



# UNIVERSITY OF GOTHENBURG

## SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master Degree Project in Innovation and Industrial Management

### **The Secrets to a Successful Digital Transformation**

*A Single Case Study at AB SKF*

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The Secrets to a Successful Digital Transformation  
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# Abstract

**Title:** The Secrets to a Successful Digital Transformation

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**Keywords:** Digitalization, Supply Chain, Digital Transformation, Digital Supply Chain

Technological development has over centuries triggered industrial revolution which has transformed industries. As an effect of inventions like, Big Data and Internet of Things the business climate of today is now entering a fourth industrial revolution, which is characterized by digitalization and connectivity. Applying this new era on the different activities and nodes within the supply chain are beneficial, as these technological enhancements make it possible for companies to provide a faster, more accurate, more flexible and more customized supply chain work. Different surveys presented within the topic of digitalization in relation to the supply chain indicates that companies are recognizing the fourth industrial revolution and are acting in order to adjust their activities to this new era. However, the same surveys also identify obstacles, and companies acknowledge that they have a long way ahead before a full transformation to a digital supply chain can be finalized. Therefore, the aim of this master thesis is to investigate how an incumbent firm, AB SKF progress with a transformation to a digital supply chain as well as what opportunities and challenges that are aligned. Furthermore, in order to achieve the purpose, a qualitative research strategy has been applied. The research was executed as a single case study with data collected from semi-structured interviews.

The conclusions suggest that SKF is progressing with a transformation to a digital supply chain by taking several actions. First, the company has formulated a digital strategy that is attached to the global SKF organization. Second, SKF has initiated several digitalization projects that target different nodes in the supply chain and in different manners take data actions. Lastly, SKF has adopted an iterative stance in the transformation process towards a digital supply chain which requires for organizational-braveness. Moreover, it has been identified that the respondents at SKF acknowledge that the opportunities and challenges presented in the Literature Review are present in their digital transformation process. Further, there are also additional opportunities and challenges present at SKF in relation to the transformation towards a digital supply chain.

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# 1. Introduction

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*The aim of the introduction chapter is to introduce the reader to the topic and research question of this thesis. The chapter starts by presenting a background of the study, thereafter the research problem and research gap are discussed which evolves to the purpose and research question of this study. Furthermore, the case company SKF is introduced, as well as an elaboration of their relation to digitalization. Additionally, delimitations and abbreviations are listed before presenting the disposition of the study.*

---

## 1.1 Background

In our forever changing business climate, change has become a vital part of how firms operate, and transforming in relation to novelties are necessary in order to survive. (Helfat et al., 2009) Therefore, the business climate of today demands for industrial progress. This makes searching for new solutions key for competitive advantages but also a strategy for survival. During the last century, many new innovations, technologies and progressions have affected how industries work, and one of the most powerful and durable innovation has been digitalization. Digitalization has drastically changed many industries at its core and continues to break new ground. Business models and business strategies constantly change as an effect of an increased degree of digitalization both within- and across-organizations. (Loebbecke and Picot, 2015)

A field that is facing several opportunities and challenges in relation to digitalization is manufacturing. Within this field, digital inventions are about to change everything. Since the first industrial revolution in late the 18<sup>th</sup> century, the manufacturing process has gone through many radical shifts. The first industrial revolution was characterized by the shift from handmade production to mechanical production powered by steam and water. (Schrauf and Bertram, 2016) In the beginning of the 20<sup>th</sup> century, the second industrial revolution took by and electrification enabled mass production and the first production line was introduced. As new innovations and technologies emerged, the third industrial revolution began in the 1970s where the computer became the centerpiece as well as automation, IT and improvement of telecommunications. (Schrauf and Bertram, 2016; Lorenz et al., 2015) Thus, as an effect of inventions like Big Data and Internet of Things (IoT) discussions about that we today are entering the formation of a fourth industrial revolution is evident. The concept of a fourth industrial revolution, also called Industry 4.0, was initially initiated in Germany in 2011 and steams from the concept of smart-factory. (Loebbecke and Picot, 2015) Simply explained, the core of the fourth industrial revolution is digitalization, connectivity and that every product and stage of the production line carries information and communicate with one another (Löffler and Tschiesner, 2013). The opportunities that these changes are enabling are endless.

This as an increased degree of digitalization can make many of the stages in the manufacturing smarter and thereby both more cost-effective and more adaptive. The goal with an increased degree of digitalization within production is to connect the flow of material with the flow of information. Additionally, this allows machines and components to interact with each other and thereby allow for the creation of a better and smarter production line. (Löffler and Tschiesner, 2013)

Nonetheless, manufacturing is only one node among several within a supply chain, and the effects of a fourth industrial revolution stretch over all nodes within the supply chain. Digitalization of the full supply chain enables companies to address challenges in all nodes of the supply chain, this as technological enhancement makes it possible to provide a faster, more accurate, more flexible, more customized and more efficient procurement, production and final delivery. Furthermore, different digital inventions enable a higher degree of transparency which allows for increased interaction and information sharing among the parties within a supply chain, from supplier to producer and final customer. (Alicke, Rexhausen and Seyfert, 2017)

The effects of the fourth industrial revolution can already be displayed, and that the buzz around Industry 4.0 no longer is a trend of tomorrow, rather a fact of today. Different surveys presented within the topic of digitalization in relation to the supply chain indicates that companies are recognizing these changes and are acting in order to adjust their activities to this new era. According to a survey performed in 2014 by PwC, where over 2000 companies were asked, 72 percent responded that their level of digitalization in relation to the supply chain will increase, and 83 percent answered that they aim towards using data analytics in their decision-making process. (Geissbauer, Vedso, and Schauf, 2015) Furthermore, according to research conducted by Forrester Consulting in 2014 nearly 90 percent of the companies participating in the study responded that they have started to implement IoT solutions within logistics and transportation. Hence, approximately 50 percent of the respondents believe that IoT solutions will improve the supply chain, and nearly 40 percent expect IoT to increase their level of cost-effectiveness. (Witkowski 2017) Moreover, according to MHI's annual survey performed in 2016 and presented by Michel (2017), 80 percent of the respondents believe that a digital supply chain will be the predominant model for supply chains in the future.

## **1.2 Problem Discussion**

A new industrial revolution will have many implications for existing firms and will require large investments and necessary changes on established operations. As much point towards a major shift in how industries are operating, as a result of digitalization, it is important for all market participants to adjust and adapt to these changes.

To achieve a transformation to a digital supply chain there are many aspects of current operations and capabilities that need to be improved. As stated above, companies recognize the importance of an increased degree of digitalization in the supply chain, however, they also identify obstacles along the way before a full transformation can be finalized. According to a survey performed by PwC in 2014 50 percent of the over 2000 responding companies admit that their organization lack digital culture and training. In the same survey, it is also identified that only 18 percent of the responding companies label themselves as having mature data analytic capabilities within their organization. (Geissbauer, Vedso and Schauf, 2015) Furthermore, according to research conducted by Forrester Consulting in 2014, 40 percent of the respondents express concerns about how an implementation of a more digital supply chain will affect the privacy and security of the firm, and nearly 38 percent express that a high degree of complexity in a digital supply chain will affect the smoothness of the transformation. (Witkowski, 2017)

Moreover, transforming to a digital supply chain requires transformations in many aspects of the current business and as known, change is always demanding and challenging (Diedrich and Guzman, 2015). There are several factors that affect how well different companies adjust and adapt to transformations within the industry, for example, can the size of a firm, knowledge among staff, current investments and routines affect how well an organization is able to adjust to new inventions. Hill and Rothaermel (2003) argue that one evident factor that affects the capability to adjust and adapt to transform is the level of incumbency. Incumbency affects the performance of firms when markets are revolutionized by radical technological innovations and that firms that are categorized as an incumbent can face a decline in performance when markets change. There are several famous examples of market-leading incumbent companies that are forced into bankruptcy due to lack of ability to adjust and adapt to the changes appearing in the business environment. (Hill and Rothaermel, 2003)

### 1.2.1 Research Gap

The academic literature and consultancy firms are united. The industrial progression is entering a new era, which to a great extent is driven by digitalization (Loebbecke and Picot, 2015). Moreover, it can be identified that the concept of a digital supply chain is adopted by the industry itself, this as different surveys pinpoint that organizations are taking actions in order to increase the degree of digitalization within the supply chain. (Geissbauer, Vedso and Schauf, 2015; Witkowski, 2017; Michel, 2017). However, the research gap that this master thesis is aiming towards filling is to investigate *how* an incumbent firm *approaches* this transformation. Therefore, a single case study will be performed to identify how a transformation to a digital supply chain can be met and what actions that are taken.

## 1.3 Purpose

The purpose of this thesis is to, through a single case study, at SKF, investigate how an incumbent firm progress with a transformation to a digital supply chain. Moreover, the aim of this thesis is to identify what opportunities and challenges that are aligned with the transformation towards a digital supply chain.

### 1.3.1 Research Question

The following research questions have been formulated in order to reach the purpose of this thesis.

- How does an incumbent firm act in order to approach the transformation to a digital supply chain?
  - What opportunities and challenges are aligned with a transformation to a digital supply chain?

## 1.4 Case Company

AB SKF, originally known as Svenska Kullagerfabriken is a global company founded in Gothenburg Sweden in 1907 (SKF, 2018a). SKF is one of the world's leading suppliers of products and services within the field of bearings and seals, additionally, SKF's offer does also include technical support, maintenance services, license monitoring and training. The organization is divided into a number of business areas reaching customers within three customer segments, Original Equipment Manufacturing (OEM), distributors and end-users. Moreover, SKF is today represented in over 130 countries, 40 industries and has approximately 45 000 employees. (AB SKF, 2018; SKF, 2018b)

### 1.4.1 SKF and Digitalization

SKF has initiated their work towards becoming a more digital organization, this to take advantage of the new available technologies. In their annual report from 2017, different strategic visions and investments are presented with the purpose of adapting the organization in general, and the different activities in the supply chain in particular, to the new digital era. Further, SKF states that their aim with the digital transformation is to increase customer value. This initiated digital era is by SKF labeled as Industry 4.0 and has enhanced the formulation of a digital strategy including the possibilities to increase efficiency in the supply chain. (AB SKF, 2018)

## 1.5 Delimitations

The research conducted has several limitations which affect the scope, but also possible findings aligned with the research. To begin with, the composition of a single case study by its-self is a limitation, as a single case study investigate one company, within one industry and thereby exclude many aspects. This thesis is limited to only investigate the transformation to a digital supply chain at SKF, neither the aspects of suppliers or customers are included in the study. Moreover, all the respondents comprise of employees at SKF.

Furthermore, the study is limited to certain definitions. First, a supply chain is in this thesis defined to include all nodes and activities that stretches from raw material to final consumer. Second, an incumbent firm is defined as a market-leading firm that possesses a large market share within their operating industry. However, even though this thesis aims to investigate how an incumbent firm act in order to approach the transformation to a digital supply chain, the concepts of digitalization and supply chain will be explained in general terms, independent of organizational characteristics.

SKF has initiated a digital strategy in order to reach a digital business model. Within their digital strategy, there are several projects currently operating in parallel. However, due to the availability of time, information and respondents at SKF the project Supply Chain 4.0 is the project that this thesis elaborates most granular.

## 1.6 Abbreviations

In this thesis, several abbreviations are present. Below, a table comprising of these abbreviations are presented.

*Table 1.1: List of abbreviations.*

Abbreviations	
<b>DC</b>	Distribution Center
<b>ERP</b>	Enterprise Resource Planning
<b>IoT</b>	Internet of Things
<b>IIoT</b>	Industrial Internet of Things
<b>OEM</b>	Original Equipment Manufacturer
<b>PoC</b>	Proof of Concept
<b>SC 4.0</b>	Supply Chain 4.0
<b>VMI</b>	Vendor Management Inventory

## 1.7 Disposition

The thesis comprises of the following sections illustrated in figure 1.1. To begin with, an Introduction to the thesis subject is presented. Secondly, the theoretical findings are presented in the Literature Review. Third, the Methodology used to conduct the research is presented. In the fourth section, the research Empirical Findings are presented. Fifth, the Analysis of the findings are stated. Lastly, the thesis is finalized by presenting the Conclusions.

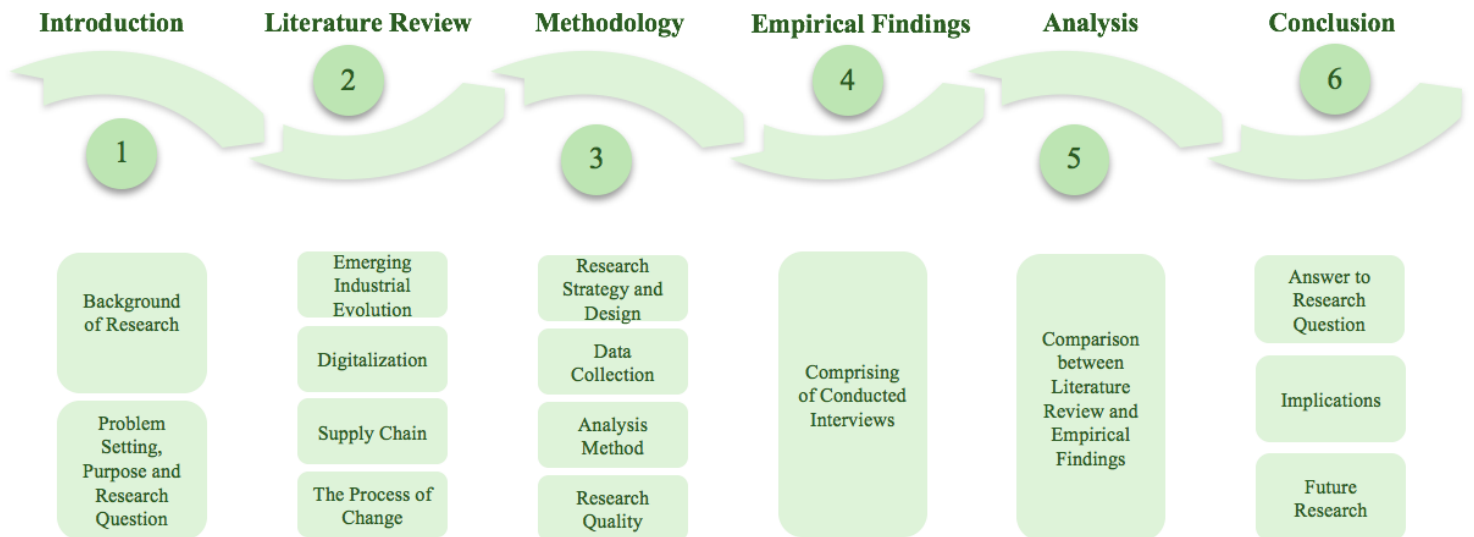


Figure 1.1: Disposition.

## 2. Literature Review

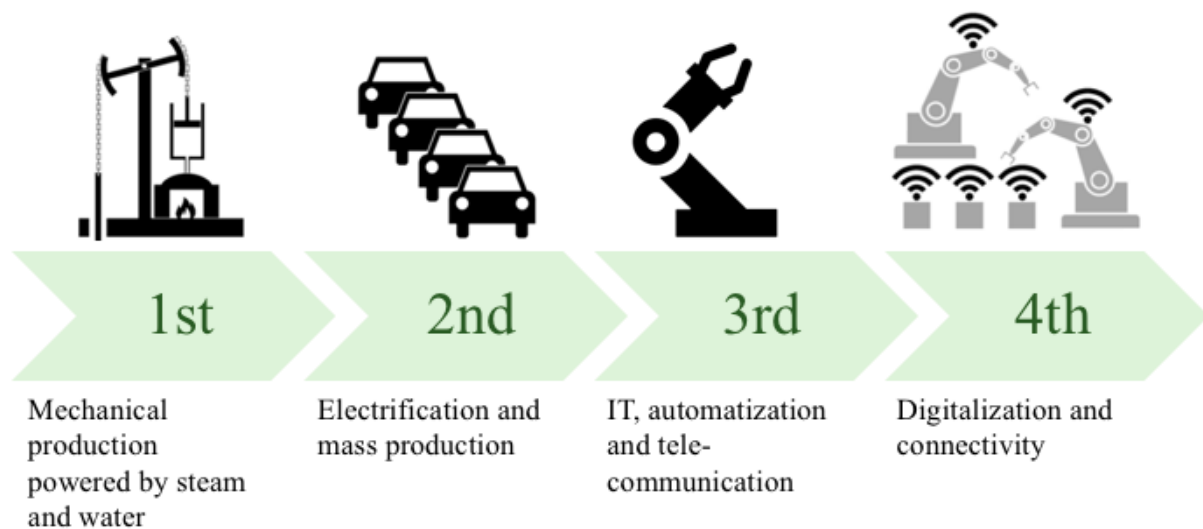
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*The following chapter presents the theoretical frameworks that this thesis constituted of. The emerging industrial evolution is presented as well as different aspects of digitalization. Further, literature related to the field of the supply chain and digitalization of the supply chain is presented. Lastly, the process of change is elaborated upon as well as opportunities and challenges in relation to digitalization.*

---

### 2.1 Emerging Industrial Evolution

In the beginning of the 21<sup>st</sup> century, the fourth industrial revolution had emerged as a result of improved technologies and innovations. The information age evolved and transformed into the fourth industrial revolution which is characterized by digitalization. Moreover, digitalization is one of the most powerful inventions and developments during the last century, which is radically changing the business climate. The new technologies have drastically changed many industries at its core affecting business models and business strategies. (Loebbecke and Picot, 2015)



*Figure 2.1: The four phases of the industrial revolution, made by authors based on Schrauf and Bertram (2016).*

Industry 4.0, smart factory, factory of the future, cyber factory or connected factory are all concepts describing the era of the fourth industrial revolution. Hence, the fourth industrial revolution is known by many different concepts that in the end describes the same phenomenon, digitalization of operations. (Geissbauer, Vedso, and Schauf, 2015; Lorenz et al., 2015) Nevertheless, independent of the label of the fourth industrial revolution this era is dependent upon technologies and inventions such as data analytics, cloud computing, Big

Data and IoT. These are the core competencies evident for the emergence of the fourth industrial revolution. (Schrauf and Bertram, 2016) Moreover, Beyerer, Jasperneite and Sauer (2015) stress that companies will extract, combine, connect and deliver resources in new ways where the need for human interaction decreases.

## 2.2 Digitalization

Digitalization is by Markovitch and Willmott (2014) described as a process, where different digital technologies and tools are integrated into the business environment. Hence, digitalization is, therefore, the process an organization undertakes when moving its existing business model towards a digital business model (Markovitch and Willmott, 2014). To enable digitalization, digitization must proceed (Manyika et al., 2016). Digitization is defined as the process of converting analog information into a new digital format (Matt, Hess and Benlian, 2015). Before, and sometimes still today, business processes were or is analog. Files, manuals and instructions consist of physical hard copies. As a result of new and improved technologies, the process of transforming information, and making it available in a digital format is possible. (Wortmann and Fluchter, 2015) When the stage of converting analog information into a digital format is finalized, digitalization can take by and create a foundation for a digital transformation. The foundation of digitization and digitalization has enhanced the possibilities to create new business models and concepts, and the digital transformation is emerging due to digitized data and digitalized applications. (Matt, Hess and Benlian, 2015)

### 2.2.1 Tools, Techniques and Applications within Digitalization

With an increased degree of digitalization within various businesses, different tools, techniques and applications have emerged. Major consulting firms, such as McKinsey, PwC and Boston Consulting Group firms are presenting diverse technology trends, applications and tools that act as building blocks for the fourth industrial revolution. (Lorenz et al., 2015; Geissbauer, Vedso and Schauf, 2015; Feige et al., 2016; Baur and Wee, 2015; Schrauf and Bertram, 2016) Example of these technological trends, applications and tools are Big Data and intelligence analytics, cybersecurity and fraud detection, IoT platforms, simulation and human-machine interaction as well as cloud computing. Without these technology trends, applications and tools the fourth industrial revolution would not be facilitated nor emerged.

There is an extensive range of technologies that has emerged in the digital transformation of the fourth industrial revolution. To meet the changes in the market, Big Data, IoT and data security are identified as the three most central tools, techniques and applications that companies must adapt to and build capabilities around in order to enhance the new market needs. (Geissbauer, Vedso and Schauf, 2015; Feige et al., 2016; Schrauf and Bertram, 2016) Therefore, these three concepts will be further elaborated below.

### *2.2.1.1 Big Data*

The information available today has radically changed format. Data has gone from being structured, easily tracked and mainly based on historical events to become unstructured and extracted from a variety of sources available in real time. (Galbraith, 2014) Big Data is a technology available that can manage and conduct analyzes of large amounts of data and information (Witkowski, 2017). Moreover, Big Data is commonly defined by three dimensions, also known as the three V's namely; volume, velocity and variety (Gunasekaran et al., 2017; Fernandez-Miranda et al., 2017). As previously mentioned, data is collected from multiple sources creating extensive volumes of data and the data is produced in a variety of formats. Moreover, the data is produced in a rapid pace. For the data to make sense and give meaning to the organization it must be analyzed in time before the information becomes indifferent. (Galbraith, 2014)

Nevertheless, the characteristics of Big Data together creates a complexity that is difficult to manage. Challenges arise related to making sense of the data. It is difficult to link, match, cleanse and transform available data into valuable information. (De Mauro, Greco and Grimaldi, 2016; Fernandez-Miranda et al., 2017; Sanders, 2014) To address these challenges advanced technologies that can capture, storage, distribute and analyze the data in a correct sense and timely manner is required, therefore well-functioning legacy systems are a prerequisite to Big Data analyze. Properly managed information extracted from Big Data sources provides companies with an evident opportunity to enhance new insights, make better-grounded decisions and meet new market demands. (Berner, Graupner and Maedche, 2014) Hence, it is the analyses, interpretations and management of data that creates value, not the amount of data available (De Mauro, Greco and Grimaldi, 2016).

### *2.2.1.2 Internet of Things*

IoT is a concept that was founded in the late 20<sup>th</sup> century and the concept has many definitions but can be viewed as a network where data is shared (Lu, Papagiannidis and Alamanos, 2018). IoT was conceived to describe a process where the material world of products communicates and exchange information with computers and software's through sensors (Witkowski, 2017; Wortmann and Fluchter, 2015). Hence, IoT constitutes of a network where physical devices as vehicles and home appliances are connected to each other and exchange data. Moreover, Industrial Internet of Things (IIoT) is to some extent synonyms to IoT. Albeit, the integration occurs between factory machines and industrial goods which communicate and exchange information with each other and the surrounding. (Sadeghi, Waidner and Wachsmann, 2015)

The technology behind IoT has drastically evolved during the last decade and the possibilities it creates is evident. Products and services introduced based on IoT solutions have heavily increased in the business environment. (Wortmann and Fluchter, 2015) Moreover, Wortmann and Fluchter (2015) states that the one of the most prominent areas where IoT technologies have emerged is within the smart industry where products and services are connected and

developed through intelligent solutions and systems, often known under the term of the fourth industrial revolution.

The value-creating aspect related to IoT is extensive. The creation of value is not limited to a specific product or service, value will rather be extracted and created when products are connected to each other and act as a part of a greater system (Lu, Papagiannidis and Alamanos, 2018). Therefore, IoT should not be seen as a support function but rather as a core element in organizations value-creating processes and act as an evident source of competitive advantage (Wortmann and Fluchter, 2015) Using the technology of IoT in a proficient manner and extracting the right use out of it, IoT can change the way a company performs its business. IoT brings new opportunities to the market, facilitating the exchange of products and services as well as increasing efficiency in daily operations by connecting devices into an integrated system. (Lu, Papagiannidis and Alamanos, 2018)

### **2.2.1.3 Data Security**

The technology of digitalization change existing business models and companies need to adjust to new customer needs. Time to market, flexibility and improved quality are a few factors that are increasing in importance for the customers. (Loebbecke and Picot, 2015) New technologies such as Big Data and IoT are essential to enable this. By that said, digitalization is twofold, it creates opportunities as well as challenges, and an evident requirement arising from digitalization is how it is connected to security. (Heynitz and Bremicker, 2016) Increased digitalization leads to an increased vulnerability related to sharing information and data as well as sabotage and data theft. Podhorec (2012) as well as Sadeghi, Waidner and Wachsmann (2015), state that to meet all aspects related to security issues, evident cybersecurity and protection measures must be adopted. However, what seems to be a difficult hurdle to overcome is the willingness to share data and information. Despite technological security systems, the insecurity to what another party can do with the information is still evident, this is identified by Du et al. (2012).

### **2.2.2 Digitalization for the Purpose of this Thesis**

To create value, the usage and analysis of data are evident. To enhance the data that is valuable for the specific purpose, techniques such as Big Data and IoT are necessary in order to generate, as well as handle the data available. Together does the available information, Big Data and IoT establish an integrated value-creating network that acts as the foundation to reach the full potential of the data available. (Khurana, Geissbauer and Arora, 2018) However, there is an extensive range of technologies that have emerged in the digital transformation of the fourth industrial revolution. (Feige et al., 2016; Schrauf and Bertram, 2016) In this thesis, will digitalization act as a broad term describing the process a company undergo when reaching a digital business as well as the incorporation of evident technologies necessary in order to meet the opportunities and challenges aligned with the transformation to a digital supply chain.

## 2.3 Supply Chain

Defining supply chains are difficult and a variety of definitions exists. Thus, a supply chain consists of connected individuals, organizations, resources, activities and technologies that together create a network. A supply chain stretches from the raw material through manufacturing and ends with the finished good. It is a complex system where raw materials are converted to finished goods and then later distributed to the end-user. (Ghiani, Laporte and Musmanno, 2004; Fredendall and Hill, 2016)

### 2.3.1 The SCOR Framework

Every companies supply chain is unique, this as the activities and operations performed by companies cannot be directly translated and transformed between different companies. However, to better visualize the activities performed in the supply chain simple visualizations have been created in order to enable generalized suggestions of improvements. These visualizations capture the essence of certain nodes and describe how both information and material flows. A well-known framework, that is applicable to all industries is the Supply Chain Operations Reference framework also known as the SCOR framework. This framework describes the structure of a supply chain and was established by the Supply Chain Council in collaboration with two consulting firms in the late 1990's. The SCOR framework is designed with the purpose to enable companies to communicate, compare and develop new or improved supply chain practices. Furthermore, the framework presents a standard description of the processes and activities that together create complex supply chains. (Stewart, 1997; Raman et al., 2018)

The SCOR framework, visualized in figure 2.1 focuses on four basic supply chain nodes, namely plan, source, make and deliver. *Plan* refers to the day-to-day planning activities, like assess supply resources, aggregate demand requirements, inventory planning, assess distribution, determine production and capacity planning for all different channels within the supply chain. Moreover, plan does also refer to the more long-term planning activities related to supply chain configuration, resource planning and different product phases. *Source* includes all the activities related to the process of acquiring materials, which are to; obtain, receive, inspect, hold and handle different materials. Furthermore, source does also include supplier certification and assessment of sourcing quality. The third node in the SCOR model, *make* refers to the actual execution process, the production. Essential events in this node are the request of material, manufacturing and packaging. Moreover, make also refers to the maintenance of facilities and equipment, assessment of production quality and scheduling. Finally, *deliver* is the last node in the SCOR framework and consists of many different activities. First, there is demand management, which refers to the construction of forecasting, plan sale campaigns and analyze point of sale. Furthermore, deliver does also refer to the promotion and pricing of products. Second, there is order management which refers to entering and maintaining orders, account and receivables as well as handling invoices. Third, there is warehouse management which includes all activities in relation to storage of the

products. Fourth, there is transportation management which refers to the activities in relation to the management of traffic and the actual movement of the product. Fifth, there is installation management which refers to the installation of the produced product at the customer's site and the scheduling of these activities. Lastly, delivery also refers to the assurance of the delivery quality and the business in relation to distribution channels. (Stewart, 1997; Sanders, 2014; Raman et al., 2018)

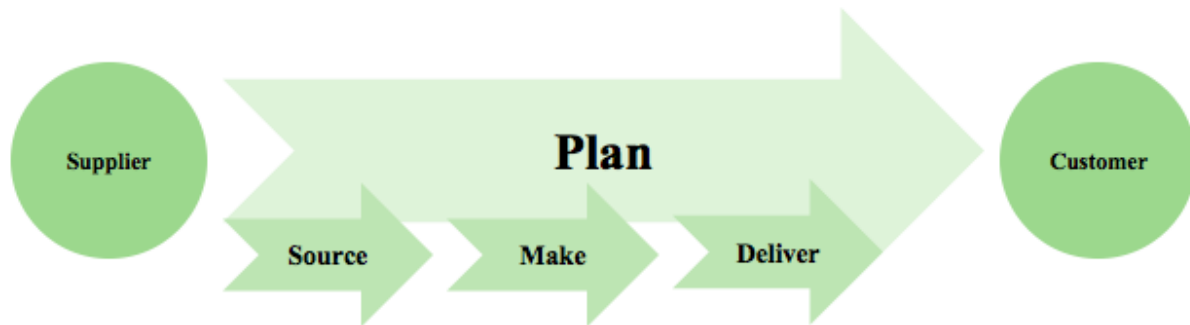


Figure 2.2: The SCOR model, made by authors based on Stewart (1997).

### 2.3.2 Supply Chain Information Sharing

The above framework, the SCOR framework is a generalized visualization of a supply chain. A visualization like this often focuses on the flow of material within the supply chain, however, it is equally important to pay attention to how information flow in the supply chain. (Zhou and Benton, 2007; Fredendall and Hill, 2016) Over the last period of time the degree of complexity in relation to supply chains has increased, mainly due to that the geographical scope has broadened. Today, it is not rare that a producing company's supply chain stretches over several continents and countries. This increased degree of complexity demands a more intelligent and dynamic system for sharing information, this as information asymmetry within the supply chain is a common source of inefficiency within the supply chain. (Fiala, 2005) Improving the flow of information in a supply chain has many benefits, this as information reduces uncertainty. By incorporating an integrated information flow a company can reduce inventory and shorten their lead times while reducing their costs. This, in turn, allows the supply chain to better respond to customer demand. (Fredendall and Hill, 2016)

When discussing information sharing within a supply chain, the information being shared can be divided into two categories. The first category requires information concerned about the every-day operations. Sharing this type of information gives short-term benefits to the supply chain operations and can reduce the risk brought by asymmetric and incomplete information, cut down lead times, mitigate the bullwhip effect, as well as reduce total cost while increasing total supply chain profit. (Ganesh, Raghunathan and Rajendran, 2014) The information being shared to achieve these benefits are e.g. information about quantity, lead time, workforce allocation, equipment status and capacity. When sharing this type of information, the supply chain can operate more dynamic and better facilitate other nodes with what is demanded.

Commonly when sharing this type of information, different Enterprise Resource Planning (ERP) -systems are used. (Fredendall and Hill, 2016)

The second category requires information sharing regarding more strategically important data which can lead to long-term improvements in the supply chain operations. This can be information regarding; new necessary investments, optimization of the locations of different nodes, new customer or supplier relations being developed or completely new ways of sharing the information in the supply chain network. (Fredendall and Hill, 2016) Commonly discussed in today's globalized supply chains are outsourcing of certain activities, locating production at more cost-efficient sites but also how to better integrated information sharing within the complete supply chain. (Madenas et al., 2014) When data is shared in the supply chain decisions about these issues are easier to make and can be better grounded in the actual operations. Therefore, information sharing has long-term benefits as it can help in decision-making regarding the improvements of the supply chain. (Fredendall and Hill, 2016)

It is important to regularly share information in the supply chain in order to reach both the short- and long-term benefits. Additional, it is important to consider the quality of the information being shared, this in sense of time, accuracy, adequacy, completeness and reliability. (Du et al., 2012) Without a well-functioning flow of information sharing the supply chain optimization and improvement goals are more difficult to reach (Fiala, 2005). However, as Du et al. (2012) identifies, it is important to consider that there can be a difference in the willingness companies have to share information. It is identified that close partnership agreements among different stakeholders increase the willingness to share information.

### *2.3.2.1 Supply Chain Information Sharing Transformation*

The SCOR framework, along with other generalized and simplified models visualizing the supply chain often illustrate the supply chain as a linear process. However, as a result of the technological advancements, it can be more accurate to see the flow of information in the supply chain as a network rather than a linear process. This is strongly affected by emerging technologies, disruptive innovations and an increasing industry clock speed. (MacCarthy et al., 2016) Information created in a network structured supply chain in today's digital era can move independently of the product and that the data available makes the different nodes and activities of the supply chain more integrated. (Kache and Seuring, 2015) Many supply chains of today are going through a transformation, from a staid sequence to a more dynamic, interconnected system which to a greater extent incorporates different partners. The most profound difference between a linear supply chain and a so-called supply network is how information is shared and how information flows between the nodes within a supply chain. Furthermore, there is a difference in how nodes are managed, in a classic linear supply chain the different nodes are managed and operated as isolated functions rather than, as in the supply network, all nodes are integrated and aiming for the same goal. (Mussomeli, Gish and Laaper, 2016) Below, an illustration visualizes the difference in how information is being

shared as well as how nodes are being managed and connected in a classic linear supply chain compared to a supply network.

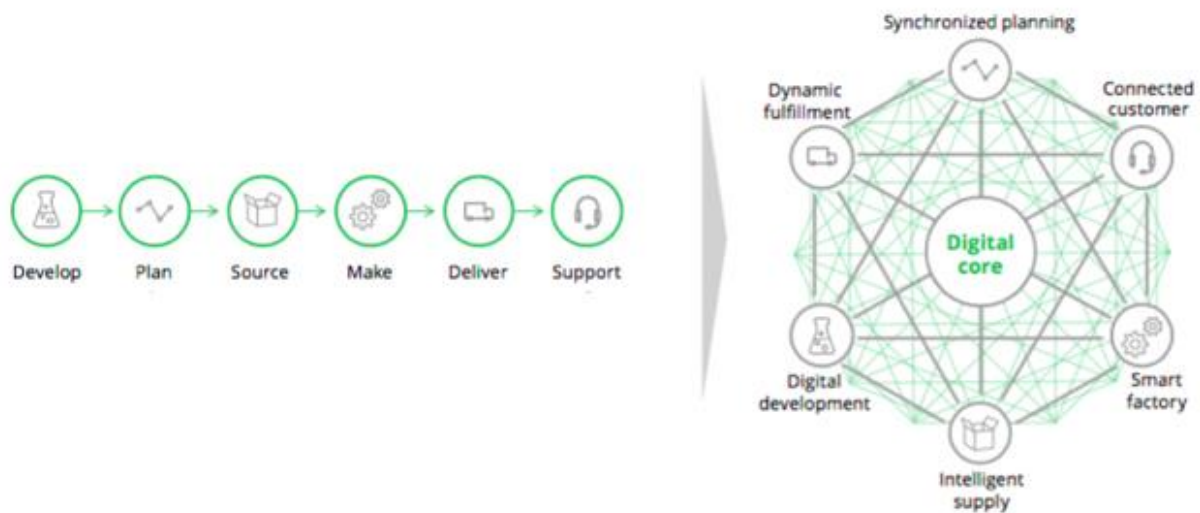


Figure 2.3: Shift in information flow in traditional supply chain to digital supply network, made by authors based on Mussomeli, Gish and Laaper, (2016).

### 2.3.3 The Next Generation of Supply Chains

Supply chains are not static, they transform and develop both in appearance and how they are managed over time. What affects the evolution of a supply chain can have its origin from many different aspects, it can be economic change, technological development, change in regulatory frameworks, political factors or shift in strategic choices. (MacCarthy et al., 2016) Therefore, the transformation of a supply chain can be argued to be driven by either internal or external factors. The internal factors are often associated with a shift in the overall strategy of the company which implies a change in how the supply chain is managed and structured. The external factors are often associated with a change in customer preference, new technology, disruptive inventions or new emerging markets. Additionally, how firms are responding to these external shifts will also affect the appearance and structure of the supply chain. (Chakravarty, 2014)

As new technologies are developed and used in relation to the supply chain, improvements of functions of the supply chain can be performed. In a best-case scenario, a digital supply chain will enable a faster, more flexible, more granular, more accurate and more efficient supply chain work. Technologies and inventions that will enable this improvement are mainly driven by different ways to use and analyze data and this, for example allows firms to construct predictive analytics based on internal and external data, better plan different activities and increase the transparency through the supply chain which enables a more adaptive and collaborative supply chain. (Alicke, Rexhausen and Seyfert, 2017) By using data in the supply chain it is easier to see and share knowledge and information about different activities and events in the chain and thereby adjust these activities to the actual demand (Michel, 2017).

Taking the development, a step further, the next evolutionary stage in relation to supply chains, will according to Schrauf and Bertram (2016) be characterized by a digital ecosystem. In a digital ecosystem, the intention is that supply chains and networks are completely integrated to each other. Moreover, processes, as well as customers' interfaces will be integrated and virtualized. Collaborations between companies and organizations will be a key source to create value. Value will no longer be a source extracted from working in isolation, the need of competences and knowledge extracted from peers will be evident. (Schrauf and Bertram, 2016)

### 2.3.4 Big Data and Supply Chain Transformation

A way to enter the next generation of supply chains is to apply Big Data. The supply chain network gathers large amounts of data from a variety of sources (Raman et al., 2018). Connecting the use of data with the above presented SCOR framework there are several activities within the different nodes in the supply chain that can be improved and made more efficient. Starting with the activities in relation to *plan*. With the analyses of the data, the possibility to make predictions of the future emerges, as one of the most significant aspects of Big Data analytics is the possibility to make predictive analytics. (Sanders, 2014) This is also argued by Gunasekaran et al. (2017) who states that Big Data predictive analysis has a positive correlation with operational performance. Moreover, as the technological solutions evolve the sophistication increases and better and more reliable analyses about the future can be made. Therefore, Big Data and digital tools can be used to predict future demand, which can enable better planning of inventory and production capacity as well as offering efficiency and cost benefits, facilitating faster responses to environmental changes and enhancing relationships with customers and suppliers. (Gunasekaran et al., 2017; Sanders, 2014)

The next node in the SCOR framework is *source*, which activities also can be improved by the use of Big Data analytics. Many everyday tasks, like order processing, can be made faster and more accurate with the use of Big Data. This as more accurate predictions of what materials that are needed can be made but also that automatic digital systems between the buyer and the supplier can be used which reduces the time between order placement and order fulfillment. (Sanders, 2014; Raman et al., 2018) Furthermore, Sanders (2014) states that it is often estimated that around 80 percent of the costs for a manufacturing company can be addressed to the sourcing department. The use of Big Data makes the sourcing more accurate and optimized, and by that, the costs can be radically reduced. Continuing, the next node in the SCOR framework is *make*. The actual make stage in a supply chain is complex and differs between companies, but much comes down to the importance of coordinating and matching the products that the firms are making with the products that the customer demands. This process is made more efficient with the usage of Big Data analytics, everything from quality to labor utilization can be improved as a way of strengthening market competitiveness. Continuing on, more frequent analyzes of operational performance can be made which simplifies the work towards constant improvement of production. The last and most activity intensive node of the SCOR framework *deliver*, which also can be improved by the use of Big

Data analytics. As Big Data analytics makes it easier to predict future demand, several of the activities included in the node of delivery is made more efficient. Campaigns can be improved by analyzing how customers act, transportation can be made more accurate as Big Data can optimize the route, warehousing can be optimized and the prices can be set based on fact rather than intuition. (Sanders, 2014; Raman et al., 2018)

### 2.3.5 Internet of Things and Supply Chain Transformation

In addition to Big Data, IoT is another prominent technology that can be used in order to transform the supply chain to the next generation of supply chains. IoT refers to a network where the material world of products communicates and exchange information with computers through sensors. This possibility creates endless of opportunities for improvement and evolvement of the supply chain. (Witkowski, 2017) Ben-Daya, Hassini and Bahroun (2017) describes the relation between IoT and supply chain as a network where objects are connected through digital devices with the purpose to sense, monitor and interact both within and among companies. Moreover, the aim is that planning, control and coordination activities should be facilitated in real time. This by agile and visible information tracking and sharing in the supply chain processes. (Dweekat, Hwang and Park, 2017) By using IoT solutions can, for example road transport become automatically controlled, which makes it possible for customers to track its package and warehousing can become more efficient as well as planning and inventory (Witkowski, 2017).

IoT and its implications on the different nodes of the supply chain can be visualized through the SCOR framework. To begin, the *plan* node within the SCOR framework in combination to IoT enhances the possibilities to receive real-time information to improve the day to day planning activities much related to inventory, capacity planning and aggregate demand. IoT solutions in relation to planning enable the supply chain to be aligned through the organization, both internally and externally and over different segments (Dweekat, Hwang and Park (2017). Secondly, with *sourcing* IoT solutions can allow the buyer to track and trace the goods as it moves through the supply chain, it enables a higher flexibility in supplier selection and provide valuable real-time visibility of costs. Following with the *make* node of the supply chain many IoT solutions are connected to automatization and smart factory, which both enables a manufacturing process based on smarter decisions and more efficient operations. Ending with the *deliver* node of the supply chain the IoT solutions can have a great impact on the different activities aligned with the delivery of the goods or services. IoT solutions can create a more communicative and collaborative warehousing, which saves both time and money. Furthermore, IoT solutions can enable reduction of inventory, real-time transport information, accurate customer delivery and more effective quality-controls. (Ben-Daya, Hassini and Bahroun, 2017)

## 2.4 The Process of Change

The process an organization undergo when a shift from a current state of business operation to a new state business operation, can be classified as a change process (Todnem, 2005).

Organizations, like humans, in general, are creatures who act on known routines and appreciate stability, therefore closely related to change processes are often resistance and different challenges. Today, in our forever changing business climate, change has become a vital part of how firms operate, and transforming in relation to novelties are necessary in order to survive. (Helfat et al., 2009) To succeed with an organizational change in a vastly competitive and incessantly evolving business environment Todnem (2005) and Gunasekaran et al. (2017) argue that management and leadership supportive of change is a crucial source to success. Continuing, Diedrich and Guzman (2015) argue that change is not a process that companies should take easy on. Rather, it is a continuous work where multiple stakeholders' perspectives, actions and desires must be considered and met. Hence, change is a continuous and ad hoc process where the path of evolution seldom is predetermined, rather change comes in all shapes, forms, sizes and situations. (Todnem, 2005)

How change operates differs among organizations and therefore what challenges and opportunities that are aligned with the change also vary. However, it is common to argue that the change process is more difficult to overcome in large and established organizations, so-called incumbent organizations. (Tripsas, 1997; Hill and Rothaermel, 2003) Moreover, Hill and Rothaermel (2003) states that the reason to why an incumbent firm fails to survive a radical change varies, but some similarities can thus be identified. To begin with, the economic incentives for investing in a new radical technology are few, this because large investments are often being made on existing machinery. (Tripsas, 1997) Moreover, organizational inertia and established relationships with stakeholders are additional factors presented by Hill and Rothaermel (2003) that affect the success but also the willingness from incumbent organizations of meeting technological change is identified as an evident factor.

### 2.4.1 Digital Supply Chain Change Process

Transforming to a more data-driven, and digital supply chain can be considered as a change process. This as the integration of digital technologies in a supply chain will change many different aspects within business operations. (Michel, 2017) Matt, Hess and Benlian (2015) argues that in order to succeed with a digital transformation, it is important to formulate a digital transformation strategy that serves as a central concept when integrating the entire coordination, prioritization, and implementation of digital transformation within a firm. However, Sanders (2014) argues that there are three categories that can summarize the barriers towards a change to a data-driven and digital supply chain and these categories are; technology, processes and people. The mistake many companies do is that they solely invest in one of these three categories. However, in order for a data-driven and digital supply chain to work, all of these categories need to be updated and aligned with the new approach.

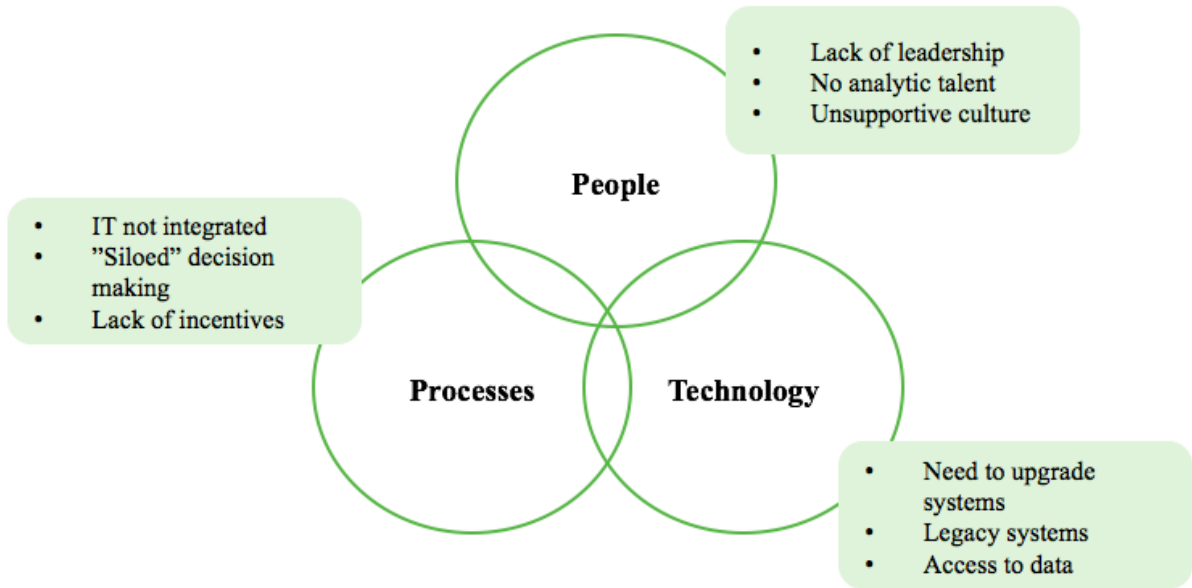


Figure 2.4: Barriers for implementation of a data driven and digital supply chain, made by authors based on Sanders (2014).

The barriers in relation to *technology* are primarily concerned about the upgrading of different systems. An implementation of a data-driven, and digital supply chain requires acquisitions of suitable IT-systems, hardware, applications and services that support the technology. These investments vary between different organizations and there is no recipe for success that is applicable to everyone. However, what is common among these types of implementations is that they are expensive and requires an extensive amount of preparations. In order to obtain a positive implementation, it is key that the acquired technology is compatible with the existing IT and business systems and that it does not create isolated systems that do not communicate with each other. (Sanders, 2014)

Furthermore, when transforming the current business model, a common mistake is that current *processes* are neglected. In order for a data-driven and digital supply chain to work in an efficient way, all the processes aligned with the supply chain must be connected and IT integrated. One barrier for this is that the current processes are far from connected and IT integrated which creates a requirement for restructuring the workflow. These reformations are often challenging and time-consuming and for an organization to undertake this challenge the incentives need to be strong. (Sanders, 2014)

Lastly, as with all organizational change, the *people* within the organization and their mindset towards this change is key for the outcome. One identified barrier towards an implementation of a data-driven and digital supply chain is insufficient leadership. Often the leaders of the organizations lack understanding of the benefits of a more data-driven organization but also lack the full capability of how to lead for the change. Furthermore, as this digital era is rather new there is often a lack of digital and analytical talent among the employees. This requires

for investments in training of staff and educating in how the new systems are used and how the systems and processes should be managed. (Sanders, 2014)

As identified, there are many opportunities, but also challenges installed when implementing a more data-driven and digital supply chain. In a Delphi study conducted by Kache and Seuring (2017) 15 experts within the field of Big Data Analytics and Supply Chain Management where asked to review the opportunities and challenges that are aligned with increased usage of data and digital tools within businesses. The study revealed several opportunities and challenges, these findings are presented in table 2.1 and table 2.2.

*Table 2.1: Opportunities aligned with increased use of data and digital tools within a supply chain, made by authors based on Kache and Seuring (2017).*

*Table 2.2: Challenges aligned with increased use of data and digital tools within a supply chain, made by authors based on Kache and Seuring (2017).*

Opportunities
<ul style="list-style-type: none"> <li>• Enhance discovery and availability of information within the supply chain</li> <li>• Supply chain visibility and transparency with real-time control, multi-tier visibility irrespective of data location</li> <li>• More accurate decision making through automation and machine-to-machine processes</li> <li>• Increased real-time responsiveness</li> <li>• Increased granularity in demand planning</li> <li>• Product traceability which leads to lead-time reduction and re-routing possibilities</li> <li>• Enhanced integrated optimization and collaboration with the entire supply chain ecosystem</li> <li>• Inventory optimization</li> <li>• Access to customer and supplier data enhance innovation capacity</li> </ul>

Challenges
<ul style="list-style-type: none"> <li>• Building a data-driven mindset in decision making</li> <li>• A need to evolve current organizational structures, such as processes and reporting structures</li> <li>• To “sell” the concept of data usage to customers</li> <li>• Lack of required skilled employees</li> <li>• Lack of powerful IT-infrastructure to process real-time information</li> <li>• Need for high investments</li> <li>• Identify the relevant data and avoiding inaccurate information</li> <li>• Information and cyber security, as threat of information leakage and differentiation between private and public data</li> <li>• Integration and collaboration cross-functional and across companies</li> </ul>

## 2.5 Summary of the Literature Review

The Literature Review takes off by presenting the emerging of the fourth industrial revolution, which is characterized by digitalization. (Loebbecke and Picot, 2015) Digitalization can be described as a process, where different digital technologies are integrated into the business environment (Markovitch and Willmott, 2014). Evident technologies used in order to enhance digitalization are Big Data and IoT (Lorenz et al., 2015; Geissbauer, Vedso and Schauf, 2015).

Digitalization will affect how organizations operate and one aspect that the fourth industrial revolution elaborates upon are the implications this will have on the supply chain. But to

begin with, a supply chain consists of connected individuals, organizations, resources, activities and technologies that together create a network. Moreover, a supply chain stretches from the raw material through manufacturing and ends with the finished good. (Fredendall and Hill, 2016) Supply chains are complex and unique in character, however, they are often visualized in generalized models. This thesis presents a framework called SCOR. The SCOR framework consists of four nodes which are, plan, source, make and deliver. (Stewart, 1997) All of these nodes consist of activities which operations can be improved with the use of digital technologies like Big Data and IoT (Sanders, 2014).

When discussing supply chain operations, it is important to not neglect the significance of information sharing. It has been identified in the Literature Review that an enhanced flow of information will characterize the next generation of supply chains as these will enable an integrated and shared data view. Technologies and inventions that will enable this improvement are mainly driven by different ways to use and analyze data. This will enable a faster, more flexible, more granular, more accurate and more efficient supply chain work. (Alicke, Rexhausen and Seyfert, 2017).

Lastly, as a transformation to a digital supply chain can be considered as a change process it is important to identify and acknowledge the opportunities, challenges and barriers aligned with an increased use of data and digital tools within a supply chain. (Kache and Seuring, 2017; Sanders 2014)

## 3. Methodology

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*This chapter presents the applied methodology used when conducting this study. Decisions in relation to research strategy and research design are motivated and argued for. Moreover, the data collection process is described, and the method used for the analysis is presented. The chapter is finalized by providing a discussion of the quality of the research.*

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### 3.1 Research Strategy

There are two primary strategies when conducting a research, quantitative and qualitative. Which research strategy that is applied is often based on the purpose and the research question of the study. (Bryman and Bell, 2011) In this thesis, the purpose is to provide an understanding to *how* an incumbent firm is approaching a transformation towards a digital supply chain as well as what opportunities and challenges that are identified. This will be enhanced from an inside perspective of SKF in order to receive insight in perceptions and thoughts. The purpose has characteristics which result in conclusions and findings based on words rather than numbers as well as finding the depth within the chosen topic. Thus, the aim of this thesis is *not* to quantify the findings and therefore a qualitative research strategy is most suitable to apply. Additionally, a qualitative research strategy allows for unpredicted data and information to emerge during the research process. (Bryman and Bell, 2011; Yin, 2011)

Moreover, a qualitative strategy is known for taking an inductive research approach, implying that the theories are constructed based on the findings from the empirical research. The opposite of an inductive approach is a deductive approach where hypotheses are formulated based on previous conducting research. (Bryman and Bell, 2011) However, in this thesis, a combination of an inductive and deductive approach has been advised, namely an abductive research approach. This because an abductive approach allows to examine existing research before the data collection begins as well as being allowed to add theory in a later stage. (Bryman and Bell, 2011; Patel and Davidson, 2011) Moreover, literature and reports related to how companies on an aggregated level work with the fourth industrial revolution and digitalization of the supply chain do exist. Hence, little research has been performed in relation to a single company's work with a transformation towards a digital supply chain and it has therefore been evident to be able to modify the theoretical framework along the process, which is in line with arguments stated by Yin (2011) when using an abductive research approach. However, Patel and Davidson (2011) states that an essential drawback with an abductive research approach is that the researcher is affected by previous experiences implying that no researcher is conducting their work unconditionally. Albeit, in order to be able to answer the stated research question an abductive research approach is necessary.

## 3.2 Research Design

The design of the research should be decided based on what is most suitable in relation to the purpose and research question of the study, as well as generating evidence in relation to what the researcher is interested in. Moreover, reliability, replicability and validity are three prominent criteria necessary when evaluating the conducted research. To enhance affirmative reliability and validity within the conducted research it is important to have a well-structured and designed plan for the data collection and continued analysis. (Bryman and Bell, 2011) To answer the set research question and meeting the researches aspirations of this study, the appointed research design in this study is a single case study.

### 3.2.1 Case Study

To be able to answer the stated research question and attain the purpose of this research a single case study design has been used. A case study enables the researcher to in a detailed way explore, investigate and perform analysis of a certain case. A case study focuses on the complexity and specific situation of a single case which can be an organization, a location, a person or an event. (Bryman and Bell, 2011) For this thesis, the company SKF is selected as the object for the case study. SKF is addressed as they have stated a digital strategy applicable to their global organization, which is announced and elaborated in their latest annual report (AB SKF, 2018). This strategy aims at several digitalization processes in different areas, where digitalization of the supply chain is a key action. SKF has a goal to increase the degree of digitalization within their production and supply chain, which makes SKF a suitable candidate to investigate in order to meet the stated purpose. Further, SKF is to be seen as an incumbent firm. Moreover, the Gothenburg area, where the SKF headquarter is located, is in proximity to the researchers.

However, it is argued by many researchers that no generalizable results can be drawn on a single case study since it is difficult to assure that the study is representative for a larger population. (Bryman and Bell, 2011; Patel and Davidson, 2011) With this in mind, the aim of this thesis project is to receive insights and perceptions from employees at SKF in relation to the purpose of the thesis and not create general conclusions applicable for a larger population.

## 3.3 Data Collection

The data that this research is based upon consists of data collected from both primary and secondary sources. Primary data is such data that is collected for the first time while secondary data is data that has been extracted and collected by others. Hence, secondary data does not necessarily need to extract from other researchers, it can be collected by companies or other organizations. (Bryman and Bell, 2011)

### 3.3.1 Primary Data

In order to receive deeper insights and knowledge related to the purpose and research question, primary data has been collected. The primary data has been gathered through conducting semi-structured interviews with employees within the SKF organization possessing insight in the digitalization of the supply chain. To gather data, by conducting interviews enables the researchers to receive data and information of the current state within the area of interest (Bryman and Bell, 2011) at the case company SKF. Moreover, the purpose when conducting the interviews was twofold, at first to receive a deeper understanding and knowledge about the transformation process but also to obtain the respondents' perceptions in relation to the topic.

#### 3.3.1.1 Selection of Respondents

The selection of respondents is an evident and crucial event, especially when the empirical results primary is based on the performed interviews. To avoid biased results Yin (2011) states that the respondents should not be appointed because they are predicted to confirm the expected results of the study. Therefore, to avoid biased results the respondents in this research was selected with the aim to provide different views related to the research question. The researchers had a contact person at SKF who acted as a bridge between the researchers and the respondents. In accordance with the researchers and their contact person, employees at SKF with insights in the digital supply chain transformation process was identified and thereafter asked to participate in an interview. This method can be recognized as convenience sampling or more specifically a snowball sampling method (Bryman and Bell, 2011). According to Bryman and Bell (2011), a convenient sampling method is done by collecting responses from people available at the moment and a snowball sampling method is a form of convenience sampling. Moreover, the researcher is the party who take initial contact with relevant people for the research and use that contact to create contact with others when addressing snowball sampling. (Bryman and Bell, 2011) Yin (2011) argues that the use of snowball sampling increases the validity of the research by identifying respondents that can contribute with relevant knowledge and insights when conducting the interviews.

Moreover, the potential respondents were in advance to accepting to participate in an interview assigned with a presentation of the authors as well as the purpose of the interview. This presentation was distributed by the contact person at SKF in order to give the potential respondents a clear picture of the case before deciding to participate or not, the presentation can be found in Appendix A<sup>1</sup>.

As previously mentioned, the purpose with this research is to investigate how an incumbent firm, SKF are working with the transformation towards a digital supply chain. It is therefore important to reach and conduct interviews with representatives from different parts of the

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<sup>1</sup> Note that the explicit research question has been altered during the research process. However, our profound implication is that this has not changed the purpose of the thesis.

organization and more specifically within different parts of the supply chain. The respondents contributing to this thesis is presented in table 3.1. The respondents have confirmed that their name and job title is displayed in this thesis.

Table 3.1: List of respondents.

Respondent	Title	Language	Date	Location of Interview
Jan Levander	Project Manager - Supply Chain 4.0, SKF Logistics & Demand Chain	Swedish	2018-03-26	SKF Headquarter, Gothenburg
Gibril George	Business Analyst Sales and E-Business at SKF IT	Swedish	2018-03-29	SKF Headquarter, Gothenburg
Marcus Freivald	Senior IT Project Manager at SKF Group	Swedish		
Mike Strilziw	Global Supply Chain Expert	English	2018-04-05	Telephone
Carl Pucher	Country Manager Sweden at SKF Business Consulting	Swedish	2018-04-05	SKF Headquarter, Gothenburg
Axel Baarlid	Business Analyst, SKF Business Consulting	Swedish	2018-04-05	SKF Headquarter, Gothenburg
Sofia Fagrell	Project Manager - Supply Chain 4.0, SKF Logistics & Demand Chain	Swedish	2018-04-10	SKF Headquarter, Gothenburg
Christer Cedervall	Director at SKF Logistics & Demand Chain	Swedish	2018-04-13	SKF Headquarter, Gothenburg

### 3.3.1.2 Interview Methods

Depending on availability and location of the respondents the interviews was conducted either face to face or over telephone. In total was six interviews performed face to face at SKF headquarter in Gothenburg and one interview over telephone since the respondent was located in Germany. In one of the face to face interviews, two respondents were attending at the same time. Bryman and Bell (2011) states different pros and cons related to the different ways of performing interviews. Face to face interviews tends to be more rewarding in the sense that the respondent is less likely to give an avoiding answer. Moreover, it is easier to build a personal connection between the respondent and the researcher as well as when meeting a person, the researcher can register for details concerning the respondent's expressions and reactions during the interview. On the other hand, telephone interviews have the positive impact that it is easier to schedule and it is possible to reach respondents located in other areas than the researchers. Additionally, a group setting can imply the consequence of the respondents guiding each other in different directions affecting the answers. (Bryman and Bell, 2011)

Before the interviews were performed an interview guide containing the main topics was distributed to the respondents in order to give them an insight into what the researchers would ask (Appendix B). Bryman and Bell (2011) states that this is an action that contributes to

strengthening the dependability of the research. Moreover, distributing the interview guide in advance gives the respondents the possibility to prepare for the interview as well as for the researchers to maintain a clear path of the interviews. (Bryman and Bell, 2011)

The duration of the interviews alternated from 30 minutes to a bit over an hour. Both researchers were present during all seven interviews. Moreover, the interviews were recorded and later transcribed. There are pros and cons with recording and transcribing interviews. The choice of transcribing was decided by the researchers with the reason that it enhanced the possibility for both to be active during the interviews as well as facilitate the process of comprising the empirical findings. The researchers had in advance divided the questions that would be asked during the interview among them, with the purpose that when asking the question that person was in charge of listening and asking follow-up questions and the other person was in charge of taking notes and register for details of the respondent. Having two researchers present during the interviews applies a risk that the respondent feels uncomfortable when more than one person is present. However, the advantage of having two people register more aspects and thus obtaining more essential information is greater the disadvantage in this case. (Bryman and Bell, 2011)

### *3.3.1.3 Interview Questions*

In order to acquire the respondents own perspectives of a phenomenon, as well as receiving a deep understanding of a situation a flexible interview structure is most suitable (Bryman and Bell, 2011). To enhance flexibility, a semi-structured interview approach was used. Semi-structured interviews provide both the respondent and the interviewer with the opportunity of a two-way interaction and communication (Yin, 2011). Prior to conducting the interviews an interview guide was established (Appendix B). This guide includes the main questions that were to be explored and reasoned around during the interview. Additionally, the interview guide covered the main aspects in relation to the purpose and research question of the study. Moreover, the interview guide was established but the interview questions were formulated to enhance the respondents' possibility to reflect and reason around the question. This in order to extract as much information as possible. However, the respondent could depart from the questions which enlightened to new insights and elaboration of the answers. Thus, to receive answers to all the desired questions the interviewer, when necessary, guided the respondents back to cover the key questions.

Bryman and Bell (2011) argues that an interview guide is a good tool to use in order to enhance both flexibility and structure when conducting an interview. However, research shows that there is a risk of having an interview guide. The risk is connected to the fact that the respondent may feel limited and not allowed to speak freely about the assigned subject and also the interviewer might not capture what the respondent find most important. (Bryman and Bell, 2011) Thus as stated above, the interviews performed in this study was semi-structured and the interview guide acted as a guideline rather than a defined set of questions. The researchers had an open mind when asking the questions allowing the respondent to steer the conversation in order to capture unexpected information. (Yin, 2011; Bryman and Bell,

2011) The benefits of constructing and using an interview guide outperformed the disadvantages. The interview guide acted as a foundation for the researchers and enhanced the possibility to achieve consistency and structure for the interviews.

Furthermore, the interview guide was constructed in the way of first asking general introductory questions and later evolving to covering more in-depth and detailed questions in relation to the subject of the thesis project. The first questions asked during the interview did investigate the supply chain of SKF today and evolving to questions revolving around the interpretation of a digital supply chain and the aligned challenges. Moreover, questions related to the transformation process was asked and the interview guide is finalized with questions going deeper into the specific project that SKF has initiated in relation to their work towards a digital supply chain. Described above is the foundation of the interview guide. Thus, depending on the respondents' position and knowledge the questions were slightly altered in order to receive a greater view of the phenomenon investigated in this thesis. Moreover, having a clear order and structure of questions make the respondents feel secure in the interview situation. This also enhances the reliability of the answers (Bryman and Bell, 2011).

#### *3.3.1.4 Language*

The interviews conducted in this research was conducted either in Swedish or English. Which language that was selected for each interview was based on the convenience of the respondent. The interviews were later transcribed in the same language that was used during the interview, however, all empirical material was compiled in English. As this leads to a need of translating Swedish results to English, it is important to keep in mind the challenges aligned with this. Translation is a problematic action especially when conducted by the researchers themselves since they possess a rather subjective stance in the process. Xian (2008) states that data translated by the researchers in a qualitative research is problematic because of the fact that the researcher is a subjective translator implying that elements such as cultural aspects and issues related to linguistics are present and difficult for the researcher to consider. Considering the above aspects, this research has taken the above issues into consideration when translating the interviews, and the researchers have strived towards an objective stance when translating the transcribed material. This is in line with Xian (2008) recommendations.

### **3.3.2 Secondary Data**

To enhance an overall understanding of the scope and subject of the thesis project, the process of gathering secondary data has been an evident part. The included secondary data creates a foundation of evident knowledge for the thesis and acts as a base where further analyses can be built upon. Therefore, the collection of secondary data was primarily conducted at the beginning of the thesis process. Moreover, literature, academic articles, scientific reports as well as management and consultancy reports have been collected from databases such as

Emerald, Scopus and Google Scholar provided by the Economic Library in Gothenburg to create the Literature Review. Moreover, there is no ultimate approach to enhance when collecting secondary data. The majority of secondary sources included in this thesis is extracted from digital sources. The subject of the thesis is a rather new phenomenon, implying limited access to books since that takes time to submit. Nevertheless, the above sources of secondary data are considered as suitable in relation to the time and scope of this thesis project. (Patel and Davidson, 2011) When collecting secondary data, it is important to be critical. However, it saves time and resources, and secondary sources is an evident way to enhance data and information that already exist (Bryman and Bell, 2011). When searching for secondary data certain keywords have been used. These keywords were primary “fourth industrial revolution”, “industry 4.0”, “smart-factory”, “factory of the future”, supply chain development”, “supply chain”, “supply chain information flow”, “digitalization”, “digital supply chain”, “Big Data”, “Internet of Things” and “organizational change”.

Furthermore, in order to better enhance a broader view of the situation at SKF, in relation to the studied phenomenon, the choice of including secondary sources in the empirical findings was advised. The incorporated secondary data represents the figures and tables in the empirical findings, as these are based on secondary material distributed by SKF. It is important to stand critical to this type of data (Bryman and Bell, 2011) since it is produced by the company itself and often is material used for the purpose to market the organization. Hence, the data extracted from company produced material was critically judged by the researchers before advised in the study.

### **3.4 Analysis Method**

Bryman and Bell (2011), describes a process called iterative analysis approach. This approach requires that the researchers repeatedly go back and forth between the theoretical findings, empirical findings and the analysis. In this thesis, this approach has been applied since the topic of research is considered to be rather unexplored and therefore certain sections might need to be elaborated as the acquired knowledge increases.

In order to build an empirical framework as well as creating a possibility to set the collected data in relation to the theoretical findings a structured method for analyzing the findings is necessary. A common method used to approach data analysis, within qualitative research is called thematic analysis. This method emphasizes the findings of patterns or themes within the data. (Bryman and Bell, 2011) In this thesis, patterns in the gathered data were identified by the use of color coding. The aim was to find empirical material aligned with all the headings in the Literature Review and each heading was given a color which then guided the analysis. This enables a structured method for finding patterns in the gathered data. Furthermore, the aim of the empirical findings is to map the processes and activities in line with the digital transformation work at SKF. In order to achieve this, a narrative approach has been used, which by Bryman and Bell (2011) is described as a suitable way when retelling

and capture human experiences within the investigated area. A narrative approach aims to make sense of organizational processes by translating individual experiences to a coherent picture of a phenomenon. By acquiring individual experiences the researchers have created a coherent picture, of the digital transformation process at SKF. Therefore, there is no need to explicitly name which individual respondent that has said what, as the purpose is to compile a coherent picture.

## 3.5 Research Quality

Establishing and ensuring quality is important in all research. To measure the quality of the research produced, it is classic to state the level of reliability and validity. These measurements are foremost connected to quantitative research. However, in order to applicate these measurements on qualitative research, some alterations to the meaning of these concepts need to be done. (Bryman and Bell, 2011; Yin, 2011) Thus, some authors argue that to fully seize the correct quality of a qualitative research the concepts of reliability and validity should be replaced by the measurement of trustworthiness and authenticity. These concepts should, according to Guba (1985) and Guba and Lincoln (1994), better grasp the quality of a qualitative research as it recon that there can be more than one absolute truth. However, in this study, the quality of the research will be measured by adapting the concepts of reliability and validity to qualitative research.

### 3.5.1 Reliability

Reliability is defined as the ability for others to replicate the findings in the conducted research. Measuring reliability is problematic in qualitative studies since the social setting of the research is key for the findings, but to better grasp the reliability of this study the concept is being divided into external and internal reliability. (Bryman and Bell, 2011) In both external and internal reliability, the essence of reliability in a qualitative context is consistency (Leung, 2015).

#### 3.5.1.1 External Reliability

External reliability refers to how well the study can be replicated. This is difficult to meet within qualitative research since it is impossible to fully replicate a social setting in which the result once was found. However, in order to increase the external reliability, it is important that the authors are very transparent with the choices that have been made in the study and argues for the different procedures in the study. This as a clearer and easy to follow structure increase the possibility to replicate the study. Furthermore, it is argued that in order to truly replicate a qualitative research the researcher needs to adopt a similar social role as the original researcher. (Bryman and Bell, 2011)

In order to increase the external reliability of this study, the authors have sought after to stay as transparent as possible with all the different choices made in the research strategy, design and analysis. Therefore, extra time and effort have been put into describing the method by which this thesis has been followed.

Furthermore, there is always a risk to not be able to obtain fully external reliability due to an interviewee want to remain anonymous and the recording cannot be published for other researchers, which reduce the possibility of replicating the study. However, in this research, the respondents have agreed to share their name and position and these are presented in table 3.1. This, in combination with the attachment of the interview guide makes it possible to replicate all the conducted interviews.

#### *3.5.1.2 Internal Reliability*

Internal reliability refers to an agreement among researchers. If several researchers can agree and find similar conclusion based on the same observations, data and insights, the internal reliability is high. To decrease the risk of low internal reliability more than one researcher is favorable. A common concept when discussing internal reliability is inter-observer consistency, which refers to that two or more observers of the same behavior are agreeing upon what they are observing and how they code that observation. (Bryman and Bell, 2011)

In order to retain a high internal reliability, there are two researchers in this master thesis project, which increase the level of internal reliability as that the authors validated each other in what has been observed and heard during the interviews, thus ensuring inter-observer consistency.

#### *3.5.2 Validity*

Validity is concerned with the integrity of the conclusions that are generated from the research and is a measurement which investigates if the study measures what it intends to measure. (Bryman and Bell, 2011) According to Yin (2011), a valid study is a study that in a correct manner has collected and interpreted its data, this so that the conclusion accurately reflects and represents the real world of what is studied.

In order to increase the degree of validity in a qualitative research, Maxwell (2012) have identified seven strategies for combating the threats to a high validity within qualitative research. These seven steps and how these have been used in order to assure a high validity is presented in table 3.2.

Table 3.2: Seven strategies for combating the threats to a high validity within qualitative research (Maxwell, 2012).

Strategy	Actions taken by the researchers
<b>Intensive long-term involvement</b> – to produce a complete and in-depth understanding of the situation, the opportunity to make repeated observations and interviews is important.	A close relationship with our contact person at SKF made it possible for us to re-ask questions and clarify concepts.
<b>Rich data</b> – to fully cover the field observations and interview with detailed and varied data.	To increase the richness of the data the interviews have been transcribed.
<b>Respondent validation</b> – to obtain feedback from the people studied, to lessen the misinterpretations of their self-reported behaviors and views.	The summarized and written material from the interviews has been sent to the contact person for feedback, this to ensure that they agree upon what is being written.
<b>Search for discrepant evidence and negative cases</b> – to test rival or competing explanations.	During the collection of data, a sense of skepticism has been held, this to always question the level of accuracy in what is found and to see if rival “truths” can be found in other sources.
<b>Triangulations</b> – to collect converging evidence for different sources.	The intention has been that the secondary data collected should be confirmed in different sources, however this was not fulfilled in all theories used.
<b>Quasi statistics</b> – use actual numbers instead of adjectives.	No attempts have been made to underpin the empirical findings with numbers. This as the respondents do not know what, e.g. financial benefits that will be aligned.
<b>Comparison</b> – to compare explicitly the results across different settings, groups or events.	As the research design is a single case study the level of comparison is limited, however the researchers have collected data from different departments and settings within the selected company.

Moreover, a commonly discussed aspect within the validity of research is to what level the results of a study can be generalized. A well-known aspect related to case study research design is the difficulties of receiving results that can be generalized among the findings. (Bryman and Bell, 2011; Yin, 2011) Since this study is conducted with a single case study design the research does only take the perspective of the investigated company SKF. Every setting has its own characteristics affecting the answers and these aspects create a rather subjective stance of the situation which hampers the possibility to state that these results are directly applicable to another company or situation.

## 4. Empirical Findings

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*The following chapter aims to compile the findings from the conducted interviews with representatives from SKF. The findings are complemented with secondary data distributed by SKF, this regarding the figures and tables in this section. First, the SKF supply chain of today is presented, followed by a presentation of how the digitalization of the SKF supply chain is approached. Lastly, opportunities and challenges are presented.*

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### 4.1 The SKF Supply Chain

A supply chain can be described and defined in several different ways. According to the respondents, the supply chain that is operating at SKF today was developed in the late 80s and early 90s. The supply chain of SKF is considered to stretch from the supplier, through the factory to the final customer. Moreover, SKF has a production strategy where they want to produce as close as possible to the customer. This is an evident aspect of the SKF supply chain setup and it is stated by the respondents as the production or manufacturing footprint. In each region or continent, SKF has a distribution center (DC) to stock their products. However, the respondent's states that it is important to mention that there are always exceptions from this. In some cases, the products go straight to customer from production as well as there are separate stocking points. There are many different supply chain setups, hence the starting point is to produce against the five distribution centers, and the market demand is then supplied through these distribution centers.

SKF is a company providing products for many different markets with diverse characteristics and needs. To meet these needs, SKF has developed three different supply chain setups based on customer type. These are OEM, distributors and end-users. The foundation in these three supply chain setups is similar, all setups use the same suppliers, same production sites and distributor centers, however how SKF interact with the three customer segments differs.

*“To meet the needs of our customers have we developed three different supply chain setups, one for OEM customers, one for distributors and one for end-users.”*

In the first supply chain setup, reaching the OEM customer, the SKF product is sold as a component to a manufacturer who is using the SKF product in its final product. In this setting, the supply chain looks quite traditional but can take several directions. However, delivery is often performed direct from production or distribution center to customer.

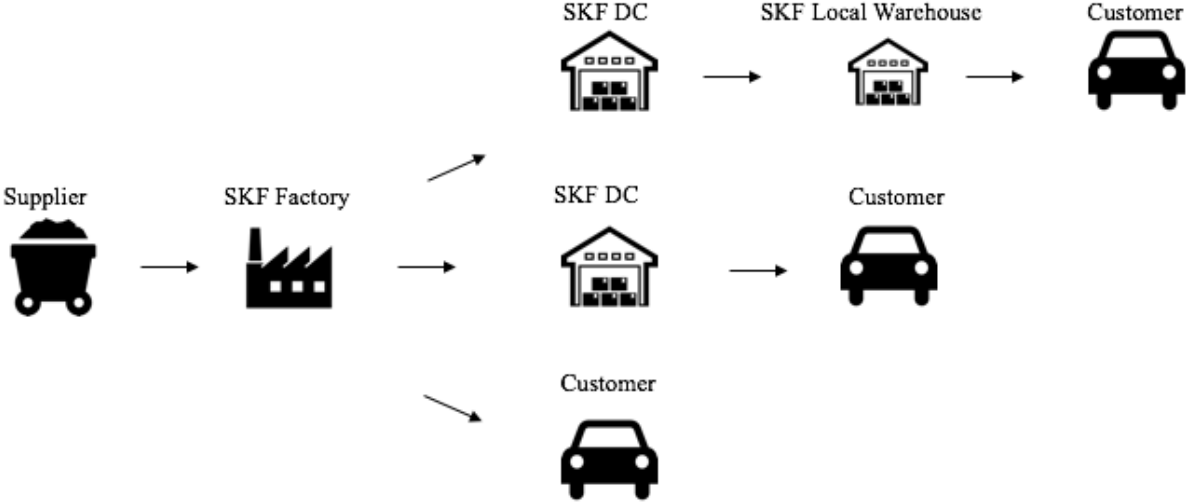


Figure 4.1: Illustration of SKF supply chain OEM set-up, made by authors.

In the second supply chain setup, sales of SKF products go through distributors. SKF has collaborations with several large distributors and distribution programs over the globe. This way of selling SKF products are more or less common in different regions. SKF sales through distributors are often more frequent in regions where sales through distribution generally is popular or in regions where it is more difficult to have local SKF offices. To increase the effectiveness, SKF has established Vendor Management Inventory (VMI) settings with some distributors. VMI implies that SKF plans and decides what products that should be in the inventory at the distributors' site.

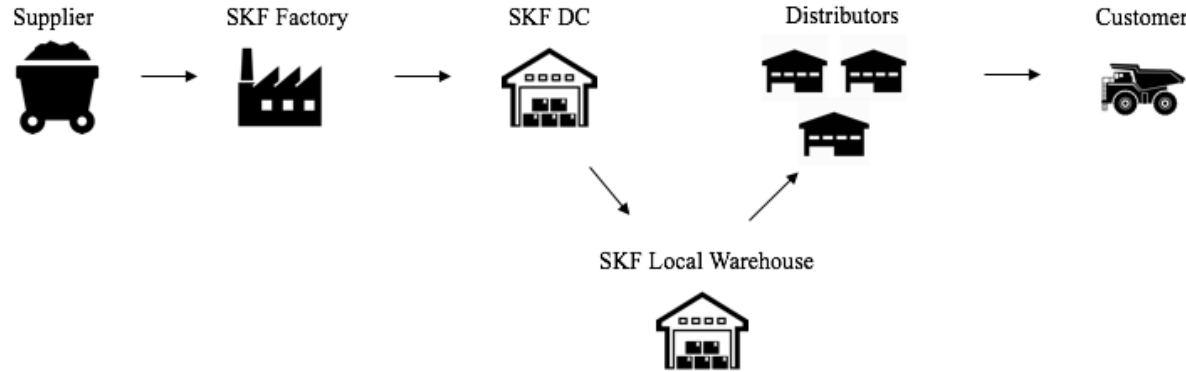


Figure 4.2: Illustration of SKF supply chain distributor set-up, made by authors.

The third supply chain setup is reaching end-users. In these cases, SKF has built a direct relation with the end-user and therefore can sell the SKF components without interaction of any other parties. These connections are often designed as service offers with close interaction.

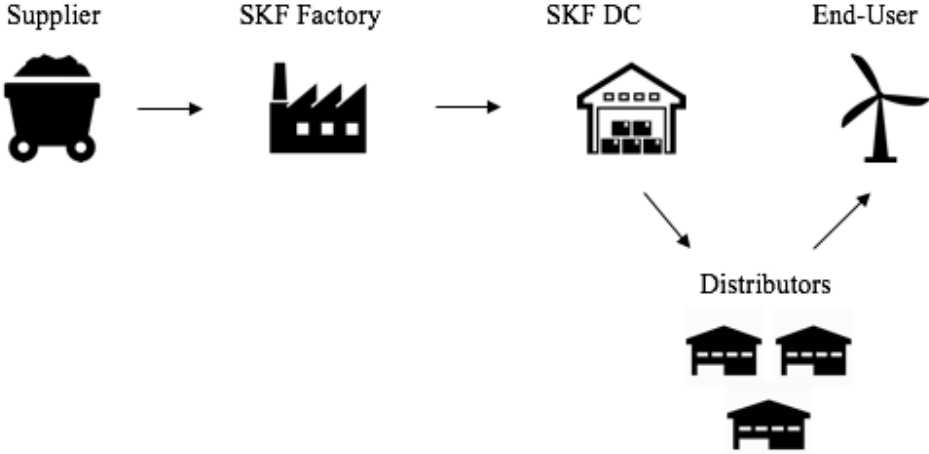


Figure 4.3: Illustration of SKF supply chain end-user set-up, made by authors.

According to the respondents, the products produced by SKF has a long lifecycle, both when it comes to the time the bearings can last as a component in a machine, but also regarding the evolution of the bearings. Respondents argue, that the bearing to some extent still looks the same as it did in 1907 when SKF was founded. This implies that there has not been an evident need to change the production line nor the supply chain. The respondents compare the production of an SKF bearing and the production of a car. Companies operating in the automotive industry release new vehicle models more often than SKF is releasing a new bearing. When an automotive company presents a new vehicle, they often build a new production line and then also implement new technologies and adjust to current standards and designs. However, as the product per say allows SKF to use the same production line, the incentives to replace and re-design a production line has not been as evident.

*“Our bearing is a standardized product with a long lifecycle – it is not like a car or an iPhone. So, our processes have not had a reason for significant change over the last decade, and neither has our supply chain. However, the industries using our products has changed.”*

### 4.1.1 Challenges in Relation to the SKF Supply Chain

The current supply chain at SKF is by the respondents described as a well-functioning and well-developed supply chain. However, the supply chain has not been adjusted nor adapted to the business actions in today's rapidly changing business environment. According to the respondents, this creates challenges for SKF, for example regarding meeting lead-time requirements, predicting accurate demand and access information. This implies that the supply chain needs to be updated in order to keep up with the industry standard and satisfying the customers. The operations at SKF is today planned in silos. Each node i.e. each

warehouse, each production site and each DC plans and optimizes their own operations, without consideration of the entire supply chain. The supply chain is therefore described by the respondents as sub-optimized.

Moreover, the respondents at SKF states that the greatest challenges identified with the current supply chain are lead-times, availability of products and preparing for digitalization. The production sites are running at full capacity and the demand is higher than the supply of SKF products. This creates long lead-times and the risk of losing customers. If SKF does not deliver as desired, there is a great chance that the customers are leaving for competitors.

In addition, the warehouse stock itself is a challenge the respondents identified as crucial. Neither if it is a factory warehouse in Gothenburg, the local distribution center in Europe or if it is a local warehouse in Finland, it ties capital. To reduce the level of tied capital is something that SKF is working with, and closely connected to this is to reduce the costs aligned with keeping inventory. In this area, SKF has a zero-stock vision that states that they do not want to produce for stock, i.e. what is produced is produced to satisfy a pre-stated demand. Hence, today it is necessary to keep stock in order to meet the lead-time and availability of SKF products demanded by the customers.

*“Stock is a necessary evil, and something that we want to get rid of.”*

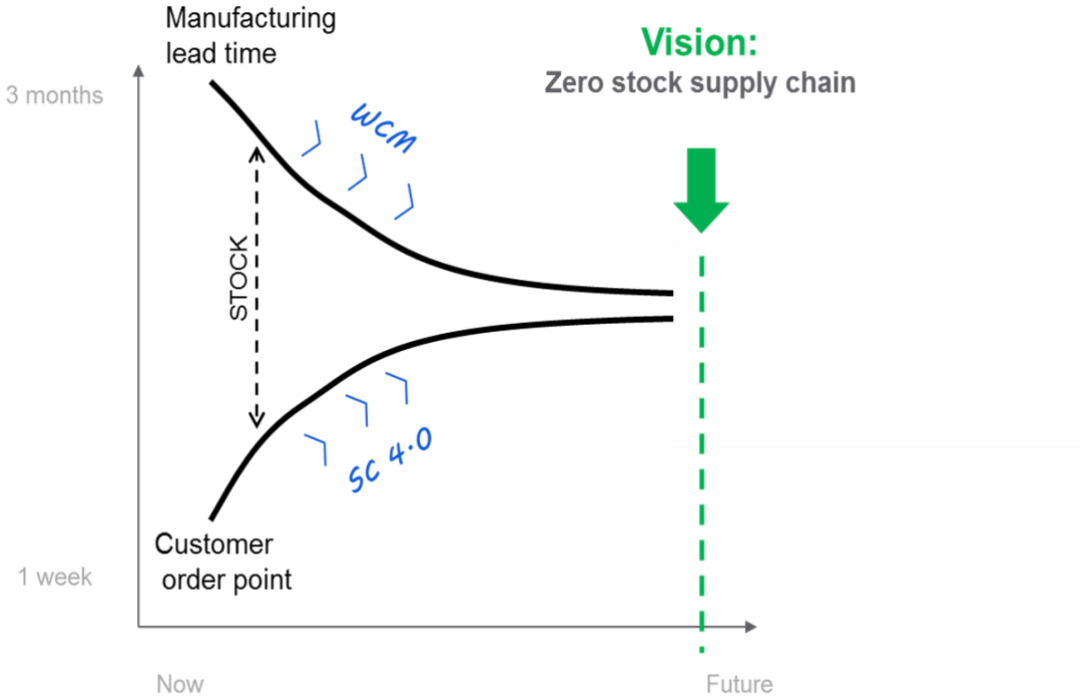


Figure 4.4: Zero-Stock Vision at SKF, material distributed by SKF.

## 4.1.2 Reasons for Transforming the SKF Supply Chain

In order to meet the challenges aligned with the supply chain SKF has today, a transformation of the supply chain is planned and initiated. According to the respondents at SKF, market conditions are changing, this as customers desire new and improved solutions, as well as increasing their demand. The respondents are sure that the solution to meet the challenges is to increase the degree of digitalization, as digitalization is described as a revolution affecting how business can be made.

*“The world as we know will change because of digitalization.”*

The respondent's states that by observing a supply chain, one easily can see that the more that can be covered in one flow, the better it would be. Thus, what is new today is that there are new technologies and computer systems to use in order to handle the data and take accurate decisions based on the information available. Digitalization for SKF is to make the information, i.e. supply and demand visible through the entire supply chain for those parties in need of the information. By receiving access to this information, it is possible to be more proactive, as well as better and faster decisions can be made throughout the supply chain. The respondent's states that it is in one aspect a new way of working, however also a continuous improvement. Hence, it is a matter of taking small steps and use the tools available.

*“Digitalization involves a lot of tools, but it does not mean that SKF will change our entire way of working. It is rather a way to use this technique in order to make things even better.”*

According to the respondents, the reasons for why SKF is progressing with a transformation towards reaching a digital supply chain are several. First, SKF is a company that always strive towards being at the forefront of industrial evolution but also to take proactive decisions in order to maintain their position. To enable being a proactive actor the respondent's states that SKF has to change in order to keep up with an evolution in the industry climate. If SKF does not meet this changing business climate their competitors will take their market shares. As the respondents state it, this is the threat to the superior position they have today, but digitalization also comes with endless of opportunities.

*“We have to, otherwise our competitors will gain our market shares.”*

According to the respondents, central for SKF is to earn a profit. In order to so, it is evident to be flexible and have the ability to adapt to new ways of doing business. The respondents are referring to classic examples from history where market leaders are missing out on business opportunities. As the business climate of today is characterized by change, the respondent's states that they can feel an anxiety within the industry and that some are afraid of not keeping up with the change.

*“No one wants to be the new Nokia.”*

Additional reasons that the respondents state to why SKF is progressing with the transformation towards a digital supply chain is that the customers are going in that direction and are asking, and sometimes also offering SKF to work in a 4.0 environment. A digitalization of the supply chain will also imply business benefits for SKF, such as reduced-costs, inventories and lead-times. Hence, the behavior of the customer has changed. The customer is demanding new ways of conducting business. The consumer behavior within heavy industry has gone from a business to business behavior to taking after general customer behavior implying characteristics of a business to consumer behavior. Thus, in the end, it is identified by the respondents, that SKF should be a company that it is easy to do business with. Furthermore, the respondents at SKF states that there is a spirit within the company to strive towards seeking for new opportunities to obtain new business relations, and one way to do this is to take a proactive stance in digital transformation.

*“The process of reaching a supply chain 4.0 aligned with different digitalization projects is all about making it easier to do business with us.”*

## 4.2 Digitalization of the SKF Supply Chain

All respondents agree, the work towards adapting to the new digital era has started at SKF but there is still a long way to go. Increasing the degree of digitalization within a multinational company do not happen over a night, the process of transforming the organization is something that happens gradually. Therefore, the timeline for when a transformation can be finalized is unknown. However, as the world surrounding SKF is rapidly changing, actions need to be taken in order to be able to take part in the business climate of the future. The digitalization work performed at SKF has an emergent character and is sprung from individuals' interest and will to change the operations at SKF. To a beginning, the digital work at SKF operated without a label, but as concepts as Industry 4.0 and technological improvements were defined, internal digitalization projects were created, and a more goal-oriented work was performed. As a result of this, SKF today has a clear strategy to increase both the customer satisfaction and the performance at SKF, where digitalization used in order to reach these goals. Increasing the degree of digitalization is seen as a competitive advantage but also a possibility to be in lead, this as the bearing industry, in general, is lagging behind, compared to other sectors. Many respondents are referring to the automotive industry and using them as an example of a sector that has worked with digitalization for a longer period of time and as an industry that has a greater digital presence.

*“The automotive industry has come a lot further in how to automate flows between themselves as a supplier and their customer. While we, at SKF, at the same time, still have a lot of paper, email and phone calls in our communications and not much are linked electronically.”*

As an effect of the emergent interest to evolve the operations at SKF in line with the new digital era, SKF has formulated a digital strategy and initiated different digital projects. Today, several of these projects are up and running with the purpose to increase the digital

presence in different nodes and make the supply chain more digital. Within the organization, SKF has assigned one person responsible for coordinating these digitalization projects. The responsibility aligned with this position is to see the different connections, assure that the same work is not performed in duplicate but also to push the digital strategy at SKF forward. Furthermore, this person has the responsibility to ensure that the digital work that is performed is in line with what the customers are asking for, this in order to certify that the digital transformation initiatives are up to date and responding to a customer demand.

The digital projects performed at SKF are operating in parallel, but the goal is to eventually connect these and thereby fully digitalize the different nodes in the supply chain. A selection of the digitalization projects most connected to the supply chain transformation that the respondents are discussing is presented in table 4.1.

Table 4.1: A selection of strategic digitalization projects at SKF, made by authors based on material distributed by SKF.

Project	Description
<b>World Class Manufacturing</b>	A project to enable the safest, most resource-saving, flexible and cost-efficient production and logistic processes. A milestone was reached in 2017 when the fully automated production channel was finalized in Gothenburg. The goal is to introduce these technologies worldwide.
<b>Condition Monitoring</b>	Through sensor technology enable a monitoring of the condition of the different bearings. A sensor is installed in the bearing that communicate the condition of the bearing. The goal is to be able to better predict the demand of a certain bearing by knowing when the bearing needs to be replaced.
<b>Integrated Planning</b>	A project, which emphasize that SKF look at all the internal storage points in the supply chain, and for each article, plan and optimize the entire inventory and distribution of the article for the entire flow. The goal with integrated planning is to enable a better and smarter planning of the overall production and storage for a product.
<b>SAP Implementation</b>	An investment has been made to implement SAP in all SKF countries. Today the different countries have different legacy systems which makes the connections complex. Introducing SAP will enable a smoother communication among nodes, both internally and externally. SAP is today initiated in 9 countries.
<b>Supply Chain 4.0</b>	A project that aims towards reaching end-to-end information visibility within the supply chain. By creating an end-to-end visibility, the supply chain optimization can be driven by real-time customer demand and the benefits are real time response in relation to planning and execution. The goal is to use data from SKF, OEMs, distributors and end-users, to create one common data view to optimize and customize the end-to-end supply chain. The project is based on several pilot projects and the first pilots have been executed in 2017.

According to the respondents, these different digitalization projects are today more or less operating in silos, but the hope is to connect them and take advantage of the synergies created. The value that these projects individually produce is marginal in comparison with the value they can create together. Furthermore, the respondent’s states that what is essential, regardless

of project, is the dependability of Big Data and IoT technologies. SKF is constantly connecting and analyzing data with the purpose to improve their processes. This data is used in order to enable electronic communication.

*“I really think that regardless of which department, or part of the organization you are looking at, there are initiatives born of digitization and automation. I think, simplified that it is possible to move from a silo structure to cross-functional structure by utilizing digitization and new tools.”*

### 4.2.1 Making the SKF Supply Chain Connected

One digitalization project initiated in order to take the SKF supply chain into the new digital era is a project called Supply Chain 4.0 (SC 4.0). This project is, along with the other projects mentioned in table 4.1 a part of SKF's digital strategy towards reaching an organization that is aligned with the operations, processes and applications of Industry 4.0. The project as such was initiated in the fall of 2016 and aims to use data from SKF and its customers to create one common data view to optimize and customize the end-to-end supply chain. Hence, the goal is to make the SC 4.0 project span over all nodes of the supply chain, in order to enable end-to-end visibility and through this visibility provide a better value proposition for customers and suppliers.

Figure 4.5 illustrates both the visibility within the SKF supply chain today and their vision of how they see their supply chain in the future. SKF has a vision to improve their supply chain and create an end-to-end visibility from supplier to end-user. The visibility that SKF has today stretches from the purchasing unit at the customer to SKF's customer service, referred to stage zero in figure 4.5. This implies that the production site at SKF does not possess any insight in the purchasing unit at the customer, they are only provided with an order book from SKF customer service stating what and how much they need to produce. What SKF desires to do, is to stretch this visibility in order to see the real customer demand, i.e. to see what the production site at the customer need and produce after that demand, stage one in figure 4.5. In the long-term vision are suppliers and end-users also interacted, this is illustrated in stage two in figure 4.5.

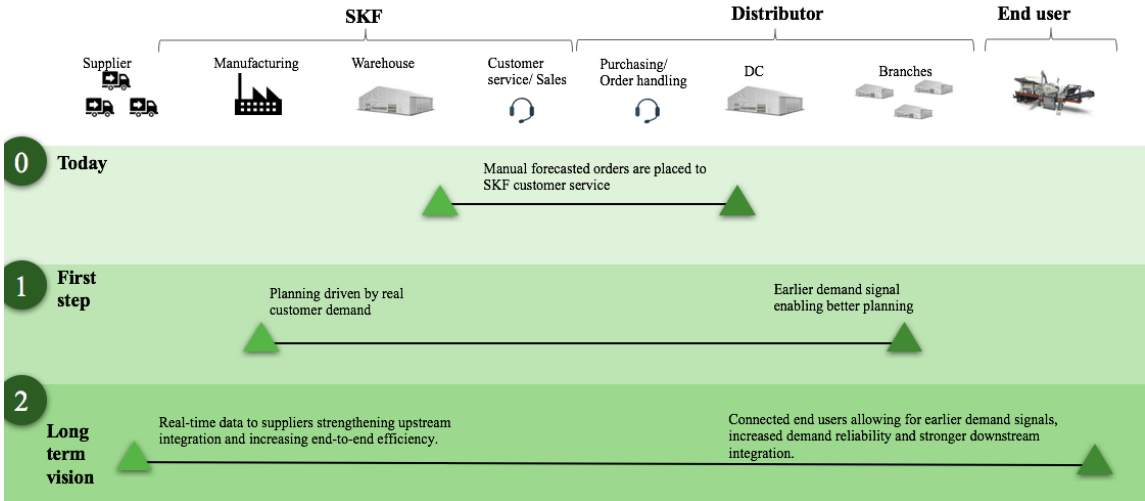


Figure 4.5: Illustration of SKF's supply chain end-to-end visibility vision, material distributed by SKF.

The SC 4.0 project, in combination with the projects in table 4.1 has the purpose to digitalize and fully integrate the SKF supply Chain. The SC 4.0 project is managed by the Logistic and Demand Chain department at SKF, but other departments are also included, mainly as providers of information. The different SKF factories and customer service are two departments that are included in the project. It is important that these departments are involved in the work since their everyday operations are affected by the results of the project. They have been given time to offset in order to provide the project team with certain information. Furthermore, this project has gained top-management attention which can ease the spreading of the message and gain legitimacy within SKF.

*“...we have high top-management attention on this project, so we work together with top-management and update them how the work is progressing. They contribute by creating rings on the water and by being our ambassadors in this.”*

The SC 4.0 project is built upon several pilots, called Proof of Concept, hereafter referred to as PoC where selected customers from all three customer segments are included in the process. The project is based on the action of extracting real-time internal and external data to optimize and customize the end-to-end supply chain for the different customer segments, OEM's, distributors and end-users. The goal is to reach full transparency of stocking points and product flow from production to the point of consumption. Furthermore, an earlier and more accurate demand visibility on item level, and a visibility all the way to SKF manufacturing planning is strived for.

In this initial project only customers are included, i.e. only downstream in the supply chain is analyzed. However, in a second step an extension to include the suppliers and also go upstream in the supply chain is desired. Moreover, this is necessary as the respondents at SKF argues that the full potential of a SC 4.0 concept only can be reached if all nodes are included. In a traditional supply chain, it is common to only consider one node downstream and one node upstream, therefore every node sub-optimizes in order to reach the demand that is visible for them. With the transformation to a digital supply chain, SKF desires to reach full transparency and that all nodes can see everything, and thereby a full optimization of the supply chain can be reached.

*“In the traditional supply chain, one sees a node ahead and one behind. We know what demand they have, and we begin to plan and optimize for that demand. Every time we do this, we sub-optimize and we lose time if a re-planning is needed as the real demand actually is something else. This results in increased lead-times and stock levels. What we are trying to address with an increased transparency, that all nodes have access to the same information.”*

The respondents at SKF states that, in order to reach full transparency, the flow of information needs to transform. How SKF aims to transform their flow of information is illustrated in figure 4.6.

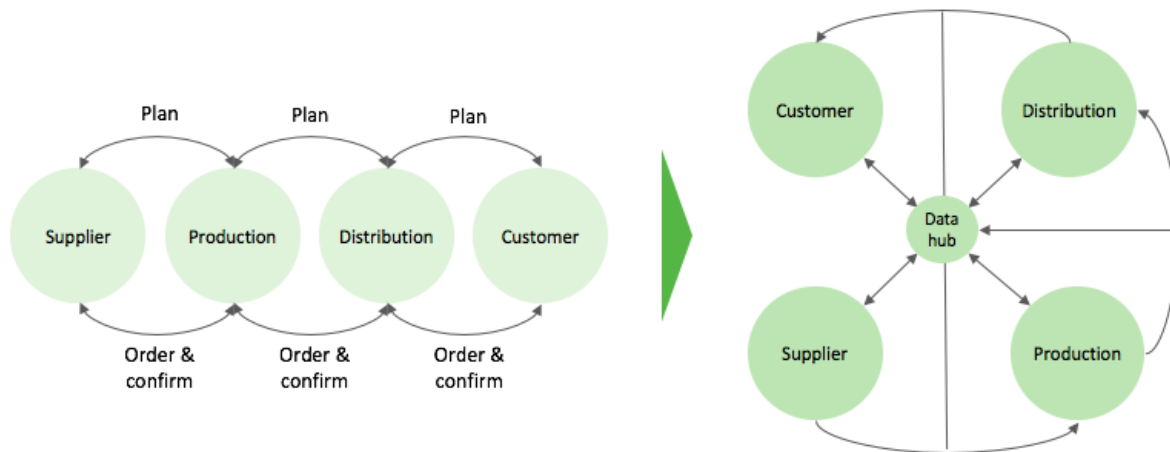


Figure 4.6: Illustration of how SKF aim to transform the information flow in their supply chain.

#### 4.2.1.1 Project Phases of Supply Chain 4.0

The SC 4.0 project consists of different phases. The first phase is to perform a number of different PoC's with selected customers within the three different customer segments. How a PoC operates differs from case to case, but the common ground is that this is a pilot project, where the customers are included in the development process of finding ways for SKF to optimize its supply chain based on real customer demand from real-time data. The respondents state the importance of selecting customer that is available for this type of collaboration, the proper operations and skills but also has the right spirit to contribute. The idea with performing these PoC's is to prove that the operations are possible to implement at a variety of customers and at a large scale.

In figure 4.7 are one PoC from each customer segment presented with a description of the actions in the PoC but also the overall desired benefits and outcomes identified by SKF.

Supply chain setup	OEM	Distributor	End-User
<b>Description of PoC</b>	<ul style="list-style-type: none"> <li>• Connect the SKF production planners to the real demand of the OEM plant.</li> <li>• Review the existing logistics execution setups.</li> <li>• Find ways to use the produced real-time data from SKF and OEM to create one common data view.</li> </ul>	<p>Phase 1</p> <ul style="list-style-type: none"> <li>• Access data through a new system solution shadowing existing VMI process, initially without involving the distributor or changing existing operating model.</li> </ul> <p>Phase 2</p> <ul style="list-style-type: none"> <li>• Involving the customer and connect the customer demand with the SKF supply chain planning. The new process is replacing current VMI process.</li> <li>• Create a platform that in the future also connect the distributors end-users to the SKF supply chain planning.</li> </ul>	<ul style="list-style-type: none"> <li>• Connect the customer demand to the SKF supply chain.</li> <li>• Connect to the maintenance plan in order to pick up demand signals.</li> </ul>

#### Desired Benefits

- Increased flexibility and agility by acting on data.
- Shorter information lead-time
- Early warnings in SKF order book, based upon delivery schedule from customer demand data.
- Improve service level.
- Lower supply chain costs.
- Increased customer entanglement.

#### Desired Outcomes

- Industrialize the concept of SC 4.0 and prove scalability.
- Position SKF in the forefront of the digital transformation and strengthening existing relationship with customers.

Figure 4.7: Presentation of PoC from each customer segment with overall desired benefits and outcomes, made by authors based on material distributed by SKF.

The respondent's states that this way of working is new for SKF. Traditionally SKF is always investigating a new concept thoroughly before adopting it. Working with pilots, like these PoC does has a "trial and error" mentality and an iterative working method. However, the traditional SKF way of implementing new ideas does not work for this type of transformation. Both, as during the time it takes to thoroughly investigate the business climate can drastically change but also that these concepts of SC 4.0 are that new that there is not much to base the investigation on.

*"We will see where we end up, this is learning by doing."*

The second phase of this project is about finding the critical mass where these types of operations are effective. The respondent's states that, as it appears now, to implement these solutions on all customer are not fruitful. So, an investigation about which customer segments that are economically defensible to do this integration with is to be done but also which SKF factories that are most suitable to engage.

*"In the first phase, we proved that this worked for a certain OEM customer with a high demand of SKF products, however, this does not translate that this type of method can be applied on all OEM customers with a high demand. So, that is what we are trying to do now, extend the scope of PoC customers which hopefully will generate proof of scalability and generalizability."*

In the last stage, which not yet has been reached, the goal is to package and industrialize the concept of SC 4.0 and make it as generic as possible. This to be able to reach scalability and generalizability of the findings. How this will look like, how far away it is and what resources that are needed is still unknown.

*“Every PoC is tailor-made for that particular customer relation since all customers have specific needs and prerequisites. Finding scalability is definitely the most challenging step that we will face in this transformation. So far, we do not have a kit that we can industrialize and send out and say - this is how SKF does SC 4.0. We are still in an R&D phase, I would say, and trying to understand how we define SC 4.0 within SKF.”*

### 4.3 Opportunities Aligned with the Digital Era

The opportunities SKF hopes to achieve with transforming the supply chain to the digital era is by the respondents described as the foundation and reason to why the transformation is initiated. Below, identified opportunities are presented.

The respondents at SKF discuss the importance of, by them, so-called internal project champions. The respondents describe these people as individuals who are dedicated as well as see the importance of the digital transformation and truly believes in what the projects aim to reach. These people give SKF an opportunity to better address the identified challenge but also to achieve the digital strategy. The importance of individual project champions is according to the respondents a central aspect when working within a new undiscovered area such as the transformation towards a digital supply chain. This, as there will be a need for people who are dedicated to the digital transformation to ensure that the process emerges. Champions are necessary at all organizational levels. In top-management, champions can provide legitimacy but also financial support. At an operational level, champions can provide good spirit and willingness to change current operations but also to perform additional work tasks that will enable the finalization of the transformation. As the digital transformation projects at SKF still is operating in parallel with the daily operations there is a need to dedicate extra effort in addition to the usual assignment in order to contribute to the projects. The performance of these tasks is dependent upon the internal project champions as these people will put in the necessary effort but also motivate others.

Acquiring information regarding the customers' true demand as early as possible is argued by the respondents as the main identified aspect that will elevate the supply chain. This information will be visible in order to enhance the planning process throughout the supply chain. Availability and visibility of information provide the opportunity to, reduce lead-time and stock levels as well as facilitate the planning process of SKF products.

*“Only by increasing the visibility in the supply chain, we believe that we can make better decisions and produce towards a real demand and not be taken by surprise when the order arrives.”*

Many of the tasks performed by employees at SKF will be simplified and improved as a result of digitalization. Service level and customer contact will be enriched. Increased information integration will, for example result in that Customer Service can focus on value-adding activities instead of managing orders. Moreover, within SKF, the respondents identify that the department at SKF that immediately see the opportunity with increased visibility in the supply chain is the production planners, this because they can base their actions on real-time demand.

*” We want to see the customers true demand, the production sites are experiencing problems related to unstable order books – the factory wants to see the direct forecast from end-customer, today is this information managed through customer service.”*

The respondent's states that the opportunities aligned with this transformation do not only exist from the perspective of SKF. Equally important is to see the benefits for the customers. By increasing the visibility within the supply chain the customers' cost will also decrease, as they will not be forced to keep a safety stock for SKF products at their site. Further, the customers can plan their production upon actual availability of SKF products and thereby mitigate the risk of a breakdown.

*“This is not only for SKF, our customers will benefit just as much – they just have to believe in us and see the possibilities that a 4.0 environment can provide. We have made great progress in attracting customers but there is still a long way to go.”*

The respondent's states that a digital supply chain implies an integration of the SKF operations with the operations of the customers. When sharing data with each other, the before isolated processes become more integrated. This creates benefits for both SKF and the customer. The customer can expect a higher service level and SKF has the chance to create a “lock-in” effects between the supplier, SKF and the customer's as their operations are tied to each other.

*“An integrated, digitalized supply chain is beneficial for both us and our customers as we can provide a better and more accurate service.”*

The process of transforming the supply chain to become digitalized is also performed with the incentives to create a business benefit. By increasing the degree of digitization in relation to the supply chain, shorter lead-times decreased costs and less capital tied in inventory can be achieved. This, in turn, will attract new- but also retain customers.

*“SC4.0 is a tool to maintain current customers, but also to gain new customers as it gives us a competitive advantage.”*

SKF cannot plan their customers' inventory, but if they have information about their customer's inventory, their forecasts, stock levels, what they intended to order, their safety stocks, etc. SKF can take that information into account and make their planning even better. Today the work has started from the perspective of SKF towards the customer, however, in

the future, the suppliers will also be included. The respondent's states that it is important to remember that this process still is in an early stage and there is yet a lot to come.

*“If we can provide this kind of information to our suppliers, they can also have the opportunity to optimize. When the suppliers also are connected an optimization of the entire supply chain is possible.”*

## 4.4 Challenges Aligned with the Digital Era

According to the respondents, the transformation towards reaching a digital supply chain contain different challenges and these are presented below.

First, in order to make the transformation to a digital supply chain the respondent's states that a joint belief needs to steer the different operations. According to the respondents, the stakeholders that need conviction exists both internally and externally and at all levels within the organization. The last year a lot of effort has been put on trying to sell the concept of digitalization internally. According to the respondents, it is important to not underestimate the internal sales process but also to constantly update those involved about the progression in relation to the projects. As it is today the involved business areas, at different factories and customer services are contributing to the projects in parallel with their daily operations, therefore it is important to ensure that they are convinced about the benefits this work will bring.

*“I, as a single individual within the SKF organization can sit and talk how much I want about this, but the reason we do this is because we believe in the concept of digitalization and because we want to make life easier for all SKF employees and customers who work in the supply chain. So, from the beginning it is a lot about convincing, making people understand and spreading the message internally.”*

Further, what some respondents defined as most important is to convince external stakeholders to share their data. As the SC 4.0 project, to a large extent is built on the collection and sharing of data between SKF and its customers, the gathering of this data is crucial for the project. SKF needs quantity figures regarding how many SKF products that are located in a particular location and how many units that are consumed. Getting access to this customer data is difficult. First, the customer question what the data will be used for. Second, the customer needs to have the resources and time within their organization to spare to a new project that will take time and effort from their daily operations. Third, it will also be a challenge to convince the customers to share the data continuously and in the right format in order to be able to analyze and use it.

Second, the respondents identify that the most crucial node in the supply chain to adapt to the digital era is the production. This as there is a requirement for high investments of new machinery and technologies in order to reach World Class Manufacturing standard in all SKF

factories. Furthermore, the introduction of new technologies in relation to manufacturing often require rather advanced IT-knowledge among the workers at the factory. This is something that might be lacking at some locations.

*“Creating World Class channels in all SKF factories are expensive but a necessity in order to create an Industry 4.0 environment. However, updating the factory standard and working methods often requires for high IT-knowledge among factory employees, which is something that we might lack at some locations today.”*

Third, the respondents identify challenges in relation to data management. It is difficult to manage the data available and enhance the right information from large volumes for the specific purpose. Furthermore, respondents address the challenge with aligning people within a large organization and create common systems and methods for sharing information and knowledge.

*“SKF is a company that comprises of talented employees, but it is a huge company. What I think needs a little more attention is that we need to find better synergies and step away from working in silos.”*

Lastly, the respondents argue that the allocation of resources are always a critical aspect of any process. This address both tangible and intangible resources. Hence, the respondents state that SKF possesses the financial strength as well as the right knowledge and experience within the company to undergo a transformation like this. However, the challenge does instead lie in how these resources should be allocated and how to prioritize.

#### 4.4.1 Change Process Issues

The respondents at SKF identifies that the process of change is challenging. SKF is a large organization with presence in many countries over the globe. Therefore, the respondents acknowledge that there are plenty of opinions, wills and working methods that need to collaborate and come to an agreement. Further, the global presence also affects the smoothness of the transformation as cultural differences can affect how the transformation is received.

*“SKF is a huge company, not a startup company that you just can turncoat. There are around 45 000 employees, from over 100 different countries and over 100 different factories that shall interact. It is not so easy to change something that has been around for over 100 years. So, it is a big challenge, it is a process and a journey. We talk a lot about change management, not just in relation to our project, but at SKF in general.”*

Furthermore, in large organizations bureaucracy can hinder the smoothness of some operations. For SKF the respondents mainly discuss bureaucracy as something that interferes with swiftness in decision making but also that the bureaucracy has created security issues in relation to information sharing within the organization.

*“Then, of course, it is always a built-in bureaucracy in large organizations based on security, where processes take relatively long time.”*

As this transformation will affect many departments within the SKF organization the respondent's states that the transformation will lead to changes in roles and work tasks. For example, the SC 4.0 is to a great extent about connecting the different planning functions at SKF with the customers planning functions. As a result of improved connectivity, it might be needed to re-define roles and responsibilities within SKF, this in order to shorten information lead-times. One example that the respondents discuss is the role of Customer Service in a 4.0 environment. With the introduction of a digitalized supply chain, the factory planners at SKF can take informed decision based on data without involving Customer Service.

*“There will be a new operating model for us internally and how we exactly want to work with SC 4.0 is still unclear. But change always means new roles, new responsibilities and new ways of working.”*

Lastly, regardless of the size of the organization or size of the transformation the human factor and the employee's willingness to change will play an important role in how well the transformation is implemented and executed.

*“The human factor affects everything. We will always interpret information differently. Individuals are different, and it is, in the end, the interest to meet the new that determine the outcome.”*

## 5. Analysis

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*In this chapter, the theoretical frameworks presented in the Literature Review will be discussed in relation to the empirical findings of this study. This with the aim to elaborate an answer to the research question of this thesis. The analysis is built upon the same structure as the Literature Review. Hence, starting by discussing the implication of an emerging industrial evolution, followed by digitalization and supply chain. Lastly, the opportunities and challenges are elaborated in relation to the change process.*

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### 5.1 Emerging Industrial Evolution

SKF is one of the world's leading suppliers of products and services in the field of bearings. From the company's origin in 1907, till today, the main business of SKF has been to produce and sell bearings and as the respondent states the bearing itself is quite similar to when it first was invented. This implies that there has not been an obvious need for change in business operations, as the product itself does not require that. However, SKF is according to the respondents, a company that has a willingness to always be at the forefront of industrial evolution and to make proactive decisions in order to maintain in a leading position. This willingness is well needed in today's inconstant business climate, where a new industrial revolution based on digitalization is knocking on the door. According to Loebbecke and Picot (2015) the fourth industrial revolution emerged in the beginning of the 21<sup>th</sup> century as a result of improved technologies. The information age evolved and transformed into the fourth industrial revolution which is characterized by digitalization. These technological improvements have drastically changed many industries at its core and are affecting business models and business strategies independent of industry. The respondents at SKF states that SKF acknowledges this change in the business environment and that the evolution already is affecting some of their business relations. Furthermore, they recognize that they, in order to survive needs to be up-to-date with modern technology, but also with modern customer behavior. According to the respondents, customers today are demanding new ways to conduct business. The customer behavior within heavy industry has gone from a traditional business to business behavior to mimic characteristics of a business to consumer behavior. Therefore, SKF needs to adjust and change in line with the emerging industrial revolution.

However, the size of SKF and its market position affect the agility in how well and fast they can adjust to a change like the fourth industrial revolution. As the respondents at SKF states, SKF is a huge company, with approximately 45 000 employees and many stakeholders. This gives SKF other conditions to act by when change is necessary, they are not a start-up one can turncoat when needed. This corresponds with Hill and Rothaermel (2003) discussion regarding incumbency and its effect on how well a firm is able, but also willing to adjust to

market change. The article states that the level of incumbency affects the performance of firms when markets are revolutionized by radical technological innovations and that firms that are categorized as an incumbent can face a decline in performance when markets change. The reason behind this varies but some similarities can thus be identified. To begin with, the economic incentives for investing in a new radical technology can be few, but also organizational inertia and established relationships with stakeholders. The respondents at SKF thus states that the shift in market standard and customer behavior is undeniable and in order for SKF to stay in their market leading position a proactive stance needs to be taken although a transformation will be challenging.

## 5.2 Digitalization

SKF has, in order to meet the new business environment, characterized by an era of digitalization and connectivity, formulated a digital strategy which is spread over their global organization. The company's digital strategy is representing in what direction SKF is heading with their business. Moreover, the respondent's states that SKF's digital strategy is an evident part in the company's desire of being a proactive actor, working towards meeting their customers and partner's expectations as early as possible, preferably even before they have realized a need themselves. Hence, the respondent's states that the progression towards increased digitalization has been an aspiration and desire for a long time among top-management and within SKF, however, the time has now come when tools, techniques and applications have emerged in order to enable this progression. This correlates with what Markovitch and Willmott (2014), as well as Manyika et al. (2016), argues that the technological innovations of digitalization have enhanced the possibilities to create new business models.

As stated above, what SKF desires to enhance by digitalizing their business is to improve their business operations and create a competitive advantage in order to attract new, as well as retain current customers. The take that SKF has on this new era of digitalization is strongly connected to the evolution of new techniques and systems to generate and analyze data collected from multiple sources and origins, in large volumes and at high speed. Moreover, SKF wants to enable ways to generate, convey as well as integrate more data. Additionally, SKF's desire that the data available will communicate and act on its own, without human interaction. Big Data and IoT are two prominent technologies within digitalization (Lorenz et al., 2015; Geissbauer, Vedso and Schauf, 2015; Feige et al., 2016; Schrauf and Bertram, 2016) and adopting these will to a great extent enable what SKF desires to do.

The respondents at SKF acknowledge that properly managed data will elevate their business operations. Thus, the challenge they identify is closely tied to the action of managing large amounts of data, as well as making value-creating righteous decisions based on the data. Fernandez-Miranda, et al. (2017) and De Mauro, Greco and Grimaldi (2016) acknowledge the difficulties of handling and manage large amounts of data.

Continuing, IoT is an evident digital technology to generate data and this is something that SKF has taken advantage of. As briefly mentioned above, SKF strives towards enabling communication between devices without human interaction. This is recognized by Lu, Papagiannidis and Alamanos (2018) who describes that IoT is a network where physical devices are connected to each other and exchange information. The respondent's states that SKF is a company that has invested in technologies based on IoT solutions. A project that operates at SKF today is called Condition Monitoring. The information provided by the sensors is analyzed and used as for future business decisions. The aspiration at SKF, and what they are working towards is an organization where products and services are connected and developed through intelligent solutions and systems with the purpose to enhance a smart business, which, according to the respondents is an evident characteristic of today's industrial era. This is also confirmed by Wortmann and Fluchter (2015) who states that a prominent area where IoT technologies have emerged is within smart industry.

## 5.3 Supply Chain

The formation of a supply chain can be described and defined in several different ways, this is recognized both in the Literature Review and by the respondents. Every supply chain is unique in character; however, some general visualizations exist which captures the essence of certain nodes and describes how both information and material flows. The framework selected for visualizing a supply chain structure in this thesis is called SCOR, and consists of the nodes; plan, source, make and deliver. (Stewart, 1997; Raman et al., 2018) Comparing this general visualization with the supply chain structure at SKF, some similarities can be identified. Both SKF and the SCOR framework includes all the supply chain nodes from raw material, at the supplier to the actual delivery of a final good to the customer. Furthermore, both the SCOR framework and the respondents at SKF identifies the importance of a granular plan, regarding demand and capacity in the different nodes. However, it cannot fully be argued that the SKF supply chain can be visualized with the generalized SCOR framework this as SKF has three different supply chain setups.

### 5.3.1 The Supply Chain Information Sharing Transformation

The digitalization strategy that SKF is working towards are not aiming to change the supply chain setup. The supply chain structure, as it is today should be maintained but the goal is to optimize and adjust its operations to the digital era. One of the most profound improvements that SKF intends to address with an increased degree of digitalization is to integrate the information flow in their supply chain. In today's supply chain structure at SKF, the different planning activities within the nodes are not completely integrated, they rather act in silos. SKF are aiming towards changing this and enabling a more network structured supply chain where information available in the chain is more integrated. This correlates with what Mussomeli, Gish and Laaper (2016) identify as a supply network and the most profound difference between a linear supply chain and a so-called supply network is how information is

shared and how information flows. Furthermore, there is a difference in how nodes are managed, in a classic linear supply chain the different nodes are managed and operated as isolated functions rather than, as in the supply network, all nodes are integrated and aiming for the same goal. Below a comparison of how the Literature Review and SKF are visualizing the transformation of how information should flow is presented.

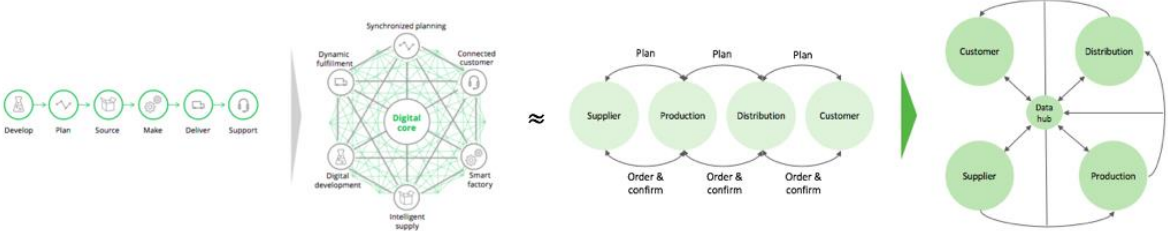


Figure 5.1: Comparison of how SKF aim to transform their information flow and the literature review, made by authors inspired by Mussomeli, Gish and Laaper (2016).

SKF prospects that an increased degree of information sharing within the supply chain will lead to an optimization of its operations. This increased degree of information sharing should both be internal at SKF but also cross-organization boundaries and include customers and suppliers. According to theories, there are both short-term and long-term benefits with an increased degree of information sharing within the supply chain. The short-term benefits can be achieved by sharing day-to-day operational data. Sharing this type of information can reduce the risk brought by asymmetric and incomplete information, cut down lead times, mitigate the bullwhip effect, as well as reduce total cost while increasing total supply chain profit. (Ganesh, Raghunathan and Rajendran, 2014) The long-term, benefits of sharing information among all nodes in the supply chain are much concerned about the ease of taking strategically important decisions. If the decisions are based on shared data, it will be easier to take an accurate decision and the decisions would be connected to actual business operations. (Fredendall and Hill, 2016) Issues being addressed with analyzes of this type of data are strategic decisions about outsourcing of certain activities, locating production at more cost-efficient sites but also how to better integrated information sharing within the complete supply chain. (Madenas et al., 2014) SKF's desire is to reach both short-term and long-term benefits with an increased degree of information sharing, however, it could be argued that the focus initially is to achieve the short-term benefits. This as the hope is to enable an optimized flow of information and thereby also optimize the flow of material within the supply chain. The first step is to incorporate and share data down streams in the supply chain, both regarding SKF's own storage points but also customer data about what material they use and when. This in order to enable a more precise forecast for production and a smarter warehouse management.

### 5.3.2 The Next Generation of the SKF Supply Chain

SKF has a desire to transform their supply chain and make it more adjusted to the supply chain standard of tomorrow. In order to do so, SKF has created an outspoken digital strategy but also initiated a number of digitalization projects with the purpose to upgrade different nodes in the supply chain to the digital era. All this to enable an optimization of the operations within the supply chain. These projects are today operating in parallel, but the goal is to one day connect these and thereby reach a more complete digitalized supply chain. The approach that SKF has towards this, rather radical transformation is to take small steps, and not rush into changing operations. Furthermore, due to the novelty of this way of operating within the industry, a learning-by-doing approach is applied. According to the respondents at SKF this is not a traditional approach at SKF, however necessary in this transformation process.

As stated, SKF's way of realizing the digitalization is to initiate several projects. A selection of these digitalization projects is presented in table 4.1 in the Empirical Findings. Conducting this study has resulted in the insight of the action upon data. Therefore, it could be argued that a common denominator for all these projects are data, either it seeks to generate, convey, act on or integrate data. In table, 5.1 below, the different projects are connected to a data action.

Table 5.1: Presentation of supply chain digitalization projects and its data action.

Project	Data Action
<b>World Class Manufacturing</b>	Act on data
<b>Condition Monitoring</b>	Generate data
<b>Integrated Planning</b>	Act on data
<b>SAP Implementation</b>	Convey data
<b>Supply Chain 4.0</b>	Integrate data

The project called World Class Manufacturing aims to enable SKF to have the safest, most resource-saving, flexible and cost-efficient production and logistic processes. This shall be reached by the introduction of more advanced technologies that allows fully automated production and also by making the manufacturing process *act on data*. The data that is generated or integrated in other nodes in the supply chain shall act as the decision foundation for what to produce, therefore the production shall act on data. According to Sanders (2014) the actual make node in a supply chain is complex and differs between companies, but much comes down to the importance of coordinating and matching the products that the companies are making with the products that the customer demands. However, the process of matching what is produced with what is demanded can be made more efficient with the use of data analytics.

Continuing, with the project called Condition Monitoring, this project seeks to *generate data* by installing a sensor in the bearing that communicates the condition of the bearing. The goal is to be able to better predict the demand for a certain bearing by knowing when the bearing needs to be replaced. This can to a great extent be translated to that SKF are aiming towards

enabling to bearing to “talk”, which correlates with the foundation of IoT, that the material world should communicate with computers by exchanging data. (Witkowski, 2017). In relation to the activities in a supply chain, IoT enables that planning, controlling and coordinating activities can be based on real time-data. (Dweekat, Hwang and Park, 2017)

Next, the integrated planning project emphasize that SKF look at all the internal storage points in the supply chain, and for each article, plan and optimize the entire inventory and distribution of the article for the entire supply chain flow. By doing so, SKF can base its action on more accurate inventory information, which will affect production as well as inventory levels. Therefore, it could be argued that the Integrated Planning project seeks to *generate data* for SKF so that a better inventory knowledge can be reached. This correlates with what Gunasekaran et al. (2017) identify, that the analyzes of data in relation to inventory management can enable better planning of inventory.

Furthermore, SKF has initiated a project to implement SAP in their organization. This is a project that is highly resource demanding and will take time to realize as the SKF facilities worldwide today are operating in a multiple range of different legacy systems. However, the benefits of implementing SAP are numerous as it will enable a smoother communication both internally, but also cross-organization boundaries. SAP seeks to *convey data* within the chain and as Berner, Graupner and Maedche (2014) argues well-functioning legacy systems are a prerequisite for Big Data analyze. Therefore, it could be argued that an upgrading of the legacy system is a necessity for what SKF is trying to reach, a more integrated information flow in the supply chain.

Lastly, SKF has introduced a project called SC 4.0, which seeks to enable end-to-end visibility. This project is striving towards spanning over all nodes in the supply chain and *integrated data* available in all nodes. However, the project is just in its introduction phase where solely certain customers are included in the work to prove that this way of using and integrating data is possible, but also profitable. The next stage is to find ways to scale and generalize the solution to all customers, and later also suppliers. The goal of SKFs transformation to a supply chain that operates under the condition of a 4.0 environment is to better be able to predict demand and thereby optimize the production and reach the stated zero-stock vision. According to Sanders (2014) can an integration of data analyzes in the supply chain enable what SKF visions, as the integration of data creates a better foundation for more accurate demand predictions.

## 5.4 The Process of Change

SKF is undergoing several organizational changes aligned to their initiated digital strategy. SKFs transformation towards a digital business is presented throughout the global organization and the digital strategy is central to the company’s continuous work of how they want to perform their business operations. Matt, Hess and Benlian (2015) recognize that an

evident factor of reaching a successful digital transformation is the formulation of a strategy and this is something that SKF has acknowledged as they have formulated a strategy and started their work towards reaching a digital organization. The initiation of a digital strategy has evolved in multiple directions as a mean to cover the many aspects that exist within a supply chain. Due to the many operations, activities and work tasks that will change, the digital transformation that is taking place at SKF can be defined as a process of change. This corresponds to the description of change provided by Todnem (2005) who states that the process an organization undergo when leaving a current state of operation, to the desired state is acknowledged as a change process.

An evident part of a change process is that it contains challenges (Diedrich and Guzman, 2015). However, with challenges opportunities arise, and this fact is recognized by the respondents at SKF. The respondent's states that change is difficult but undeniable in an increasingly competitive business environment. The fear of lacking behind industrial standard as the technological level within the industry sector is increasing, is evident among the respondents. This is also a direct reason of why SKF is progressing with digitalization. SKF is an organization that aims to take a proactive stance to meet what their market demands, both in terms of what the customer desires but also what their organization needs. Beyerer, Jasperneite and Sauer (2015) argues for the advantages of being in the forefront and actively working with improvements, both internal and external in order to meet the changing business environment. This is in line with the progression and work that SKF is undertaking in order to remain market leading within their industry.

The respondents recognize that the process aligned with meeting the new era of digitalization and incorporate new ways of conducting business is a process that must take time. Moreover, they state that the timeline is unpredictable and the path forward is something that has to evolve as a result of both internal and external factors. By this said, it can be argued that SKF does not take easy on the actions related to the process of change and, SKF is progressing with small steps. This corresponds with what Diedrich and Guzman (2015) argues as evident factors within organizational change, that change is a continuous process where multiple stakeholder's perspectives must be considered.

Sanders (2014) states that there are three categories; technology, people and processes that constitute the barriers when reaching a digital and data-driven supply chain. Hence, a common mistake is that companies solely invest in one of these three categories. The projects listed in table 4.1, describes the core of the transformation to a digital supply chain at SKF. Within these projects, it could be argued that the advancement of technical aspects, as well as the upgrading of processes, are clearly acknowledged by the SKF organization. However, it is less clear how SKF are incorporating the challenges aligned with the category people. Many of the planned operations will affect the everyday work of the SKF employees. For example, an update of factory standards and work methods does require high IT knowledge among employees, and this is a factor that is identified as critical among the respondents at SKF. However, it is not clearly stated how the required knowledge will be reached. In addition, SKF also states that certain roles within different departments will change as the

transformation to digitalization progress. The current roles will in the future comprise of new tasks in order to meet the new digital era. However, how this change will be managed is not clear. Below, in table 5.3 are the barriers identified by Sanders (2014) connected to each digital supply chain project at SKF.

Table 5.2: Sanders (2014) categorization of barriers in relation to SKF projects.

Project	Sanders (2014) category
World Class Manufacturing	Technology
Condition Monitoring	Technology
Integrated Planning	Process
SAP Implementation	Technology
SC 4.0	Process

### 5.4.1 Opportunities and Challenges with the Transformation to a Digital Supply Chain

There are several factors, opportunities and challenges that must align in order to meet the transformation to a digital supply chain. The respondents at SKF are convinced that the identified opportunities related to the transformation towards a digital supply chain outweigh the challenges. Nevertheless, the respondents do not take easy on the transformation and are aware that the journey towards reaching a fully integrated digital supply chain with end-to-end visibility is a complex process. However, in order to be able to progress with this complex process, the respondents at SKF highlights that a prerequisite is to have internal project champions, not only within their own organization but equally important among their partners. The importance of internal project champions is according to the respondents a central aspect when working within a new undiscovered area such as the transformation towards a digital supply chain. This, as there will be a need for people who are dedicated to the digital transformation to ensure that the process emerges. At SKF the respondents both highlights champions in top-management and at operational level. The internal project champions pushing for digital transformation at different organizational levels can contribute in different ways, however mutually is that these people are helping the digitalization projects to create value but also to be finalized.

#### 5.4.1.1 Opportunities

Opportunities can be seen as the foundation when initiating a change, this as reaching the aligned opportunities is the goal of initiating the change. It could, therefore, be argued that without any outspoken nor identified opportunities, the purpose of investing in a process of change is not evident.

The overall goal with the digitalization work at SKF is to enable a better value proposition to the customer, and in today’s constantly-changing business environment transformation is necessary. As stated, the transformation of the SKF supply chain has just started and therefore

cannot the full opportunities of a data-driven, and digital supply chain be identified. However, SKF has clear goals with this transformation and these can be argued to translate to the opportunities they hope to achieve. Furthermore, experts within Supply Chain Management and Big Data identifies several opportunities aligned with a digital and data-driven supply chain (Kache and Seuring, 2017). It could be argued that the identified opportunities can be categorized within two primary opportunities, namely, *supply chain optimization* and *enhanced visibility*. These two categories of the identified opportunities are based on the characteristics in relation to the different opportunities. Firstly, the category of supply chain optimization comprises of opportunities that will optimize the supply chain in terms of effectiveness, tractability and accuracy. The second identified category of enhanced visibility consists of opportunities based on increased availability of real-time information. Based on the opportunities presented in the Literature Review, the identified categorization of the opportunities is presented in table 5.3.

Table 5.3: Categorization of opportunities, made by authors based on Kache and Seuring (2017).

Categorization of identified opportunities					
<b>Supply Chain Optimization</b>	Increased granularity in demand planning	Product traceability which leads to lead-time reduction and re-routing possibilities	Enhanced integrated optimization and collaboration with the entire supply chain ecosystem	Inventory optimization	More accurate decision making through automation and machine-to-machine processes
<b>Enhanced Visibility</b>	Enhance discovery and availability of information within the supply chain	Supply chain visibility and transparency with real-time control and multi-tier visibility irrespective of data location	Access to customer and supplier data enhance innovation capacity	Increased real-time responsiveness	

The respondents at SKF acknowledge all the identified opportunities presented in table 5.3. However, through the gathering of the empirical findings, the authors have identified that some opportunities are re-occurring and therefore recognized as more dominant within the transformation process at SKF. The opportunities that have been identified as the most evident opportunities at SKF are the following three; (1) enhanced integrated optimization and collaboration with the entire supply chain ecosystem, (2) inventory optimization, and (3) supply chain visibility and transparency with real-time control and multi-tier visibility irrespective of data location.

In addition to the opportunities presented in table 5.3, the respondents further identify opportunities that are evident in order to progress with a transformation towards a digital supply chain. First, when performing improvements of inventory management, the aim is to achieve a reduced level of tied capital. An evident result, with a digital supply chain that produces based on true demand, is that the capital tied in inventory is reduced. This factor is not only recognized at SKF but also by the customers and suppliers of SKF. The second, evident opportunity identified at SKF in relation to a digital supply chain is the aim to develop a closer collaboration and interaction with stakeholders. From SKF's point of view, an increased degree of interaction with stakeholders will enhance the possibility to create a lock-in effect relating to increased incentives to continue to be attached to SKF as a manufacturer and provider of bearings. Thus, the aim is always to create value for all stakeholders involved.

#### 5.4.1.2 Challenges

There are several challenges identified in the Literature Review (Kache and Seuring, 2017; Hill and Rothaermel, 2003; Sanders, 2014) that are related to the transformation to a data-driven, and digital supply chain. It could be argued that these challenges can be categorized into three different categories based on the character of the identified challenge. The identified categories are *resources*, *data handling* and *internal and external relations*. To begin with, the category of resources comprises of challenges that require both tangible and intangible resources. Secondly, the challenges categorized as data handling are related to data actions such as generation of data, conveying of data, to act upon data and to integrate the data. Lastly, the challenge identified as internal and external relations consist of challenges primary aligned with the human factor, both within and across organizational boundaries. Based on the presented challenges in the Literature Review, the identified categorization of the challenges is presented in table 5.4.

All the identified challenges presented in table 5.4 are more or less acknowledged by the respondents at SKF. Through the gathering of the empirical findings, the authors have identified that some challenges are re-occurring and therefore recognized as more dominant within the transformation process at SKF. Those challenges that have been identified as the primary challenges that re-occur among the respondents at SKF are the following five; (1) need for high investments, (2) identify the relevant data and avoiding inaccurate information, (3) a need to evolve current organizational structures, such as processes and reporting structures, (4) to “sell” the concept of data usage to customers, and (5) integration and collaboration cross-functional and across company boundaries.

Table 5.4: Categorization of challenges, made by authors based on Kache and Securing, (2017); Hill and Rothaermel, (2003); Sanders, (2014).

Categorization of identified challenges					
<b>Resources</b>	Lack of powerful IT-infrastructure to process real-time information	Lack of required skilled employees	Need for high investments	Lack of sufficient leadership	
<b>Data Handling</b>	Identify the relevant data and avoiding inaccurate information	Information and cyber security, as threat of information leakage and differentiation between private and public data	Building a data-driven mindset in decision making		
<b>Internal and External Relations</b>	A need to evolve current organizational structures, such as processes and reporting structures	To “sell” the concept of data usage to customers	Integration and collaboration cross-functional and across companies	Organizational inertia	Change established relationship stakeholders

Beyond the challenges identified in the Literature Review, the respondents at SKF acknowledge additional challenges. These are mainly in relation to the progression of the project SC 4.0. The most prominent challenge that SKF is facing corresponds to the second phase within the SC 4.0 project, namely to reach scalability of the findings conducted in the PoC’s. As previously mentioned, SKF has initiated PoC’s within the three different supply chain setups. However, the upcoming action is to extend the findings to multiple customers, with the desire to enhance a foundation that can act as a blueprint in order to facilitate generalizability of the PoC’s.

## 6. Conclusion

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*This aim of this chapter is to present the concluding remarks of the study based on the results enhanced from the conducted research. Moreover, the stated research question will be answered and the chapter will end with implications and suggestions for future research.*

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### 6.1 Revisiting the Research Question

The purpose of this thesis is to, through a single case study, at SKF, investigate how an incumbent firm progress with a transformation to a digital supply chain. Moreover, the aim of this thesis is to identify what opportunities and challenges that are aligned with the transformation towards a digital supply chain. Below, the answers to the two research questions are presented.

#### *How does an incumbent firm act in order to approach the transformation to a digital supply chain?*

In order to approach the transformation to a digital supply chain, SKF has taken several decisions that together enable them to meet the changing business climate. One of the actions has been to formulate a digital strategy, which is attached to the entire SKF organization. As a result of this strategy, several digitalization projects have been initiated that targets different nodes in the supply chain with the purpose to upgrade the overall supply chain operations. The goal is to integrate these projects and a manager is allocated to monitor the separate projects and assure that the individual actions taken in each project are in line with their overall digital strategy. Furthermore, SKF highlights that a prerequisite to succeed with a digital transformation is to have employees truly dedicated to the aim of the change. At SKF the work towards reaching a digital supply chain is attached both with top-management but also further down in the organization. This is much thanks to several internal project champions who promote the transformation towards digitalization and a digital supply chain.

The digitalization projects at SKF goes hand in hand and are equally important for SKF to finalized in order to reach a digital supply chain. What acts as a denominator for these projects is the shared focus on data. It has been identified that the project that SKF has initiated serves different data actions. Therefore, it can be argued that SKF is approaching the transformation to a digital supply chain with focusing on how SKF better can generate, convey, act on and integrate data in the supply chain operations. All the initiated digitalization projects at SKF are today operating in silos and as this thesis mostly elaborate upon the operations in the project named SC 4.0, the most profound conclusions of how SKF acts in this transformation is based on the activities in that specific project. However, the activities

performed in the SC 4.0 project capture the novelty of fourth industrial revolution and the digital era as SKF are adopting, for them, completely new working methods. The actions that SKF performs in the SC 4.0 project are characterized with a “learning by doing”- approach and has an iterative character as customers are included in the process towards the transformation to a digital supply chain.

To conclude, *how SKF acts in order to approach the transformation to a digital supply chain* can be summarized in three co-working actions; (1) the formulation of a digital strategy that is attached in the global SKF organization, (2) the initiation of several digital projects that targets different nodes in the supply chain, as well as focuses upon different data action, with the purpose to upgrade the overall supply chain operations, and (3) the possession of organizational-braveness that enable them to take an iterative stance in the transformation process.

***What challenges and opportunities are aligned with a transformation to a digital supply chain?***

Different opportunities and challenges, in relation to a transformation towards a data-driven and digital supply chain has been identified both in literature and by the respondents at SKF. Through the process of this study, it has been identified that the respondents at SKF acknowledge that the opportunities and challenges stated in the Literature Review are present in their digital transformation process. The identified opportunities and challenges aligned with a transformation to a digital supply chain are listed in table 6.1 and 6.2.

*Table 6.1: Compilation of identified opportunities in literature and empirical findings.*

Opportunities
<ul style="list-style-type: none"> <li>• Supply chain optimization</li> <li>• Enhanced visibility</li> <li>• Reduce level of tied capital</li> <li>• Lock-in effect</li> </ul>

*Table 6.2: Compilation of identified challenges in literature and empirical findings.*

Challenges
<ul style="list-style-type: none"> <li>• Resources</li> <li>• Data handling</li> <li>• Internal and external relations</li> <li>• Scalability of the digital transformation to all supply chain setups</li> <li>• Generalizability of the digital blueprint</li> </ul>

However, important to consider is that the transformation process towards a digital supply chain at SKF are under progression and therefore it is difficult to fully state which opportunities and challenges that are aligned throughout the process. The stated opportunities and challenges are built upon current insights.

## 6.2 Implications

The findings in this thesis provide insights in how an incumbent firm is approaching the transformation to a digital supply chain. The implication that this thesis provide is that by adopting organizational activities and operations to the new digital era many opportunities can be reached. However, the transformation process comes with challenges that are important to not neglect. By investigating the digital transformation at SKF we see that their path to reach a digital supply chain is not fully pre-determined nor obvious in its direction as a result of an ever-changing business environment. Hence, this study provides a more qualitative in-depth understanding of transforming to a digital supply chain compared to consultancy reports focusing on finding quantitative measurements indicating upon the importance of moving towards a digital business and digital supply chain. As this thesis elaborates on how SKF are progressing with their transformation to a digital supply chain, the insights presented should be used as guidelines rather than recommendations for other organizations facing the same need to transform. This is in line with the fact that this research is performed as a single case study, and therefore no general conclusions or recommendations can be given.

## 6.3 Future Research

This research has come across several important aspects in relation to how an incumbent firm act in order to approach the transformation to a digital supply chain as well as the identification of aligned opportunities and challenges. However, not all aspects of a digital transformation can be covered in this format. Therefore, it is suggested that future research could focus upon investigating the subject in a broader stance. To begin with, this research is conducted with the research design of a single case study. This implies several limitations, mostly related to the possibility to draw generalized conclusions. With this in mind, it would be interesting to conduct research that includes multiple cases and see if there are any general characteristics to be found. The inclusion of a greater number of cases could add to the generalizability of the findings within the research area.

Furthermore, due to the availability of time, information and respondents at SKF solely certain aspects of the digital transformation process could be investigated thoroughly. Therefore, it can be suggested to conduct research which investigates all the initiated digitalization projects but also to include empirical findings from external SKF stakeholders, such as customer and suppliers.

Lastly, due to the novelty of the researched area and the fact that SKF is in the initiation stage of their digital transformation, it would be interesting to conduct future research which investigates the actual results of the transformation, and how well these results correlate with what at first was intended.

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## 8. Appendix

### Appendix A: Presentation Email

#### *Master Thesis Outline*

This document is a presentation of the authors, Matilda Olsson and Sofia Torpfeldt as well as the subject and purpose of our forthcoming master thesis project. You are now reading this document since we believe you would be a perfect candidate for us to interview in order to achieve the purpose of our thesis project.

As stated above, there will be two authors for this master thesis. The reason behind this partnership is a combined interests and similar academic backgrounds. We both started our education at the School of Business Economics and Law, with a Bachelor Degree in Business Administration with a specialization in Logistics and then followed with the master program of Innovation and Industrial Management.

The background to our master thesis project is that business models and business strategies constantly changes as an effect of an increased degree of digitization. One of the fields that have faced and are facing several changes in relation to digitalization is the many operations and stages of manufacturing. Within this field, digital inventions have changed everything. Since the first industrial revolution in late 18<sup>th</sup> century the manufacturing process has gone through many radical shifts. Most lately, as an effect of Internet of Things and Big Data, many are discussing that we today are entering the formation of a fourth industrial revolution characterized by digitalization. However, it is not just the manufacturing of goods that are affected by Internet of Things and Big Data. As an effect of the foundation of the fourth industrial revolution and as a part of it, another phenomenon has been established, which addresses and includes all the aspects of the value chain, not just manufacturing. This phenomenon is called Supply Chain 4.0, the digitalization of the supply chain.

We are addressing SKF as your organization openly are directing these issues and in your annual report from 2016 outspoken are focusing on your work to increase the degree of digitalization within your production and supply chain. In the academic literature, the studies regarding how companies actively are working with digitalization of supply chains are few and therefore, we see our case study of your work as a great opportunity to investigate how this implementation can actually look like and what opportunities and challenges that are aligned.

The purpose of this thesis is therefore, to investigate how an incumbent enterprise is refuting the challenges and meeting the opportunities aligned with the implementation of innovations invented in relation to the fourth industrial revolution and more specifically an integration of a digital supply chain.

- How can an incumbent firm act to elevate their work of an implementation and integration of a digital supply chain?
  - What challenges and opportunities are aligned with an implementation and integration of a digital supply chain?

Thank you for your attention and for considering helping us in our data collection in order to achieving the purpose of our thesis project.

Best regards,

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## Appendix B: Interview Guide

*We are interested in knowing how an incumbent firm act in order to approach the transformation and integration of a digital supply chain. And, which challenges and opportunities that are aligned with this.*

### **SC Today**

How would you describe SKF's supply chain today?

### **Interpretation of SC 4.0**

Industry 4.0 and more specifically digitalization of the supply chain, what is your interpretation of these concepts and what does it mean for SKF?

### **The transformation process**

How does the implementation plan look like, what phases and areas are introduced first?

In your annual report, there is quite lot of information regarding what SKF is doing in connection to SC 4.0 and Industry 4.0. Thus, what's interesting to know is how this work is initiated and how it is performed in a good way?

What parts in the transformation process are crucial for the introduction to be as smooth as possible?

### **Challenges and opportunities**

What are the main opportunities and challenges at SKF with the transformation towards a digital supply chain?

### **The project**

*SKF has now initiated a project in relation to the implementation of a digital supply chain, called SC 4.0.*

In the latest annual report, SKF has a clear vision of a progression towards a more digital organization and an organization that adapts the inventions aligned with Industry 4.0. We assume that this project is a way of meeting the new era of digitalization related to Industry 4.0.

- In what way does this project contribute to the overall goal of a supply chain 4.0?
- Do you know if there are any other initiatives within SKF in different departments that also strives towards an increased degree of digitalization in the supply chain?