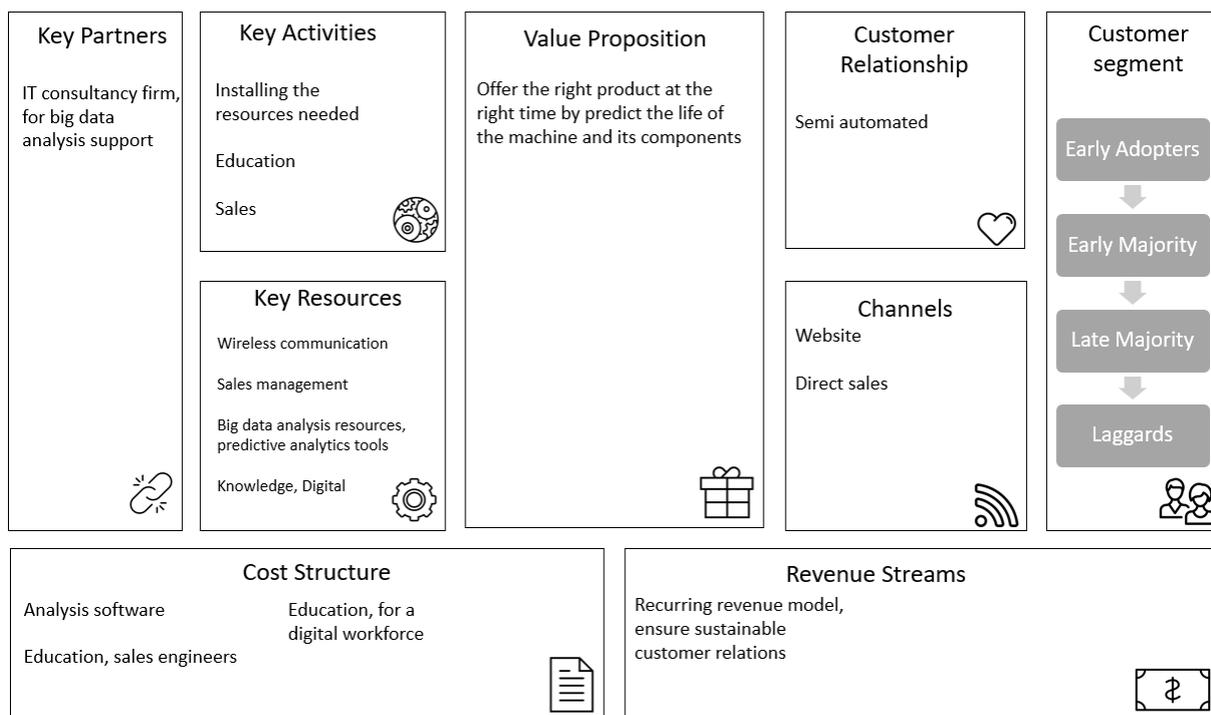


Figure 6.4. Illustrates the business model of “Offer the right product at the right time”

As seen in figure 6.4, the value proposition will be communicated in a semi-automatic way which means that it will be automated where it is possible. Direct sales will be used as a way to approach customers with the supplement of an extended version of today’s website. A combination of personal and digital channels is recommended due to the predicted maintenance system along with the customer demand. As mentioned above, in order to reach a predictive maintenance system, tools for predictive analytics and a wireless communication system will be needed. The required technologies needs to be installed and lectured in how to use in order to make the transformation as efficient as possible. In addition, the sale engineers need to learn how to interpret the data correctly, creating another need of education. A

strategic partnership with an IT consultancy company would be necessary in order to support the new installments and required training.

### 6.2.1 Discussion of the proposed business models

In order to reach a sustainable transformation, improvements of both existing products and services are desired (Westerman, 2014). As mentioned in section 3, Frame of reference, Bilefield (2016) emphasizes the importance to transforming throughout the organization in order to succeed with a digital transformation. In line with these reasonings, the three proposals presented above will be linked together to create a completeness and sustainable transformation. The three proposals together represent an improvement in both product and service and as they involve both sales, product and service department, the transformation will be performed throughout the organization. The digital transformation of ACCT can be illustrated with a circular orbit, see figure 6.5.



Figure 6.5. The proposed process of digital transformation.

As the discussion above proposes, the linkage between the three proposals can be presented as following. Initially, ACCT should offer an energy efficient solution due to future customer demands and external forces such as increased cost of energy and environmental aspects. In order to maintain the condition of the machine, efficiently performed services are required. With a proactive approach, the customer will receive time efficient service at the right time without any disruptions in production. Someday, the machine will need to be replaced. Using proactive sales management, ACCT can offer the right product at the right time, prior the customers' awareness. In line with the first proposed business model, the right product is characterized by energy efficiency. In order to reach a sustainable transformation, all three proposals in the circular orbit is of importance. As seen in previous section, all three business models have some resources and activities that are alike and those will be shared between the models.

As discussed in the above analysis, the customers are segmented into their digital potential and adoption rate. In line with Roger's (2003), the heavy automotive companies were classified as early adopters and the medium sized petrochemical company was classified as a

laggard. Since the characteristics differ between the early adopters and the laggard, the total duration of the circular orbit will be shorter for the early adopter compared with the laggard. As mentioned in the external empirical results, the medium sized petrochemical company does not consider that the importance of energy efficiency will increase in the future. Those actors will thereby be more difficult to persuade why they should buy an energy efficient solution. In addition, as laggards tend to be very traditional in relation to new proposal, the process of demonstrating the benefits of a digital product or service will be longer in comparison to the heavy automotive companies that are perceived as open and accessible for new opportunities. It may thus be considered unprofitable to put effort and allocate resources on digital offerings to the laggards.

Since these three business models all contain digital elements, combined with the fact that ACCT does not yet possess all digital capabilities needed, the digital adoption process is of great importance. Because of the high importance of digital adoption, it is also considered to be the main obstacle for ACCT to successfully implement these business models and linking them together.

### **6.3 Action plan for ACCT**

In order for ACCT to exploit the benefits of digitalization and to utilize the suggested business models, ACCT should, in line with Libert et al. (2016) and Maxwell (2017) framework of transformation, ensure the following steps in the digital transformational process:

#### **Reality check**

In order to reach a successful transformation, ACCT needs to clarify their starting point in terms of what they do and how they do it. In the case of ACCT, they should be aware of how common changes are executed within the company and use that as a starting point, see section 5, *Empirical results*. While documenting these activities, it is also important for ACCT to realize that what they did years ago might not be the most efficient way to do it today. For an incumbent company, realizing its inferior position in digital contexts is a first step. Since the powerhouses of 20th century have difficulties in adapting to new digital initiatives, as Wessel et al. (2016) argue, it is essential for ACCT to realize that they might ask for help and direction from external partners. The internal empirical results demonstrate a strength in technological awareness while a weakness in actual usage and mindset towards change. As previous digital projects have indicated, the obstacles with implementation have been the lack of adoption. In order to avoid previous mistakes, ACCT should as discussed above clarify their starting point. ACCT appear confident in their own digital abilities, stating that they have nothing to gain from collaborating with other companies when developing new technologies (see section 5, *Empirical results*). Such over self-confidence implies the risk of not being attentive enough to their surroundings, for ACCT, and thus the risk of being overrun by innovative 21<sup>st</sup> century corporations increases (see section 2, *Industrial digitalization*). For this reason, it is of high importance for ACCT to truly engage in this first step and to avoid being subjective when clarifying their starting point.

In addition, Maxwell (2017) stresses the importance of understanding the customers' and their total needs. As seen in the internal empirical results, customer differs in requirements, production needs and what they value. In line with this, ACCT might consider changing the assumption of product based segmentation and rather use a more customized approach, as the segmentation presented above.

### Company assets

The second step in achieving a successful transformation, is according to Libert et al. (2016) to do a compilation of all assets within the company, tangible as intangible. In line with Osterwalder and Pigneur (2010) reasoning about the oversight of human resources, it is even more important for ACCT to emphasize the intangible assets such as skills of employees. In the empirical results, previous digital project are presented and from that information it can be concluded that ACCT seems to lack the intangible resources needed to perform a digital transformation. For example the ACCT project of incorporating mobile phones in the service technician's' daily work had a long execution time due to a lack of digital knowledge and incentives. In order to perform this step successfully, ACCT needs to be aware of what they are possessing. For this step, it is equally important as for the previous that ACCT obtain an objective viewpoint when compiling company assets to avoid the risk of becoming outdated by being overly self-confident.

### Future visualization

As the third step in ACCT's action plan, sustainable goals needs to be established. As discussed in section 1, *Introduction*, the purpose of the current digital transformation is to increase the company's efficiency and profitability. Initially, to clarify these goals, these KPI's should be quantified. In addition to this, ACCT should establish long term goals that are in line with the company's prevailing KPI's. The purpose of not treating the digital goals separately from the company's overall goals is to avoid misalignment and thus facilitate prosperity.

Libert et al. (2016) claim that one should look at the transformation as a creation of a digitalized network where the primary actor, in this case ACCT, can benefit from the external actors. Consequently, ACCT should think outside their current barriers and embrace the external environment. Tentatively, as mentioned in the above analysis of partnership, ACCT should explore the opportunities of partnering with actors that possess knowledge that ACCT lack. As the interviewees at ACCT described their core competences it was clear that IT and digital technology was not included (see section 5, *Empirical results*) and it is therefore recommended, as suggested in the three business models, that ACCT engage in alliances where such knowledge can be gained.

### Begin the transformation.

Wessel (2017) discusses the difficulty of getting all different incentives at a company to become aligned. There will always be employees that disagree, as in the ACCT case interpreted from the internal empirical results. In order to meet the uncertainties that a transformation generates, Libert et al. (2016) recommend actors to conduct a pilot study while Wessel (2017) argues for creation of small clusters. In line with these arguments and the above analysis, pilot studies with an associated feedback loop are recommended to decrease the future implementation time. In addition, pilot studies performed in small clusters with visible results could facilitate the conviction of the more resistant employees. As was shown in the empirical results (section 5), the digital resistance appear to be highest amongst the service technicians, which constitutes a risk when implementing the business model that is previously referred to as "Proposal 2" that implies service technicians using advanced digital equipment. For this reason this area requires extra attention and it is recommended that ACCT perform a pilot study at a department that appear more willing to accept new technology to, when showing examples of successful implementation and the benefits of the new technologies, gain trust from the more suspicious individuals.

### Measurements

As presented in the internal empirical results, ACCT follows the proverb, what gets measured gets done. Currently, ACCT holds many measurements. Although, during a digital transformation, new KPI's needs to be created (Libert et al. 2016). The above mentioned KPIs such as efficiency and profitability are useful when the transformation is executed but until then, new KPI's needs to be established (Libert et al. 2016). KPIs during a digital transformation is often characterized by non-financial index such as conversion rates and click through rates among others. The challenge is to connect these non-financial indicators with a company's business. In the case of ACCT, this may involve investing in new methods of measurements.

## 7. Conclusion

*In the following section, the conclusion of the thesis will be presented. By answering the three research questions specified in section 1, Introduction, the following purpose of the thesis will be achieved:*

*“The purpose of this thesis is to analyze how Atlas Copco Compressor Technique can innovate its business model in order to increase efficiency and profitability, given digitalization.”*

### **RQ1: How could the Swedish air-compression industry be affected by digitalization within the next five years?**

Concluding from the findings, the compressor industry is developing and moving towards increased digitalization. The main industrial implication related to digitalization that is recognized is the prevailing threat of new entrants. The threat may appear by actors doing the same things as incumbents, but in an improved way, or by disruptive actors substituting the incumbent firms. At the same time, as companies embrace the new possibilities and opportunities of digitization, the risk of companies disrupting the mature compressor industry is evident. ACCT’s competitors are, similar to ACCT, characterized as incumbent firms which indicate that they experience the same difficulties as ACCT in adapting to digitalization. New entrants do not experience path dependency to the same extent as incumbent firms and are thus often free to explore problems from different points of view than the traditional. Highly digitalized new entrants, for which digital technology is a natural part of the business, may one day solve the same problems for customers as ACCT does but in a more innovative and efficient way. These new entrants may also use new innovative business models that enables them to fully utilize the benefits of digitalization and thus constitutes for the greatest threat for ACCT.

Actors within the compressor industry are implementing digital technologies aligned with the concept Industrie 4.0 to increase competitiveness against new threats such as new entrants and substitutes. Adapting to digitization has enabled competitors to alter their business models, moving from product focus towards embracing a more holistic view of the purpose of their business. This imply that within five years the industry will constitute of actors doing business in alternative ways than today. Incumbents in the compressor industry are developing their value propositions incrementally and are likely to follow in the footsteps of the automotive companies and develop more digital products, still maintaining the basic way of doing business with some exceptions. Incumbent clients are offered high quality products, such as energy efficiency and predictive maintenance services.

Summarizing this section, the Swedish air compression industry could be affected by digitalization in different ways. The Swedish air compression industry is likely to be characterized by a larger amount of actors within the next five years due to the fact that digitalization is making it easier for new actors to enter the market. The actors have likely embraced digitalization and the use of differentiated business models while incumbent firms still struggle with digital and innovative solutions.

### **RQ2: What opportunities and threats will digitalization imply for Atlas Copco Compressor Technique in terms of products, processes and people?**

The opportunities that emerge from digitalization are concluded to be energy efficiency and value adding services and enhanced customer relationships. At the same time, these

opportunities also appear for competitors which constitute as a threat to ACCT. The external findings indicate that there are small differences between compressor suppliers' competitive offers, so it will be how well their offers are executed that will differ.

In order to capture the opportunities it is concluded that the transformation must come from within ACCT. In establishing the processes and people needed to execute the digital competitive strategy and thereby capture the product related opportunities, new ones arise. By obtaining an engaged workforce and supporting processes, opportunities for further digital development appear organically. Opportunities for digital development, by internal initiatives, is captured by a shared vision and leadership combined with both top down and bottom up information flows. Barriers towards such development are lack of knowledge and lack of incentives to adopt new ways of doing things. It is recommended to encounter these threats, to provide an organizational structure that enables two way communication, educating employees and acquiring digital competence.

The main conclusion of this research question is that the product, process and people dimensions are interconnected and mutually reinforcing. Opportunities created in one dimension will enable new opportunities in the other two as well. Barriers towards those opportunities are lack of knowledge and opposition towards doing things in a new way.

**RQ3: How should Atlas Copco develop their business model within five years by employing digitalization in order to expand their business through new revenue streams?**

Starting from today's situation and the potential opportunities and threats that ACCT could face in a transformation, three business models that can be considered interrelated have been created. As the complexity of the problem lies in a lack of knowledge of how to respond to digital change, the recommendation to ACCT is to adopt the three following business models; one that offer energy efficiency solutions, one that offer more time efficient services at the right time and one that offer provocative sales management in terms of offering the right product when the customers are in need of a new one. In addition to these business models, an action plan of how to embrace digital changes is provided as a complementary. The action plan involves the following five steps; a clarification of the company's starting point, an identification of the company's assets both tangible and intangible, a visualization of the future in terms of establishing long term goals, an alignment of the different incentives within the company and finally, measure the digital transformation process.

It can be concluded that by adopting the three business models presented, a sustainable transformation can be achieved. The business models combined include digital elements that can emphasize internal adoption processes and value creation in the form of efficiency and customization. By combining technology with digital adapted internal processes and a knowledgeable workforce, ACCT has the opportunity to develop their business through new revenue streams. In addition, the recommended transformation will differ in execution time between industry segments. Different industry segments require different approaches and adaptation techniques whereby a recommendation will be to begin the transformation with the consumer group *early adopters*. Subsequently, the remaining groups of customers can be targeted. In order for ACCT to transform throughout the organization and to perform a successful business model transformation, the emphasis must lie at the technological adoption rate where the human perspective is the center of gravity (transformation).

ACCT should develop their business model by incorporating the three chosen digital offers (energy efficiency, efficient services and provocative sales management) in order to expand their business within five years.

## 8. Future research

*In the following chapter, possible areas for future research will be presented and discussed and above that, criticism of the report will be ascertained.*

In hindsight, it can be argued that the result of the study can be applicable in other industries as well. The mindset to transform the entire organization is equally important, regardless of what sector the company operates within. However, it is essential to be aware of the possible criticism that can be directed towards the study. Even if the study aimed to disarm the concept of digitalization, it is important to be aware the risks that are involved. Companies must actively decide on the level of transparency in order to avoid possibly fatal security breaches. Thereby it is recommended to further investigate the possible risks a digital transformation could entail.

This study can be seen as an indicator for ACCT to value the perspective of customers in a larger extent. A future recommendation to ACCT is therefore to perform a more extensive customer research with a wider range of participating customers, both in terms of number of interviewees but also additional sectors and a wider geographical distribution. A larger sample size could enable a higher level of credibility of the study and thereby result in a more representable research to be used for further developments.

However, it can be discussed from another point of view, whether an extended customer research would help or hinder a future digital transformation of ACCT. Both the focal company and its customers are defined as incumbent firms and one of their common denominators is the resistance to change and digital initiatives which leads to the question how useful that type of research would possible be. As Henry Ford once said, “If I had asked people what they wanted, they would have said faster horses”. If ACCT would like to keep their front position in the line of compressor suppliers, they should consider the meaning of Henry Ford’s quote and act from there. An alternative future recommendation for research could be to, instead of asking the customers what they want, observe what they need. In a world of constant change, thinking outside the box is essential for every actor, regardless of the characteristic of the company.

Further related to customers, it would be of interest to study a new segmentation and investigate its feasibility to ACCT. As observations indicate, customers from different sectors have different needs whereupon they can be divided into differently segments. Since the characteristics differs between these groups, they could be approached differently. This study can be seen as an indicator for a possible change, however, to get an applicable segmentation, a more extensive research should be performed before any decisions are taken.

## References

- Achtenhagen, L., Melin, L. and Naldi, L. (2013). Dynamics of Business Models - Strategizing, Critical capabilities and Activities for Sustained Value Creation. *Long Range Planning*, 46 (2013) 427-442
- Air Compressor Guide (2016a) <http://www.air-compressor-guide.com/blog/using-compressed-air-think-again> (2017-02-01).
- Air Compressor guide (2016b) <http://www.air-compressor-guide.com/blog/the-cost-of-compressed-air> (2017-02-01)
- Amit, R. and Zott, C. (2012) Creating value through business model innovation. *MIT Sloan Management Review*. March 20. <http://sloanreview.mit.edu/article/creating-value-through-business-model-innovation/> (2017-02-15).
- Andersson, A. (2015). Volvos nya chassissimulator – används av Ferrari och Porsche. *Automotorsport*. September 10. <http://www.mestmotor.se/automotorsport/artiklar/nyheter/20151009/volvos-nya-chassissimulator-anvands-av-ferrari-och-porsche> (2017-03-28)
- Baller, S., Dutta, S. and Lanvin, B. (2016) *The Global Information Technology Report 2016: Innovating in the Digital Economy*. Geneva: World Economic Forum.
- Bar-Joseph, U. (2013). Big Data = Big Trouble: How to Avoid 5 Data Analysis Pitfalls. <https://searchenginewatch.com/sew/how-to/2289574/big-data-big-trouble-how-to-avoid-5-data-analysis-pitfalls> (2017-04-05)
- Bates, K. Bates, H. and Johnston, R. (2003). Linking Service to Profit: The Business Case for Service Excellence. *International Journal of Service Industry Management* 14. 2 edition p173-184
- Baur, C. and Wee, D. (2015). *Manufacturing's next act*. McKinsey&Company. June 2015. <http://www.mckinsey.com/business-functions/operations/our-insights/manufacturings-next-act> (2017-05-21)
- Bilefield, J. (2016) *Digital transformation: The three steps to success*. McKinsey&Company. April 2016. <http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/digital-transformation-the-three-steps-to-success> (2017-02-04)
- BIAB tryckluft (2011) *Trycklufts guiden*. Ludvika. [http://www.maskincentrum.com/sites/290/content/docs/TryckluftGuiden\\_2011\\_.pdf](http://www.maskincentrum.com/sites/290/content/docs/TryckluftGuiden_2011_.pdf) (2017-03-11)
- Bossen, H. and Ingemansson, J. (2016) *Digitalisering av svensk industri – Kartläggning av svenska styrkor och utmaningar*. Stockholm: Vinnova
- Bradley, C. and O'Toole, C. (2016) *An Incumbent's guide to digital disruption*. McKinsey Quarterly. May 2016. <http://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/an-incumbents-guide-to-digital-disruption> (2017-03-10).

Bundesregierung (2015). Europe must become faster. [https://www.bundesregierung.de/Content/EN/Reiseberichte/2015/2015-01-21-merkel-davos\\_en.html](https://www.bundesregierung.de/Content/EN/Reiseberichte/2015/2015-01-21-merkel-davos_en.html) (2017-03-17)

Business model (2017). Financial Times Lexicon. <http://lexicon.ft.com/Term?term=business-model> (2017-02-10).

Carreiro, P. (2015) Industry 4.0: an industrial evolution, rather than a revolution. <http://www.techradar.com/news/world-of-tech/industry-4-0-an-industrial-evolution-rather-than-a-revolution-1286048> (2017-03-15)

Cleverism (2015) <https://www.cleverism.com/key-resources-building-block-in-business-model-canvas/> (2017-03-23).

Company Ingersoll Rand (2017). Innovation at Ingersoll Rand. <http://company.ingersollrand.com/ircorp/en/discover-us/innovation.html> (2017-03-20)

Davenport, T. and Dyché, J. (2013). Big data in big companies. SAS Institute Inc.

Dearing, J.W. (2009). Applying Diffusion of Innovation Theory to Intervention Development. Colorado: Institute of health research.

Deloitte Digital (2015). <https://eu.deloittedigital.com/en/content/digital-maturity> (2017-02-14).

Diplomacy Edu (2017). Standardisation – The Key to Unlock the Sustainable Development Goals (SDGs) . <https://www.diplomacy.edu/blog/standardisation-%E2%80%93-key-unlock-sustainable-development-goals-sdgs> (2017-03-15)

Doz, Y. and Kosonen, M. (2010). Embedding Strategic Agility: A Leadership Agenda for Accelerating Business Model Renewal. Long Range Planning Special Issue on Business Models, Vol 43, N°2-3, April/June 2010.

Easterby-Smith, M., Jackson, P.R., Thorpe, R. (2015) Management & Business Research. Thousand Oaks: Sage.

Egy (2016) Kompressorer har ett brett användningsområde. <https://egy.nu/kompressorer-har-ett-brett-anvandningsomrade/> (2017-02-04).

Equalclimate (2017). Sveriges vision - Ledande miljö nation i världen. [http://www.equalclimate.org/se/vem\\_gor\\_vad+/sverige/statliga\\_satsningar/Sveriges+vision%3A+ledande+milj%C3%B6nation+i+v%C3%A4rlden.9UFRzGWI.ips](http://www.equalclimate.org/se/vem_gor_vad+/sverige/statliga_satsningar/Sveriges+vision%3A+ledande+milj%C3%B6nation+i+v%C3%A4rlden.9UFRzGWI.ips) (2017-03-18)

Evry (2017). Fordonsindustrin. <https://www.evry.com/sv/branscher-och-it-tjanster/it-tjanster/applikationstjanster-och-losningar/erp/evrys-erbjudande-for-tillverkandeindustri/fordonsindustrin/> (2017-03-30)

Fargel, J. (2014). SAP To showcase augmented reality at CTIA. Augmented reality for enterprise alliances. September 8. <http://thearea.org/sap-showcase-augmented-reality-ctia/>

(2017-04-12)

Fitzgerald, M., Kruschwitz, N., Bonnet, D. and Welch, M. (2013). Embracing Digital Technology: A new strategic imperative. Massachusetts: MIT Sloan Management Review.

FN (2017). Agenda 2030 - Globala mål för hållbar utveckling. <http://fn.se/vi-gor/vi-utbildar-och-informerar/fn-info/vad-gor-fn-2/fns-arbete-for-utveckling-och-fattigdomsbekampning/agenda-2030-globala-mal-for-hallbar-utveckling/> (2017-03-17)

Gandhi, P., Khanna, S. and Ramaswamy, S. (2016) Which industries are the most digital (and why)? Harvard Business Review. 4/2016.

Gathio, M. (2015) How Applications of Big Data Drive Industries. Simplilearn. October 20. <https://www.simplilearn.com/big-data-applications-in-industries-article> (2017-03-22)

Geissbauer, R. Vedso, J. and Schrauf, S. (2015) Industry 4.0: Building the digital enterprise. PWC, September 2015. <http://www.pwc.se/sv/publikationer/transport/industri-4-0-viktiga-resultat-for-transport-och-logistikbranschen.html>

Germany Trade and Invest (2017). Industrie 4.0. <https://industrie4.0.gtai.de/INDUSTRIE40/Navigation/EN/Topics/industrie-4-0.html> (2017-05-16)

Golfman, J. and Lammers, T. (2015). Modular product design: reducing complexity, increasing efficacy. Ernst and Young. February 2015.

Globalportalen (2017). Klimat och miljö. [http://globalportalen.org/amnen/klimat-miljo?gclid=Cj0KEQjwwLHBRDD0beVheu3lt0BEiQAvU4CKsZa4-M6Fa2syKFCAm3j24mAqPwDuWZmJG1Zcshi\\_dwaAl7w8P8HAQ](http://globalportalen.org/amnen/klimat-miljo?gclid=Cj0KEQjwwLHBRDD0beVheu3lt0BEiQAvU4CKsZa4-M6Fa2syKFCAm3j24mAqPwDuWZmJG1Zcshi_dwaAl7w8P8HAQ) (2017-03-18)

Hammer, M., Hippe, M., Schmitz, C., Sellschop, R. and Sommers, K. (2016) The dirty little secret about digitally transforming operations. Harvard Business Review. 5/2016.

Heaslip, R. (2015). TEDxOxbridge - The new digital business. [Youtube] [https://www.youtube.com/watch?v=\\_h1XmNejD-s](https://www.youtube.com/watch?v=_h1XmNejD-s) (2017-03-10)

Heiner, L. Fettke, P. Feld, T. and Hoffmann, M. (2014). Industry 4.0. Business & Information Systems Engineering. Vol 6: Iss 4. Springer Fachmedien Wiesbaden

Hendersen, A. (2016) The State of manufacturing. Greenville: GE Digital.

Internet of things Sverige (2017). IoT för innovativ samhällsutveckling. <https://iotsverige.se/> (2017-03-21)

Internet World Stats (2017) <http://www.internetworldstats.com/stats.htm> (2017-03-27).

Kaeser (2017). Intelligentare tryckluft. Kaeser kompressor AB <http://www.kaeser.se/Images/P-1665-SE-tcm12-288443.pdf> (2017-02-25)

Kaeser kompressoren SE (2017). Kaeser report: Nyhetsmagasinet för produktionsföretag. Kaeser kompressoren. Germany, January 2017.

Kane, G.C., Palmer, D., Phillips, A.N., Kiron, D. and Buckley, N. (2015) Strategy, not technology drives digital transformation: Becoming a digitally mature enterprise. MIT Sloan Management Review. July 14. <http://sloanreview.mit.edu/projects/strategy-drives-digital-transformation/> (2017-03-15).

Kautzsch, T. (2016). German Manufacturing Is Leading a Digital Industrial Revolution. Harvard Business Review. 06/2016.

King, H. (2013) What is digital transformation? The Guardian. November 21. <https://www.theguardian.com/media-network/media-network-blog/2013/nov/21/digital-transformation> (2017-02-10).

LaRiviere, J. McAfee, P. Rao, J. Narayanan V.K. and Sub, W. (2016). Where Predictive Analytics Is Having the Biggest Impact. Boston: Harvard Business Review Press.

Libert, B., Beck, M. and Wind, Y. (2016) How to navigate a digital transformation. Harvard Business Review.

Lindström, J. (2016). Digitalisering för företag inom tillverknings- och processindustrin. Visionärt kunskapsunderlag till den regionala digitala agendan. Luleå tekniska universitet

Light, P.C. (1998). Sustaining innovation. San Francisco: Jossey-Bass.

Littlefield, M. (2015). Siemens Innovation Day: A New Vision for IIoT and Digitalization. LNS Research. December 18. <http://blog.lnsresearch.com/siemens-innovation-day-a-new-vision-for-iiot-and-digitalization> (2017-05-02)

Markovitch, S. and Willmott, P. (2014) Accelerating the digitization of business processes. McKinsey&Company. May 2014. <http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/accelerating-the-digitization-of-business-processes> (2017-02-22).

Marr, B. (2016) What Everyone Must Know About Industry 4.0. <https://www.forbes.com/sites/bernardmarr/2016/06/20/what-everyone-must-know-about-industry-4-0/#552bbd90795f> (2017-03-10)

Minnick, J. (2016). The Biggest Cybersecurity Problems Facing Manufacturing In 2016. Manufacturing business technology. January 25. <https://www.mbtmag.com/article/2016/01/biggest-cybersecurity-problems-facing-manufacturing-2016> (2017-04-12)

Mochari, I. (2016) Why half of the S&P 500 companies will be replaced in the next decade. Inc. March 23. <https://www.inc.com/ilan-mochari/innosight-sp-500-new-companies.html> (2017-03-06).

Nanda, S. (2017) ELGI aims to be the world's No.2 in compressed air systems. Engineering Review. January 23. <http://www.engrreview.com/elgi-aims-worlds-no-2-compressed-air-systems/> (2017-02-15).

Nordström, J. (2015). Digital innovation leadership: How to master digital transformation in the face of disruption. 3gamma. December 8. <http://3gamma.com/insights/digital-innovation-leadership-how-to-master-digital-transformation-in-the-face-of-disruption/> (2017-03-15).

Onyesolu, M.O. and Felista, U. E. (2009). Understanding Virtual Reality Technology: Advances and Applications. Nnamdi Azikiwe University, Nigeria

Osterwalder, A., and Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. Hoboken: John Wiley & Sons.

Oswald, G. and Schreckling, E. (2015). Shaping the Digital Enterprise: Trends and Use Cases in Digital Innovation and Transformation. Springer, September 26. p313

Pease, A. and Zistl, S. (2014). Simulation: Bringing Reality to the Virtual World. Siemens. October 1.

Piejko, P. (2016) 16 mobile market statistics you should know in 2016. DeviceAtlas. April 12. <https://deviceatlas.com/blog/16-mobile-market-statistics-you-should-know-2016> (2017-03-26).

Powell, W (2016). Wearables at Work: Finding Value for Smart Gadgets and Augmented Reality in the Enterprise. SAP Teched Online. <http://events.sap.com/teched/en/session/13674> (2017-04-14)

Rafinejad, D. (2007). Innovation, Product Development and Commercialization: Case Studies and Key practices for market leadership. J. Ross Publishing

Ratkovic, B. (2013). Service Models of the Future: Information on Demand. Siemens. April 4. <https://www.siemens.com/innovation/en/home/pictures-of-the-future/digitalization-and-software/simulation-and-virtual-reality-service.html> (2017-04-07).

Reality technologies (2016). How Reality Technology is used in Manufacturing. <http://www.realitytechnologies.com/manufacturing> (2017-04-17)

Regeringskansliet (2015). Närings och innovationsministern tillsätter en advisory board for nyindustrialisering, Pressmeddelande 2015-01 <http://www.regeringen.se/pressmeddelanden/2015/07/narings--och-innovationsministern-tillsatter-en-advisory-board-for-nyindustrialisering/>

Rogers, E.M. (2003). Diffusion of innovations (5th ed.). New York: Free Press.

Rouse, M. (2012). System of systems. Techtargat. February. <http://searchmicroservices.techtargat.com/definition/system-of-systems-SoS> (2017-04-25)

Rouse, M. (2017). Big data analytics. Techtargat. March. <http://searchbusinessanalytics.techtargat.com/definition/big-data-analytics> (2017-04-16)

Sahin, I (2006). Detailed review of Roger's diffusion of innovations theory and educational technology-related studies based on Roger's theory. The Turkish Online Journal of Educational Technology. Volume 5 Issue 2 Article 3

Schulte, M.A. (2016) Digital transformation in the manufacturing industry. Frankfurt am Main: IDC Central Europe GmbH.

Statistiska Centralbyrån (2016). <http://www.scb.se/hitta-statistik/sverige-i-siffror/samhallets-ekonomi/export-och-import-av-varor-och-tjanster/#1f9e092b-2626-43fc-86db-31bae01a9491> (2017-02-15)

Slack and Lewis. 2015. Operations Strategy. Pearsons. 4th edition.

Svenskt näringsliv (2013) Underlätta omställningen till ett digitaliserat samhälle. Stockholm: Svenskt näringsliv. <https://www.svensktnaringsliv.se/fragor/digitalisering/> (2017-03-15)

Szefur (2017). Ingersoll Rand Discusses Compressed Air Systems. <http://www.szefur.pl/ingersoll-rand-discusses-compressed-air-systems/> (2017-04-20)

Technavio (2015). Global Air Compressor Market: Forecast and Statistical Analysis 2015-2019. <https://www.technavio.com/report/global-air-compressor-market-forecast-and-statistical-analysis-2015-2019> (2017-02-28)

Technopedia (2017). Modular programming. <https://www.techopedia.com/definition/25972/modular-programming> (2017-04-30)

Tukker, A. (2004). Eight types of product-service system: Eight ways to sustainability? Experiences from suspronet. Business Strategy and the Environment 13:th edit, p.246–260

VFDs (2017). What is a VFD?. <http://www.vfds.com/blog/what-is-a-vfd> (2017-04-30)

Volvo Cars (2014). Polaroptimera din bil. [http://www.volvocars.com/se/bilar/upptack/polestar-optimering?gclid=CjwKEAjwvYPKBRCYr5GLgNCJ\\_jsSJABqwf7RR10jFzdbvT-zMNYXXxwM3uxRyvDH5lo7bMxD\\_sjBoC4eDw\\_wcB#](http://www.volvocars.com/se/bilar/upptack/polestar-optimering?gclid=CjwKEAjwvYPKBRCYr5GLgNCJ_jsSJABqwf7RR10jFzdbvT-zMNYXXxwM3uxRyvDH5lo7bMxD_sjBoC4eDw_wcB#) (2017-05-15)

Volvo Cars (2015). Drive systems - Drive modes. <http://support.volvocars.com/kr/cars/Pages/owners-manual.aspx?mc=312H&my=2015&sw=14w46&article=56df725f2fff617ec0a801e8016cc45a> (2017-05-15)

Wee, D. Kelly, R. Catell, J. Breuning, M. (2015). Industry 4.0 How to navigate digitization of the manufacturing sector. McKinsey & Company. April 2015.

Weinelt, B. (2016) Digital transformation of Industries: In collaboration with Accenture. World Economic Forum.

Wessel, M. (2017) Creating value in a digital economy. [Webinar - Harvard Business Review] <https://hbr.org/webinar/2017/01/creating-value-in-a-digital-economy> (2017-02-22)

Wessel, M., Levie, A. and Siegel, R. (2016). The problem with legacy ecosystems. Harvard Business Review. 11/2016.

Westerman, G., Bonnet, D. and McAfee, A. (2014). Leading digital: Turning technology into business transformation. Boston: Harvard Business Review Press.

Westerman, G., Tannou, M., Bonnet, D., Ferraris, P. and McAfee, A. (2012) The digital Advantage: How digital leaders outperform their peers in every industry. Capgemini Consulting & MIT Sloan Management.

Wixom, B. and Ross, J. (2017) How to monetize your data. Massachusetts: MIT Sloan Management Review January 09.. <http://sloanreview.mit.edu/article/how-to-monetize-your-data/> (2017-04-20)

World Economic Forum (2016) How you transform society through digital. [Youtube] [https://www.youtube.com/watch?v=9CcY9d\\_jQKQ](https://www.youtube.com/watch?v=9CcY9d_jQKQ) (2017-02-14).

WWF (2017) Mänsklig påverkan. <http://www.wwf.se/wwfs-arbete/klimat/mansklig-paverkan/1124268-mansklig-paverkan-klimat> (2017-03-05)

Yongzhao, Z. Liu, L. Wang, L. and Shen, Y. (2013). Wireless Sensor Networks for the Internet of Things. Sage Journals. January 1.

#### Interviews

Atlas Copco Compressor Technique

[1] General Manager of Atlas Copco Compressor Technique. 2017-04-11

[2] Vice President of Operations, Compressor Technique Service division. 2017-04-10

[3] Lead manager Sweden. 2017-04-11

[4] Business Process Manager Sweden. 2017-04-11

#### External Actors

[1] Automation Engineer at a large paper mill company. 2017-02-16

[2] Strategic purchaser at a large paper mill company. 2017-02-13

[3] Purchase Manager at a medium sized paper mill company. 2017-03-08

[4] Procurement coordinator at a medium sized petrochemical company. 2017-03-07

[5] Procurement specialist at a medium sized petrochemical company. 2017-03-07

[6] Operating engineer at a small petrochemical company. 2017-04-25

[7] Operating engineer at a small petrochemical company. 2017-04-13

[8] Accountable engineer at a large pharmaceutical company. 2017-04-12

[9] Process manager at a micro beverage company. 2017-04-12

[10] Maintenance administrator at a large heavy automotive company. 2017-04-10

[11] Plant maintenance manager at a large heavy automotive company. 2017-04-25

[12] Maintenance engineer at a large heavy automotive company. 2017-04-25

## Appendix A: Interview template, Customer interviews

- How does the production process look like?
- What are your requirements today?
- How has the production change during the last 5-10 years?
- What are the competitive factors in your industry?
  - How have they changed the last 5-10 years?
  - How will the change within the next 5-10 years?
- What are your current challenges?
- How have you digitalized your organization?
  - Are you planning further digitalization?
- How are you going to develop your production in the near future?
- What are your requirements for the future?
- What future challenges have you identified?
  
- What is important of a compressor supplier? (complete diagram)
  - Price
  - Lead time
  - Service
  - Quality
    - How is quality measured?
  - Energy efficiency
    - How is energy efficiency measured?

### *Compressor specific*

- What kind of function does the compressor have?
  - Which parts of the production are affected by compressors?
- What kind of compressor suppliers do you have?
- How do different providers' offer differ?
  - Main advantages with each?
- Are there any potential supplements that you miss today?
  
- What will be important of a compressor supplier in the future? (complete diagram)
  - Price
  - Lead time
  - Service
  - Quality
    - How will quality be measured?
  - Energy efficiency
    - How will energy efficiency be measured?

## Appendix B: Interview template, Internal interviews

- How do you perceive your industry?
- What is Atlas Copco Compressor techniques vision today?
- What is your core competence?
- How do you compete?
- What kind of KPI's are there?
  - Will these change in the near future?
- How do you work with operational efficiency?
  - In will you work with operational efficiency in the future?
- How are changes usually executed?
- How are changes usually received?

### *Strategy*

- How does the governance look like?
- How are strategies executed over time?

### *Offerings*

- Which offerings do you have today?
  - Service and products.
- Which offerings are “best sellers”?
- How compatible are your products?
- What are your offerings, in terms of energy efficiency?
  - Separate or included?
  - How are these offerings received?
- In which extent do you collaborate with external actors today? (customer, competitor, supplier, third parties)?
  - Do you have any relations with universities? What kind and to what purpose?

### *Customer*

- Which are the customer demands?
- How do AC interact with you customers?
- How do you work to understand the customer demand?
- Do you have a segmentation for customers? How?
- What characterizes them?
- Are there any specific segments that have grown much the last 5 years?
- Which customer segments generates highest revenue?

### *Application areas*

- Which are the application areas?
- Are there any specific application areas that have grown much the last years?
- Do you any specific application areas that have potential to grow in the coming years?

### *Business model:*

- How did your business model look like 5-10 years ago?
- What is your business model today?
  - Which reasons spurred this change in business model?
- How do you work with your business model today? Upcoming changes?

### *Digitalization:*

- What kind of technologies/developments are you investing in today?
- How far have you digitalized your organization?
  - What kind of processes are digitalized?
- What is Atlas Copco vision and goal with digitalization?
  - Growth/efficiency or both?

- How has previous digitization-projects been performed?
  - Were there any difficulties? In that case, what kind?
- Which opportunities for digitalization do you see today/tomorrow?
- Where does digitization initiatives come from?
- What competence regarding digitization do you possess?
  - Are you planning to recruit other competences?

# Appendix C: Polar chart, External interviews

The below diagram was used during the external interviews, both from a current perspective and a future perspective.





