UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

**Master Degree Project in Innovation and Industrial Management**

# Industrial Internet of Things

*How technology providers capture a competitive edge by analyzing the Business Model Environment*

Julia Franke and Moa Gustafsson

**Graduate School**
Master of Science in Innovation and Industrial Management
Supervisor: Rick Middel

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By Julia Franke & Moa Gustafsson


School of Business, Economics and Law, University of Gothenburg,
Vasagatan 1 P.O. Box 600, SE 405 30 Gothenburg, Sweden


Contact: julia.franke@hotmail.com or moa.gustafsson.92@gmail.com

**Abstract**

Technological development and innovations have over centuries triggered Industrial Revolutions that have transformed industries. Our society, and not at least the manufacturing sector, is facing a progressive digitalization known as the Industrial Internet of Things (IIoT), which is prospered to transform the industry and disrupt legacy business models. The technological impact of this change has proved to bring impressive improvements in quality, efficiency, and flexibility. However, the business perspective of this change lack attention and research of tomorrow's business models is required. The purpose of this explorative research is therefore to analyze how the development of IIoT affects providers´ business models within the manufacturing sector, excluding elements of technological investigations.

The research is based the Business Model Environment framework, which initially investigates what external forces that affect the development of IIoT, followed by analyzing the transformation of providers' business models. The novelty of the chosen area claimed a qualitative approach comprising interviews with providers of IIoT solutions and experts of the field. Findings show that data security will play an increasingly important role in future, together with the establishment of technological standards. In addition, the IIoT market is growing in both size and speed of development, making the Legal aspect, Switching Costs, and Market Attractiveness the most influential externalities. Providers' business models will undergo extensive transformation within the nearest future. IIoT technologies enable new customized solutions, which transform both the Value Proposition and Customer Relationship. These elements will also imply changes in the Revenue Streams, as new payment models are required for sustained competitiveness. The intensified competition makes alliances favorable, and Key Partnership is prospered to be increasingly important in future. The providers of IIoT technologies will face tremendous changes in nearest future, and IIoT will bring advantages for all parties in the value chain.

**Keywords**: *Industrial Internet of Things, Manufacturing, Business Model Environment, External Forces, Business Model Canvas, Innovation, Transformation, Competitiveness*

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# 1. INTRODUCTION

*This chapter aims to introduce the reader to the research question by providing the background of this thesis. Moreover, our definition of IIoT, problem setting, empirical setting, objective, and limitations will be presented before outlining the disposition of this study.*

## 1.1 BACKGROUND

Our society is transforming, trends evolve faster than ever before and rapidly changes in technology intensify competition. The digital development has shaped a universe of intelligent products, processes, and services communicating with each other. Advances in technology generate new possibilities that will disrupt legacy business models and change the entire value chain. (Accenture, 2015a; Schaeffer, 2017) Companies are facing challenges of staying competitive; the landscape is rapidly changing and fast decision-making to improve efficiency is gradually getting more important. (Lee, Kao, Yang, 2014) Operations are becoming progressively globalized, and supply chains grow more complex, signifying businesses of becoming more cost-efficient to meet customers demand. (BCG, 2016) The world is facing an undergoing development of Cyber-Physical Product Systems (CPPS), describing the merge of digital and physical worlds, summing up to a technological revolution of data, services, and the Internet of Things (IoT). (Mell & Grance, 2011)

The transformation is similar to the development from past Industrial Revolutions, all being triggered by disruptive innovations interacting with each other. (Schmidt et al., 2015) Today, more than two hundred years after the First Industrial Revolution, we are at the edge of the fourth one, Industrie 4.0, initiated by the German government in 2011 as a project to promote digitalization of manufacturing. The term describes a paradigm shift from a centralized- to decentralized production, implying rapid transformation in design, manufacturing, operation, and service of manufacturing systems and products. (European Parliament, 2015; PwC, 2016a) The development is expected to reshape an already competitive landscape and bring major transformations to established industries. (PwC, 2014) Industrie 4.0 is experiencing an increasingly growing attention, particularly in Europe, but also in the U.S, coined as the Industrial Internet of Things (IIoT). (Schmidt et al., 2015) An established definition of the concept is lacking, although companies are choosing similar ways of expressing this development. The IIoT is characterized by the connection of physical- and digital systems, where technological innovations are united to create radical industries and new economic models. (Roland Berger, 2016; IoT Analytics, 2016a)

The term Industrial Internet of Things will be used for consistency and is in this paper defined as:

*"The next phase in digitalization of the manufacturing sector, driven by a combination of technological innovations that integrate the physical- and virtual words. Traditional factories are transformed into smart factories, in which humans, materials, and energy resources are interconnected and optimized."*

This development has come to impact a wide range of industries all over the world, and is especially apparent in the manufacturing sector where conversion is seen at a high pace. Traditional productivity levers are lagging behind the advancement in manufacturing and are now trying to act. Companies invest in automation and robot technologies, redesign their manufacturing networks and move closer to their customers and R&D centers. By combining the strengths of optimized industrial manufacturing with the Internet and cutting-edge technologies is the traditional way of manufacturing transformed and new business models generated. (Schmidt et al., 2015) The industrial industry comprises two-thirds of the world gross domestic product and will now change beyond its recognition. The way machine based processes are organized, labor used, and information shared will transform. (Schaeffer, 2017) Around five million devices are becoming connected every day with each other, Internet, or both. It is evident that the world has become digitally connected to the point of no return. (Ibid)

> *"The fusion of the physical and the virtual world into cyber-physical systems will have a disruptive impact on every business domain of manufacturing companies." (CapGemini, 2014, p.4)*

The ongoing transformation opens up for new opportunities, and providers of both hardware and software are trying to enter and capture shares of the growing IIoT market. However, succeeding in this expanding and competitive market demands transformation of business models. The external environment will to a large extent affect tomorrow´s business models. Beyond a technological development, are key trends of social, environmental and legal character determining strategic foresight. (Osterwalder, 2011) Developments in the global economy, including economic and political factors are according to Cleverism (2017) considerable. The magnitude of this change compels providers undertaking of a comprehensive analysis of the industry and the market. (Osterwalder, 2011)

> *"There is no turning back. What matters now is to make the most of the digital transformation". (Schaeffer, 2017, p.13)*

Above discussion interprets that IIoT signifies a role in companies' future directions and attention on a strategic level. It is essential that providers capture the potential before competitors enter the market and race them out. (McKinsey, 2015)

## 1.2 EMPIRICAL SETTING

This research is conducted in collaboration with a multinational company representing a possible future provider of IIoT solutions. The study is thereby taking a provider´s perspective, but will not be limited to a specific company. Different providers of both hardware- and software solutions will be included in the study. The term providers will be used as a collective expression for all actors; hardware- and software players that offer solutions to manufacturing companies on the IIoT market.

## 1.3 PROBLEM SETTING

The importance of chosen research area is highlighted in many different contexts, and was presented as one of most important topics at the World Economic Forum in Davos 2017. IIoT is prophesied to become the next Industrial Revolution and has captured attention from companies all over the world. Experts are publishing reports with promising financial numbers, making it an important part of all big players' agendas. IIoT is well known among prominent providers and manufacturing companies, however academics and experts are still struggling to properly define the concept. (European Parliament, 2015)

The novelty of related technologies and its field of application automatically raise a number of questions. IIoT implies a transformation that will affect companies' business models in many different aspects, but how this will evolve and which factors that influence this development is yet to discover. The size of this transformation comes with both risks and opportunities, and current challenges refer how businesses will operate in future. Critics argue that IIoT is too expensive, too unreliable, and too oversized. Others claim that it is a poorly defined concept and suffers from inflated expectations, while some consider it to be nothing but a dream. (European Parliament, 2015)

Much attention is brought to this topic from companies and governments all over the world, and the lack of knowledge and previous research of IIoT makes it attractive from an academic point of view. Furthermore, the article *Industry 4.0 - Potentials for Creating Smart Products: Empirical Research Results*, written by Schmith et al. (2015) argues that there is an absence of research on the potential of IIoT, suggesting future research based qualitative interviews to capture a broader perspective of it. (Schmidt et al., 2015)

## 1.4 RESEARCH QUESTION

The objective of this thesis is to analyze the advancement of IIoT and its impact on providers' business models. Moreover, we seek to investigate which external factors that will be most influential in determining the advancement of IIoT, and additionally analyze what elements of providers' business models that will be affected. The Business Model Environment framework by Osterwalder, Pigneur and Clark (2010), found in Appendix A, constitutes the basis in our selection of external forces, whereas the Business Model Canvas examining the impact on the business model.

The problem description, settings, and objective leads to following research question, divided into two sub-questions to address the specific area of research.

***HOW WILL THE DEVELOPMENT OF IIOT AFFECT PROVIDERS' BUSINESS MODELS?***

*- What external forces will affect the development of IIoT?*
*- What elements of providers' business models will be transformed by IIoT?*

The questions will be answered by studying theory and conducting interviews with respondents who possess specific knowledge in chosen area. The aim of this research is to complement previous research by focusing and analyzing the Business Model Environment. The innovative perspective of IIoT will contribute to the fields of study in Innovation Management and Business Development. An area of research which in today's society needs more attention than ever before.

## 1.5 LIMITATIONS

The objective of this thesis is to investigate the business perspective of IIoT by addressing external forces that will influence the progress, and the transformation it brings to providers' business models. The purpose it to create a general picture on a strategic level rather than a deep-oriented analysis. This research will be limited to the Business Model Environment, a tool forming the foundation when focusing external environment and its impact on elements within a business model.

This thesis will contribute to the literature of IIoT from a business perspective focusing the manufacturing sector. Additional industries will not be analyzed, and the manufacturing sector is consequently the referring point even though it not explicitly mentioned. Moreover, the focus of this research directs strategic opportunities, which to a large extent exclude technology-oriented aspects.

## 1.6 DISPOSITION

The research proceeds as following: The Theoretical Framework introduces the concept of IIoT and concerned areas of the Business Model Environment. Next follows a reflection of used Methodology, providing an explanation of how the research has been carried out. Subsequent chapter, Empirical Findings, presents the results by using the chosen framework. The Analysis compares theoretical- and empirical findings by discussing the compliance, which then constitutes the foundation for answering the research question. Finally, the Conclusion summarizes our findings by providing an answer to the research questions and suggestions of future research. *Figure 1.1* below outlines the research process and structure of the report.


*Figure 1.1: Disposition of the Research Process*

# 2. THEORETICAL FRAMEWORK

*This chapter presents the theoretical basis of this report by providing an understanding of used frameworks and theories. Initially is the concept of IIoT explained, followed by the Business Model Environment framework, outlining the foundation of this research. The disposition is visualized and explained below.*

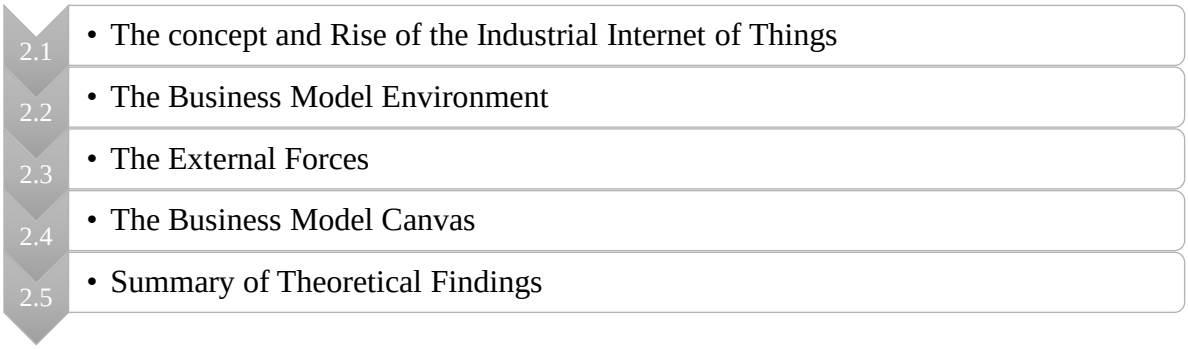


*Figure 2.1: Disposition of Theoretical Framework*

Above visualization shows the disposition of the theoretical framework. The first part introduces the background of the IIoT concept, following section introduces the Business Model Environment framework constituting the basis of this study. The following subchapter discusses external forces in relation to the Business Model Environment. Next comes the Business Model Canvas, discussing implications of IIoT on providers' business model. The chapter concludes with a summary that will be used later in the analysis.

## 2.1 THE CONCEPT AND RISE OF THE INDUSTRIAL INTERNET OF THINGS

The world has during centuries been fundamentally challenged by innovations and developments of new ideas that are facilitated through visionaries, scientists and entrepreneurs. Technological revolutions have generated paradigm shifts forming our whole existence and turned our lives as it appears today. The literature often refers to these as Industrial Revolutions, essential foundations for our modern life. All revolutions we have experienced so far have been triggered by technical innovations. (Brettel et al., 2014; Roland Berger, 2014b) The First Industrial Revolution started in Great Britain at the end of the 18th century where the development of water- and steam powered engines enabled mechanical manufacturing, and created the basis of today's factories. The Second Revolution intensified the use of electrical energy and brought significant changes in production systems in the beginning of the 20th century. The defining characteristics constituted the transformation to scale production of goods based the division of labor, which introduced the concept of mass-production and assembly lines. Pre-existing systems such as telegraphs and railroads were introduced to industries, contributing to the rise of mass production. The Third Revolution also named the Digital Revolution, incorporated computers and digital technology into the production sites. Electronics and information technology were used to automate production, constituting the widespread of digitalization in 1970s. This advancement was, and still is, a direct result of the huge development in information- and communication technology.

(Schmidt et al., 2015; GTAI, 2014) Today, our world is standing on the edge of what is prospered to become the Fourth Industrial Revolution; our society is experiencing a shift in which the real- and the virtual worlds are rapidly converging. This new revolution, termed the Industrial Internet of Things (IIoT), is advancing automation of manufacturing processes to an upper level by introducing customized and flexible mass-production technologies. (Cleverism, 2017) The machines will act as independent entities that are able to collect, analyze and perform upon data. The Fourth Revolution has, just as previous revolutions, potential to raise global income levels and improve the quality of life for people all over the world. (World Economic Forum, 2016)

The IIoT, also recognized by its name Industrie 4.0 given by the German Engineering Federation at Hannover Messe in 2011, was initially a German governmental lead to establish Germany as both the market for, and provider of, advanced manufacturing solutions. The initiative was partly a reaction against the increased outsourcing of manufacturing facilities. (GTAI, 2014; European Parliament, 2015) Today, the concept is spread all over the world with altering labels depending on location; Industrial Internet of Things, Smart Factories, Advanced Manufacturing, Smart Manufacturing, Industry 4.0, Manufacturing 4.0, are some to be mentioned. (Roland Berger, 2016; European Parliament, 2015) However, in this research will Industrial Internet of Things, (IIoT) be used. Below follow two sections where technological innovations and characteristic trends within manufacturing are discussed, all contributing to the growth of IIoT.

### 2.1.1 Technological Innovations as Value Enablers

The IIoT brings disruptive technologies with potential to boost productivity and create value-adding solutions that are tailor-made to customers, enabling enhanced fulfilling of customer requirements with increased profitability. (PwC, 2014) Technologies of IIoT bring increased speed, mass-customization, improved quality, upgraded productivity and greater flexibility. Some technological innovations are disruptive, while others have been used in manufacturing for years. Cyber-Physical Product Systems (CPPS) is defined as transformative technologies used to manage interconnected systems between physical assets and computational capabilities. (Lee, Bagheri & Kao, 2014) CPPS can be developed for managing Big Data and leveraging the interconnectivity of machines to reach the goal of intelligent, resilient and self-adaptable machines. (Geissbauer, Vedso & Schrauf, 2016) A couple of technologies are comprised to provide the foundation of IIoT, namely the IoT, Big Data, Cloud Technology, Advanced analytics, Artificial Intelligence, Additive Manufacturing (3D-printing), Machine Learning, Human Interaction, and Advanced Robotics. Sensors and machine vision coupled with improved artificial intelligence allow robots to fulfill their role in manufacturing as independent productive units. (CapGemini, 2014) The idea of "Cobotics", co-worker in cooperation with Robotics, is created to make complex part of the manufacturing process easier, safer and faster. (Gehm, 2016, PwC, 2016b)

Abovementioned technologies are often thought of separately, but in combination, they create and integrate the physical- and the virtual world. Applying the principles of IoT with the dynamics of connected devices, machines, materials and physical objects in manufacturing,

brings the idealistic concept of "Industrial Internet of Things". (Geissbauer, Vedso & Schrauf, 2016) Furthermore, emerging technologies within IIoT have an important role in challenging traditional business models. Technologies enable organizations to operate their business and ecosystems by increasing the interconnection of people and things. IIoT technologies open up for new opportunities in digital integration and data-driven services, enabled by the access to information in real-time. (PwC, 2016a; McKinsey, 2015) The advancement of new technologies is highly affected by market trends; in the end it is most often customer needs that determine the success and growth of a specific technology.

### 2.1.2 Trends within Manufacturing Contribution to the Advancement of IIoT

The pressure of meeting customers' demands at lower costs increases as the competitive market is becoming globalized. Disruptive innovations and continuous improvements are considered central for the creation of new solutions, implying improvements in lead-times, energy efficiency, and an increased individualized customer focus through the value chain. (Deloitte, 2014) The rise of IIoT can be considered an outcome of increasing pressure within manufacturing where characteristic trends as backsourcing, mass-customization, and operational effectiveness have pushed the development forward. (PwC, 2016c)

In the 1990s were outsourcing and offshoring dominating trends that aimed to improve profitability by moving production to low-cost countries. As the trend intensified, multinational enterprises began to questionnaire the accuracy and cost-effectiveness of their decisions. Consequently, the advantages of outsourcing began to shrink in the 2000s, as wages rose and freight costs increased. (McKinsey, 2015) Companies were facing more problems than anticipated and today is backsourcing a growing phenomenon. (Kotlarsky & Bognar, 2012) Secondly, product customization will be the most determinant factor in value creation during next industrial transition, together with a reduction of capital employed to obtain it. These new value drivers possess considerable potential in creating new activities and jobs. (Roland Berger, 2016) The mindset is no longer based economies of scale and volumes; local and flexible production near the demand is the new logic. (Ibid) Mass-customization and the use of Big Data are important value drivers, contributing to improved understanding and decision-making in the field of knowledge management and business intelligence. (Schmidt et al., 2015) The concept of manufacturing-on-demand implies that no inventories are required as production is geared to demand. (Roland Berger, 2016) Adaptation to digital manufacturing adds efficiencies and reduces the distance to the customer; a decentralized, agile and competitive standpoint is created. (PwC, 2016c) Lastly, the context of IIoT establishes a paradigm shift where central areas of improvement are quality, labor, and speed, all driven by development in digitalization and advanced analytics. The cost of quality is projected to be reduced by 10-20% and besides improved resource- and asset utilization is the total machine downtime estimated to be reduced by 30-50%. (McKinsey, 2015) Further, the level of productivity is forecasted to increase by 26%. (McKinsey, 2016) A new generation of global value chains and real-time optimized networks characterizes IIoT by integrated transparency and high levels of flexibility. (Deloitte, 2014; PwC, 2014) IIoT is anticipated to optimize businesses and operational effectiveness, and 90% of manufacturing companies expect increased, or at least a remaining, level of competitiveness when adapting.

The emerging technologies of IIoT play an important role in the development of IIoT, thereby challenging traditional business models. (Geissbauer, Vedso & Schrauf, 2016; Wiesner, Padrock & Thoben, 2014)

## 2.2 THE BUSINESS MODEL ENVIRONMENT

The growing complexity of the economic landscape in combination with greater uncertainties caused by technological innovations makes scanning of the external environment more important than ever. (Osterwalder, Pigneur & Clark, 2010) The forces in the environment are categorized in four groups of Key Trends, Market Forces, Macro Forces, and Industry Forces. Osterwalder, Pigneur, and Clark (2010) suggest a mapping of these areas to determine how different directions of the business model might evolve. The comprehensive framework named The Business Model Environment, *figure 2.2*, explores environmental factors that affect a company when determining the impact on, and transformation of the Business Model Canvas.

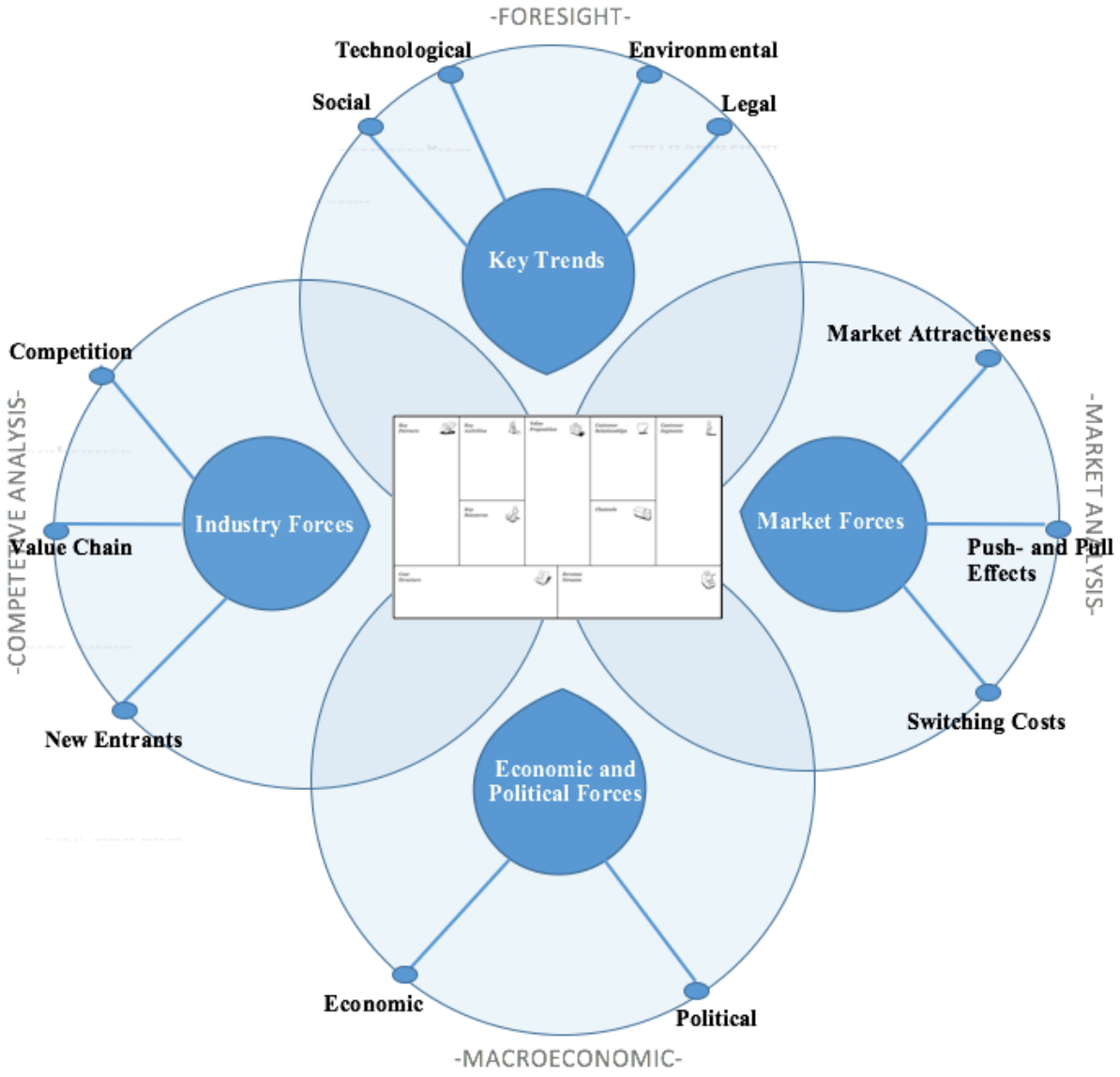


*Figure 2.2: The Business Model Environment, Own design*

In a business context are external forces of highly importance as pressure that arises outside an organization affects how a company or industry is developing. External forces are uncontrolled factors that corporations must respond to in order to stay competitive. The ability to adapt is significant and covers aspects of foresight, market analysis, macroeconomics, and competitive analysis. Below are all external forces that impact the development of IIoT described.

## 2.3 BUSINESS MODEL ENVIRONMENT – EXTERNAL FORCES

### 2.3.1 Key Trends

The first area of the external environment in the Business Model Environment is key trends, constituting the corporate foresight. Factors to consider affecting the development are social-, technological-, environmental-, and legal aspects. (Osterwalder, Pigneur & Clark, 2010)

*Social*

The transformation that IIoT implies forces a change of humans' role in the industrial value chain. (Roland Berger, 2014a) The industrial sector has until today been a workplace for people with various educational levels, where a majority of the employees have been uneducated. These jobs will to some extent be replaced by robots, requiring new skills from the employees to control and program robots. (PwC, 2016a) At the same time, people's educational level is forecasted to grow all over the world. (Roser & Ortiz-Ospina, 2017) Digital technology blurs organizational boundaries and creates flexible workplaces and organizations where delegation of leadership and decentralized decision-making will be in focus. (Accenture, 2015b) The expertise, practical experience and ability to make sound operating decisions will be embedded in the system itself. (Roland Berger, 2014a) Employers need personnel with creativity, decision-making skills as well as technical- and digital expertise. (European Parliament, 2015) Behaviors and attitudes have over past decades been of importance within transformations, the success of a change is foremost determined by the mentality of the employees and leaders. (McKinsey, 2017a; Roland Berger, 2014a) Another possible outcome of IIoT is an increasingly segregated job market, divided in "low-skill/low-pay"- and "high-skill/high-pay" segments, which will increase the social tensions. (World Economic Forum, 2016) A decline in growth of working-age populations is prospered as a result of declining birthrates. The aging populations in many economies imply that peak employment will occur in most countries within 50 years. (McKinsey, 2017b)

*Technological*

Innovations in digital technology have started to transform the manufacturing sector and bring new opportunities. Embedding and sharing of components creates a global integrated value chain where CPPS communicate over IoT and generate Smart factories. (Geissbauer et al., 2016; Cleverism, 2017) The value of IIoT lies firmly within analytics of data to make accurate decisions in real time. This capability requires resources to analyze the data, moreover, tools and standards to enable a value creation of the data. (PwC, 2016a) Cloud computing allows companies to consume a compute resource instead of creating and

maintaining computing infrastructures internally. (Mell & Grance, 2011) The new technologies are expected to decrease costs and increase efficiency, and in the U.S are more than three of ten manufacturers assumed to adopt augmented reality technologies by 2018. (PwC, 2016a; PwC, 2016c) Today's factories would transform into IIoT factories by applying CPPS in current industrial practices, and thereby creating significant economic potential. (Lee, Bagheri & Kao, 2014) IIoT technologies have become cheaper and its sophistications have increased, making it likely to become mainstream. Production costs and market prices have tumbled to commodity levels over the past two decades, and prices have fallen by up to a factor of almost 50 percentage compared a few years ago. (Schaeffer, 2017) The new technologies enable increased flexibility, shortening lead-times, spur innovation and has the capacity to transform business models. (PwC, 2016c; Deloitte, 2014)

*Environmental*

Questions of environment and sustainability are frequently highlighted in today's society. Consumers are expecting and pushing companies to take their responsibility, and regulations are established to limit emissions. (Houghton, 2013) The utilization of IIoT technologies allows great potential in saving resources. Production can be monetized with higher levels of precision, generating a reduction in default products and scrap. A decrease in energy consumption is prospered as a result of implementation of smart technologies in factories, enabling higher efficiency in both production and usage. Additionally, optimized routes of transportation is one of several examples that reduce the CO2 emissions. (Advanced MP Technology, 2017) On the other hand, IIoT also brings challenges to the environment. New connected devices are replacing older products, resulting in increased amount of electronic waste, which is prospered to accelerate with the speed of IoT development and shortening of product-cycles. (Ibid)

*Legal*

The digitalization has come to affect business all over the world. IIoT implies usage of digital technologies at high levels, were huge amounts of data constantly are being transferred and produced, making data protection and ownership of data important. The development highlights a number of legal questions including employee supervision, product liability and intellectual property. The Internet of Things opens up for new avenues for data theft, industrial espionage and attacks by hackers. (Cleverism, 2017) A hyper-connected world implies a threat of cyber risks, making protection from attacks required. The IoT transforms physical objects into targets for politically motivated hackers and organized crime. (McKinsey, 2015) Associated with these risks is also the security level of cloud solutions that is being questioned, as losses of intellectual property can be very harmful. (Bosch, 2015; European Parliament, 2016) The abovementioned problem of security is according to Banafa (2017a) an inevitably problematic and complex task; the architecture of current IoT systems is a challenge. By 2021 are huge threats expected to emerge within IoT, hackers will find new ways to attack. (Banafa, 2016a) IoT devices are poorly secured today and according to Gartner (2016) will the amount of worldwide market spending for cyber security accelerate in growth. More than half of all manufacturers will in 2018 not be able to recognize threats from

weak authentications processes, and by 2020 are 25% of corporate attacks expected to involve IoT. (Banafa, 2016a) Today, laws addressing IoT exposures around the world are lacking, and the exponential rise of connected devices will cause complicated issues. (Banafa, 2016a)

### 2.3.2 Market Forces

The Market Forces constitutes the market analysis, which investigates the powers shaping the market and affecting the development of IIoT. Factors to consider are Market Attractiveness, Push- and Pull effects, and Switching Costs. (Osterwalder, Pigneur & Clark, 2010)

*Market Attractiveness*

The IIoT is a trend with significant implications for the global economy, spanning industries from manufacturing, mining, agriculture, and oil to utilities. The economic potential is enormous; the most conservative independent estimates the IIoT spending worldwide at $20 billion in 2012, with spending expected to reach $200 billions by 2020. (Accenture, 2015c) More optimistic estimates of the value created by IIoT counts as high as $15 trillion of global GDP by 2030. (Accenture, 2015c) The number of connected devices is increasing, by 2020 are up to 75 billion devices expected to be connected, which will generate trillions of interactions. (World Economic Forum, 2017) The digital disruption transforming the industrial sphere is one of the world´s megatrends, affecting companies representing two-thirds of global GDP. (Schaeffer, 2017)

*Push- and Pull Effects*

IIoT describes an outline in two different directions, the application-pull and the technology-push. (Lasi et al., 2014) The application-pull constitutes new requirements from customers, where increased competition and demands of resource efficiency in the traditional model of manufacturing are seen. (BCG, 2016) Higher flexibility in product development and more decentralized organizations is required. IIoT is associated with increased productivity, cost reduction, and revenue growth by manufacturers. (Ibid) Large capital resources are required from the manufacturing companies to change and adapt their current practices, but the investments will also generate new business opportunities. (Roland Berger, 2014b) Lasi et al., (2014) are particularly describing a shortening of development periods for innovations where time-to-market constitutes a success factor for many companies. Another factor is the individualization of demand; a shift from the seller's into a buyer's market is noticed, forming a customized batch-size-one. Research anticipates that around two-thirds of today´s companies can boost efficiency and value through a gradual introduction of digitized processes. (Schaeffer, 2017) Moreover, the industrial sector is for many countries a central part of the economy, and technology is essential for efficient manufacturing. New technologies have pushed a paradigm shift within manufacturing and formed highly automatized and mechanized industries. Existing manufacturing systems are organizing themselves towards decentralization, and new systems in distribution and procurement are established. (Accenture 2015a; Beecham Research, 2015) An advanced digitization and rapid development in Information and Communication Technology (ICT) offer buzzwords such as Web 2.0, Apps, Smart Technology and Digital Factories; all contributing factors for an

exceptional technological push. (Lasi et al., 2014) It is expressed that IIoT is being driven primarily by equipment producers rather than from a customer demand. (European Parliament, 2015)

*Switching Costs*

The digital transformation requires an organizational shift for companies undertaking this development. Compatibility and adjusting to existing systems might contribute to an organizational resistance to change. (Bosch, 2015) According to PwC (2016a) are industrial companies required to develop a robust digital culture and make sure that clear leadership from top management drives change. A further issue concerning switching costs relates standards. Clearly defined standards and regulations comprise the basis of horizontal- and vertical connection of value chains and allows a seamless exchange of data. (PwC, 2014) It is essential to take advantage of networks and ensure that the exchange of data between machines, systems, and software within a networked run smooth. (European Parliament, 2016) Until today, no international standard has applied the market and providers are using different technologies that lack interoperability. A commonly agreed international standard can according to European Parliament (2015) ensure interoperability across different sectors and countries. Thereby encourage the adoption of IIoT technologies by assuring open markets worldwide for manufacturers and products. A competitive edge will be captured when an industry standard is created and all players have compliance with it. (McKinsey, 2015) The creation of standards requires a certain degree of openness and collaboration between companies. (European Parliament, 2016) McKinsey (2015) advises providers to get involved in the definition of standards to gain a competitive edge, and thereby ensuring the readiness of their organization and technology. The aggregation of data is particularly important when implementing IIoT since it increases the total value and hence the ability to collect and analyze the scale, scope, and frequency of available data. The aggregation refers, in particular, the adoptions of two standards; a technological and a regulatory. (McKinsey, 2015; Banafa, 2016b)

### 2.3.3 Economic and Political Forces

The macroeconomics perspective of Osterwalder, Pigneur and Clark (2010) constitutes of Economic- and Political Forces. A transformation of the IIoT represents a macroeconomic shift of all industrialized countries. The establishment reflects the advancement undertaken by nations regarding economics and industrial policies. (Roland Berger, 2016) Corporate investments and growth are influenced by local economies and political initiatives; competitive advantages and the power of politics cannot be ignored. Below are fundamentally economic- and political factors discussed, all concerned the development of IIoT.

*Economic*

Economic forces are associated the conditions of the market and financial infrastructure, which below are described in two directions, Global Market Conditions and Industrial Sector. First, the Global Market Conditions are the digital disruption and transformation of the industrial sphere, a direction that affects companies representing two-thirds of global GDP.

(Schaeffer, 2017) The largest impact is seen in U.S, UK, Germany, Japan, and China, which also are focused below. The location of global industrial production has changed considerably the past two decades. Manufacturing jobs in traditional industrial economies such as Western Europe, Japan, and the U.S are nowadays (2011) only 60%, compared to an earlier (1991) total of almost 80% manufacturing jobs. (Deloitte, 2014; PwC, 2016b) The IIoT will impact GDP and is forecasted to raise real gross product by 1% in 2030. (PwC, 2016a) The U.S economy will advance US$6.1 trillion in accumulated by 2030, and China is expected to raise its GDP with US$1.8 trillion by the same year. Moreover, China and the U.S seem to gain greater economic advances from IIoT compared India, Russia, and Brazil for example. Germany and the U.K have potential to raise GDPs by US$700 (1.7%) and US$531(1.6%) billions respectively. (Accenture, 2015b) Emerging economies rise in their position as competitive industry players, nations in Asia, excluding Japan, are the main challengers. (Roland Berger, 2014b) The competition from emerging markets is increasing, and manufacturing activities are becoming more globalized, 40% of the worldwide manufacturing is held in emerging countries. Emerging countries have doubled their share in last two decades, whereas Western Europe has lost over 10% of manufacturing value added. (Ibid)

The Industrial Sector plays a central role in the economy of the European Union since manufacturing itself comprising almost 2 million companies, 33 million jobs, and counting for 15% of added value (compared to 12% in the U.S). (Roland Berger, 2014b) The industry is a key driver in research and job creation; the sector is described as the "economic engine" of Europe by generating 80% all innovations and 75% of its exports. (Roland Berger, 2014b; PWC, 2016a) The industrial sector is planning to commit US$907bn p.a. to IIoT, which is about 5% of annual revenue according to a global survey by PwC (2016a). The whole market of IoT is forecasted to become a multi-dollar market by 2020. (IoT Analytics, 2016b) A recent study explains that the manufacturing sector will drive 34% of the entire IoT value in the global economy over the next decade. (Beecham Research, 2015) Corporate investments are mostly focused digital technologies nowadays, but also training of employees and motivation of an organizational change. (PwC, 2016b) The size of investment might be too big to accomplish for small- and medium-sized enterprises (SMEs), and consequently, cost these manufacturers their market position in future. (Cleverism, 2017; European Parliament, 2015) A study conducted by (PwC, 2016a) showed that expected payback period of IIoT investments were two years according to 55% of the companies, and as many as 92% believed that the investments would payback within five years. (Ibid) Changing dynamics within a company makes it crucial for businesses to convert Capital Expenditure (Capex) to Operational Expenditure (Opex). Rapid advancements in technology make investments less predictable, as IT-services and infrastructure are becoming cloud-based. Services, features, and operations can be purchased when needed and used on demand, through payment models as licensing, subscriptions, pay-per-usage or pay-per-outcome. (Zambrano, 2014) The outcome economy represents a shift from competing by selling features and benefits of products and services, towards competing by selling measurable results relevant to the customer. (Global Design, 2017)

*Political*

Political forces refer firmly different incentives that are likely to impact the growth of IIoT. The objectives of implementing policies across the world are often the same; increased competitiveness and relocation, or preservation of activities. (Roland Berger, 2016) Below are the leading national- and international initiatives described. Germany was as aforementioned the first nation who used policies as a way to institutionalize its commitment to IIoT, by introducing Industrie 4.0. (European Parliament, 2016) The German action plan of High-Tech Strategy 2020 include Industrie 4.0 and has been allocated funding of up to €200 million. Since its establishment in 2010 has several different initiatives evolved worldwide. (GTAI, 2014)

The Advanced Manufacturing Partnership (AMP) was launched in U.S in 2011; a national effort to bring industries, universities, and the federal government together. The aim was to invest in emerging technologies to create high-quality manufacturing jobs and enhance global competitiveness. (Kurfuss, 2014) China, known as the world leader in manufacturing and low-cost-exports has taken several actions for increased competitiveness. Made in China is seen as the Chinese equivalent to Industrie 4.0, and aims to create a manufacturing revolution underpinned by smart technologies. The ambition is to turn China into a "strong" manufacturing nation within a decade by digitalize and modernize ten different prioritized sectors. (China Go abroad, 2015) Internet Plus is another Chinese initiative that will connect retail and manufacturing with the cloud. It aims to upgrade traditional industries, strengthen the security of Internet infrastructure and increase quality- and effectiveness of economic development, moving from labor-intensive manufacturing to a higher level in the value chain. The Internet Plus intends to become a significant driving force of innovative economic and social development by 2025. (European Parliament, 2016)

The European Union Commission made an international agreement in 2012 of increasing the manufacturing share of GDP from 15% to 20% by year 2020. (Roland Berger, 2014b; PWC, 2014) In addition, China and Germany jointly agreed to intensify cooperation on the digitization of industrial processes in July 2015. The cooperation includes development of norms and standards, data security for firms involved, and effective protection of intellectual property rights. The agreement includes a development of associates between each countries initiative, the German's Industrie 4.0 and China´s "Made in China 2025". (European Parliament, 2016)

### 2.2.4 Industry Forces

The competitive analysis constitutes the Industry Forces that affect the development of IIoT, namely Competition, The Value Chain, and New entrants. (Osterwalder, Pigneur & Clark, 2010)

*Competition*

This industry force identifies incumbent competitors and their relative strengths, where the maturity and enhancement of new technologies are altering an already competitive landscape. Strongest competition is expected to derive from big players; providers with financial capital and a stable customer base. (McKinsey, 2016) However, governmental initiatives, technological legalizations, and intellectual properties are factors triggering competition further. (Osterwalder, Pigneur & Clark, 2010; World Economic Forum, 2016) IIoT is anticipated to optimize production and operational effectiveness, where 90% of the industrial manufacturing players are expecting an increased, or at least a remaining, level of competitiveness when adapting. The IIoT has reached attention from various industries, and players with background in both software and hardware are now competing of becoming leading providers of the market. (IoT Analytics, 2015) The incumbent companies Intel, Microsoft Corporations, Cisco Systems, Google, and IBM are considered being the most prospering in an analysis made by IoT Analytics. Other companies mentioned as influential and highly competitive are Siemens, SAP, Oracle Corporation, General Electric, and Amazon. (IoT Analytics, 2015; Frost & Sullivan, 2017) Moreover, a number of leading manufacturers are considered early adopters of IIoT, by them Bosch, Siemens, and General Electric, that simultaneously as using the technologies themselves, are competing of becoming the leading providers. (Frost & Sullivan, 2017) According to Banafa (2017b) are U.S, Switzerland, Finland, Sweden, Norway, and Netherlands countries leading the IIoT transformation, ranked by its national absorptive capacity based social, political, and economic enablers.

*Value Chain Actors*

This industry force aims to investigate the impact of suppliers and other value chain actors, where the context of IIoT establishes a shift in optimizing how data and information are shared along the value chain. (Osterwalder, Pigneur & Clark, 2010; McKinsey, 2015) The adoption of IIoT is understood as the next horizon of productivity including an organizational transformation where a combination of smart products, services, and new experiences will disrupt legacy business models and shake up the entire product value chain. (McKinsey, 2017a; Schaeffer, 2017) Vertical- and horizontal integration of data in real-time enable information processing and closes the loop by turning data into actions; a significant automatization is reached. (McKinsey, 2015) The adoption of IIoT by manufacturers implies a shift for other players in the value chain. The pressure on suppliers will continue to rise; a modification of their components is required to enable interoperability and communication through devices. IIoT disrupts the value chain and requires companies to rethink the way they do business. (Ibid)

*New Entrants*

The competitive analysis identifies the threat imposed by new entrants on the market by investigating their possibilities, focus and value proposition. (Osterwalder, Pigneur & Clark, 2010) A transformation in business models is considered an opportunity for new players on the market. Small start-ups and innovative companies are fast moving and might constitute a

threat towards current providers. Incumbent companies must react swiftly to the strategic implications IIoT designates their business models. (McKinsey, 2015) Start-ups within IoT capture great attention and are provided with large amounts of funding. (Banafa, 2016b) IoT will transform industries and the basis of competition by creating companies that change the manufacturing sector in the same way Uber challenged the traditional business model of the taxi business. (Beecham Research, 2015) The transformation of business models implied by IIoT will create opportunities for new players and change the competitive landscape; new entrants will be competing for existing- and new sources of profit. (McKinsey, 2015)

## 2.4 BUSINESS MODEL ENVIRONMENT – THE BUSINESS MODEL CANVAS

Previous theory clarified which, and to what extent the external forces will affect the development of IIoT, enabling companies to understand their particular needs and requirements. This section of the Business Model Environment, constitutes the Business Model Canvas and signifies the transformation of business models implied by the external environment. (Osterwalder, Pigneur & Clark, 2010)

The choice of business model is dependent on company-specific knowledge, ideas, and data, and defines how these assets can be used and developed. (McKinsey, 2015) Companies invest extensive amounts of resources to explore and improve new technologies but often lack the ability to innovate the business models in which the innovations are supposed to fit. (Chesbrough, 2010). A business model is more generic than a business strategy; a strategical analysis is fundamental when forming a competitive and sustainable business model. (Teece, 2010)

The Business Model Canvas is a strategic management tool allowing organizations to design, describe, challenge, and formulate their business model. (Osterwalder, Pigneur, and Clark, 2010) It constitutes of nine building blocks, which are described below in relation to IIoT.

*"A business model describes the rationale of how an organization creates, delivers, and captures value" (Osterwalder, Pigneur & Clark, 2010, p.14)*

### 2.4.1 Customer Segments

This block defines which customers an organization aims to reach, and identifies the major market segments by describing where biggest growth potential exists. (Osterwalder, Pigneur & Clark, 2010) An organization must decide which customer segment to serve, and once the market is targeted, the business model can be designed to specific customer needs. (Ibid) Below section starts by discussing industries and continues with different geographical markets.

The concept of IIoT has potential to affect almost every function of every industry, the entire span from healthcare to gas included. However, some sectors will lead the change, by them primarily manufacturing and high-tech industrial production with applications of supply chain management, inventory management, and industrial asset management. (Banafa, 2017b) A significant degree of variation of the potential of automation and financial gains using today´s

technology is noticed among different sectors. Research shows that the proportion of physical activities in predictable environments such as factory welders, cutters, and soldiers have a technical automation potential above 90 percent, based on adapting currently (2017) developed technologies. (McKinsey, 2017b) The technical automation potential is negatively correlated with wage and skill levels. Globally are activities with automatization potential comprising 1.2 billion employees and $14.6 trillion in wages (counted for all sectors). (McKinsey, 2017b) Geographically is the largest potential in China and India, together comprising more than 700 million full-time employees that have jobs with automatization potential, (covering all sectors) which depends on the relative size of their labor forces. (Ibid) The potential is also large in Europe, where 63 million full-time employees and more than $1.9 trillion in wages are associated with possibilities of automatization. (McKinsey, 2017b; PwC, 2016b) Geographically, four economies account for just over half of these total wages and employees, namely China, India, Japan, and U.S. Manufacturing automation is more likely to be adopted sooner in countries with high manufacturing wages, such as North America and Western Europe, than in developing countries with lower wages. (McKinsey, 2017b; Accenture, 2015b)

### 2.4.2 Value Proposition

The value proposition describes which value and need a business is creating, satisfying, or solving for a specific customer segment. The value proposition answers why customers are choosing one company over another, thereby constituting a company´s competitive edge. The value is found in performance, customization, newness, design, brand, price, cost reduction, risk mitigation, accessibility, etc. (Osterwalder, Pigneus & Clark, 2010) New business models are arising around novel value propositions, driven by the possibilities to collect, use and share data. (McKinsey, 2015) The new business models can be built on offering solutions around integration and new services unlocked by the disruptiveness of IIoT. (Ibid) The integration of products and services generates new possibilities, packaged into offerings for the manufacturing sector. (McKinsey, 2015; Bezerra Barquet et at., 2013) Below follows examples of new value propositions facilitated by IIoT technologies.

New combinations of products and service elements enable increased performance and mass-customization. (Bezerra Barquet et al., 2013) Reduction in time-to-market and increased quality generates additional value to the manufacturing sector, and an implementation of IIoT can reduce time-to-market by 30 to 50 percent. (McKinsey, 2015) Furthermore, new values are generated when providers offer solutions or services through subscriptions or licensing instead of selling single product offerings. These payment models enable providers of IIoT solutions to advance the offering during the entire life-cycle, for example by offering maintenance services and updates generating increased value. (Bezerra Barquet et al., 2013) Another example is speeding up manufacturing companies' development processes and thereby contributing with added value. (McKinsey, 2015)

### 2.4.3 Channels

Distribution channels comprise the third building block, concerning how the value proposition is distributed, delivered and communicated to the customer segment. The channels constitute a company´s interface towards the customers and play an important role by providing feedback and awareness about offerings. The choice of channels depends on what customer segment a company is targeting, and what value proposition they offer. (Osterwalder, Pigneus & Clark, 2010)

Transforming from offering products over single sales, to selling products- or services packaged as complete solutions over longer time-horizons implies a natural change in distribution channels. The pure physical delivery of a product must be extended with new channels for service provision. (Wiesner, Padrock & Thoben, 2014) The value proposition is turning increasingly customized by novel technologies and digitalization that create new opportunities to reach and retain customers in new ways, requiring an evaluation of the distribution channels. (Bezerra Barquet et al., 2013) Furthermore, innovative platforms and channels such as the Blockchain model generates difficulties of managing the whole chain, and becomes advantageous because by its decentralized formation and public participation. The Blockchain is secure by its design and constructed that a database as upholds constantly growing list of records. (Banafa, 2017a)

### 2.4.4 Customer Relationships

The customer relationship describes what type of relationship that is established with specific customer segments. The relationship can range from automated to personal, and be driven by different motivational factors such as customer acquisition, customer retention, boosting of sales. (Osterwalder, Pigneur & Clark, 2010) The relationship between the providers and manufacturing companies are changing when products are transforming into services. The goal is no longer product sales, rather long-term total service offerings that can satisfy unmet customer needs. (Lee, Kao & Yang, 2014) Entirely new automated customer relationships are enabled through IIoT; access and evaluation of data has the ability to improve products and services. (Siemens, 2016) The selling transaction is being replaced by permanent relationships with the manufacturing companies. (Wiesner, Padrock & Thoben, 2014)

Enterprises will shift focus from conventional low-margin products created for anonymous markets to forming very personalized relationships driven by customer retention. (Schaeffer, 2017) Enterprises that used to deal with business clients will in the future be forced to think of them as end-consumers. Businesses are facing a trend of industrial consumerism, implying that the top criteria for success or failure are the outcome of quality and experience of service. The key to boosted outcome-economy will be stronger customer relationships than ever imagined before. (Schaeffer, 2017; Wiesner, Padrock & Thoben, 2014)

### 2.4.5 Revenue Streams

The revenue streams reflect how much the customers are willing to pay for a specific product or service. The revenues can be generated from asset sale, usage fee, subscription fees,

leasing/lending/renting, licensing, advertising and brokerage fees. The pricing model can be built on either a fixed- or dynamic pricing mechanism. (Osterwalder, Pigneur & Clark, 2010)

The long-term nature of the relationship between a provider and its customers implies that a new model based recurring and dynamic revenue streams must be created. (Bezerra Barquet et al., 2013) Product sales within the manufacturing sector have historically been the largest source of profit in proportion to overall expenditure; however, this portion is likely to decline. (McKinsey, 2015) The new business models result in a shift from product-based revenues towards service-based revenues, platforms, applications and developments of ecosystems. The new profit sources that are being created will primarily be captured through subscriptions or licensing. (Bezerra Barquet et al., 2013; McKinsey, 2015)

The IIoT generates new revenue streams and turning manufacturers expenses from Capex to Opex when offerings are being transformed to pay-per-usage or outcome-based models. (McKinsey, 2015) From a provider's perspective will revenues no longer be generated by a one-time sale of a product, the focus is rather continual revenues through services or usage fees. (Wiesner, Padrock & Thoben, 2014) Payment may be based the availability of the product and/or service, how often it is used, and the end result of usage. (Bezerra Barquet et al., 2013) Today, most companies sell features, not quality or cost. Competition will be based the ability to deliver quantifiable value to the customers in the new outcome economy. (Global Design, 2017)

### 2.4.6 Key Resources

The key resources enable creation of value propositions, customer relationship, and revenue streams, making it the most important asset of a business model. These resources can be physical, financial, intellectual or human, owned by the company or acquired from key partners. (Osterwalder, Pigneur & Clark, 2010) Providers of the IIoT must make considerable investments in intellectual capital and human assets as key resources are being transformed. Competencies in services development, product-service integration and collaboration are required. (Wiesner, Padrock & Thoben, 2014) New competences to deal with their customers must be developed, implying a shift in organizational culture and market engagement. (Bezerra Barquet et al., 2013)

### 2.4.7 Key Activities

The key activities are required to create the value proposition, earn revenues and maintain customer relationships, thereby comprising the most significant efforts when operating. Moreover, key activities differ between companies and the needs it is fulfilling, and can for example be problem solving, production, or providing of a platform/network. (Osterwalder, Pigneur & Clark, 2010) The transformation implied by the IIoT forces providers to focus key activities. Cyber physical systems create a dependency between the provider and the manufacturing companies. Key activities within the manufacturing sector have historically focused production, but new platform-based activities are taking over. The most important activity is nowadays during the usage phase when the provider monitors the performance through connected technologies and networks. (Bezerra Barquet et al., 2013)

### 2.4.8 Key Partnerships

Key partnership constituting the network of suppliers and partners with purpose to optimize, reduce risks, or acquire resources, and thereby comprises the cornerstone of the business model. A separation can be made into strategic alliances, coopetition, joint ventures, and buyer-supplier relationships. The transformation of IIoT is highly complex and diverse solutions have been created to capitalize the numerous benefits it might bring. (Beecham Research, 2015) When a single company cannot address specific revenue potentials itself, collaborations with other complementary businesses might be the solution. (McKinsey, 2015) Partnerships including private establishments, public-private partnerships, and public partnerships, are created aiming to help companies achieve the common goal of connected industry. (Beecham Research, 2015) The proposition of value creation through products and services embraces a complex network of suppliers and competencies. The establishment of such network requires identification of actors and which competencies they can provide throughout the product lifecycle. (Bezerra Barquet et al., 2013) Ideally should suppliers, IT-companies, and connectivity providers, partner with each other and with manufacturing companies. Diversified alliances, buyer-supplier partnerships and unusual acquisitions might be the new pillars of business models. (Wiesner, Padrock & Thoben, 2014)

### 2.4.9 Cost Structure

The cost structure explains operational expenses within a business model, and typically distinguish between two types of cost structures, cost-driven and value-driven, however most business models fall in between. (Osterwalder, Pigneur & Clark, 2010) The new logic of value creation requires value-based pricing models, including variable costs of products and their associated services. Financial and accounting practices requires adaption, since the time-period of financial flows changes considerably from immediate return of capital and payback towards extended usage-periods for subscriptions and pay-by-usage models. The entire revenue will not be realized when the product or service is delivered, implying that providers must make substantial initial investments. (Bezerra Barquet et al., 2013) This transformation increases the financial pressure on providers; they must have financial resources to bridge this period. The cost structure must thereby support a new demand of cash-flows, as the payback period of the value delivered often is longer than the payback period of physical products sales. In addition, the provider must bear the costs involved in the use of maintenance services; upgrades, replacement of parts etc. (Ibid)

## 2.5 SUMMARY OF THEORETICAL FINDINGS

In below tables is the theoretical impact from external forces as well as the Business Model Canvas summarized.

### 2.5.1 External Forces

**Theoretical summary of External Forces**

| | | | Theory |
|---|---|---|---|
| | | **Factor** | **Mentioned** |
| **Key Trends** | **Social** | Changing job-tasks | ✓ |
| | | Organizational resistance to change | ✓ |
| | | Decentralized decision making | ✓ |
| | | Increased educational requirements | ✓ |
| | **Technological** | Increased speed of development | ✓ |
| | | Reduced cost of technologies | ✓ |
| | **Environmental** | Reduced waste and scrap | ✓ |
| | | Increased resource efficiency | ✓ |
| | | Short Product-lifecycles | ✓ |
| | | Governmental regulations | ✓ |
| | **Legal** | Ownership of data | ✓ |
| | | IP-rights | ✓ |
| | | Risk of attacks | ✓ |
| | | Data protection | ✓ |
| **Macro Forces** | **Economic** | Expected raise in GDP | ✓ |
| | | Re-localization of production facilities | ✓ |
| | | Investment size | ✓ |
| | **Political** | Influential international initiatives | ✓ |
| | | Influential national initiatives | ✓ |
| **Market Forces** | **Market Attractiveness** | High market value | ✓ |
| | | High growth rate | ✓ |
| | **Push- and Pull Effects** | Pull: New business opportunities | ✓ |
| | | Pull: Need of resource efficiency | ✓ |
| | | Push: New technologies | ✓ |
| | **Switching costs** | Organizational resistance | ✓ |
| | | Technological standard | ✓ |
| **Industry Forces** | **Competition** | Big players | ✓ |
| | | IPRs | ✓ |
| | **Value Chain Actors** | Disrupt of value chain | ✓ |
| | | Increased transparency | ✓ |
| | **New Entrants** | Start-ups | ✓ |

*Table 2.1: Summary of External Forces*

### 2.5.2 The Business Model Canvas

**Theoretical summary of Business Model Canvas**

| | | | Theory |
|---|---|---|---|
| | | **Factor** | **Mentioned** |
| | **Customer Segmentation** | Industry segmentations | ✓ |
| | | Geographical segmentations | ✓ |
| | **Value Propositions** | Increased performance | ✓ |
| | | Mass customization | ✓ |
| | | Cost reduction | ✓ |
| | | Time-to-market | ✓ |
| | | Improved quality | ✓ |
| | **Distribution Channels** | Customized services | ✓ |
| | | Complete solution | ✓ |
| | | Block chains | ✓ |
| | **Customer Relationships** | Customer retention | ✓ |
| | | Automated customization | ✓ |
| | **Revenue Streams** | Pay-Per-Usage | ✓ |
| | | Pay-Per-Outcome | ✓ |
| | | Subscriptions | ✓ |
| | | Licensing | ✓ |
| | **Key Resources** | Intellectual capital | ✓ |
| | | Financial capital | ✓ |
| | **Key Activities** | Platform based | ✓ |
| | **Key Partnership** | Allianceses | ✓ |
| | | Buyer-Supplier relationship | ✓ |
| | | Acquisition and Start-ups | ✓ |
| | **Cost Structure** | Value-based-pricing | ✓ |
| | | Variable costs | ✓ |

*Table 2.2: Summary of Business Model Canvas*

# 3. RESEARCH METHODOLOGY

*The following chapter describes the methodology and choices made when conducting this research. Decisions of strategy and design are motivated and overall performance described. The chapter ends with a description of how empirics have been gathered and analysis conducted.*

## 3.1 RESEARCH STRATEGY

A qualitative strategy is chosen for this research, motivated by the novelty of studied topic and previous limited knowledge of the concept. Besides, an openness to unexpected answers and unproven data were desirable, as well as a certain degree of flexibility to allow adjustments of interview questions accordingly with discoveries from pilot interviews. Morgan (1998) further argues that a qualitative strategy enables obtaining insights and understandings of how things evolve over time, which strengthens our choice of strategy. Moreover, anticipated difficulties of reaching a large number of respondents with accurate knowledge excluded a quantitative strategy. (Bryman & Bell, 2011) An exhaustive analysis covering various aspects and implications were required to answer our research questions, which reinforced our choice of an abductive approach. Motivated by modest previous research in chosen area, likewise our limited knowledge within the topic, we found an abductive approach advantageous when conducting this study. The ability to modify the literature review after the data collection was considered explicit beneficial for the purpose of this research. (Bryman & Bell, 2011)

The interpretations made by the researchers in a qualitative strategy automatically make the results susceptible to bias. Furthermore, the nature of a qualitative research makes it is difficult to generalize the results. (Bryman & Bell, 2011) The aim of this thesis was not to generalize across companies over time, rather framing the IIoT market in Business Model Environment from a provider perspective. The outcome of this report is thereby contingent particular factors in a limited timeframe and in context of specific settings.

## 3.2 RESEARCH DESIGN

The purpose of this study was to analyze data collected from qualitative interviews, making the research explorative by its nature. Additional insights were captured from experts during the IIoT exhibition at Hannover Messe. The comparison of various standpoints constitutes the value of qualitative research, motivating collection of different types of data. (Bryman & Bell, 2011) The Business Model Environment compound the foundation for our research by structuring our process and providing suggestions of areas to investigate. (Osterwalder, 2010) The original model was modified to suit our purpose and direct our research questions. A visualization of the adapted model in provided in *figure 2.2*.

The choice of perspective is with a consideration of the novelty of this area, where real examples and user cases still are rare. Our wish of a holistic view and avoidance of biased results generated additional interviews with experts of the field, including both academics and consultants. Yin (2009) argue that numerous of interviews unavoidably cost some richness;

nevertheless, it will lead to a progress of the research that is more generalizable. We examined twenty interviews in total, a number we argue conforming a comparative analysis and reasonable due to given time constraints.

## 3.3 RESEARCH METHODS

The research method is according to Bryman & Bell (2011) the technique of data gathering and covers the creation of used interview guide, the participation of interviewees, and our visit at the Hannover Messe. Thereby, the objective of this section is to outline an overview of choices made through the data collection. Two sets of data are used to answer our research questions; Primary- and Secondary Data, each described in the following sections.

### 3.3.1 Primary Data Collection

The data collection was mainly based semi-structured interviews; a method we argue suiting our explorative study. Semi-structured interviews enable a broad perspective, allow unpredicted replies and thereby accommodating our explorative research. Moreover, a semi-structured technique of interviewing is helpful for relatively inexperienced researchers due to its balance of guidance and focus. (Bryman & Bell, 2011) Furthermore, the method made it possible to adapt and iterate issues along the way as the researchers increased their knowledge within the area and improved their interview technique. The closure of the data collection at Hannover Messe, the place where the concept originates from, gave us a unique opportunity to ask clarifying questions, verify our findings, and gather the most recent updates from experts all over the word.

*Selection of Companies and Respondents*

Our literature review identified a number of companies and organizations which distinguished as prospering within the area. This group comprised software- and hardware providers that were prominent in IIoT, consultancy firms publishing reports within the topic, and organizations conducting research or by other reasons were considered useful. In addition, agendas of IIoT exhibitions were studies to find companies and speakers whom might be valuable to interview. This search generated a list of companies and individuals whom we were interested in talking to, a priority we allowed to expand and modify along the way. The process of finding the right individuals involved examining their position, competencies and background. This search was made through search engines like Google and the social media network LinkedIn. The interviewees were selected based the criteria of working directly or indirectly with IIoT, Industry 4.0, or Smart Factories, which comprised search words used to find individuals who possessed the right knowledge. Emphasize was focused experiences rather than specific title or position. The individuals were approached by email explaining the purpose of this thesis and their contribution. See Appendix B.

*Practicalities*

The data collection has been carried out in two different ways, where approximately half of them were conducted face-to-face and rest of them through Skype. The Sten A Olsson scholarship gave us the opportunity to collect data and gather insights at two different

locations besides our hometown. From our literature review, we identified Germany and the U.S as prospering nations within the research area, and our desire was made to travel there to increase the quality of the interviews. The grant generated face-to-face interviews in Silicon Valley, the leading tech hub in the U.S, and additional interviews and insights at the Hannover Messe; the world's leading IIoT exhibition. Below in table 3.1 provides an overview of all interviews.

**Empirical Data: Overview of Interviews**

| Company | Position of Interviewees | Location | Date | Channel | Language |
|---|---|---|---|---|---|
| Siemens | Product Manager, Automation | Gothenburg | 2017-03-09 | Face-to-Face | Swedish |
| **Intel Corporation** | **Strategy and Business** | **Silicon Valley** | **2017-03-14** | **Face-to-Face** | **English** |
| General Mills | Product Development | Silicon Valley | 2017-03-14 | Face-to-Face | English |
| **San Jose State University** | **Faculty & Academic Advisor** | **Silicon Valley** | **2017-03-16** | **Face-to-Face** | **English** |
| Gilead Sciences | Industry Business Solutions | Silicon Valley | 2017-03-16 | Face-to-Face | English |
| **Cisco Systems** | **Industrial Products Group** | **Silicon Valley** | **2017-03-19** | **Face-to-Face** | **English** |
| RISE | Product Manager within IIoT | Gothenburg | 2017-03-23 | Skype | Swedish |
| **Chalmers University** | **Professor, Head of Product** | **Gothenburg** | **2017-03-23** | **Face-to-Face** | **Swedish** |
| Cybercom | Head of Connected Engineering | Gothenburg | 2017-03-24 | Skype | Swedish |
| **KUKA** | **Director of Product Marketing** | **Gothenburg** | **2017-03-27** | **Face-to-Face** | **Swedish** |
| Roland Berger | Senior Partner | Gothenburg | 2017-03-28 | Skype | English |
| **IBM** | **Engineer in Cloud technologies** | **Gothenburg** | **2017-03-28** | **Skype** | **English** |
| David Sidhu & Associates | Managing Partner, IIoT Practice | Gothenburg | 2017-03-29 | Skype | Swedish |
| **ÅF** | **Business Manager Digitalization** | **Gothenburg** | **2017-03-30** | **Skype** | **English** |
| Innovationszentrum Industri 4.0 | Co-Founder & Board Member | Gothenburg | 2017-03-30 | Skype | English |
| **McKinsey** | **Consultant, IIoT** | **Gothenburg** | **2017-03-31** | **Skype** | **English** |
| Industrial Internet Consortium, | Chairman and CEO | Gothenburg | 2017-04-03 | Skype | English |
| **Microsoft Corporation** | **Offering development IIoT** | **Hannover Messe** | **2017-04-24** | **Face-to-face** | **English** |
| Bosch | Strategy, New Business | Hannover Messe | 2017-04-24 | Face-to-face | English |
| **Accenture** | **Consultant, IoT** | **Hannover Messe** | **2017-04-25** | **Face-to-face** | **English** |

*Table 3.1: Overview of Interviews*

Our interview guide was based our research questions, and the structure followed the Business Model Environment. The interview questions were discussed in the same set-up for all interviews, but focus has been altering due to our growing knowledge of the topic and time restrictions from the respondents. All interviewees received the interview guide in advance, Appendix C, including a figure visualizing our research focus. Pilot interviews were conducted to assure the interviewees understanding of our questions and chosen focus. Initially, basic questions of IIoT were asked to ensure the respondents' knowledge level, confirming a certain level of quality of the empirical data. The interviews were thereafter conducted according to an outside-in- approach, starting with the external factors and finished by discussing the business model. A visualization of our research model, figure 2.2, was shown during the interviews to facilitate discussion and respondents' understanding of our research focus. According to Bryman and Bell (2011) coding and categorizing of data are critical to consider, which we emphasized by recording the interviews and complement with notes. Both researchers were present during all interviews, enabling us to divide the tasks of taking notes and recording to one person, while the other person could focus on the interviewee and ask the right questions.

Face-to-face interviews tend to be more fruitful, and the respondents are less likely to provide the answer "I don't know". (Bryman & Bell, 2011) A circumstance we considered especially

important during our first interviews when our knowledge still was limited. Telephone interviews have the benefits of being far cheaper and easier to administer compared to face-to-face interviews, which suited us well considering our restrictions and limited resources. (Bryman & Bell, 2011) Our usage of video calls instead of telephone interviews had the benefit of capture face expressions and ability to maintain eye contact with the respondents.
The answers from the respondents were summarized in a table, Appendix D. This format allowed a good overview, and areas with weak data were complemented in upcoming interviews. All respondents were contacted after the interviews as a gesture to show our appreciation for their participation. This opportunity was also used to complement some of the interviews with additional information of the Business Model Canvas as this category of questions tended to require more time for reflection from the interviewees. In addition, several respondents provided us with additional material such as articles or reports after the interview.

### 3.2.2 Secondary Data Collection

This research was initiated by an extensive literature review. Information regarding background, definitions of IIoT, and manufacturing trends was collected which established the foundation of the theoretical framework as well as forthcoming data collection. A data sheet was created based our notes from screening published literate to as later were focused in our report and during interviews. The theoretical findings were complemented and expanded as the research proceeded. Most secondary data is based articles and reports, i.e. existing literature within the field of IIoT. Electronic databases were used to find relevant information, among them Business Source Premier, Google Scholar, Emerald, GUNDA, GUPEA and LIBRIS. The most frequently used keywords when searching were: IIoT, Industry 4.0, Smart Manufacturing, Smart Factories, Business Model Environment, and Business Model Canvas. Date of publication represented the most central search criteria, a factor that facilitated our segmentation of information. However, one critical factor to mention is that some articles haven been used more frequently than others, making them explicitly influential in this research. Our choice of using the Business Model Environment framework by Osterwalder, Pigneur and Clark (2010) resulted in a domination of that specific article and model. Finally, source criticism was of high importance for two reasons. First, our limited knowledge of this area created difficulties of evaluating the credibility of diverse information sources. Secondly, the financial aspect of IIoT and the many stakeholders involved requires a constant questioning of respondents´ as well as articles intention. We are aware of that there is a tendency towards positivism among both authors and respondents, which we have kept in mind during both primary- and secondary data collection.

## 3.4 DATA ANALYSIS

The literature review ended with a figure summarizing all findings, concluding of our theoretical standpoint. The figure provided an overview of central findings which later enabled a structured comparison of theoretical- and empirical findings. Our ambition and procedure were to analyze received data in tandem with the on-going collection. The study aimed to investigate the Business Model Environment of IIoT from providers´ perspective,

making an analysis of rich data appropriate when answering our research questions. The recording of interviews provided a validating effect and simplified the transcript process in whole. Theoretical reflections were established and the collected data was progressively coded during the entire research process. Moreover, empirical data were coded into one-, some-, many-, most-, and all respondents, five spans that enabled an easy and appropriate process of analysis.

## 3.5 RESEARCH QUALITY

There are numerous of factors that require attention to assure a consistent research, and according to Eisenhardt (1989), is an evaluation of validity, reliability, and replicability of a study necessary. With that in mind, we attempted to deliberate all factors that were considerable and possible to meet. Although our data collection was initiated by pilot interviews to increase the quality of forthcoming interviews, it became apparent that our discussions with the respondents became more fruitful by time. This implies a possibility that the quality of our interviews increased over time, as we could address questions of higher level and the respondents could provide more specific answers. However, some respondents were more prepared and willing to share information than others, regardless order followed. National differences are considered a second possible obstacle, brought by differences in both culture and native tongue. A majority of the interviews were in English, the researchers´ second language, which might have created difficulties to grasp certain undertones. Cultural differences automatically bring different perspectives and might be especially influential when discussing specific topics such as political- and societal factors. Nevertheless, we appraise that all interviews regardless nationality had high level of quality without too big stumbles. Finally, all respondents have qualified positions within IIoT and employment at influential companies or research institutes, see table 3.1. Above section ensures that our data is collected with accurate methods to ensure a high level of quality.

### 3.5.1 Validity

Central aspects considering the quality of a research refer the concept of internal- and external validity. Internal validity is a justification that the research measures what it intends to measure. External validity refers the research ability to be generalized and applied other cases. (Bryman and Bell, 2011) The generalization of this study might be arguable as the drawback is the difficulty imposed by a limited amount of respondents. Although, we consider this study to have a high internal validity based primarily two factors; first, a clear research question and in the completion a clear answer. Secondly, all respondents had distinguishing positions within the IIoT and gave answers that validated each others.

### 3.5.2 Reliability

Reliability concerns whether the results of the study are consistent and is in a qualitative research associated with the problematic that settings cannot be exactly duplicated. (Bryman and Bell, 2011) In our case, this concerns whether the conclusions are stable or not. A strong reliability is in general difficult to accomplish in qualitative studies since it is impossible to freeze internal- and external circumstances, and this study is not an exception. Nevertheless, it

is arguable to say that our clarification of decisions made along the process increase the reliability of this thesis. Moreover, to strengthen the internal reliability of heard and observed things were the authors validating each other, which confirmed the inter-observer consistency. (Bryman and Bell, 2011)

### 3.5.3 Replicability

Closely related to reliability is the concept of replicability, which concerns if the study is replicable or not. (Bryman & Bell, 2011) To make a study replicable, it is crucial to explain the procedures in great detail. In order to strengthen the replicability for this study, we were carefully processing our section of research methodology; research strategy, design, data collection, analysis, and quality. However, the reliability and replicability of this study are important aspects to take into consideration, not at least since we choose a qualitative research strategy in an area with on-going activities. To conclude, the novelty and constant attention of this area indicate that we will face huge developments in upcoming years, decreasing the ability to replicate the study in a reliable way.

# 4. EMPIRICAL FINDINGS

*This section aims to present primary data, which mainly concern the outcome from semi-structured interviews in a deliberate and transparent way. Empirical findings from this research have been divided into two sections, where each section following the logic of the Business Model Environment; first is external forces presented, followed by the impact of business models.*

## 4.1 EXTERNAL FORCES AFFECTING THE DEVELOPMENT OF IIOT

Pressure and dynamics from the external environment are important when businesses are changing. Below follow findings summarized from our interviews, including our visit at the Hannover Messe.

One respondent explains IIoT as an overall framework of how to digitalize the manufacturing sector, whereas most respondents emphasize a combination of IoT, Cloud Computing, and Digitalization. Another respondent confirms by summarizing IIoT as an incremental development of factories that includes new technologies and CPPS. The outcome is a decentralized system where horizontal integration and vertical of value chains are essential. Further, IIoT aims to create new innovations, increase quality, efficiency and digitalization. Some respondents argue that the concept is a bit blurry, but agree with its goal of improving processes and products through connectivity. Whether IIoT is evolutionary, revolutionary or, a disruptive varies between the respondents.

### 4.1.1 Key Trends

Concerned areas within key trends are powers formed by legal, societal, technological, and environmental aspects. Most attention was addressed the legal part, where almost all respondents observed a lack of regulations and governmental problems of keeping up with the development of new technologies.

Social

An underlined key trend is the social aspect; how social factors will influence organizational development towards technological advances. As aforementioned, the organizational resistance to change is highlighted, and problems with an organization's acceptance are something many respondents emphasize. Most respondents argue that the development from selling products to selling services requires a change in the workforce. Some respondents expect a reduction of jobs, while other interviewees argue that the outcome will be job creation as a result of new work tasks. One respondent express:

*"Jobs and workforce have been changing over centuries, this is nothing new at all. Just think about the great shift of urbanization, how farmers became manufacturing workers."*

Most respondents expect that the change that IIoT brings will result in a net effect of work creation and job losses, where the tasks that require the least education will be replaced by tasks where special knowledge within IT is required. The respondents clarify that the most

impacted group of this change are individuals at the factory floor. Moreover, ethical aspects are underlined, some respondents argue that companies need to concern humans´ purpose when robots are taking over jobs. A change in requirements of the workforce might create a strong organizational resistance. However, most respondents explain that this resistance can be related differences in generations. Not all employees see retraining and education as possible solutions for them; gaps in demographics and polarization create complexities. One respondent argues that education is needed because it encourages people to act with security in mind. Furthermore, some respondents believe that changing in work tasks will reduce boundaries within organizations, white- and blue collars will move closer, immediate decision-making and analysis will be essential. Some respondents assume that peoples´ lives will change in future. Time spent at work is likely to decrease since IIoT will provide a solution to a reduced need for labor; a problem some of the industrial nations are dealing with. Technologies must follow the society, where one respondent supposes that time at work in future might be 25-30 hours a week, robots and other intelligent technical development will support the rest.

*Technological*

The development of technologies will obviously play a significant role for the development of IIoT. From many respondents, it became apparent that the future involves IoT and integration of all components within CPPS. One expert stated:

*"IoT is here to stay. There is no going back now. We just need to bring the pieces of technologies, business, and society together, with standards and control. Most of the required pieces are already here."*

Most respondents explain that development of new technologies goes faster and is less costly nowadays. The manufacturing sector is facing improvements in the area of software and hardware, but the speed of development between these differ according to the respondents. However, these opinions were dependent on the employment of particular respondents. Respondents with software experiences anticipated problems with hardware and contrary, respondents with a background in hardware stressed problems with software as crucial. The interviewees highlight a future technological impact of robotics, autonomous systems, machine learning, artificial intelligence, and additive manufacturing. Collaboration between autonomous technologies and humans are central aspects according to many respondents. A transparency of systems, known as open-sources, is emphasized from a software perspective in almost all interviews.

Simulations, cloud computing, sensors, and an enlarged digital infrastructure are argued to become essential for future enhancements. Additionally, new technologies requiring the ability to leverage existing products in order to create value for existing customers. Some respondents underline the opportunity additive manufacturing is reaching. Additive manufacturing, also is named 3D-printing, is an innovation that probably will upturn in long range, an advancement that will make small scale production more fruitful. Moreover, experts justify that the ability to make visualizations, decentralized decision-making, and ensure quality will advance the manufacturing sector in general. An advancement as according to

some respondent is reliant and empowered by big data, smart data, and connectivity. Some respondents also believe that 5G and digital twins outline foundation for the next step in manufacturing, these advancements enabling an improved connectivity and enlarged operational effectiveness. According to many respondents are what we nowadays term smart things becoming smart components, a development based new technologies and a utilization of cloud analytics.

*Environmental*

Most respondents explain that IIoT will have a positive environmental impact due to improvements in energy- and resource consumption. All interviewees argue that digitalization is a driver to advance sustainability, real-time information creates huge potentials of boosting the manufacturing sector and reduce waste. Customers are demanding sustainable alternatives to a larger extent than earlier, making the environmental aspect a factor companies cannot deny. Some respondents argue that a sustainability focus is expected from companies today rather than boosting a competitive edge. The governments are supporting businesses that emphasize the environment in several nations, and subsidies are often used as drivers. Additionally, governmental policies hinder decisions that go against sustainability goals. Companies are pushed to stretch their environmental awareness, which corresponds with IIoT technologies. Reduced transports are seen as an outcome of backsourcing. Moreover, some respondents are also highlighting that digitalization increases transparency and enables traceability of products and processes.

*Legal*

All respondents emphasize that society is unprepared for the forthcoming digital shift, regardless the recent increase in data- and security regulations. Questions of privacy, ethical aspects, integrity, security, and ownership of date require additional laws and regulations. Greatest areas of legal issues relate cyber security, all connected devices will become security risks, and this threat is a necessity to concern and solve. Some respondents stress that hackers will be a rising threat in the future. One respondent explained:

*"Most industries are not ready for connected devices, which mainly is due to the lack of security."*

The collection, use, owning, and responsibility of data cause problems concerning the integrity aspects, the IPRs, and the willingness of share data. Many respondents explain that excellent customer relationships and new types of contracts are required; the classification of data is becoming key. Moreover, issues regarding data integrity will probably differ between generations, where younger individuals are more open-minded in general, and elder usually more resistant. Some respondents argue that national support for technologies already have started to develop. Nevertheless, some respondents mentioned that Europe is especially limited by these regulations because all 28 member nations of the European Union have different national laws. The same respondents explain that laws and regulations of IIoT are required across national borders. The legal aspect would be easier to tackle if international directives were created. Another factor relates the difficulty in predicting how new

regulations will impact, which in turn makes the development volatile. However, an ambition to harmonize data law seems to be on its way; many respondents highlight the importance of the new privacy regulation GDPR (General Data Protection Regulation) within the European Union. Security within technologies is a controversial question where the opinions vary. Many respondents explain that security will form a hinder for development or adoption of technologies, while others claim the opposite; but all agree that the manufacturing industry will transform even if the security issue remains unsolved. Nevertheless, the security is an important element to consider, and most respondents explain that management within companies facing an enlarged responsibility for setting up secure processes for its products or services.

### 4.2.2 Market Forces

The second externality entitled market forces is divided into market attractiveness, need and demands, and switching costs. Empirical findings explain that all categories constitute an important role in when assessing market dynamics, however, the factor of standards in switching costs is mentioned as the most influential aspect to consider.

*Market Attractiveness*

The attractiveness of the IIoT market is high according to all respondents, increased flexibility, greater resource efficiency, reduced waste, and shorter time-to-market are promises made to the manufacturing companies. Respondents justify that five years ago, IIoT was just a conception, and nowadays everyone wants to be a part of it. The consumer market is fastest to adapt; larger companies are usually dependent on stability, stakeholders and rigorous investment calculations. Additionally, most respondents argue that the money is on the corporate market, not on the consumer market where focus previously has been. However, one respondent argues that the business value of IIoT is not realized yet and it might thereby be more of a hype than reality in some cases. Another interviewee emphasizes that even though the attractiveness is high, the market readiness is low. Technologies are here, but the maturity for change is at an early stage. Another respondent explains:

> *"The market attractiveness is much more than a utilization of new technologies. Since business must be driven by a strong management is an organizational transformation required."*

*Needs and Demands*

The respondents have different opinions concerning the needs and demands, where some argue that it results from a push from the technology providers, and others believe that market demand is the driving force. However, many respondents consider it to be a combination of push- and pull strategies. One respondent explains:

> *"It is difficult to predict if a pull or push will be the driving force. However, pull is required to complete market penetration."*

Another respondent stress that the market of IIoT technologies currently is facing a push, but will in coming years move towards a market pull. Some respondents explained that some companies are labeling products as "IIoT" for marketing purposes. Nevertheless, companies will over time understand how IIoT will improve their effectiveness and profitability. The globalization forces the manufacturing sector to gain all competitive advantages possible, which means that they are naturally converting towards pull. Most respondents highlight how progressively essential differentiation, service provision, and reduction of lead-times are in current's economic landscape.

In general, manufacturing companies are under pressure and must increase their profits before anyone else races them out. Most respondents underline that financial benefits are fundamental for attractiveness, followed by the ability to adapt and adjust current offering. Many respondents believe that big players will have easiest to conform, their financial capacity makes investments in new areas possible. According to the same respondent, Small- and Medium-sized Enterprises (SMEs) might have more difficulties to adapt and are not obviously attracted; the investments might be too big compared its value creation. The providers of hardware- and software consider IIoT as an exceptional opportunity to new sources of profit, either as a complement to their existing offering or as a new strategic direction. According to most respondents, providers wish to develop new techniques, and companies at the forefront are trying to push new solutions on the market. However, some respondents say that it has been too much focus on disruptive technologies, the real value creation has a tendency to be forgotten. Many respondents explain that today´s business environment makes it difficult to create long-term strategies, the world is transforming at a rapid pace.

*Switching Costs*

The respondents argue that switching costs are high, but might differ between both segments and companies. Many respondents underline that IIoT implies a significant change, not only in the investment of technological solutions, but also an organizational resistance to change.

Most respondents stress the importance of making an effort, a willingness from all parties in the value chain is required. However, some respondents believe that future advancement concerning international standards and open source system will to some extent reduce switching costs. Some respondents argue that the industry will come to a tipping point when the adoption is high enough to make the cost of staying outside exceed the cost of switching. Most respondents explain that the IIoT is a paradigm shift, it is an evolution rather than a revolution, and needs a step-by-step process for transformation. Many respondents are further discussing standards as a highly important driver for providers' ability to run appropriate offerings. By common standard(s) would manufacturing companies' easier and more efficiently adapt and the development of IIoT would run smoother. Most interviewees believe that standards are necessary, and today´s lack of standards is a huge obstacle for the progress of IIoT. The opinions concerning who will set the standards differ between the respondents. Some respondents argue that non-profit organizations must set the standards and bring companies together, united around one standard. Others claim that big players will create

standards, either jointly or by several different standards emerging. Some of the respondents also argue that open standards are the way to go. The difference between hardware- and software industries is also brought up by several interviewees, implying that the software industry historically lack standards, whereas several different standards have dominated the hardware industry. However, some respondents argue that standards are not always required; standards are a matter of adoption. Despite category of employment, most respondents agreed. They do not believe that one international standard will dominate in future, rather several different covering various industries and geographical areas.

### 4.1.3 Economic and Political Forces

The third externality involves dynamisms created by economic and political forces, whereas the later has been the most prominent in this research. Governmental initiatives are forecasted to influence the development increasingly; both national and international activities are fostering growth worldwide. Economic factors foremost involve an increased pressure of efficiency that IIoT is prospered to enable.

*Economic*

The respondents emphasize that economic factors are to reflect, and arguing that economic gains are more important than political factors. The attitude towards IIoT is firmly determined upon financial gains, where IIoT is considered an opportunity to boost local production and spur the whole economy. Moreover, many respondents mentioned that a country´s financial situation and interest of manufacturing certainly will matter. IIoT brings an automation of factories according to many respondents, which they consider a solution to the declining populations many countries are facing, especially within Europe. Another mentioned influential aspect is taxes and tariffs on imports and exports, where higher taxes disfavor and lowering exchange.

Many respondents argue that from a corporate point of view, the adoption of IIoT requires huge investments. Investments as in some cases are too high for companies to manage. Excessive investments are according to some respondents the main barrier for manufacturing firms, this due to uncertainty in cash flows and measurements. However, another respondent underlines that an adoption does not necessarily need to be radical, an incremental transformation might be advantageous. One respondent explains that manufacturing companies should start small and then scale up. Investment costs for full-scale production are high, but a usage of services is relatively cheap. Some respondents explained that support from government is essential to full-scale adoption. Support from governments in the manufacturing sector is logical; it creates a healthier corporate environment by time, where labor, export and hence the GDP will become stronger. Furthermore, according to most respondents are operational efficiency gains prospered to be massive, savings where labor costs are the main driver. Further, many respondents emphasize that the financial model of IIoT technologies and solutions is changing, which most likely will be beneficial for manufacturing companies. A transformation from investments in machinery towards

alternatives as subscriptions, pay-per-usage and similar is fundamental. An application of new technologies will in a corporate context create large impacts on companies' business models.

*Political*

Most respondents highlight that nationally focused politics are dominating, and the ongoing development of IIoT is seen as an opportunity for bringing jobs back and building a stronger economy. National initiatives are seen in Germany, India, Russia, China and Japan to mention a few. According to some respondents are political powers different between continents, but also within Europe. However, political initiatives correlate with the value it is expected to create, and one interviewee argues that most governments are supporting advances within IoT. Many respondents explain that there is only one thing to keep in mind considering the government; all results must prove efficient and the payback period cannot be too long. Moreover, some respondents highlight the trend of nationalism that is recognized worldwide. The closure of borders and extended restrictions on international trade are contributing factors that are limiting the development and making people less open to new ideas. One respondent express:

*"The nationally focused politic is very important and will hammer the upcoming development. Unfortunately, current politics are turning unstable, and the future is difficult to predict."*

Many respondents said that the progress of IIoT builds upon an allowance of collaborations and communication between devices and networks, an interaction that might be hindered by the trend of protectionism that is noticed today. International collaborations and open standards the way to go according to some respondents.

### 4.2.4 Industry Forces

The fourth externality in this research refer industry forces and constitute competition, value chain actors, and new entrants. The respondents believe that competition will be high among the big players in general, especially considering software and IT-companies. Moreover, the interviewees argue that new start-up companies and alliances will enter the market.

*Competition*

All respondents consider the market of IIoT as highly competitive; big players are dominating and driving the development forward. These players are taking the lead in the creation of standards and patents, thereby playing an important role. Most respondents are mentioning Siemens, SAP, KUKA, Bosch, GE, Intel, Microsoft, Cisco and Amazon as players at the forefront. Companies that currently are trying to restructure their value proposition to stay competitive. One respondent argues that big players actively are trying to figure out how to change themselves in a strategic view, furthermore, how to adapt their business models. Many respondents explain that a creation of an ecosystem will require extensive investments and platforms, excluding smaller players from taking a leading position. In addition, the competitiveness might be influenced by a company´s origin, where one respondent perceived cultural aspects central in addition to law and regulations. The respondent noted that a country

like Sweden with low-hierarchical systems might be advantageous, which endeavor continuous improvements and new innovations. Moreover, many respondents are mentioning an upswing in China concerning IPRs, a country that during last years has been thriving in fostering new technology players. The governmental support is huge in China, giving Chinese competitors a considerable advantage. According to many respondents is the access to data brought up as the most critical competitive advantage, implying that the company with most data has the best chances to succeed. Moreover, some respondents explain IIoT as a merge of the information technology- industry and the operational technology industry. The mix of these two indicates that organizational factors and management requires additional focus for success. One respondent explains:

*"Communication and a spot-on branding are essential in new businesses. Winning competitive advantages requires a flexible management that is quick to act on changes in the external environment."*

*Value Chain Actors*

All respondents believe that future value chains will be connected and automatized at higher levels than before. A shift from a value chain to a value network is expected, moreover, increased transparency and connection of all devices within a network. Most respondents explain that value creation will move closer to the end-customers, nowadays, customization is possible at a higher scale and lower cost. In accordance to above considered, large players will form specific standards and thereby gain most power, forcing suppliers to play by their rules and adapt. One respondent highlights that the difference between value chains across different continents. For example, Europe is more concentrated in its value chain compared North America, due to only a few big players dominating. Most respondents justify that the whole value chain will be disturbed to some extent and moreover, the necessity of understanding the entire value chain with different parties, structures, systems, and functionalities.

*"Connecting and understanding of supply chains is the future; a value based outcome where all companies, suppliers, and customers are connected. Access to data and bandwidth will be valuable assets."*

*Threats from New Entrants*

Many respondents mentioned start-ups as an outstanding group of new players and hence a threat to consider. Start-ups have the power to enter the market and develop new innovations at a rapid pace. Contrary, big players reap benefits of acquiring successful start-ups instead of developing new ideas in-house. Some respondents mentioned start-ups acting a catalyst for IIoT manufacturing. One of the respondents says:

*"When everything is becoming cloud-based and connected will mature players don't have the capacity to react quick enough. This gives room for start-ups and other players to enter the market."*

However, the big players will always have advantages of access to capital and most respondents believe that alliances and joint ventures will increase in future; companies need to focus their competitive edge and capture niche markets. Many respondents believe that alliances across unexpected industries and sectors will increase enormously in the future. Furthermore, respondents emphasize that new actors might constitute a risk for established players since they do not need to consider the strategic fit with their former businesses and investments. Outdated and expensive systems might form a barrier for big players.

## 4.2 IMPACT ON BUSINESS MODEL CANVAS

The development of business models is focused in this section, describing the results from the data collection.

*"IIoT is not only the technology. It is highly related business models, new organizational forms, and relations between machines and workers. The most common misunderstanding is probably that IIoT only concerns the technological aspects."*

Some respondents explained that the challenge cannot be addressed specific parts of the business model, the complexity refers the whole context which one respondent stated:

*"The real hurdles lie in the way all parts of a business model are connected, and how their integration and interaction will change. The whole business model logic and patterns will transform. Providers entering the market of IIoT need to adapt their business models to stay competitive."*

Generally, the respondents believed that customer relationship, revenue streams, and key partnership will be most affected. Below are all nine building blocks discussed.

### 4.2.1 Customer Segments

Many respondents explain a market segmentation based two elements; industry sector and geographical location.

From an industry point of view, many respondents explain that the division in different segments is based the matureness of the industries. At the frontline and most prominent within manufacturing are industries such as airline, automotive, electronics, and pharmaceutical. These sectors are according to most respondents addressed to be first in adapting the IIoT; however, more sectors will follow by time. In addition to above industries are many interviewees discussing sectors that are capital intensive, complex, and concerned by a steep technological development as beneficial for adopting IIoT solutions. Examples of these type of industries are energy, transportation, utilities, and infrastructure. Geographically, most respondents consider Japan, Germany, and the U.S to be the leading countries. Additionally, is China noticed as an upcoming nation with expanding possibilities. Some respondents underline that difficulties in politics and regulations make cooperation between these countries difficult. In a broader perspective, some respondents emphasize that diverse

geographical areas are differently focused, where Europe, for example, is more concentrated on manufacturing, whereas the consumer market historically has been driving the U.S.

### 4.2.2 Value Propositions

The value proposition will transform according to all respondents, highlighting that products nowadays are turning into services. IIoT brings new opportunities of steering the value preposition towards increasing customer demands. Many respondents underline that customers´ requirements are rising; increased quality, reduced time-to-market, customized solutions, and at the same time, lower costs are expected. An intensified competitiveness through higher effectiveness, performance, and a leverage of automatization is expected. All respondents believe that IIoT will bring new value to the customers. Many respondents empathize that businesses are buying the outcome rather than the quality or costs of products or services, a shift towards outcome-economy is highlighted. In addition, a shift towards servitization is described and exemplified with the development of renting engines in the airline industry by one respondent.

### 4.2.3 Distribution Channels

The distribution channel is likely to undergo a change according to some of the respondents. Previously explained trend of servitization, where products are transforming into services, is argued by the respondents to be the strongest factor causing a change in distribution channels. Moreover, advancements in digitalization and customization enable companies to distribute and reach their customer in new, more individualized ways. Moreover, many respondents note that software becomes increasingly important within the manufacturing sector; never before has software been as influential as it is today. Another emphasized development is the concept of block chains, dismissing central authorities and recognized by its secure design.

### 4.2.4 Customer Relationship

All respondents explain that customer relationship is a very central factor, where future relationships will be driven firmly by customer retention. Most respondents emphasize that close and permanent relationships with the customers are turning gradually necessary. The trend of an increasingly customized product will affect customer relationships, according to many respondents is the ability of automatically customize offerings substantially. In addition, the aftersales market comprising maintenance and updates generates a potential of additional revenues. Customer relationships is by many respondents considered being one of the most essential building blocks as long-term relationships are supposed to have greater importance in future than ever before.

*"The endless amounts of data created every day is of higher importance than ever. Data enables monitoring of manufacturers´ processes in real-time, thereby giving possibilities to strengthen the customer relationship by building trust and commitment."*

### 4.2.5 Revenue Streams

All respondents were united in mentioning revenue streams as the block that will encounter the most significant changes when providers enter the IIoT market. The past focus on consumers was also emphasized by many respondents who explained that the largest margins and thereby opportunities are in industrial business. Changes in revenue streams are generated through new methods of payments as IIoT enables new ways of selling solutions. In future, the manufacturing sector will be provided complete solutions that empower their operational activities. Applications are identified to be a huge part of the future profit.

Future revenue streams are dependent upon recurring customer relations according to most respondents. New payment models include subscriptions, licensing, pay-by-use, and pay-per-outcome. All respondents argue that future revenue streams are based a dynamic structure as most likely will have an enormous impact on businesses. Some respondents express uncertainty in future cash flows as an implication of new customer demands. One respondent is explicitly underlining the impact of selling solutions by-use, implying that the single transaction model will soon become obsolete. Some respondents emphasize that new payment models such as pay-per-usage, or pay-per-outcome are needed, an outcome economy is a likely future. The respondents believe that this change towards new methods of payment will continue and spread further across new industries, transforming from platform-as-a-service towards infrastructure-as-a-service.

### 4.2.6 Key Resources

Key resources were given limited attention by the respondents. However, some describing financial assets as the most influential resource since it creates power and ability to invest.

### 4.2.7 Key Activities

Many respondents believe that key activities will remain the same to a great extent. However, the development from products to services is mentioned to have a significant impact and form the future within manufacturing. Historical domination of production activities will now be transformed into production networks, making managing interfaces between different products, partners, and platforms key activities in future.

### 4.2.8 Key Partnerships

Many respondents explain that partnerships are becoming increasingly important as a result of a boom in connectivity, and emphasize the requisite of focusing companies' core competencies. Some respondents explained that alliances are forming across unexpected industries, and new partners create mutual ecosystems, which also determines the basis of IIoT. Software- and hardware providers are collectively developing technological foundations. Buyers and suppliers are becoming dependent on each other, and many respondents believe that a higher level of cross-functional collaborations will be observed in future. One respondent express:

*"The key is the connectivity making specific service providers vital in determining a product´s success. The cloud opens up new opportunities for selling data created by products, which form new business models."*

Moreover, many respondents justify that in addition to acquisitions will start-ups be a critical aspect to reflect. The respondents explain that start-ups often are more innovative and dynamic compared established firms; they have an ability to develop what the market needs, even when the customers don't even understand what they are requiring. Some respondents argue that start-ups are primarily prominent in developing specific products or services which larger players acquire.

### 4.2.9 Cost Structure

None of the respondents argue that cost structure is likely to change.

# 5. ANALYSIS

This section presents our analysis of gathered empirical data in comparison with the previously given theoretical framework. The chapter begins by analyzing the impact of the external environment and finishes by analyzing the impact of providers' business model.

## 5.1 EXTERNAL FORCES AFFECTING THE DEVELOPMENT OF IIOT

From discussions with the respondents, it became apparent that the digital development within the manufacturing sector is a widely discussed topic and classified of high importance on both software- and hardware providers´ agendas. The definitions provided by both theoretical- and empirical findings correspond with each other, both underlining the integration of physical- and virtual worlds as transforming industries. (Roland Berger, 2016; IoT Analytics, 2016a) Some respondents argue that the concept is quite blurry, which also becomes evident in the theoretical review, as the name of the phenomenon varies across national borders. (Roland Berger, 2016; European Parliament, 2015) IIoT aims to create innovations, increase quality, efficiency and digitalization according to the respondents and the theory. The latter adding that satisfaction of customers´ demand with increased profitability is one of the most important outcomes. (Deloitte, 2014; PwC, 2014)

### 5.1.1 Key Trends

Key trends are divided in social, technological, environmental and legal trends, which all have been discussed in theory and with the respondents. The legal aspect distinguishes by being rated as having highest impact on the development of IIoT by both theoretical and empirical findings. Further, the social aspect is widely discussed but does not appear determining for the development; financial opportunities conquer possible social downsides. Below table summarizes the findings from theoretical- and empirical data.

**Analysis External Forces: Key Trends**

| | | Theory | | Empirical | |
|---|---|---|---|---|---|
| | **Factor** | **Mentioned** | **Impact** | **Mentioned** | **Impact** |
| **Social** | Changing job-tasks | ✓ | Medium | ✓ | High |
| | Organizational resistance to change | ✓ | High | ✓ | High |
| | Decentralized decision making | ✓ | Medium | ✓ | Medium |
| | Increased educational requirements | ✓ | High | ✓ | Medium |
| **Technological** | Increased speed of development | ✓ | Medium | ✓ | High |
| | Reduced cost of technologies | ✓ | High | ✓ | Medium |
| **Environmental** | Reduced waste and scrap | ✓ | High | ✓ | Medium |
| | Increased resource efficiency | ✓ | High | ✓ | Medium |
| | Short product-lifecycles | ✓ | High | ✗ | – |
| | Governmental regulations | ✓ | Low | ✓ | Medium |
| **Legal** | Ownership of data | ✓ | High | ✓ | High |
| | IP-rights | ✓ | High | ✓ | High |
| | Risk of attacks | ✓ | High | ✓ | Medium |
| | Data protection | ✓ | High | ✓ | High |

*Table 5.1: Analysis of External Factors, Key Trends*

*Social*

The social factors are widely discussed among both researchers and respondents, and the arguments and opinions are countless. However, the impact on the development of IIoT does not appear to be distinguishingly strong comparing other categories. The organizational resistance to change is the most distinguishing factor from both theoretical- and empirical findings. Transformation of job tasks is considered to have a medium impact according to theoretical findings, whereas the respondents express their worries for a strong resistance among employees in the factories. (Accenture, 2015b; World Economic Forum, 2016) The theory takes two directions; the optimistic emphasizes a transformation of jobs, whereas the other side argues that jobs will disappear. (Accenture, 2015b; World Economic Forum, 2016; McKinsey, 2017a) Some of the respondents confirm that there are two different views of this change, but the majority is not worried, meaning that IIoT is a natural evolution and thereby no difference compared previous revolutions.

The organizational resistance is the most important factor according to some of the respondents, implying that it is one of the greatest obstacles to IIoT growth. Developing a digital culture supporting the development is considered necessary by theory. Moreover, PwC (2016a) adds that transformation must be driven by top management, which signalizes the magnitude of this development. Some respondents argue that organizational boundaries will decrease as white-collar- and blue-collar workers are moving closer together. New digital technologies will enable decentralized decision-making, and thereby support the development by reducing organizational boundaries. (Accenture, 2015b) Regardless the outcome of the transformation, it is evident from both theory and empirical findings that new technologies in the factories will require new skills from employees which they do not possess today. (Roland Berger, 2014a; McKinsey, 2017a; World Economic Forum, 2016; PwC, 2016a) The respondents believe that these new skills will demand a higher level in educational requirements, which is confirmed by Roser & Ortiz-Ospina (2017), further arguing that peoples´ educational levels are rising all over the world. The requirement of new skills and education might thereby not be as problematic at the respondents believe. The theory further argues that educational requirements might create an increasingly segregated job market where high- and low skills jobs are separated, an anxiety excluded by the respondents. (World Economic Forum, 2016)

To conclude, the social perspective brings diverse opinions, implying that it is hard to forecast the outcome before the adoption is advanced at a higher scale. From discussions with the respondents it came clear that the digital development within the manufacturing sector is a widely discussed topic and classified of high importance on both software and hardware providers´ agendas. The definitions provided by both theoretical (Roland Berger, 2016; IoT Analytics, 2016a) and empirical findings correspond with each other, both underlining the integration of physical and virtual worlds and transforming industries. Some respondents argue that the concept it is a bit blurry, which also becomes evident in the theoretical review, as the names of the phenomenon varies across national borders. (Roland Berger, 2016; European Parliament, 2015) IIoT aims to generate new innovations, increase quality, efficiency and digitalization according to the respondents, which goes along with theory,

adding that it aims to fulfill customer requirements with an increased profitability. (Deloitte, 2014; PwC, 2014)

*Technological*

The technological perspective has foremost focused two factors that have been prominent in both empirical and theoretical findings. First, the cost of exploiting new technologies and secondly, the speed of this development. The rapid technological progress is explained as an important factor affecting business all over the world, creating a global integrated value chain. The theory emphasizes a technological infrastructure where integration of the physical- and virtual worlds is feasible across companies and nations. (Geissbauer, et al., 2016; Cleverism, 2017) The respondents are further arguing that collaboration between autonomous technologies and human are central aspects. Theory confirm this by providing examples as advanced robotics, 3D-printing and augmented reality, technologies that all are transforming the manufacturing sector. Schaeffer (2017) explains that new technologies at lower costs advance this development, a factor the respondents confirm, adding that combining new technologies with businesses will improve the outcome.

Theoretical- and empirical findings emphasize an increased speed of development as prominent in IIoT. The respondents are underlining an issue resulting from differences in speed between software- and hardware providers as hardware are slower in development compared software. The value of IIoT lies firmly in the ability to make use of data to make accurate decisions according to PwC (2016a). This indicates that the advancement of IIoT might be hindered by the different speeds of development that is creating difficulties of integrating the virtual and physical worlds.

*Environmental*

The environmental impact is primarily noticed in theory, where a reduction of waste, increase resource efficiency and shortening of product lifecycles are highlighted as the most influential factors with a high level of impact.

Theoretical findings take two different standpoints, arguing that IIoT brings both positive and negative aspects to the environment. (Houghton, 2013; Advanced MP Technology, 2017a) An increased focus on sustainability in our society is noticed by both the respondents and theory, Houghton (2013) argue that IIoT brings great potential in saving resources. Most respondents consider environmental factors as less influential, foremost mentioning positive outcomes as a reduction of waste and resource efficiency. New digital technologies generating a reduction of waste due to higher levels of quality according to Advanced MP Technology (2017a). This is confirmed by the respondents, arguing that digitalization improves the efficiency of energy- and resource consumption. The respondents are further discussing regulations and limitations set by the government that brings a positive environmental impact, exemplifying with quotas of emissions as a factor limiting the greenhouse effect. However, some respondents bring skepticism towards the sustainability part of IIoT, implying that companies are using it as an argument for goodwill. The theory is partly confirming the skepticism where Houghton (2013) argues that there is a downside of new technologies that should not be forgotten.

Billions of new connected devices replacing other products generate massive amounts of e-waste and shorten the life cycles of the new products.

The difference in opinions between theory and empirical findings can result from various causes, but also indicates and gives reason to believe that the respondent's answers are biased as many of them consider IIoT being a positive advancement of today's manufacturing processes. The fact that only a small share of today's factories has adopted IIoT and its aforementioned technologies makes it difficult to forecast the environmental outcome of implementation.

*Legal*

The legal aspect is firmly focused four different factors, the ownership of data, IP-rights, the risk of attacks and data protection. All factors, except the risk of attacks, are considered to have a high impact on the development of IIoT according to both empirical and theoretical findings, making the legal aspect one of the most influential factors in the external landscape.

IIoT implies production and transformation of increasing amounts of data with accelerating speed. (Cleverism, 2017) The respondents believe that this will cause problems referring the collection, usage, ownership and responsibility of data, which is confirmed by theoretical findings, especially underlining that the cost of cyber security is increasing every year. (Cleverism, 2017; Bosch, 2015; European Parliament, 2016; Banafa, 2017a) The respondents believe that rapid technological developments will require new laws and regulations to a greater extent than ever before. Banafa (2017a) confirms by stating that security will be a problematic and complicated task in future. A concern regarding the impact of new regulations is expressed by the respondents, arguing that prediction is difficult which makes the development volatile. Additional anxiety is expressed concerning the European Union, as all countries have different laws that must be united, which is hindering the creation of common regulations and laws. Additionally, new innovations, solutions and technologies require protection to sustain its competitive edge, making IP-rights increasingly important according to Cleverism (2017). The respondents agree and discuss problems of increased globalization and differences in regulations across national boundaries.

The increasing number of devices that are connected by IoT opens up for escalating problems of hacker attacks, data theft, and industrial espionage according to theory. (McKinsey, 2015; Bosch, 2015; European Parliament, 2016) The respondents additionally state that attacks from hackers will be a rising threat in future together with the overall lack of security. Further, the security determines the readiness of connected devices, indicating that security problems need to be solved before we will see widespread advance of IIoT. Privacy is another concern brought up by the respondents but excluded from previous research, where corporate security is of higher importance than privacy concerns. The question of privacy might thereby be discounted in favor of other legal issues in corporate organizations. There is reason to believe that above-mentioned privacy concerns might increase the organizational resistance to change, not at least from employees' point of view.

To conclude, data plays an increasingly important role in modern manufacturing, making protection of data essential for capturing and sustaining a competitive market position.

### 5.1.2 Market Forces

The market forces are represented by attractiveness, push/pull- effects, and switching costs, all recognized and evaluated in theory and empirical findings. A high level of coherence is considered among all factors, where a general high impact is noticed in market attractiveness and switching cost, adding them to the most important factors in the external environment. A summary of the findings is visualized in the table below, followed by an analysis of the different factors.

**Analysis External Forces: Market Forces**

| | | Theory | | Empirical | |
|---|---|---|---|---|---|
| | **Factor** | **Mentioned** | **Impact** | **Mentioned** | **Impact** |
| **Market Attractiveness** | High market value | ✓ | High | ✓ | High |
| | High growth rate | ✓ | High | ✓ | High |
| **Push- and Pull Effects** | Pull: New business opportunities | ✓ | Medium | ✓ | Medium |
| | Pull: Need of resource efficiency | ✓ | Medium | ✓ | High |
| | Push: New technologies | ✓ | Medium | ✓ | High |
| **Switching Costs** | Organizational resistance | ✓ | Medium | ✓ | Medium |
| | Tehnological standard | ✓ | High | ✓ | High |

*Table 5.2: Analysis of External Factors, Market Forces*

*Market Attractiveness*

Market value and growth rate represents the market attractiveness, and are both considered to have a high level of impact according to theory and respondents. The market attractiveness is thereby considered a significant factor for the development of IIoT.

The market value is widely discussed and has a high impact according to by both theoretical findings and respondents. (Accenture, 2015c; World Economic Forum, 2017) Depending on which article you read or whom you ask, the answer of size differ. Most interviewees explain it to be an impossible question to answer due to the novelty and constant growth of this area, where all answers are considered to be more or less qualified guesses. Consultancy reports are brave enough to put numbers on it, but the accuracy of this numbers is arguable. (Accenture, 2015c; World Economic Forum, 2017) One thing is thus clear; the market potential is huge, and the answers of market size are counted in billions.

In addition, the size is prospered to accelerate in growth during upcoming years according to World Economic Forum (2017). The respondents explain that IIoT has grown from being a theoretical concept a few years ago, to today’s level of acceptance where adoption is on all prominent manufacturers agendas´. Schaeffer (2017) explains the market potential being enormous; the number of connected devices is growing, generating trillions of interactions that are accelerating in speed. Focus has historically been on the consumer market, however, the respondents explain a growing corporate market, signifying the financial potential of the industrial application of Internet of Things. The researchers' impressions from Hannover

Messe, with over 6500 exhibitors and over 225.000 visitors, reveal the potential of IIoT. The market attractiveness is high and constantly growing.

*Push- and Pull Effects*

The development of IIoT is considered to be a combination of a push from providers of new technologies, and a market demand resulting in a pull from an increased requirement of resource efficiency and new business opportunities. The respondents argue that the importance of these two directions is high for future growth, whereas theoretical findings imply a medium level of impact. Increased pressure and global competition create a demand for higher flexibility, cost reduction and revenue growth, which BCG (2016) describes as driving forces. The respondents agree by explaining that an increase in profits is necessary for manufacturing companies before competitors race them out. Globalization is further considered a factor that intensifies competition and contributing to the pull-effect for competitiveness according to the respondents. The theory also describes an efficient usage of resources as essential to maintaining low costs together with an increased focus on sustainability. (Lasi et al., 2014; Roland Berger, 2014b) The respondents agree by underlining that financial benefits are critical for attractiveness, followed by the ability to adapt and adjust offerings.

New technologies have pushed the development by creating a paradigm shift forming industries that are highly automatized and mechanized. (Lasi et al., 2014) Advancement in digitization and rapid development in ICT have merged the digital and physical world together and created a technological push. Furthermore, the industrial sector is a central part of the economy in many countries, making the development of technologies focusing industries beneficial. The respondents confirm this by describing IIoT as a great opportunity for new sources of profitmaking. Further, the rapid pace of development makes it possible to constant develop and push new technologies to the market. Literature concludes IIoT as primarily driven by providers rather from customer demand, which is partly confirmed by the respondents. Some argue that IIoT is a pull from manufacturing companies, some believe it is a push from providers, while others think it is a combination of both.

*Switching Costs*

The switching costs constitute the largest barriers to adoption of IIoT, composing an organizational resistance to change and the creation of standards. According to both theory and respondents is the organizational resistance categorized medium impact, and the question of standards ranked as highly important. The respondents argue that the transformation implied by IIoT requires an organizational change, which Bosch (2015) confirms by arguing that companies must undergo development to stay competitive.

PwC (2016a) explains that success is driven by the combination of a robust digital culture and change directed top management. The respondents confirm and adding that all parties in the value chain must be willing to undertake the transformation to succeed. Further emphasized by the respondents is a risk of disrupting normal operations during transformation, which might lead to an increase of resistance from employees.

Several different technologies in both software and hardware are, as aforementioned, required for adoption of IIoT. International specifications of technologies are today non-existent, and the respondents describe a lack of established standards. PwC (2014) explains technological standards as one of the factors forming the foundation for connecting value chains and exchanging data. Standards are further described by the respondents as essential and an important driver for providers' ability to create appropriate offerings. McKinsey (2015) further advises providers to involve themselves in the definition of standards to gain competitive advantages, and additionally ensure a readiness of their organizations and technologies. Some respondents believe that standards must be set by non-profit organizations, while other argue that the big players will create the standards. Moreover, standards will either be created jointly or by the emergence of different standards from various directions. Due to ongoing discussions, it is reasonable to believe that standards occurring both from international players and governments will compete for market acceptance in a few years. The respondents revealed that standards are essential for adoption of IIoT at higher levels, and made a distinction between hardware- and software industries. The hardware industry has historically been based numerous of standards, whereas the software has been totally absent of standards. Consolidation of previously mentioned industries with different histories might be an obstacle for the growth of IIoT. To conclude, there is an ongoing race of whom will set the standards on the market, as huge competitive advantages are possible to capture.

### 5.1.3 Economical and Political Forces

Economic- and political factors are considered important according to both theoretical and empirical findings when determining the development of IIoT. Economic advantages are emphasized as shaping the future of IIoT, and among political factors are national initiatives considered especially influential in advancing development. A summary of theoretical- and empirical findings is visualized in the table below, followed by an analysis of the different factors.

**Analysis External Forces: Macro Forces**

| | | Theory | | Empirical | |
|---|---|---|---|---|---|
| | **Factor** | **Mentioned** | **Impact** | **Mentioned** | **Impact** |
| **Economic** | Expected raise in GDP | ✓ | High | ✓ | High |
| | Relocalization of production facilities | ✓ | Medium | ✗ | – |
| | Investment size | ✓ | High | ✓ | Medium |
| | New payment methods | ✗ | – | ✓ | High |
| **Political** | Influential international initiatives | ✓ | Medium | ✓ | Low |
| | Influential national initiatives | ✓ | High | ✓ | Medium |
| | Nationalism | ✗ | – | ✓ | Medium |

*Table 5.3: Analysis of External Factors, Macro Forces*

#### *Economic*

The economic aspect is considered significant for the development of IIoT, and both empirical- and theoretical findings are especially highlighting the expected rise in GDP and

size of investment as influential. A re-localization of production facilities is further emphasized by theory, while the respondents are mentioning new payments methods as important aspects. Schaeffer (2017) argue that the digital transformation will affect companies representing two-thirds of global GDP, implying that the size and potential of IIoT is enormous. The respondents confirm by explaining that IIoT is an opportunity to boost local production and spur the economy. Further, the industrial sectors play a central role in the economy of the European Union, considering economic growth, jobs creation and value creation. (Roland Berger, 2014b) As the economic benefits will be the most determining factor for investments in IIoT according to both respondents and theory, it becomes evident why it has reached such big attention in Europe. The trend of outsourcing in Europe has been ongoing a longer time, as production facilities have relocated due to lower costs of labor in other parts of the world. (European Parliament, 2015) The respondents are however not mentioning this development; they are instead arguing that IIoT is a solution to the declining workforce that many countries are facing, particularly in Europe. The theory expresses a concern over that peak employment soon will be reached as a consequence of declining birthrates in many countries. This indicates that IIoT might bring solutions to both economic and social problems at a larger scale than first anticipated by theoretical findings.

Both theoretical and empirical findings are mentioning the size of investments constituting a challenge for many manufacturing companies. Previous research argues that the size of investment might be too big to accomplish for small- and medium-sized companies, explaining that it might cost them their market share in future. (Cleverism, 2017; European Parliament, 2015) The theory is thereby forecasting a manufacturing industry where the big players are dominating and smaller players disappearing. Some of the respondents are discussing a similar change as the investments are too big for smaller companies, but adding that a step-by-step might be a good solution. Some respondents are additionally emphasizing the possible change in business models implied by IIoT, where pay-per-use and subscriptions are forecasted to outrun the traditional investment model. This business model transformation will be further reflected in Business Model analysis.

*Political*

The political aspect foremost concerns different governmental initiatives that are powerful for the advancement of IIoT. Theoretical and empirical findings are underlining national and international initiatives as especially important. The respondents are further discussing an increased trend of nationalism as influential in hindering the development.

Roland Berger (2016) describes increased competitiveness, relocation, or preservation of activities as objectives for implementing policies. The respondents confirm by emphasizing that nationally focused politics are dominating the world today and consider IIoT as an opportunity of bringing jobs back and build a stronger national economy.

Theoretical findings further explain that the objectives vary among countries according to their strength of industries and economies. The respondents are mentioning Germany, India, China, and Russia as countries supported by strong national initiatives. Empirical findings confirm initiatives in these countries, which all distinguish as powerful nations in the

advancement of IIoT. (Cleverism, 2017; GTAI, 2014; Roland Berger, 2014b; PwC, 2014) The congruence of opinions makes it is arguable to say that the respondents are well aware of ongoing activities and that previously mentioned countries have succeeded in positioning themselves as prospering.

Theoretical findings highlight both national- and international initiatives as influential for the development of IIoT, whereas the respondents firmly discuss national ones. (Roland Berger, 2014b; PwC, 2014; Kurfuss, 2014; Cleverism, 2017) A few respondents are mentioning international collaborations as the way to go, but remain skeptic towards the realization of these. Differences in regulation and laws constitute barriers against international partnerships. The respondents are further emphasizing the abovementioned nationalism as hindering collaborations across national borders. The indicated limited success of international initiatives makes it reasonable to believe that agreements for collaboration at higher levels would benefit both the users and the providers of IIoT.

### 5.1.4 Industry Forces

The industry forces are divided into three powers and constitute competition, value chain actors, and new entrants. Overall, the industry force comprises a medium impact where the value chain is argued to become the most influential one. Moreover, it is arguable to say that industry forces might play an even more important role in forthcoming years due to the novelty of the topic.

**Analysis External Forces: Industry Forces**

| | | Theory | | Emperical | |
|---|---|---|---|---|---|
| | **Factors** | **Mentioned** | **Impact** | **Mentioned** | **Impact** |
| **Competition** | Big players | ✓ | Medium | ✓ | High |
| | IPRs | ✓ | Medium | ✓ | Medium |
| | Company´s origin | ✗ | – | ✓ | Low |
| | Access to data | ✗ | – | ✓ | Medium |
| **Value Chain Actors** | Disruption of value chain | ✓ | High | ✓ | Medium |
| | Increased transparency | ✗ | – | ✓ | Medium |
| **New Entrants** | Start-ups | ✓ | Medium | ✓ | Medium |
| | Alliances | ✗ | – | ✓ | High |

*Table 5.4: Analysis of External Factors, Industry Forces*

#### *Competition*

The competition is on average considered to have a medium to high impact on the development of IIoT according to both respondents and theoretical findings. Respondents describe the market of IIoT as highly competitive and empathize four factors of impact: Big players, IPRs, a company´s origin and access to data. Big players are according to respondents argued as having high influence, whereas theoretical findings suggest a medium impact. Two out of four above-mentioned empirical factors are not discussed in theory; companies´ origin and access to data are excluded.

The theory explains that the IIoT market has reached attention from various industries where providers with a background in different industries competing of becoming leading and set the market standards. (IoT Analytics, 2015) Companies mentioned by the respondents at the forefront are Siemens, Intel, Microsoft Corporation, Cisco System, SAP, General Electrics, Bosch, and Amazon. The respondents further argue that these players are taking the lead in the creation of standards and patents, thereby bearing an important role for future advancement. Previous research of prominent players includes above mentioned companies, adding Oracle Corporation and Google to the list.

(IoT Analytics, 2015; Frost & Sullivan, 2017) Above compliance indicate that these companies have been successful in positioning themselves as dominant players. Additionally, it implies that both software- and hardware companies are competing and mutually driving development forward. Governmental initiatives, technological legalizations, and IPRs will be factors triggering development further. (World Economic Forum, 2016) The respondents are mentioning China as one of the countries where both governmental subsidizations and new IPRs have been prominent in driving technological innovations forward during last years, which indicates that China is an influential country in the development of IIoT. Respondents are additionally mentioning companies' origin's as a determining factor of success, implying that the cultural aspect, in addition to national initiatives and regulations, might be important to consider. To conclude, the competition is considered to be strong since big players already are positioned as dominating the market. However, new players are likely to derive from supportive countries where governmental initiatives are strong and regulations are advantageous.

*Value Chain Actors*

IIoT is prospered to influence the entire value chain, a factor both theoretical- and empirical findings agree upon and rank as highly influential. The disruptiveness brought by value chain actors is considered to have high impact by theoretical findings, and medium by the respondents, while the later adds a factor of increased transparency. The adoption if IIoT will affect several players along the value chain and force them to rethink the way they do business. (McKinsey, 2015) The respondents believe that value chain will transform to a value network that is connected and automatized at a higher level than before. Moreover, since large players are prospered to form specific standards and consequently gain the most power, will other players along the value chain be forced to follow their rules and adapt. This development implies an increased level of transparency, as more players in the value chain are connected and sharing data. The respondents further explain that the value chain will move closer to the end-customer as an outcome of increasingly customized products. Both the theoretical and empirical findings emphasize a transformation affecting the entire value chain, but explanations of how this will occur and which consequences it will bring are being left out. The newness of IIoT and consequently its application areas are not convincingly developed or tested to provide a complete answer of how the transformation will affect the value chain. However, the implication from actors in the value chain might still be an important aspect to keep in mind in future as IIoT is expanding.

*New Entrants*

New entrants is considered to have a medium impact on the development of IIoT according to both theoretical- and empirical findings. Both groups are mentioning start-ups as an influential group, whereas the respondents also outline strategical alliances as important. McKinsey (2015) explains that the transformation IIoT implies on business models will create opportunities for new players to enter the market; start-ups and innovative fast movers will constitute threats to incumbent players. The respondents describe start-ups as fast-moving and flexible, which enable them to develop innovations in higher speed than incumbent actors. An advantage of flexibility and pace is prospered as the development of IIoT is accelerating in speed. Start-ups are thereby likely to be successful in developing innovations that reach market in an early stage. Moreover, theoretical findings emphasize that start-ups are dedicated significant attention and huge funding. (Banafa, 2016)

Funding makes start-ups less dependent on big players and thereby, unpredictable and powerful entrants on the IIoT market. However, opportunities for established players are underlined by the respondents, explaining that incumbent firms often have the ability to acquire successful start-ups due to financial advantages. The respondents stress that alliances are prospered to increase in future, implying that companies should focus on developing their core competencies and reap benefits from strategical acquisitions. The importance of a strategic fit in acquisitions is further emphasized; compliance is required to avoid strategic difficulties and organizational resistance. To conclude, the novelty of IIoT makes it difficult to separate new entrants from already existing players. All players are in some way new to this market, and only the future can determine whom will succeed.

In below figure are the external forces affecting future development of IIoT highlighted and visualized. Most influential and thereby highlighted are Legal, Market Attractiveness, and Switching Costs. Economic- and Political Forces follow as next important and are consequently less highlighted.

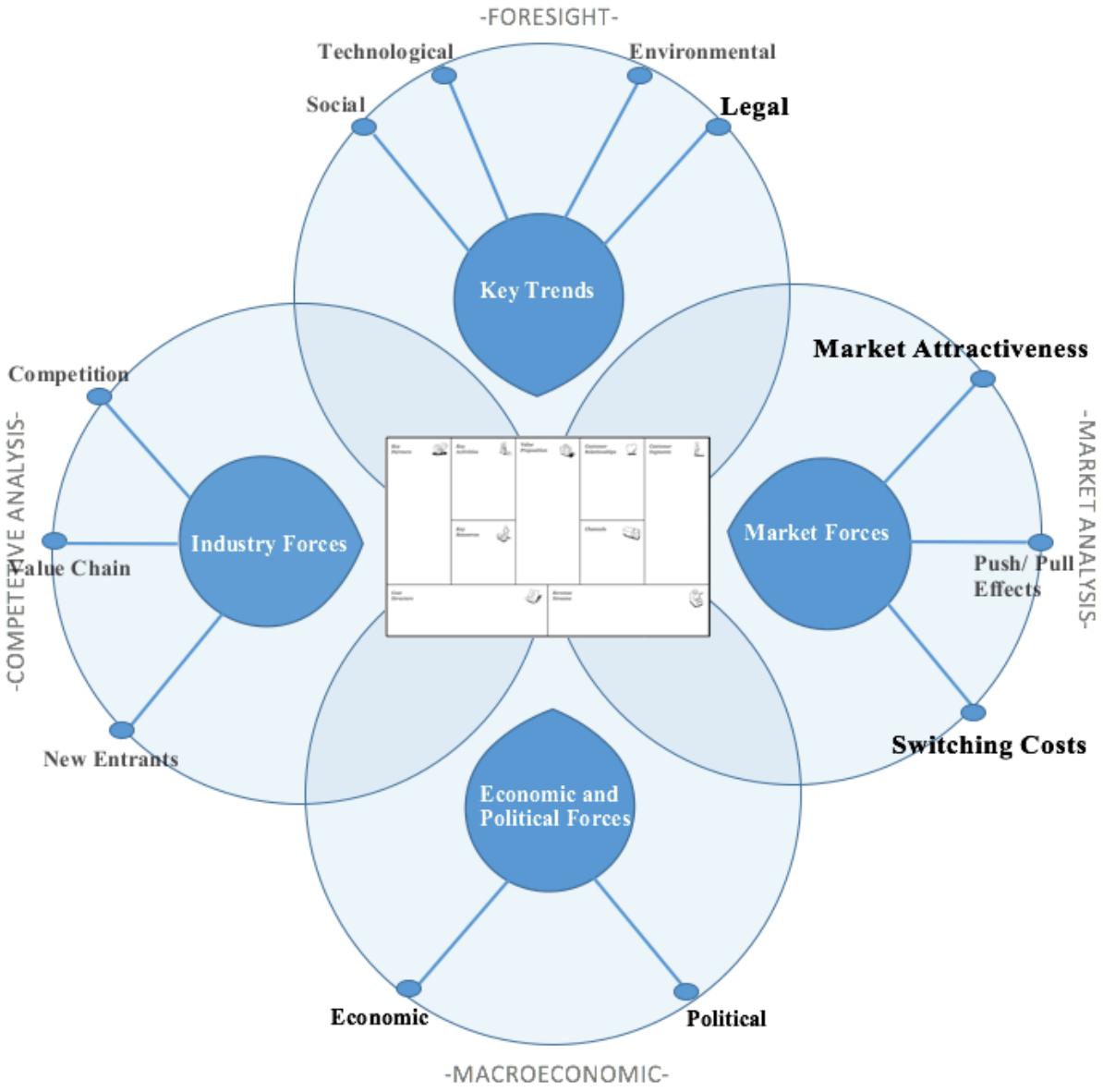


*Figure 5.1: Summary of Analysis of External Forces Affecting the Development of IIoT*

## 5.2 IMPACT ON THE BUSINESS MODELS CANVAS

This part outlines the abovementioned impact external forces bring into business modelling, more precisely the framework entitled the Business Model Canvas. First of all, one aspect was evident from gathered data; the outcome of IIoT is much more than technologies itself and there is a strong impact beyond the factory floor. Therefore, one fundamental factor to keep in mind is that today's offerings are under development. Yesterday's products have increasingly started to become services. The development towards services is considered to have an enormous impact on providers´ business models according to theoretical- and empirical findings. From above description of external forces affecting the development of IIoT and

thereby current business models, it becomes apparent that the providers of IIoT-solutions need to rethink their business models.

In following table are key findings from theoretical- and empirical studies compared and later analyzed in script. This comparison concerns all building blocks of the Business Model Canvas, namely; Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partnerships, and Cost Structure. Our following focus is to concretize which, and in what way, these nine building blocks are transformed by the development of IIoT.

**Analysis: Business Model Canvas**

| | | Theory | | Emperical | |
|---|---|---|---|---|---|
| | **Factor** | **Mentioned** | **Impact** | **Mentioned** | **Impact** |
| **Customer Segements** | Industry segmentation | ✓ | Low | ✓ | Low |
| | Geographical segmentation | ✓ | Medium | ✓ | Medium |
| **Value Proposition** | Increased performance | ✓ | Medium | ✓ | High |
| | Mass customization | ✓ | Medium | ✓ | High |
| | Cost reduction | ✓ | Medium | ✓ | Medium |
| | Time-to-market | ✓ | Medium | ✓ | Medium |
| | Improved quality | ✓ | Medium | ✓ | Medium |
| **Distribution Channels** | Customized services | ✓ | Medium | ✓ | Medium |
| | Complete solutions | ✓ | Low | ✓ | Low |
| | Block chains | ✓ | Low | ✓ | Medium |
| **Customer Relationships** | Customer retention | ✓ | High | ✓ | High |
| | Automated customization | ✓ | High | ✓ | High |
| **Reveneue Streams** | Pay-per-usage | ✓ | High | ✓ | High |
| | Pay-per-outcome | ✓ | High | ✓ | High |
| | Subscriptions | ✓ | Medium | ✓ | Medium |
| | Licensing | ✓ | Medium | ✓ | Medium |
| **Key Resources** | Intellectual capital | ✓ | Medium | ✗ | – |
| | Financial capital | ✓ | Medium | ✓ | Medium |
| **Key Activities** | Platform based | ✓ | Low | ✓ | Low |
| **Key Partnership** | Allianceses | ✓ | Medium | ✓ | High |
| | Buyer-supplier relationships | ✓ | Medium | ✓ | Medium |
| | Acquisition and Start-ups | ✓ | Medium | ✓ | High |
| **Cost Structure** | Value-based-pricing | ✓ | Medium | ✗ | – |
| | Variable costs | ✓ | Low | ✗ | – |

*Table 5.5: Analysis of the Business Model Canvas*

The visualization above shows that all nine building blocks were mentioned as transforming in theoretical or empirical findings, which imply that every part of the business model will be affected to some extent. The level of impact varies across different factors and building blocks. However, four blocks are distinguishing by representing a higher level of impact, namely Value Proposition, Customer Relationship, Revenue Streams, and Key Partnerships.

### 5.2.1 Customer Segments

The first building block, customer segments, is based a division of industry- and geographical segmentation according to both respondents and theory. The geographic segmentation is

considered to have a higher impact on the business model compared the industrial segmentation. The theory explains IIoT to be prospering in several sectors, healthcare, automotive and airline to mention a few, even though this research focusing the manufacturing industry. A division by sector is also described by the respondents, adding that industries under pressure such as the automotive industry are anticipated to be fast in adoption. Contradictory, more conservative industries will be most slow in adoption. The sectors where the potential of automation is largest will consequently be more suitable for IIoT, as a reduction in wages is highlighted as one of the most favorable outcomes according to the theoretical findings. The theory thereby suggests that the automation potential is negatively correlated with wage and skill level. (McKinsey, 2017b)

Both respondents and theory suggest a market segmentation based geographical location, which corresponds to aforementioned segments based the fact that wage levels differentiate across the world. The theory explains different reasons why specific nations stand out as prospering, which indicate that it is still too early to determine where the development of IIoT will be most successful. The respondents are mentioning Japan, Germany, and the U.S to be the leading countries in developing IIoT solutions, while theory argues that same nations must increase their effectiveness to stay competitive. Thereby it is arguable to say that these countries also have an extensive domestic market to serve. Besides, since national incentives previously have proven vital for the development of IIoT, it comes naturally that the same countries are developing solutions in a rapid pace. Moreover, China is noticed as an upcoming nation by both theoretical- and empirical findings, which signify their position as a prospering nation in the future. The countries that are leading the transformation according to Banafa (2017b) based its national absorptive capacity are not mentioned by the respondents. Either, the countries have not been successful in positioning themselves as leaders, or, it is too early to recognize the outcome of their efforts. To conclude, market segmentation is difficult to predict, and we are likely to see significant changes on the market within the nearest future. Different providers will probably focus different customers, and whether their focus is based geographical location or industry is difficult to determine at this stage of development.

### 5.2.2 Value Propositions

The second building block, value proposition, constitutes the most determining factor for a company´s competitive edge. The theory claims that the disruptiveness of IIoT unlocks new value potential for customers where platforms connecting products and enhance value through the product life cycle. (McKinsey, 2015; Bezerra Barquet et al., 2013) According to both empirical and theoretical findings are performance, mass-customization, cost reduction, time-to-market, and improved quality factors of impact. The improvement of IIoT technologies will speed up the development process and drive increased customer value. In future, the value proposition will be the real outcome which is apparent from aforementioned undergoing change towards the outcome-economy. New technological innovations make it possible to monitor a product or service beyond its traditional selling point; after-market is consequently becoming core. In general terms, the level of impact concerning value propositions is stronger according to the respondents. To conclude, the alignment of theoretical and empirical findings in addition to the overall high level of impact implies that the value proposition will be one of

the most important elements to adapt in future. The value proposition will empower providers to sustain and develop their competitive edge.

### 5.3.3 Distribution Channels

The third building block is close related a business's value proposition and form a company's interface. From a theoretical standpoint was three factors of impact recognized, customized services, complete solutions, and the practice of block chains. Factors within channels are analyzed to be of low to medium impact, indicating that this building block is of less importance compared other business model elements. The IIoT will, according to theory and respondents, provide a complete solution for the customers that make the future transactions subject of long-going permanent relationships. The level of customized solutions offered by the providers is thereby correlated with required transformation of the business model. Moreover, the requirements of channels will increase when standardized products are becoming customized services. A steep development in digitalization will be an important driver for this change. Digital innovations are truly valuable in the era of an outcome-driven economies, as data generates new opportunities to capture value and thereby an increased competitiveness.

### 5.2.4 Customer Relationships

The fourth building block, customer relationships, reflects the relationship between providers of IIoT technologies and their customers. Both empirical and theoretical findings are emphasizing retention of customers and automated customization as important factors with high levels of impact. The focus in future will, as previously discussed, be permanent, customized relationships where industrial consumerism and quality of service are top criteria. New business models enable value capturing at higher levels than before, and the respondents emphasize retention of relationships as creating unique opportunities. Moreover, customer relationships are considered to be one of the most important blocks as today's access and evaluation of data make it possible to enrich relationships. Nowadays is the creation of a product or service far more than the independent manufacturing process; a continuous data-feedback-loop creates new opportunities for an automatized customization. The transformation towards shared relationships is already up-and-running, and the level of impact is high. The big market players are constantly trying to figure out how to transform themselves in a favorable way. Respondents are underlining that companies must move closer their customers to stay competitive, an enhanced customer relationship is desired. An intensified competition is expected, as relationships already are becoming more long lasting. Customer relationships and its interactions are more valuable than ever before.

### 5.2.5 Revenue Streams

The fifth building block constitutes revenue streams and is distinguished by its high likeliness to change according to both theoretical and empirical findings. New payment models such as pay-per-use, pay-per-outcome, subscriptions, and licensing are considered influential by both parties. Both respondents and theory agree upon that pay-per-usage and pay-per-outcome will

have the highest impact, followed by subscriptions and licensing that bring medium impact on the business model.

The transformation of the industrial sector implied by IIoT imposes a change in the relationship between providers and customers. Explained by both literature and the respondents is the shift in accounting from Capex to Opex, meaning that previous single-sales are replaced by long-term relationships. The reason behind this change is the digitalization of the industry that brings new opportunities and payment models. Revenues will be based the availability of the product/service, how often it is in use, and the outcome of the usage, a change that brings particularly two consequences. The customers will only be willing to buy a company´s product/service again if they are satisfied with the result, giving customer relationships increased attention. In addition to this, new payment models as subscriptions, licensing, pay-per-use, and pay-per-outcome will transform businesses. The future revenue streams might be disadvantageous for the providers of IIoT since they are required to have capital covering all initial investments to create offerings, while the payment from manufacturing firms will be reimbursed during a long time-horizon. This transformation in revenue streams will be specifically harmful to smaller providers who do not posses the required capital to make big investments. Correspondingly, smaller manufacturing firms are likely to gain advantages from these new payment models, as both theoretical and empirical findings emphasized that adapting to IIoT might be too costly for them to accomplish. New payment models will enable an affordable adoption that gives smaller manufacturing firms with competitive advantages. Further, the incumbent providers will, if they possess the required financial strength, be able to outrace their competitors and especially smaller start-ups that do not have the necessary capital. Thereby, few incumbent players might be dominating the providers´ market in future. However, this transformation is still a few years away, but the development of IIoT implies that the change in revenue streams is enormous and complex.

### 5.2.6 Key Resources

The sixth building block, key resources, is in many ways a business´ most valuable asset, comprising the sources behind a specific value offering. From a theoretical perspective are primarily intellectual- and financial capital considered, where both are expected to have a medium impact. The respondents are only mentioning the financial aspect which also is argued to be of medium impact. Bezerra Barquet et al., (2013) discusses that new competencies to deal with customers must be developed, which also correspond previous findings. The respondents´ lack of awareness concerning intellectual capital might be explained by their titles, implying that most of them are positioned at a distance from their customers. In extension, the aforementioned organizational resistance to change might relate the nature of workers positions´. Financial capital is considered important according to the respondents, which is confirmed by Bezerra Barquet et al., (2013) explaining a need to cover up for the change in cash flows caused by the change in revenue streams. Moreover, in an initial phase of IIoT development will financial resources give providers an advantage to develop their offerings and invest in new technological solutions.

### 5.2.7 Key Activities

The seventh building block constitutes key activities, where a small change is noticed in theoretical and empirical findings. Only one factor is mentioned, an increased focus on platforms. Industrial production has historically dominated manufacturing, which in future will transform to new platform based activities. Providers will be able to monitor customer performance through connected technologies and networks. Platforms will be established as the new enabler and thereby causing a dependency between the provider and its customers. It is arguable to believe that key activities might play an increasingly important role in future as more devices and platforms are becoming connected every day.

### 5.2.8 Key Partnerships

The eighth building block, key partnerships constitute the network of suppliers and partners. Both theoretical- and empirical findings underline three factors as explicit influential, alliances, buyer-supplier relationships, and acquisitions. All factors are argued to be of medium or high impact where the respondents stress alliances and acquisitions as roughly more important than other factors. Key partnerships is considered one of the most important elements for IIoT providers since one company itself will not be able to satisfy an increased complexity of offerings. Partnerships between both private, public-private and public partnerships are established with the common goal of one connected industry. (Beecham Research, 2015) An increase of public partnerships is evident when discussing political initiatives, both national- and international initiatives are considered highly important for the development of IIoT.

Respondents emphasize acquisitions and partnerships with start-ups as increasingly important, which Bezerra Barquet et al., (2013) confirm by explaining the importance of identifying which actors and competencies that bring most value. The respondents argue that acquisition of start-ups can be especially beneficial when developing specific products or services. Today are alliances formed across industries, and the respondents explain that software- and hardware providers are co-creating technological foundations. The development of partnerships has thereby gone further than theory suggest, which also is indicated by the expansion and constant progress in this area. It is arguable to say that partnerships overall are becoming gradually important and might constitute the difference between success and failure in future.

### 5.2.9 Cost Structure

The ninth block, cost structure, clarifies a business most central expenses. From a theoretical view is a change towards value-based-pricing and variable costs the most important factors to consider. However, none of the respondents believe that cost structure will change. Pricing and cost structure are challenges for a provider’s success according to theory, not at least reflecting the transformation of revenue streams implied by new payment models. The provider must carry costs involved in maintenance and upgrading of hardware and software, which might be challenging when the pay-back period is becoming longer. Providers´ cost structure must support the new demand of cash-flows. The fact that respondents exclude this

element might indicate two things. Either, the cost is not a problem for the providers and therefore not subject to change, or, the transformation has not reached a level where the cost structure is affected yet.

In below figure are the most transforming building blocks within the Business Model Canvas and hence providers' business model framed and visualized. Concerned blocks are value proposition, customer relationships, revenue streams, and key partnerships.

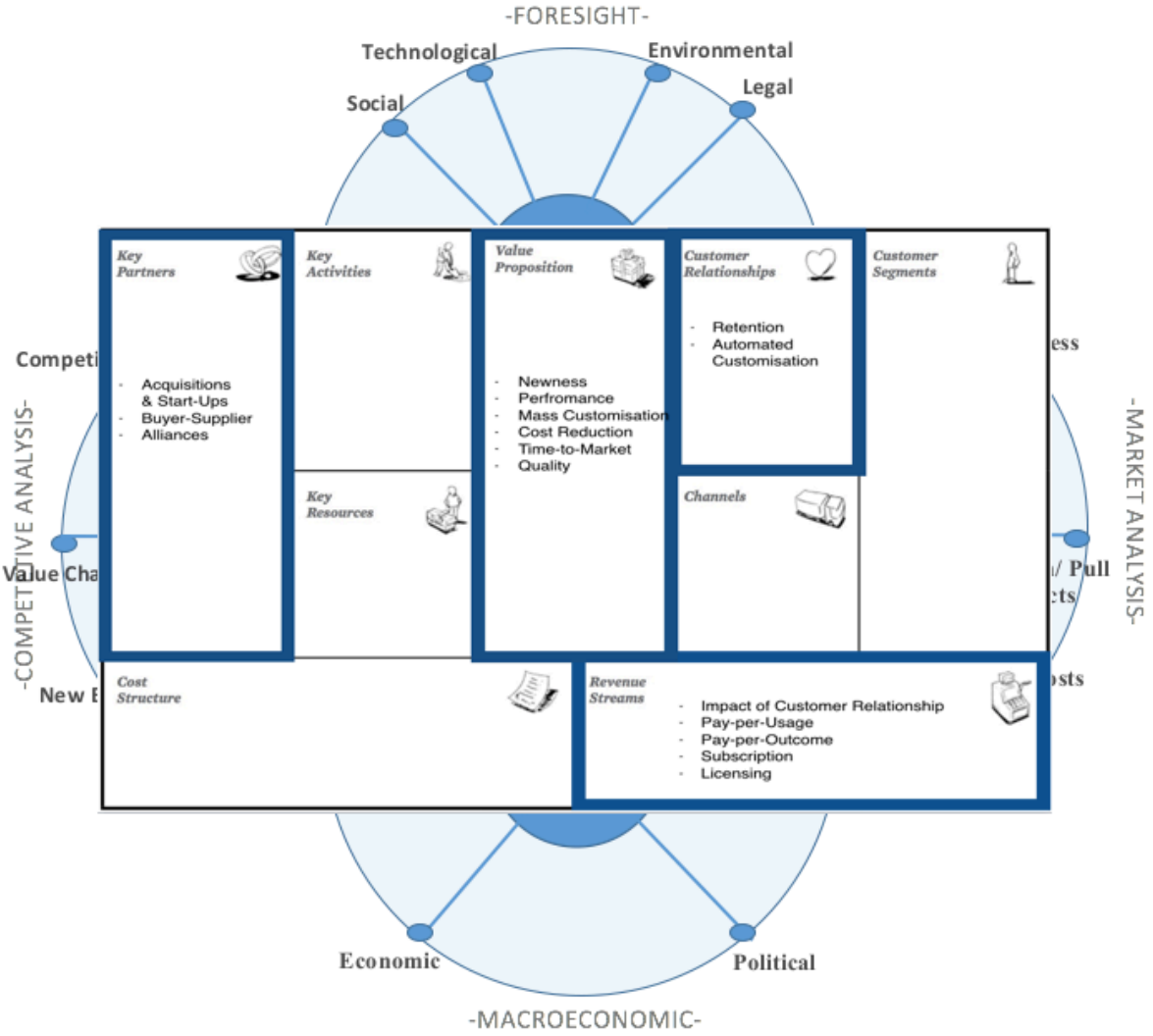


*Figure 5.2: Summary of Analysis Visualizing Transformation of Business Model Canvas*

# 6. CONCLUSION

*The aim of this chapter is to answer our research questions by summarizing and discussing the outcome of this report. Moreover, our conclusion ends with suggestions for future research.*

## 6.1 ANSWERING OF RESEARCH QUESTIONS

This thesis investigates the development of the Industrial Internet of Things, and what impact it imposes on providers' business models. Previous research is scarce within the area, and from the literature review it became evident that further investigation was needed to recognize the fully potential. This research has therefore been truly exploratory in its design in order to broaden the literature and especially focusing the business implications of the IIoT. First follows the research question, divided into two sub-questions to enable a deeper analysis, followed by the conclusions presented in separate sections.

***HOW WILL THE DEVELOPMENT OF IIOT AFFECT PROVIDERS´ BUSINESS MODELS?***

In order to answer our research question, the Business Model Environment framework was used to structure the analysis of theoretical- and empirical findings. The model provides two different perspectives; the external environment and the Business Model Canvas. Our research has consequently been conducted through an outside-in approach, starting by analyzing what external forces that affects the development of IIoT, followed by an investigation of what elements of the business models that will transform when providers' are entering the IIoT market. In total have 20 interviews been conducted with providers and experts of the field. The results from these interviews have been analyzed and compared to the theoretical findings.

### 6.1.1 External Forces Affecting the Development of IIoT

Our analysis of the external environment stressed three specific forces that will have a high impact on the future development of IIoT, namely; Legal, Market Attractiveness and Switching Costs.

The *legal* aspect constitutes problems with data security which require solutions before widespread advances of the IIoT are seen. Data is today playing an increasingly important role in the manufacturing sector, a fact that is prospered to intensify in coming years. Providing comprehensive protection of data is thus fundamental to capture a competitive market position in the long run. Secondly, *market attractiveness* is critical due to the novelty of the IIoT and determined firmly by the market size and growth rate. Even though exact numbers are missing, it can be concluded from both interviews and the Hannover Messe that the market is accelerating in both size and speed of development. The IIoT market is thereby an extremely attractive opportunity for providers. Finally, the lack of common technological standards is emphasized as the most important factor of *switching costs* and concluded to

determine the development of IIoT. Standards constitute the basis for connecting devices and consequently providing the foundation for future growth. Today are standards developed separately by international actors and governments, implying that none have been successful in winning market acceptance yet.

In addition to above aspects are *economic*- and *political forces* considered influential emphasizing the governmental interest in IIoT. Several nations recognize IIoT as a possibility of boosting local production and spurring the domestic economy as a result of the anticipated positive impacts on GDP. National- and international initiatives are consequently seen worldwide contributing to the growth of IIoT. In contrast, differences in national regulations and laws are hindering development, adding reason to believe that economic- and political factors´ importance will increase in future.

### 6.1.2 Elements of Providers´ Business Models that will become Transformed

Providers´ business models were focused when analyzing the core of used framework. Although many building blocks were under discussion in the analysis are some elements expected to transform remarkably within a few years. Most highlighted, and hence the blocks of providers' business models that will undergo the strongest transformation are Value Propositions, Customer Relationships, Revenue Streams, and Key Partnerships.

Initially, the *value proposition* is truly important for companies to be able to capture and retain customers. Tomorrow's value concerns the real outcome; companies are facing a change towards the outcome-economy. New technologies enable managing of offerings beyond its traditional selling point, making the after-market fundamental. Next, *customer relationships* will grow increasingly important as IIoT technologies cause relationships turning permanent and automatically customized at higher levels then earlier. Nowadays is the creation of offerings served by data-feedback-loops that generate new opportunities. The third block undergoing significant transformation in coming years is *revenue streams*. Pay-per-usage and pay-per-outcome will, followed by subscriptions and licensing, cause a high impact on future payment models. Providers of IIoT are required to possess capital as covering all initial investments, while the reimbursement of manufacturers payment period is extended. Consequently, smaller providers without adequate capital will suffer. A few capital-intensive providers is prospered to dominate the IIoT-market in future; start-ups lacking required financial resources will face difficulties of surviving. Finally, *key partnership* is likely to change in forthcoming years as new alliances are established across industry borders and acquisitions of start-ups are becoming increasingly valuable. A company itself will not be able to satisfy the demands resulting from an increased product complexity.

To conclude, the Business Model Environment will transform in several aspects. The legal factors, market attractiveness, and switching costs, followed by economic- and political forces will be the most significant in determining the development of IIoT. All elements in providers' business models will to some extent be concerned. However, the largest transformation is expected in value proposition, customer relationships, revenue streams and

key partnerships. The Business Model Environment is visualized in figure 6.1, highlighting the affect from the development of IIoT on providers´ business models.

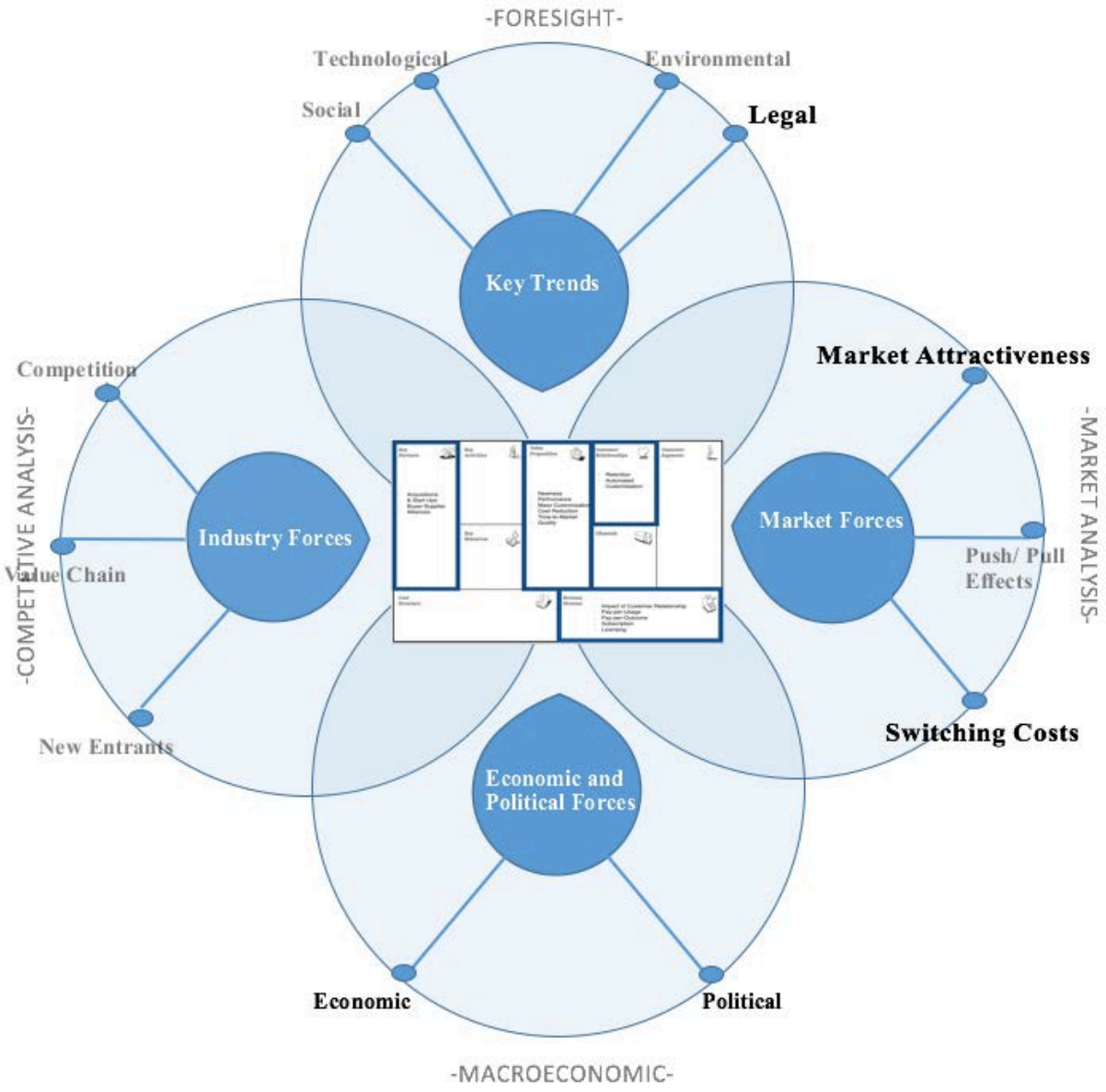


*Figure 6.1: Impact of the Business Model Environment on Providers´ Business Models.*

## 6.2 FUTURE RESEARCH

First of all, IIoT is by its nature a technological oriented area of research, making a business perspective rewarding since previous investigations foremost concern technical aspects. The aim of this thesis was to create a general picture on a strategic level through an explorative research, leaving deeper investigations of specific areas outside the scope.

Case studies focusing the correspondence between external forces and internal capabilities to compare and concretize our findings at a deeper level would be interesting future research. The study may, for example, compare resources within a company with the external forces this study concluded as most influential, e.g. how a company and its value offerings manage the future impact of legal aspects.

Further suggestion is to expand our conclusions of changes in the business models of IIoT. The most interesting element is in our opinion revenue streams, which will transform considerable in coming years. A deeper, more detailed study focusing to conclude how, and during what circumstances providers' revenue streams will change would therefore be suitable to prepare providers for the upcoming transformation

The last suggestion of future research refers the external environment and contradictory opinions between theoretical- and empirical findings. Industry forces are overall argued to comprise a medium impact, constituting Competition, Value Chain Actors, and New Entrants. However, the theory excludes some factors. It would therefore be interesting to study why factors of industry forces, such as company´s origin, access to data, increased transparency, and alliances, are conflicting between theory and respondents. Not at least since the competitive landscape probably will change at the same rapid pace as the IIoT is developing.

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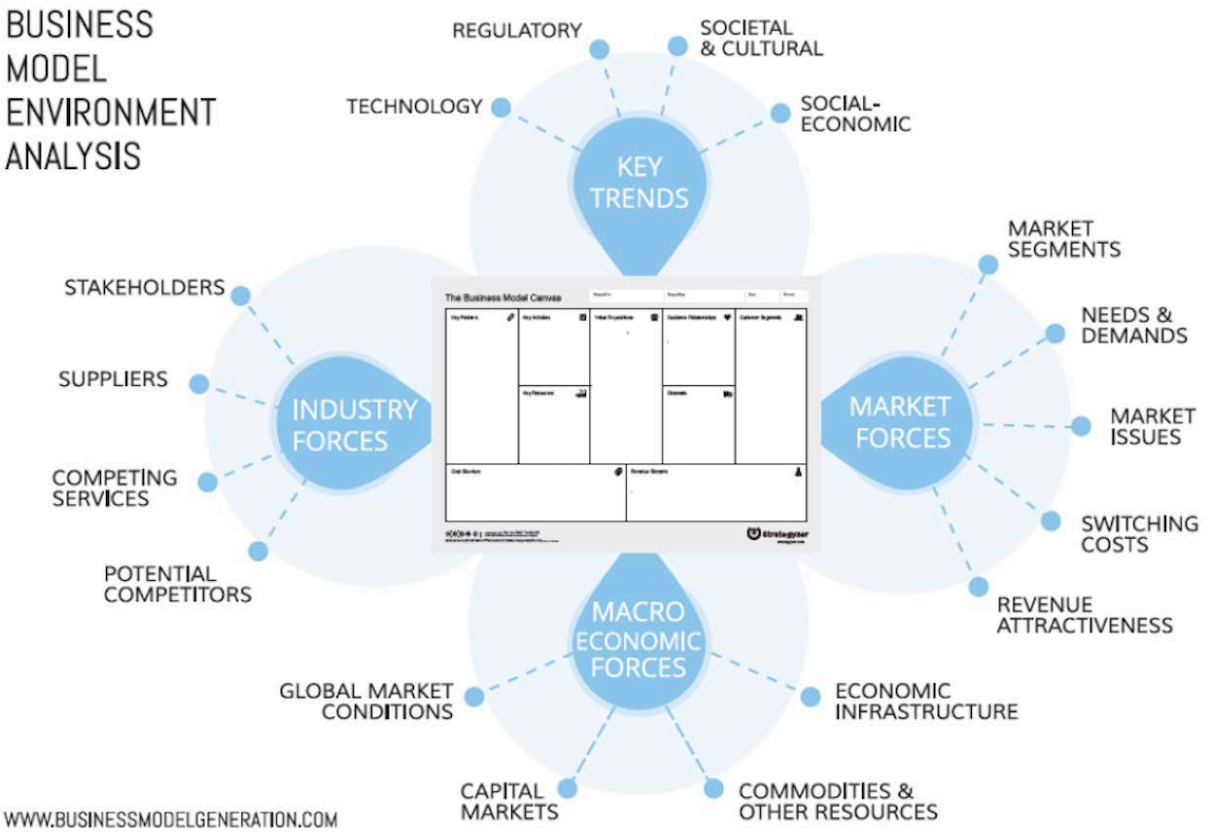
# 8. APPENDIX

## APPENDIX A: BUSINESS MODEL ENVIRONMENT ANALYSIS




*Osterwalder, Pigneur and Clark (2010)*

## APPENDIX B: CONTACTING RESPONDENTS

The message below was sent to the selected group of possible interviewees, and to the individuals as not respond, an additional follow up email were sent. Discussions of practicalities such as time and place of interview were further discussed through mail.

*Dear xxx,*

*We are two ambitious master students pursuing our final year at MSc Innovation and Industrial Management at School of Business, Economic, and Law at the University of Gothenburg. Right now, we are writing our master thesis within the topic of Industrial Internet of Things (IIoT), also known as Smart factories and Industry 4.0. Our objective is to analyzing the advancement of IIoT and its impact on providers' business models. Moreover, we seek to investigate which external factors that will be the most influential in determining the advancement of IIoT, and additionally analyze what elements of providers' business models that will be affected.*

*By that reason, we are trying to get in touch with persons like you, individuals that have knowledge and insights within the area. We would be very grateful if you would take your time to contribute with an interview over Skype/ Phone/ Face-to-face. We are very flexible when it comes to date and time - and of course, there is no problem to be anonym in the report. However, it would be valuable for us to run this interview in March, this due to time restrictions from the University.*

*Please, if you know someone that might be valuable to talk with, we would appreciate if you can provide us with contacts. Our wish is, aside from writing a thesis, to reflect the real market and industry out there.*

*Thanks in advance!*

*Kind regards,*

*Moa Gustafsson & Julia Franke*

*MSc in Innovation and Industrial Management*

## APPENDIX C: INTERVIEW GUIDE

This section of the appendix shows how our interview questions were phrased. The guideline presented below was sent to the interviews before the interview in the same format. The questions were not followed strictly, rather served as a guide and was adjusted to the interviewees, their role and the situation. Below visualization of the Business Model Environment Tool was additionally showed during all interviews to facilitate the discussion.

**Interview Guide**

- Background
- Name, position, years and role in company.
- What are you doing in relation to IIoT?
- How do you define the Industrial Internet of Things?
- What does IIoT mean for you / your company?

**External impact**
*Key Trends: What Key Trends affect the development of IIoT?*

- Societal
- Technological
- Environmental
- Legal

*Market Forces: What Market Forces affect the development of IIoT?*

- Market attractiveness
- Push- and Pull Effects
- Switching costs

*Economic and Political Forces: What economic and political forces affect the development of IIoT?*

- Economic
- Political

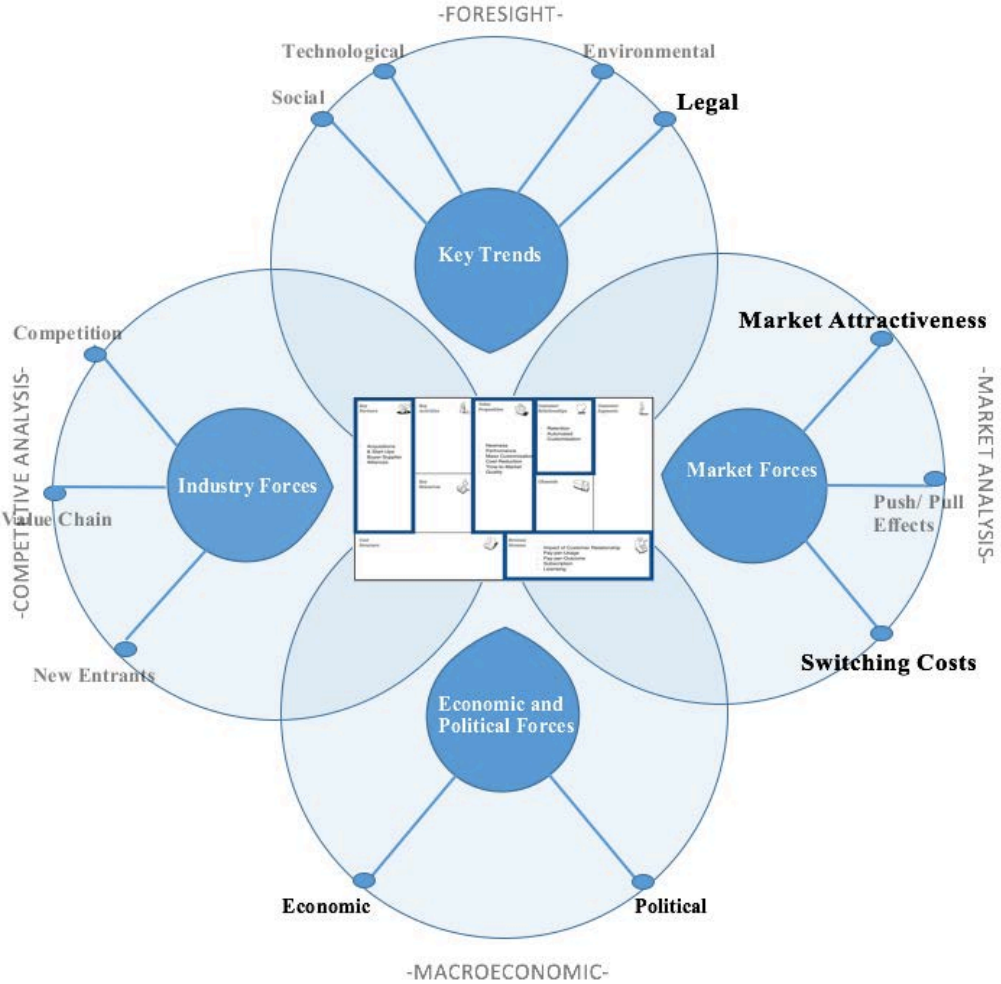
*Industry Forces: What Industry Forces affect the development of IIoT?*

- Competition
- Value Chain Actors
- New Entrants

**Business Model Canvas**

*What elements of providers' business models will be transformed by IIoT?*

- Customer Segments
- Value Proposition
- Distribution Channels
- Customer Relationship
- Revenue Streams
- Key Resources
- Key Partnership
- Cost Structure



**Empirical Data: Key Trends (1)**

| Questions / Respondents | Social | Technological | Environmental | Legal |
|---|---|---|---|---|
| **(01) Siemens, Product Manager, Automation** | **Reduction and creation of jobs. Organizational mindset and corporate culture.** | **Simluatios are key. Clouds and sensors. Digital twin. Smart Data.** | **Efficiency, reduced waste. Reduced energi consumption.** | **Requirements of traceability, IT-security.** |
| (02) Intel Corporation, Strategy and Business Development | Not much societal factors. The automation- and loss of jobs is influential. | Cloud Infrastructure, interoperability, IoT is a clear concept, but application in each industry is different. | Not very important for manufacturing. | Workers conditions. |
| **(03) General Mills, Product Development** | **Jobs reduction.** | **Cloud computing, Big Data.** | **Advanced efficiencies and reduced wasted. Goodwill perspective.** | **IP protection, Data Security. Needs to solve the security problem.** |
| (04) San Jose State University, Faculty & Academic Advisor | Loss of jobs. Cultural resistance to change. Decentralized decision-making. | Artificial Intelligence, Big Data, IoT etc. | Customers demanding sustainable solutions and govermental subsidizing eco-initiatives to increase demand. | IPR and knowledge capturing. Security, privacy, Insurances, |
| **(05) Gilead Sciences, Industry Business Solutions** | **Workforce changes. Resistance to change. Might create new social mode, working 25-30 hours per week and the robots do the rest.** | **Machine Learning. 3D-printing might be important.** | **Positive environmental impact.** | **Security is the biggest issue. Classification of information becomes key.** |
| (06) Cisco Systems, Product Manager within IIoT | Social benefits that are not part of the ecnomis value chain will not be considerd since its not part of business and money. | Mix of new technologies and future technologies. Cloud, Analytics, AI. | The industry will be developed into an interesting sustainable employer. | New regulations are difficult to predict and might have huge impact, making the development unstabile. |
| **(07) RISE, Product Manager within IIoT** | **Resistance to change among employees.** | **Big Data, Connectivity and Digital infrastructues will enable this.** | **Optimization and waste reduction. Backsourcing is important to reduce transports.** | **Regulations of Personal Data will impact, importance with data storage of personal data. GDPR. IP rights, Patents, and IT-security.** |
| (08) Chalmers University, Professor & Chair of Product Systems | The jobs will not disappear, but the tasks will. 100% of the tasks will disappear in 5% of the jobs. 30% of the tasks will disappear in 60% of the jobs. | The ability to collect data, use it in CPS and integrate all components, 3D-printing in a long range. | Circular economy will be important. | Europe is very limited by regulations. Need to overwin 28 laws for cooperation over national boundaries. |
| **(09) Cybercom, Head of Connected Engineering** | **Impact on work tasks. Reduce boundaries between whitecollar and bluecollar, only decision-making or requirements will be required in future.** | **Visualization and quality assurance will be most important. Industrial companies are discussing it, but technology is no ready yet.** | **IIoT is elementary for our environment and society. The division of resources is not equal, and this is a step on the journey forward.** | **Society is not prepared for digitlization with current laws around privacy, integrity, DGPR, Ethicals, ownership of data etc.** |
| (10) KUKA, Director of Product Marketing | Peoples fear of losing their jobs. Not a big problem since jobs always are changing, but might create organizational resistance. | Important aspect. Improvement of autonomous technologies, human in collaboration with hardwares as robotics. | Positive impact. Increased efficiency, reduced waste of materials and transports. | Data ownership and regulation concerning sharing/ownership of data will be important. Integrity aspect. |

**Empirical Data: Key Trends (2)**

| Questions / Respondents | Social | Technological | Environmental | Legal |
|---|---|---|---|---|
| **(11) Roland Berger, Senior Partner** | **Social factors will not affect the development. The workers will not have a choice, they must adopt.** | **The technologies will not be a problem, but might create difficulties when they are combined.** | **Eliminating waste.** | **Data and willingess of sharing data is a big problem. Requires outstanding customer relationship. All connected devices will be a security-risk.** |
| (12) IBM, Engineer in Cloud technologies | Organizations will need to change and low-skilled jobs disappear. Companies will face an resistance to change. Data integrity issues will probably vary in | Openness of software and systems, "open-sources". | Policies makes it difficult to make decisions against sustainsability goals, making goverment an important aspect. | Privacy and security problems to collect and use the data. The government will not be able to keep-ip, the technology is already existing. |
| **(13) David Sidhu & Associates, Managing Partner** | **Jobs will change and disappear, affecting employees. Retraining. Labor force is decreasing, IIoT will be part of the solution for that.** | **Nothing will reamin status quo, everything will change and different areas will affect eachother. Billions of connected devices by 2020.** | **Positive environmental impact, the clean-tech movement is part of this. In U.S, the initiatives differs between states.** | **IT-security need to be solved. Laws will be important to regulate data-transfer and security aspect. Security regulations will increase.** |
| (14) ÅF, Consultant New Business Solutions | Developing from selling products to services will create resistance from the organization. Resistance to change organizationally. | IoT, 5G. Customer demands products that they are able to integrate with eachother. 3D printing will rise. | Digitalization increases transparency and enables traceability of producs and processes. Increases pressure on companies. | Data security and automized decision making is two important aspect. Data ownership, integrity and regulation as GDPR. |
| **(15) Innovationszentrum Industire 4.0, IIoT Practice** | **Loss of jobs, mostly qualified jobs. New jobs will come, but less people will be required at the bottom line.** | **New forms of robotics, autonomous systems, artificial intelligence, decentralized decision-making based on cloud computing.** | **Digitalization is driver to improve sustainability and reduce waste, and resource consumption.** | **Ownership and responsibility of data. New type of contracts will be created.** |
| (16) McKinsey, Consultant IIoT | The labor force in important and also why this appears. High investments and organizational resistance to change. | | | Legalislation is lagging behind development. |
| **(17) Industrial Internet Consortium and OMG, Chairman and CEO** | **Change and reduction of jobs. Demographics gap. Polarization, where complex and low paying jobs increases, but standard jobs disappear.** | **Security is not a problem. Companies will shift products even if the security issue is not solved, so that will not be a hinder for adoption.** | | **The regional support for the technology is already in place. The regional regulations are starting to develop, most in Europe.** |
| (18) Microsoft Corporation, IIoT Offering | The ethical impact. When robots are taking over jobs, what will be the purpose for humans? Organizational resistance to change. | The fear might hinder adoption, but the technology will not be a hinder. | Real time information will reduce waste an increase efficieny. | Security problem and hackers will increase. |
| **(19) Bosch, Strategy, New Business Innovation** | **Change management problem where people need to see the value. Change must be business driven.** | | | **Biggest challenges is cyber security and cloud security. Industries are not ready for connected devices, not internet enabled. Only 5% of the** |
| (20) Accenture, Consultant IoT | Organizational culture and mindset is the main barrier. | | Huge potential. | IT-security. |

| Empirical Data: Economic- and Political Forces (1) | | |
|---|---|---|
| **Questions / Respondents** | **Economic** | **Political** |
| **(01) Siemens, Product Manager, Automation** | | **Supporting an increase in population size. Bringing jobs back is priority, causing increase in prices.** |
| (02) Intel Corporation, Strategy and Business Development | IIoT technologies help people to be more efficient, save money, and create and capture a lot of value. | Governments are positive since they want their countries to be competitive and being at the forefront of technology. |
| **(03) General Mills, Product Development** | **High cost labor market. Value trade-off.** | **Political buzz and not a driving force.** |
| (04) San Jose State University, Faculty & Academic Advisor | Macro-politic will influence and drive development. | Governmental factors influence trade agreements.Government and non-profit organizations are stakeholders. |
| **(05) Gilead Sciences, Industry Business Solutions** | | **Concern about jobs, privicies etc. and tech companies are trying to work through this through the government.** |
| (06) Cisco Systems, Product Manager within IIoT | | Positive and negative impact on development. Regulation will affect businesses and what will be most beneficial at bottom line. |
| **(07) RISE, Product Manager within IIoT** | | **Competition against low-wage countries is impossible in the end, wages will rise and quality, communication and environment is suffering.** |
| (08) Chalmers University, Professor & Chair of Product Systems | New taxes on imports and exports might have huge impact. | Governmental initiatives globally will affect. Holland, India, China etc. have their own. |
| **(09) Cybercom, Head of Connected Engineering** | **Greates impact of IIoT will be where it can deliver highest ROI.** | **National focused politics are dominating, a willingess and value of cooperation is required.** |
| (10) KUKA, Director of Product Marketing | IIoT requires high investments. | Politics will be a very important aspect. US politics will influence and is difficult to predict. |

**Empirical Data: Economic- and Political Forces (2)**

| Questions / Respondents | Economic | Political |
|---|---|---|
| (11) Roland Berger, Senior Partner | Investment is not a problem, and investment subsidies are never a good thing. | Trend of nationalism today, making us less open for new ideas. |
| (12) IBM, Engineer in Cloud technologies | Companies should start small and scale up. The investment cost for full scale production is high, but using services are relative cheap. | International collaboration and open standards are the way to go. |
| (13) David Sidhu & Associates, Managing Partner | This development is similar to IT 90s, which changed the way American companies operationalize technology. | National focused politics will hammer the development. Current politics in the US is hard to predict but an important factor. |
| (14) ÅF, Consultant New Business Solutions | The government could do more to subsidize and help the development of smart industries. | Protectionism is visable in many places. Open standads will be required. |
| (15) Innovationszentrum Industire 4.0, IIoT Practice | IoT is just the next big adoption for finding greater efficiency gains. | Political factors are an important aspect. |
| (16) McKinsey, Consultant IIoT | Cost of labor and prices are driving this change. Labor and profit will always be huge factors. | Development in pharmiceutical is for example highly affected by governmental regulations. |
| (17) Industrial Internet Consortium and OMG, Chairman and CEO | Main challenge for companies to adopt to the outcome economy. | Different countries have different initiatives to support it. China, Russia, Kazakhstan, Japan, India and many other places. |
| (18) Microsoft Corporation, IIoT Offering | The financial model is changing. | Most governments are actig and wich to support the Iiot development. |
| (19) Bosch, Strategy, New Business Innovation | Economic factors are in early stage. Suppoert from government and corporations are coming in a big wave. | Adoption speed differ between European countries, depending on which type of revenue that bring most money to the country. |
| (20) Accenture, Consultant IoT | Each nation need to spur a great climate for corporates. | Hindering regulations from a negative political mindset. |

**Empirical Data: Market Forces (1)**

| Questions / Respondents | Market Attractiveness | Push- and Pull effects | Switching Costs |
|---|---|---|---|
| **(01) Siemens, Product Manager, Automation** | **Big potential, improved quality, reduced maintenance.** | **Combination.** | **No centralized standard exist. The standard must be set by an organization. Currently eraly stage maturity.** |
| (02) Intel Corporation, Strategy and Business Development | Attractive market because of its size and development. IIoT is the next big thing and will transform the way we work and the way factories work. | Combination of push and pull. People recognize that this probably is the next big thing, but you have to prove it. | Once you are architectured in the solutions as one of the components in the solution, then noone wants to change. |
| **(03) General Mills, Product Development** | **The switching costs are fairly high, making it attractive.** | | **Lack of standards. Every IoT platform is trying to create their own standards, that is not going to change. Long term standards will determine.** |
| (04) San Jose State University, Faculty & Academic Advisor | Financial advantages must be proved. Early adopters might benefit more than first movers. | | Standards is a barrier. Non-profit org. Must set the standards and bring companies together. Adaption will come when benefits are proved. |
| **(05) Gilead Sciences, Industry Business Solutions** | **It is very attractive because of its size.** | **Combination of both. Too much focus on next disruptive technology instead of customer value creation.** | **Standards are required for pulling together different technologies. Least mode of integration will probably work best.** |
| (06) Cisco Systems, Product Manager within IIoT | High attractiveness. IIoT was a concept 5 years ago, now everyone wants to be there. Manufacturing companies are under pressure to increase their profits. | Combination of pull and push. Size of investment is big. | Europe is more driven by standards, U.S driven by companies. Governments, internet, economies will development standards togehter. |
| **(07) RISE, Product Manager within IIoT** | **The IT and OT industry differ in requirements, speed, and adoption.** | **Companies at forefront have pushed certain solutions.** | **The IT-industry lacks standards, OT have lots of them. This adoption is difficult, but the industry have much to gain in international standards.** |
| (08) Chalmers University, Professor & Chair of Product Systems | Increased flexibility, resource efficiency, profit, reduced waste and time to market are selling factors. KPIs are key. | Difficult if pull or push will drive. Pull is required for complete market penetration. | High costs for adapting to new technologies. The governments are waiting for private actors to create standard platforms and vice versa. |
| **(09) Cybercom, Head of Connected Engineering** | **Industrial companies are discussing it, but technology is no realy yet.** | **Difficult for companies to formulate long-term strategies because the world is transforming in a rapid pace.** | **Technological standards for integration, data ownership etc will determine the future.** |
| (10) KUKA, Director of Product Marketing | Manufacturing sector is under pressure to differentiate and increase effectiveness before someone races them out. This is a great opportunity! | Combination of push and pull. New technologies and connectivity is attractive at the market, but needs to be promoted. | Big players have resources to develop, but locked in old ways of thinking. Need both a data-driven and indsutry-driven perspective. IT or OT. |

**Empirical Data: Market Forces (2)**

| Questions / Respondents | Market Attractiveness | Push- and Pull effects | Switching Costs |
|---|---|---|---|
| **(11) Roland Berger, Senior Partner** | **The market is quite mature, but companies must make sure to align their business models.** | **A combination of both.** | **Low switching costs due to open sources and open systems. The developer of standards will earn huge first mover advantages. standards.** |
| (12) IBM, Engineer in Cloud technologies | The companies that are not mature for this change will disappear. | Companies want to use more data in their processes, design phase and testing. Desire to make simulations. More push than pull right now. | Standard will lowering the switching cost in general. Easier to change/form the whole business. Open standards are the way to go. |
| **(13) David Sidhu & Associates, Managing Partner** | **The money is not on the consumer application of IoT, it is on the corporate side. Large companies have great power.** | **Companies need to adopt to survive in todays competitive landscape. So pull is necessary as well as technology companies pushing.** | **The dominating standards will be set by early entrants, while first movers have done the mistakes. Lack of standards will not stop the IoT** |
| (14) ÅF, Consultant New Business Solutions | SMEs will have most difficulities to adapt. The big players will be first. | Push during recent years. Manufacturing companies are stepping up towards pull. | Several players are working on standards, but there will never be one dominating since no-one is waiting for it. |
| **(15) Innovationszentrum Industire 4.0, IIoT Practice** | **SMEs are not obviously attracted, too high investments vs. value creation.** | **Combination of push/pull, more push now. IIoT is used for marketing purpose to gain attractiveness and competetive advtange.** | **High investment costs. IIoT is an evolution rather than revolution, needs a step-by-step process. Standards will be market-driven, not from goverment.** |
| (16) McKinsey, Consultant IIoT | Automotive will probably one of the early ones just because they are under a lot of pressure. | Industries are pressed to optimize and increase efficiency. | There will not be a single standard for all markets all over the world, rather alignment with eachother and develop applications that work together. |
| **(17) Industrial Internet Consortium and OMG, Chairman and CEO** | **The focus have been on consumers, but the magins are in the industrial industry.** | | **Today´s standards is only low-level-technical of how to move data. The difficulzy is standardize information creation and analysing.** |
| (18) Microsoft Corporation, IIoT Offering | Automatization is required to survive in manufacturing industry today. | | Uncertainty of which layer a standard will be set. The winner will be one who captures scale ecnomies, not setting the standard. |
| **(19) Bosch, Strategy, New Business Innovation** | **Low market readiness. The factories are not ready. The business maturity is in an early stage.** | **More a demand form manufacturer. How to differentiate by adopting and getting the insight. It all comes down to cost of service and service of** | **High switching costs, but depends on industry. Many big players are working on standards. GE Digital, ThingsWork, Honeywell etc.** |
| (20) Accenture, Consultant IoT | Companies that dont adopt will disappear. Lack of clear numbers is limiting executives to make decisions | Combination of push and pull. Push from providers and pull from customers demanding a eduction in cost and leadtime, efficiences. | An issue of interoperability, not an issue of standards! Software development goes towards standards, open source and op stack. |

**Empirical Data: Industry Forces (1)**

| Questions / Respondents | Competition | Value Chain Actors | New Entrants |
|---|---|---|---|
| **(01) Siemens, Product Manager, Automation** | **Big players want to build products that system- and product-integrators can take to the factory and use architecture and products.** | | |
| (02) Intel Corporation, Strategy and Business Development | Players like Intel, GE and Cisco are able to pull the eco-system together and be the dominant players, giving them a competitive advantage. | Manufacturers will impose requirements on their suppliers in IT, connection and Technology. Ex. Virtual Twin. | This is the time to get in! Investment size requires provement of payoff. |
| **(03) General Mills, Product Development** | **Highly automated companies will drive the development. GE, SAP, Siemes, PLC.** | **Suppliers will develop technology and sell to manufacturers.** | **Technology companies, Google. Start-ups creating nische markets. "Doing what youre good at".** |
| (04) San Jose State University, Faculty & Academic Advisor | Speed of development and adoption differ between software and hardware. | Horizontal and vertical integration and the life-cycle perspective. | Start-ups, develop new innovations, good at improvements. |
| **(05) Gilead Sciences, Industry Business Solutions** | **There is a place for both big and small players. The small players need to be more nished, and the big players need to be very market segment oriented.** | **Access to data and bandwidth will be valueable assets.** | **Start-ups. Bigger companies slow to adoption.** |
| (06) Cisco Systems, Product Manager within IIoT | All big players will be competitors. Amazon, Microsoft, Cisco, Intel, GE. Someone must create the eco-system, which require huge investments. | Industrial value chain are more concentrated in Europe, few big players dominating. | Start-ups are coming into the market. |
| **(07) RISE, Product Manager within IIoT** | **The big players have much to gain and push development forward. Siemes, KUKA, Bosch etc.** | **The Value Chain will transform to Value Network. Increased transparency will create more evely distributed reveneus and value.** | |
| (08) Chalmers University, Professor & Chair of Product Systems | Competition between countries will vary depending on regulations and laws. Siemens, SAP, Dassault, Amazon are all possible players. | Connect supply chains is the future, where all companies, suppliers are connected with digital blueprints as prototypes. | Start-ups, venture hubs, and players changing business. Big players are depending on start-ups ability to innovate. |
| **(09) Cybercom, Head of Connected Engineering** | **Big players are taking the lead around standardizations and patents.** | **The entirly value chain is concerned, an understanding of systems and different parties is needed.** | **Startups will contribute with innovations, but are limited in resources.** |
| (10) KUKA, Director of Product Marketing | The big players will play an important role, and have the highest competetiveness. | Front of all, most value is generated close to the end consumer. | Startups and new alliances, but bigger companies will make acqusitions of these. This is not unique for IIoT. |

| Empirical Data: Industry Forces (2) | | | |
|---|---|---|---|
| **Questions / Respondents** | **Competition** | **Value Chain Actors** | **New Entrants** |
| **(11) Roland Berger, Senior Partner** | | **An understanding of the main actor, the holder of an eco-system etc. New functionallities changing an industri in the long run.** | |
| (12) IBM, Engineer in Cloud technologies | Depends on investment size and mindset, mindset of management, and organizational culture. | | Everything is becoming cloud-based, and mature playesr need to respond. This leaves room for start-ups or other players to join the market. |
| **(13) David Sidhu & Associates, Managing Partner** | **Development of IIoT will have different pace in different areas. Intel are well-positioned.** | **Large players are forcing the suppliers to play by their rules and adapt. Will eliminate the small suppliers from the market.** | **The big players will have great benefits of acquiring start-ups instead of developing new ideas in-house.** |
| (14) ÅF, Consultant New Business Solutions | Increased competition from Asia, China is catching up. The Swedish advantage of organizational culture, with low hierarcy. Creating | More value will be created in software, generating more value closer to the customer. | Advantages since they dont have old investments to take into account and bring fresh minds. Big players are diversifying into new markets. |
| **(15) Innovationszentrum Industire 4.0, IIoT Practice** | **Complex industries will be at forefront. Commodities industries will be much slower.** | | **Big players will move in to new industries, IT-companies moving to traditional industrie. New IT-companies, start-ups will also increase.** |
| (16) McKinsey, Consultant IIoT | | Automatically customized value chain is most developed. Increased transparency through the whole supply chain. | Start-ups will be part of this. |
| **(17) Industrial Internet Consortium and OMG, Chairman and CEO** | **China is seen as a major player, huge governmental support and IP-rights. German, India.** | **IIoT will impact the supply chain, the manufacture of goods, and the delivery of the finished goods to the end customer.** | **New entrants are there, but focus wrong on IoT platforms. The opportunity is at higher level, semantic descriptions in vertical market.** |
| (18) Microsoft Corporation, IIoT Offering | Every IoT platform is trying to create their own standards, that is not going to change. | | Startups solving the real problems in vertical markets will be successfull. |
| **(19) Bosch, Strategy, New Business Innovation** | **Siemes, GE, ABB etc. are teaming up the create a new digital economy. Speed and quality. Being fast and better than competitors.** | | **High investment costs. Smaller providers migh not afford to adapt which will eliminate these companies.** |
| (20) Accenture, Consultant IoT | Software copmanies will be dominating. Siemens, GE. Competion of data, the ones with most data will have best opportunitiy to develop its | | Start-ups are catalysators for growth of IoT. |

**Empirical Data: Business Model Canvas A (1)**

| Questions / Respondents | Customer Segments | Value Proposition | Distribution Channels | Customer Relationship |
|---|---|---|---|---|
| **(01) Siemens, Product Manager, Automation** | | **Improved quality, reduced maintenance. Operational Efficiency, automized functions customization, reduce leadtime and time to market.** | | |
| (02) Intel Corporation, Strategy and Business Development | Segmentation is key. Horizontal basis is not possible, must be focused specific applications for specific market segments. | Key driver. Companies like Intel, GE and other recognize that there are huge efficiencies and cost savings that can be realized. | The need is an end-to-end vertical solution with the right sensors and the right analytics that are distributed across solutions from the edge to the cloud. | Companies like Intel have to adapt, not only products but also how they work with customers and the products, adapting the business model. |
| **(03) General Mills, Product Development** | | **Value perspective is most important. Customized solutions. Operational efficiency, uptime, cost reduction. Decrease labor costs.** | | |
| (04) San Jose State University, Faculty & Academic Advisor | U.S: Consumer Focus. Europe: Macro focus. Manufacturing. | Financial benefits will determine. Time-to-market, profits, competitive advantage. | | Customer satisfaction will be key in future. |
| **(05) Gilead Sciences, Industry Business Solutions** | | **High quality of products that customers actually want. Increased effectiveness and a leverage of automatization. This is a great opportunity!** | | **IIoT brings potential of long-lasting relationships with ongoing updates or new function over time.** |
| (06) Cisco Systems, Product Manager within IIoT | Manufacturing, Utilities, Energy, Transportation, City-infrastructure. | Manufacturing companies are under pressure to increase their profits. Automation. Connected devices. | | |
| **(07) RISE, Product Manager within IIoT** | **Manufacturing industry demands reliable products. Medical industry might be able to produce completly customized products.** | **KPIs are key.** | **Channels is a close second of importance behind Value Proposition.** | **Increased amount of data requiring more trust of the manufacturer to use this data responsibly.** |
| (08) Chalmers University, Professor & Chair of Product Systems | Manufacturing and energy are the ones with most potential. Europe invest to develop IIoT. | Increased flexibility, resource efficiency, profit, reduced waste and time to market are selling factors. | | |
| **(09) Cybercom, Head of Connected Engineering** | **Players as IBM, Cisco is trying to dominate from a data driven perspective. OT meets IT.** | **Important, its easy to create a hype and forget about the value creation. A holistic picture is requried.** | | **Data-feedback-loop will change the customer realtionship.** |
| (10) KUKA, Director of Product Marketing | Cooperation between U.S and Europe will be difficult due to politics. | Customer value must be focus, but also an understanding of value offering. Manufacturing is under pressure to differentiate and increase effectiveness. | Most importantly, the channels will be changed. | More long-term focused. |

**Empirical Data: Business Model Canvas A (2)**

| Questions / Respondents | Customer Segments | Value Proposition | Distribution Channels | Customer Relationship |
|---|---|---|---|---|
| **(11) Roland Berger, Senior Partner** | **Comes down to maturness of products. Some industries are more mature; Aerospace and cars.** | **Important for companies to understand their position and value proposition, and whether IIoT fits in. Increase product prestande and competitiveness.** | **There is a huge impact on Channels.** | **Customer Relationships as companies are becoming closer to their customers.** |
| (12) IBM, Engineer in Cloud technologies | The industrial sector will be divided. Aero-space, Automotive, Electronics. Large-scale infrastructure as power station, railways building etc. | Differentiation and increased competetiveness. Consumers are demanding more customized and unique products. | | |
| **(13) David Sidhu & Associates, Managing Partner** | **IoT will be used where it can deliver ROI. Smart citys, aerospace, automotive. China is becoming a big player with patents and IP.** | **Affected to a large extent. Increased efficiency, reduced costs and provide transparency to the value chain. JIT manufacturing in real time.** | **Distribution channels will change.** | **How customer purchases the products and services will change, and thereby the relationship.** |
| (14) ÅF, Consultant New Business Solutions | Automotive industry, telecom and electronics will be the first moving industries. The big players will be first. | The value propositions are turning more to services. Increase competetiveness, cost reduction. | Increased transaperncy through the whole supply chain, enabled by digital communication-channels. | Customer segments might look the same, but the reach to the end user should not be underestimated. |
| **(15) Innovationszentrum Industire 4.0, IIoT Practice** | **Geographically: Japan, Germany, and U.S are the leading countries. Germany machinery/engineering. U.S is data-driven. Europe is industry-driven.** | **Cost reduction, increased effeiciency, time-to-market, quality, shorter development processes, new products and services.** | | **Relations are important.** |
| (16) McKinsey, Consultant IIoT | The U.S is bolder than other countries. China is coming and expermenting much. Industry division: Chemicals, mining, oil & gas. | Turning products into services. Individualisation in a late stage. All about fulfilling customers needs. The reduction of cost is the catalysator! | | |
| **(17) Industrial Internet Consortium and OMG, Chairman and CEO** | **Probably first in manufacturing, but more sectors will capture value of this after a while.** | **The outcome economy and opportunity to change the way products and platform are being sold through services.** | **IIoT will impact the supply chain, the manufacturing of goods, and the delivery of the finished goods to the end customer.** | **Customer Relationship will increase in importance.** |
| (18) Microsoft Corporation, IIoT Offering | Conservative industries will lag behind. Automotive will probably one of the early ones just because they are under a lot of pressure. | People are buying the outcome rather than the machines. | | |
| **(19) Bosch, Strategy, New Business Innovation** | **Divided in: Consumer vs. Industry, Process vs. Discrete. Heavy equipment vs. Capital Intensive.** | **Value proposition will change. Ability to adapt and foremost, ability to improve profits will be key for attractiveness.** | | **New customer relationships and retention of customers requires new dynamics.** |
| (20) Accenture, Consultant IoT | IoT and Smart homes in U.S Comcast becomes a gateway to peoples homes. Europe more manufacturing focused. | Important aspect. | Distribution chains and blockchains will increase in importance. | Companies will look at customers in new applications and industries. |

**Empirical Data: Business Model Canvas B (1)**

| Questions / Respondents | Revenue Streams | Key Resources | Key Activities | Key Partnerships | Cost Structure |
|---|---|---|---|---|---|
| **(01) Siemens, Product Manager, Automation** | | | | | – |
| (02) Intel Corporation, Strategy and Business Development | Smarter factories enable Opex instead of Capex. (IIoT solutions as a service instead of an up-front capital expenditure). | | | Key partners is the most likely to change since it is very difficult to create an IIoT solutions without key partners. | – |
| **(03) General Mills, Product Development** | | | | | – |
| (04) San Jose State University, Faculty & Academic Advisor | | | | | – |
| **(05) Gilead Sciences, Industry Business Solutions** | | | | | – |
| (06) Cisco Systems, Product Manager within IIoT | It will be a lot more service-sales. The most obvious example is jet-engines. | Financial capital will be increasingly important. | Shifts to platforms will impact a business´ activities. | Supply Chain re-engineering manufacturing processes in eco-systems of suppliers and partners. | – |
| **(07) RISE, Product Manager within IIoT** | | | | **IT and OT must be aligned. The industry must understand IT and concersely. Hybridcompetence.** | – |
| (08) Chalmers University, Professor & Chair of Product Systems | Revenue streams and payment methods will change. | | | | – |
| **(09) Cybercom, Head of Connected Engineering** | **World is moving to selling SaaS; already moved to platform as service and will move to infrastructure as service.** | | **Platforms are becoming increasingly important.** | **Companies need to collaborate to build solutions of software and hardware. Difficulcy to distribute revenues.** | – |
| (10) KUKA, Director of Product Marketing | Possible subscriptions. People are more willing to pay-by-use. Ranging from customer engagement, cost, and revenue. | | | IIoT companies will be looking to engage with new customers in new applications/industries. | – |

**Empirical Data: Business Model Canvas B (2)**

| Questions / Respondents | Revenue Streams | Key Resources | Key Activities | Key Partnerships | Cost Structure |
|---|---|---|---|---|---|
| **(11) Roland Berger, Senior Partner** | **Revenue stream will also transform, subsciptions, ownership etc.** | | | **The largest impact he suspect will be in the "Key Partners".** | – |
| (12) IBM, Engineer in Cloud technologies | Revenue streams will be affected by new payment models. Challenge of moving fram Capex to Opex based business. | Key resources are also including AI and machine learning platforms | Platform-based value delivery. | Key Partners will change since the IIoT solutions requires partners to enable total value creation. | – |
| **(13) David Sidhu & Associates, Managing Partner** | **Payment methods is most likely to change. The single transaction model will soon become obsolete replaced by pay-by-usage.** | | | | – |
| (14) ÅF, Consultant New Business Solutions | New cost structure/revenues stream with leasing. | Key resources will be more software-centered, but also business transformation capabilities are important. | | Growth of shared economies will impact. | – |
| **(15) Innovationszentrum Industire 4.0, IIoT Practice** | **Revenue Streams will change.** | | | **Key Partnerships are likely to change.** | – |
| (16) McKinsey, Consultant IIoT | | | | Both alliances and acqusitions. | – |
| **(17) Industrial Internet Consortium and OMG, Chairman and CEO** | **Revenue models and payment methods. Accounting change from Capex to Opex.** | **Move from Capex to Opex requires more financial capital.** | **Key activities will not change that much.** | **In some cases, new eco-system partners will need to courted to help growth of the new strategy.** | – |
| (18) Microsoft Corporation, IIoT Offering | Aftermarket is becoming key. | | | | – |
| **(19) Bosch, Strategy, New Business Innovation** | **Revenue model will change. Subscription, licencing, cloud based. Pay for usage models will take ower.** | **More money is required upfront by providers, as a consequence of changing revenue streams.** | **Ability to adapt and foremost, ability to improve profits will be key for attractiveness.** | | – |
| (20) Accenture, Consultant IoT | | | | | – |