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Ecosystem Approach in Value Creation
A Case Study of HMS

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Abstract

Purpose: This thesis paper aims to understand how companies in the industrial automation sector can create value for the emerging technology ecosystem.

Design/methodology/approach: A single case study approach was taken to write this thesis, the case study was based on HMS Industrial Networks AB. Primary data were collected through in-depth interviews, various personnel from HMS were interviewed which facilitated to create the case study. Secondary data were also collected mainly from industry reports and other publicly available reports. To perform the analysis relevant literature were discussed in the literature review section.

Results: The study revealed that to create value in industrial automation sector companies need to evaluate their existing role in the ecosystem and adjust the role based on their industry competence and partnership capability with other platform participants. Through collaboration with the right partners companies can create value for different stakeholders in the ecosystem. For HMS, we have suggested the role of ecosystem orchestrator, the conclusion was made based on their existing ecosystem role, extensive industry competencies and high partnership capability.

Originality/value: Previously academic research has not been done on this topic as per the knowledge of the authors. This thesis paper can be useful for academics to do further research on different industries facing issues related to value creation and professionals can apply the suggested practical implications in their industry.

Keywords: Industrial automation, IIoT, value co-creation, business model, IIoT ecosystem, emerging technologies.
ACKNOWLEDGEMENT

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Thank you all

Halmstad, 2019-05-20
List of Abbreviations

HMS: Hardware Meets Software
CPS: Cyber Physical Space
IoT: Internet of Things
IIoT: Industrial Internet of Things
OEM: Original Equipment Manufacturer
BM: Business Model
ICT: Information Communication Technology
PLC: Programmable Logic Controller
IT: Information Technology
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1. Introduction

The purpose of this chapter is to provide an overview of the fourth industrial revolution (Industry 4.0) and the impact of emerging technologies, such as Industrial Internet of Things (IIoT), on manufacturing industries. An overview of how the business model is affected by technological change. The discussion eventually leads to the research gap.

1.1 Background

The first industrial revolution began with the invention of the steam engine in 1760 which enabled a transition from farming to manufacturing (Xu, Xu & Li, 2018). The fourth industrial revolution (Industry 4.0) is transforming the manufacturing industry through emerging technologies like the Internet of things (IoT), cyber-physical systems (CPS) and cloud computing (Hermann, Pentek, and Otto 2016). The emergence of new technologies forces companies in the manufacturing industry to reposition their resources and re-imagine business models (Markides & Charitou, 2004). Manufacturing industries are applying IoT and IIoT to gain a competitive advantage in production, transportation, distribution, service, and maintenance (Atzori et al., 2010).

Established firms usually find it difficult to respond effectively to technological changes after the discovery of new technologies (Tripsas & Gavetti, 2000). It is crucial to understand how different enabling technologies are impacting the business model of a company since they are interrelated (Schneider and Spieth, 2013). The Internet of Things is a virtual network that connects different sensors, devices, objects, or people via the Internet (Gubbi, et al., 2013). These connected objects can then autonomously generate and transfer vast volumes of data (usually the Big Data) which, by data analysis, offers multiple opportunities to improve efficiency and productivity (Hare, 2014). Companies can understand their business processes by using detailed data supplied by IIoT platforms, and by increasing the efficiency of the production process with sensor data. New revenue streams from IIoT data can also be generated (Ranger, 2018). Even though there is a big hype around IIoT but, many companies are not finding it valuable and feeling reluctant to invest on because they cannot visualize the value of IIoT benefits (Roy, 2019). This phenomenon makes the case interesting for a master thesis since it is a real business case problem and at the same theoretical implication can be explored.

The authors both are personally interested in the field of IIoT and receiving an opportunity to work with one of the largest industrial automation company in Sweden (HMS Industrial Networks AB) was a rare opportunity. Working closely with the company provided the opportunity to understand the market dynamics of IIoT industry. With this thesis, the authors not only tried to understand the problem from a theoretical perspective but also a real-life case perspective. This paper aimed to create a case study about HMS, which can be utilized by other practitioners.

Various literature has been reviewed for this paper to analyze the case study. Among them, the most significant literature was IoT ecosystem model (Turber et al., 2014), where it mentions that to utilize the full potential of IIoT companies need to adopt an ecosystem approach which is based on collaboration between different stakeholders. The analysis of this has been done by incorporating different models discussed in the literature review.
1.2 Purpose

Extensive research hasn’t been done in the IoT sector and how emerging technologies are changing business models, majority of the studies focuses on the importance of establishing relationship with customers and partners (Magretta, 2002; Wirtz et al., 2016). There is also a shift in IoT business models where researchers focus on ecosystem perspective instead of firm-level perspective which is based on linear value chain. (Turber et al., 2014; Westerlund et al., 2014). Manufacturers are innovating their business models due to rapid demand for customization, high customer expectation and growing complexity of the supply chain influenced by technological advancement (Shiklo, 2019). In the industrial automation industry, rapid changes are happening as well because of emerging technologies such as IIoT, big data, and 5G (Panwar, Sharma & Singh, 2016). IIoT is becoming popular in asset-intensive manufacturing industry because of the power of enabling technologies that can transform every level of the supply chain with data driven applications. Companies are deciding which technology to invest in, and which technology will provide them the tools to gain a competitive advantage over other players (Miklovic, 2017). The nature of the manufacturing industry is conservative and plays a key role in accepting and implementing new technologies instantly. For example, the buzz around big data and IoT have been there for the long term, but companies still could not capture the value, these technologies are promising to provide (Roy, 2019). Based on this, we have explored the area of value creation process of industrial automation companies. The main purpose of this thesis paper is to understand the impact of emerging technologies on the IIoT business models and how can companies operating in the industrial automation sector create value for the different partners of the ecosystem. From the above purpose, the research question has been formulated:

Question: How can companies operating in the industrial automation sector create value for emerging technology ecosystem?

To answer the research question, the authors have formulated three objectives to help them answer the research question. The three objectives are:

1. Identifying the existing role of the company in the ecosystem.
2. Identifying core competencies of the company.
3. Identifying partnership capability of the company.

In addition to the primary purpose, this thesis also aims at examining the implications of various IIoT, business and ecosystem theories. By comparing the literature review with secondary and primary data, it is possible to understand how academic theories are aligned with practical implications. Companies operating in the manufacturing industry are all present in the ecosystem, but they have different roles. For example, machine OEMs are supplying machines to factories. On the other hand, companies like HMS are providing connectivity solution. On the other hand, companies like HMS are providing connectivity solution. The role of different players in the ecosystem are different and to leverage the benefit of different players it is crucial to understand what current role they have in the ecosystem (Leminen et al., 2012). Secondly, the core competencies of the companies also define what kind of collaboration the company can do. Lastly, the partnership capability of companies is a significant concern to participate in the ecosystem since the primary value extracted from the ecosystem is based on the collaboration of different players. Answering these questions will help us to what role the company, in this case, HMS can play in the ecosystem to create value for different stakeholders.
2. Literature Review

This section of the paper represents a review of the relevant literature in order to build the theoretical understanding to answer the research question.

2.1. Internet of Things (IoT)

The Internet of Things is a unique shift in the global IT environment. Here it represents the co-existence of two elements; the internet which is a global system of interconnected network of computers and use the standard internet protocols as the mode of communication and continuing to serve billions of ever-expanding users ranging from academics, governments, businesses, private and public users and networks (Nunberg, 2005); the second part of IoT which is ‘things’ can be any person or object which identifiable in the world, and has the potential to get connected with the internet and create novel service (Kosmatos, Tselikas & Boucouvalas, 2011). According to Atzori, Iera & Morabito (2010), in order to define IoT scholars have taken several aspects in considerations one being the side of ‘things’ which gets connected to the IoT system or on the other hand the internet protocol and also network technologies which enables the things to get connected in the network and also challenges which are inherent in IoT systems such as the organizing large volume of data or information. Madakam, Ramaswamy & Tripathi (2015), concluded that in their effort to define Internet of things (IoT) scholars agree that presently there is no there are many scholars, practitioners, organizations, users have come up with definitions over the years, however Kevin Ashton, a digital innovator considered to an initial contributor in defining IoT. One common or generally accepted ground in defining IoT is that the first stage of internet included the information or data created by the users whereas the next stage is the information or date created by things defined IoT as an open and inclusive network of objects which are intelligent as they have the capacity to organize themselves, use data and information and resources, and also proactively to act or react to the surrounding environment need.

2.1.1 Value Creation scope in IoT

According to Mejtoft (2011), value creation in IoT domain has three distinctive layers which start with manufacturing, then supporting and then reaching to value creation stage. Here, the manufacturing layer represents that a manufacturer or retailers bring in IoT products such as sensors or terminal devices; the supporting layer is utilized to collect data which is used in the value creation layer, and the final layer adopts IoT as a co-creation partner. Chen (2012), presented the layers of IoT in a more detailed manner, which are divided into four stages. Chan (2015), explained these stages in the following manner in a bottom-up approach:

- Object sensing and information gathering layer represent the first stage of smart services to start collecting the information from the surrounding environment, i.e. things and point of interest.
- In information delivering layer wide array of mediums, e.g. GMS, Cellular, 3G, WIFI, wireless sensor network, etc. are used to deliver the gathered information or data.
- In the information processing layer, pervasive and autonomic services are given through a wide range of machines in a smart and autonomic way.
- In the final or application and smart services layer, computing capabilities, efficiency, system utilization are done according to requirements.

It is up to the organizations to decide on which layer(s) they should work on to create value and develop their business model.
2.1.2 Value Co-creation in IoT Ecosystem

IoT Ecosystem refers to the alignment of several multilayered partners whom are required to interact with each other in order to achieve the goal of obtaining main value proposition or a solution; in this case the focal actor alone cannot provide the value rather combination of several actors in the IoT environment need to participate to create value (Adner, 2016).

In IoT ecosystems, captured data and the analytics are usually not known beforehand. Also, also the nature of interactions among the actors are not predefined, as a result, it creates the opportunity to create synergy with the participation of different actors with their knowledge and resources, creating multiple systems in the process also creating the possibilities of bringing in new solutions and adopt new roles (Johnson, 2001). Also, IoT solution providers are heavily dependent on outsourcing or external partners thus increasing the complexity of the ecosystem; as a result, it is also needed to understand the revenue model of the partners here (Dijkman et al., 2015). This complexity or requirement for understanding partners leads to a network-centric approach from an individual firm-centric approach; customers also play the role of a collaborator with co-creation; this collaboration among multiple actors broadens the value proposition scope and shift the dynamic from a customer-specific value creation (Turber et al., 2014). According to Ikävalko, Turkama & Smedlund (2018), this approach leads to both monetary and non-monetary benefit considerations, which increases the complexity of the ecosystem; the supplier and customer relationships in the IoT ecosystem is dependent on co-creation and the communities because of faster customer contact enabled by inherent access scope to customer data.

Ikävalko, Turkama & Smedlund (2018), identified three types of archetype role in the IoT ecosystem, which are ideators, designers, and intermediaries and all of them have unique roles in the IoT ecosystem. They explained, ideators acts as an integrator of the present offerings in the market as per their unique requirements and context, they provide the input for the necessary input the desired innovation through one-way communication in the ecosystem. Secondly, the role of the designers is to blend existing knowledge to provide or develop new services in the ecosystem with both-way communication. Finally, intermediaries act as the source of expansion of knowledge across multiple ecosystems and arrange service innovation through multi-way communication, and this role have effects on the knowledge transmission and relationship; in IoT ecosystem this last role is considered to be of more importance than other two.

2.2 Industry 4.0

Growing competitiveness, the aim to develop new markets and need for internationalization have enabled the emergence of so-called the fourth industrial revolution, at the same time it has brought the concept of Industry 4.0 and stream of academic studies. It is understood that industry 4.0 has emerged after the three significant technological advancements since the 19th century, which are steam power, electricity, and the era of computers (Cordes & Stacey, 2017). It is defined as an industrial revolution as it promotes intelligent and automated production, which has the capabilities to interact and communicate in different platforms (Piccarozzi, Aquilani & Gatti, 2018). The term of Industry 4.0 was first coined in Hanover, Germany in 2011, where the German government proposed it as a part of their economic plan, which is based on high tech industries. It is also understood that the concept of Industry 4.0 does not only represent the production aspect of revolution, but it impacts all parts of the societal aspects such as technology, business, and consumptions, production process but since then the use of this term is not confined within just Germany or the scope of engineering but also expanded into management and economic studies and practices (Li, Hou & Wu, 2017).
According to Nagy, Oláh, Erdei, Máté & Popp (2018), Industrial revolution 4.0 is of both innovative and qualitative nature also, in one side organizations are working to improve their whole production line and manage that in a more integrated way. Moreover, these organizations in the manufacturing industries need to concurrently think about the changes which are needed in the product line to remain competitive global market as well. As a result, these approaches have a significant impact on the industries and target markets as they are affecting the life cycle of the products and allowing to incorporate new ideas in the productions and in doing of business, which in turn allow organizations to have more competitiveness.

Geissbauer, Vedso & Schrauf (2015), mentioned that Industry 4.0 is based on generated data. As competitive advantage can be achieved based on how these data are captured and analyzed, and that is used to make the right decisions. So, the competitive advantage does not lie only in modernizing the productions and having integrated production line; but also by embedding digital systems in the production which can independently generate data to make right decisions, example of predictive maintenance can be drawn here, in predictive maintenance the devices themselves can generate data to notify if there is any need for service or not.

As the role of manufacturing and productions systems have become more and more complicated with the emergence of new technologies in recent decades, the role of Information Technology has also taken more forefront role as a support instrument. The usability of information technology or IT has significantly changed the way of doing work and impacted the way of doing work (Schlaepfer & Koch, 2015).

Slusarczyk (2018) found that the primary purposes of the implementation of Industry 4.0 are to have operational efficiency, effectiveness, and automation. (Pereira & Romero, 2017), mentions that Industry 4.0 is more of a generic term which incorporates new technological aspects such as the Internet of Things (IoT), Augmented Reality, Robotics, Internet of Services (IOS), Cloud Manufacturing, Cyber-physical systems (CPS) and Big data.

It is essential to adopt these new technologies to achieve an intelligent manufacturing process, and in order to do so, the organizations need to include devices, products, modules, machines, etc. Which are capable of exchanging information independently, control and monitor each other and also execute actions as to need basis, which in turn help organizations to achieve an intelligent process for manufacturing (Nagy, Oláh, Erdei, Máté & Popp, 2018).

2.2.1 Features, Challenges and requirements related to the Industry 4.0

Fourth Industrial Revolution is the main driving force behind future innovations for the coming decades (Kagermann, 2014). The critical elements related to Industry 4.0 such as interoperability, vertical and horizontal integration of production, real-time monitoring and capabilities through different platforms in ICT domain are deemed as the challenges which organizations must address to stay competitive in the market. In addition to these, the volatile market demands, increased complex nature of solutions, short product life cycles and need for continual innovation also need to be addressed (Bauer, Hämmerle, Schlund & Vocke, 2015).

After conducting a review of 22 sample academic papers by different scholars, Ibarra, Ganzarain & Igartua (2018), identified several factors which are in relevance with the challenges, features, and requirements when it impacts of Industry 4.0 traditional business models. They found different definitions of Industry 4.0 were found based on the contexts for challenges and field of technologies where it can be implemented or influences of the country of operation or industry. However, even though there is no standard definition was found, the reviewed articles have appeared to have common ground when it comes to features and descriptions while explaining the phenomenon. They also observed how industry 4.0 is impacting the traditional business models, and finally, they found how these emerging challenges can be addressed according to the findings of other scholars. After
reviewing the articles, the authors explained that with the application of systems which are ensuring the communication and the connection between machines (smart factories), this would also reveal the challenges within the organization and also involving suppliers and in turn will lead to a more standardized networked environment. So, in order to minimize these challenges, shared platforms, connections, and standardized systems should be of significant focus.

Industry 4.0: Challenges, Features and Requirements:

<table>
<thead>
<tr>
<th>Main Features of the industry 4.0</th>
<th>Main issues impacting conventional business models</th>
<th>Main requirements to face digital transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interoperability</td>
<td>Networking and Reduction of Barriers</td>
<td>Standardization</td>
</tr>
<tr>
<td>Virtualization</td>
<td>Flexibility and Personalization</td>
<td>Work Organization</td>
</tr>
<tr>
<td>Decentralization of decision making</td>
<td>Individualized mass production</td>
<td>Availability of products</td>
</tr>
<tr>
<td></td>
<td>Local Production</td>
<td>New Business Models</td>
</tr>
<tr>
<td>Real time capacity</td>
<td>Low price</td>
<td>Know-how protection</td>
</tr>
<tr>
<td>Service orientation</td>
<td>Smart goods and services</td>
<td>Availability of skilled workers</td>
</tr>
<tr>
<td>Modularity</td>
<td>Fragmentation of Value Chain</td>
<td>Research investment</td>
</tr>
<tr>
<td></td>
<td>Globalization and decentralization of production</td>
<td>Professional development</td>
</tr>
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<td></td>
<td>V-H integrated production systems</td>
<td>Legal Framework</td>
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<td></td>
<td>automation</td>
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<td>Human ingenuity</td>
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</tbody>
</table>

Table 1. Adapted from Ibarra, Ganzarain & Igartua (2018)

Furthermore, in their research Ibarra, Ganzarain & Igartua (2018), have suggested three different approaches which can be applied to address the challenges and features which came across during their study. We will briefly discuss those findings from their research paper in the below section:

1. Service-oriented approach:
It is needed to rethink to find the optimal mix of product and service, because the digital part of a mixed or hybrid solution is service. Also, the business models which were previously used in only digital industries are very much relevant in product delivery industry as well now. As a result, the emergence of industry 4.0 is persuading the organizations to head towards more service-oriented mindset rather than traditional product only approach (Livari, Ahokangas, Komi, Tihinen & Valtanen, 2016).

Moreover, in their reviewed researches they have found that it is advised for the manufacturing organizations in the developed economies to extend their value chain in service integration and not only concentrating on cost element. The goal of this approach is to gain a product service system (PSS), which entails to deliver integrated solutions with the involvement of multiple parties and providing the right solution to the customer. As a result of which, key stakeholders namely customer, suppliers and other partners involved in the solution delivery becomes a part of a network or ecosystem and also around the potential CPS.

2. Network-oriented approach:
The 2nd proposal made by Ibarra, Ganzarain & Igartua (2018), is to have a network-approach to address the challenges related to adapting industry 4.0. With the presence of interoperability in industry 4.0 the horizontal and vertical integration of a firm’s value chain gets expanded from the traditional value chain and existing network. As a result, the new actors in the value chain emerges and the role of the existing actors also gets changed. This is observed that because of this the value through an ecosystem exceeds far from mere individual value chain contributions, to adopt with this the existing business models in a manufacturing organization the sales, service or production understand the necessity to change the existing business models to cope up with the changing need for business dynamics and also to take advantage of industry 4.0 (Livari, Ahokangas, Komi, Tihinen & Valtanen, 2016).

3. User-driven approach:
The final suggestion made by the authors is to adopt a user-driven approach in order to practice industry 4.0. Ehret & Wirtz (2016), This context is referred to as manufacturing organizations to become more responsive to the need of the users, for example focusing on a design or adding more customer value in the processes. Arnold, Kiel & Voigt (2016), With the practice of this approach organizations, need to develop new capabilities to obtain new information about their customers, practicing data-driven decision making, more focus on customer experiences and also transforming into more of an ecosystem rather than dependence on the single value chain. This results for organizations to be more flexible in value propositions in both demand aspects such as batch production and fulfilling customized requirements placed by the individual customer; also, this results to more customer orientation by demonstrating off the expansion of innovative service offering.

2.2.2 How can manufacturing organizations implement digital transformations

The study of Ibarra, Ganzarain & Igartua (2018) also found the full acceptance of Osterwalder’s widely accepted Business Model for innovation levels concerning industry 4.0. They suggested four ways to have a digital transformation in manufacturing organizations with the accordance of the degree of innovation which can be implemented through an incremental progression to towards radical implementation of towards adapting industry 4.0. Osterwalder’s proposal (Osterwalder & Pigneur, 2010) describes, the required changes in for value creation (the role of critical activities, partnerships, available and potential resources), value delivery (phases involving products, partnerships, sales channels, relationships, etc.) and value capture (cost and revenue).

2.2.3 Internal and External Process optimization

This represents the adaptation of digital transformation without bringing radical changes in the organization but instead adopting incremental changes, for example with the enablement of new technologies such as cloud computing, augmented reality, big data, collaborative robots, etc. and gradually improving the performance parameters such as cost, efficiency, employee knowledge development etc. This can be the first step for manufacturing organizations to adopt industry 4.0 without undertaking significant risks (Ibarra, Ganzarain & Igartua, 2018).

2.2.4 Industry 4.0 ecosystem

Here we are also presenting the IIoT ecosystem which represents the actors which are involved for the implementations of an IIoT environment.
According to Quindazzi (2017), the total IIoT ecosystem is grounded on industrial sites; there the sensors are installed to generate one or multiple sets of data, 2nd stage includes the connectivity phase which ensures the transportation (via any available medium such as, cellular, WiFi etc.) of captured data to the end point of sensor communication and being stored there and termed as Platforms. The 4th stage represents the analytic phase of the ecosystem where required data processing is being performed to generate valuable insights and 5th or the final stage through the use of appropriate applications or hardware end user gets to use the insights or refined data; security needs to be ensured throughout the ecosystem or in every stage.

2.2.5 Role of Big Data in Industry 4.0

Carlton (2017), explains Big Data as an immensely vast pool of unstructured data which traditional database systems cannot handle; Big Data also includes storage, processing, visualization, techniques to capture data. In other words, it is the ability to comprehend an extensive set of amorphous data and transform into useful insights, and automation of the feedback system can be considered as Big Data environment. National Institute of Standard and Technology (2015), also considered Big Data as an enormous sets of data, they added by mentioning it has three primary characteristics, i.e. volume, velocity and/or variability, and in order to make use of big data; it is needed to have a very high capacity of storage, scalable architecture, sufficient analytical ability. The fourth characteristic of Big Data is ‘value’ (Sultan & Ali, 2017).

Frank, Dalenogare & Ayala, (2019), found that scholars also agree with the importance of big data over other elements of the IIoT system; The combination of the use of cloud services and IoT enables various equipment to get connected to each other, and which generates vast number of data and which in turn contributes to Big Data storage (Liu, 2017). Also, Big Data includes the data generated by different kinds of sensors which are deployed in an IoT system (Porter and Hoppelmann, 2015). Moreover, with the application of data mining with machine learning, Big Data is the most important force for Industrial Revolution and also the key element to gain a competitive advantage over others in the future (Ahuett-Garza and Kurfess, 2018; Tao et al., 2018). The reason behind of Big Data having high importance is because the amount of data it can generate, it is required to deploy digital twins in the factory floor, and subsequently the analytics service for the generated information provides the predictive maintenance support which is basically stopping a probable problem from occurring with the use of big data (Schuh et al., 2017). With the combination of analytics and big data can help to streamline production line and also enable management to take more efficient decisions in most of the elements of manufacturing businesses (Wang et al., 2016; Wamba et al., 2015).

2.2.6 5G Networks
According to Sultan & Ali (2017), 5G technology has obtained significant attention from scholars during the last few years as it is inevitable in the coming years. As far as the future of communication technology is concerned, it is inevitable that 5G will have exponential growth in the wireless communication & this technology will help to connect billions of devices (Fan, Leng & Yang, 2016). These devices will produce a vast amount of data; the probable data transfer rate in the upcoming 5G network will be around 10Gbps (Panwar, Sharma & Singh, 2016). Sultan & Ali (2017), concluded that because of these reasons, the 5G wireless network could be explained as an extremely fast and ultra-dense network which also has the capacity to ensure connectivity between all the ‘things’.

Now, with Big Data; 5G will be the primary driver to ensure the usability of Big Data in the future. IoT devices can provide a large amount of raw data, and because of its high capacity to transfer data, 5G will be the primary mode of transport for these data to computing centers for analysis. Thus, acting as the definitive bridge between the source of data and center and that too, in a swift manner (Mushtaq, 2018).

**2.3 Business Models**

Here we are discussing the role of business models, definitions also the building blocks of developing business models.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>George and Bock (2011, p 99)</td>
<td>“A business model is the design of organizational structures to enact a commercial opportunity. Three dimensions of the organizational structures noted in our definition: resource structure, transactive structure and value structure”</td>
</tr>
<tr>
<td>Zott and Amit (2010, p 222)</td>
<td>“Business model can be viewed as a template of how a firm conducts business, how it delivers value to the stakeholders (e.g. the focal firms, customers, partners etc.) and how it links factor and product markets. The activity systems perspective addresses all these vital issues”</td>
</tr>
<tr>
<td>Teece (2010, p 173)</td>
<td>“A business model defines how the enterprise creates and delivers value to the customer and then converts payments received in to profits.</td>
</tr>
<tr>
<td>Fielt (2011, p3)</td>
<td>“A business model describes the value logic of an organization in terms of how it creates and captures customer value”</td>
</tr>
</tbody>
</table>

Table 2. Definitions of Business Models (Source: Fielt, 2014)

According to Zott and Amit (2013), academic literature is not beginning to reach a common consensus in defining Business models (BM). This understanding is centred around value creation logic for all
the relevant stakeholders. Importance of the roles played by external parties which play significant role in creating value such as customers and suppliers, an structured approach to explain or comprehend value creation logic for the organization and also the Business model has established itself as a topic of research in the field of academics (Kiel, Arnold, Voigt, 2017). Zott and Amit (2013) further explained that a universally accepted definition for Business Model would be inclusive if we want to apply this in every context, so standardization of definition will lead to a misunderstanding concerning applicability. However, addressing value is presented by scholars; DaSilva & Trkman (2014), found that Business Model works to as the core logic and strategic choices organizations take to create and capture value network. Along with that, a business model also includes features such as critical resources, processes, value proposition, and a profit formula, furthermore the researchers found that generic understanding from business models are applicable to different kinds of businesses and departments, but categorizing specific business model type or model (Sohl and Vroom, 2014). Majority of the research directly or indirectly explains the types of business models which give examples of impactful business models in the fields of internet-driven or traditional industries, which presents a large number of organizations emerging in the businesses (Sohl and Vroom, 2014). For this paper, we have used the Business Model presented by Osterwalder and Pigneur (2010), as this addresses the value creation as the forefront of the business model.

**Business Model Canvas**

According to Greenward (2012), Business model canvas presented by Osterwalder and Pigneur (2010) is an easy to understand graphical presentation and explanation of nine key components of around business, which are Customer segments, channels, resources, partnerships, customer relationships, activities, value propositions, revenues and costs and combining each of these individual elements in the business leads to consideration for the whole business scope. Osterwalder and Pigneur (2010) mentions that best way to describe a business model is through these nine building blocks as it shows the logic of how an organization intends to have revenue; and they cover four main areas of a business which are customers, offer, infrastructure and financial viability.

---

Figure 2. Business Model Canvas by Osterwald and Pigneur (2010)
Following section will briefly represent each of the building blocks according to Osterwald and Pigneur (2010).

1. Customer Segments:

As the starting point block of the canvas, here the organizations target to serve different types or other companies or people, without the existence of profitable customer a company cannot survive for a long time, so they described this block as the heart of the business model. To serve these customers better the company may have to group them into segments dependent upon their needs, behaviors and attributes. And, it may have single or several, small or large customer segments. It is up to the organization to make a conscience decision about which segment they want to serve, and which can be ignored, and after determining this the organization can develop careful approach about how to serve these customer’s need effectively (Osterwald and Pigneur (2010).

2. Value Proposition:
Value proposition pursues customers to choose one company over another because the chosen company serves to solve the customer problem or satisfy the need. Individual value propositions should consist of required product and services which should cater to the need of specifically chosen customer segments. In other words, the value proposition is a bundle or selection of products which offers benefits to its customers. The value proposition can be different kinds as well; it can be entirely new for the market which can disrupt the existing way of doing business or also can be in line with existing value proposition with new features (Osterwald and Pigneur (2010).

3. Channels:
Sales, distribution, and communication work as the interface of the company to its customers. As they are the touchpoints for the customers; they play a vital role to provide the right customer experience. So, this is important to find the right mix of use of these channels in order to bring a real value proposition for the customers (Osterwald and Pigneur (2010). Customer Relationships Organizations need to understand what kind of relationship it needs to achieve with its customer segments, planning according to individual segments. The range of relationships can be automated, or personal and customer relationships are drive by three motivations which are customer retention, customer acquisition and upselling.

4. Revenue Streams
This building block represents the money that a company generates from each of the customer segments. Companies must understand what sort of money the customer segments are willing to pay against their value proposition. If this is done right, then multiple sources of revenue can be generated from a single segment. A single revenue stream can have several pricing mechanisms ranging from volume dependent, fixed list of prices, bargaining, etc. (Osterwald and Pigneur (2010).

5. Key Resources:
Authors emphasize that all business models require to have Key Resources. These resources are deployed to create true value propositions, to have customer relationships, the present value proposition to the market. Depending on the type of business model, different kind of resources are needed to cater to different scenarios. Vital Resources also can be of various forms, i.e. financial, physical, intellectual, or human (Osterwald and Pigneur (2010).

6. Key Activities:
Key activities block represents the most important task that an organization performs to make the business model work.

### 2.3.1 IoT Business Models

Osterwalder & Pigneur (2010), business model canvas which incorporates the elements of business process which aims to create value. Westerlund, Rajala, Leminen (2011), agree that the mentioned canvas has the critical elements of business models, i.e. customer, value proposition, infrastructure, and financial goals; which are widely discussed and advocated in the literature related to business models.

In order to develop an IoT business model, Leminen et al. (2012), adopted the Osterwald’s canvas and introduced ecosystem and customers as the foundation of their IoT business model. In their framework, these two elements work as the main dimensions, which helps to visualize the present and future business models in the IoT domain. In the framework which contains two by two matrix, ecosystem contains two variants which are ‘closed private and open networked’ and in the customer side is has business and consumer to present their IoT business model. As Uckelmann, Michahelles & Harrison (2011), mentions in an IoT environment requires to have a secure, scalable, open, and standardized infrastructure even if the technology state is not available now. This is also represented in Leminen et al. (2012) business model as it works with an open-ended ecosystem which transforms from a closed network; also, over a transformation from business to business customer environment to the emergence of consumer-centric solutions are expected to emerge.

![Figure 3. Framework of IoT business models (source: Leminen et al., 2012)](image)

Apart from generic IoT business model such this one, Elizalde (2018), presented several service-oriented IoT business models are already in practice for consumers (can be only business-business, business-consumer or both) as well which are briefly presented below.

<table>
<thead>
<tr>
<th>Subscription Model</th>
<th>Based on recurring revenue goal, IoT service provider offer subscription-based services to its customers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome-Based model</td>
<td>Customer pays for the benefits (or outcome) of the services availed, rather than the product itself.</td>
</tr>
<tr>
<td>Asset sharing model</td>
<td>This model focuses on the utilization of existing resources or assets in order to provide IoT services to the consumers, with the goal of maximization of the customers to earn more profit.</td>
</tr>
<tr>
<td>Data Monetization</td>
<td>Focus on developing products and services which can serve individual entities and selling the aggregated captured data to third parties (new customer segment) to provide value and in turn maximizing revenue.</td>
</tr>
</tbody>
</table>
Pay-Per-Use | This IOT business model does not focus on the generation of revenue from the deployed product rather provides services based on the usage pattern on the usage pattern of the customer.
---|---
Service offering | Developing products which are enabler or differentiator for existing services to gather more advance data or to increase efficiency.

Table 3. Different types of IoT Business Model (Source: Elizalde, 2018)

### 2.3.2 Four Elements of IoT Business Model

In addition to aforementioned business model canvas, IOT business model framework is also discussed here to have a better understanding of how the applicability of more generic business model can have relationship or implication with IOT domain or industry-specific scenario. It is assumed that traditional business models are focused on the firm-centric point of view, however, due to the dynamic nature of the IoT ecosystem where the firms have to collaborate with different actors both out and within the industry; applicability of traditional business models are not suitable (Chan, 2014). Moreover, due to the fast-changing nature of the business environment in technology-driven services, organizations must adapt rapidly according to the challenges to be successful, as a result, business model innovation are getting attention as a path to success (Sun et al., 2012). Westerlund et al. (2014) cited in Chan (2014), identified three contemporary challenges that IoT environment faces, which are the diversity of objects, the immaturity of innovation, and unstructured ecosystem. Here the diversity of objects means there are different types of IoT systems (connected objects and devices) which are not under in any standard system. Immaturity of innovation referred to as the most prolific innovations in the IOT arena have not flourished or matured to become regular products or services and finally Unstructured ecosystem refers to as the lack of having any underlying structures, value creation logic or governance; however, despite the prevalence of these challenges the IoT business models exist (Chan, 2014). According to (Gassmann, Frankenberger & Csik (2014), business models in a technology-driven environment have several key elements which are “Who, What, How and Why”. Here ‘Who’ is identified as the target or potential customer; ‘What’ refers to value proposition which is proposed to the customer; ‘How’ refers to value proposition which is proposed to the customer; ‘How’ means how the total value chain of the supplier will provide the end product to the customer; and finally ‘Why’ explains about the financial viability of the business model for example the cost structure, revenue mechanism etc. which will actually lead to profitability. From here we proceed to concepts surrounding ‘Value’ as we have found it be one of the central concept surrounding businesses in present context.

![Figure 4. The archetypical business model (source: Chan, 2014)](image-url)
2.4 Value Creation

Before we start discussing about ‘Value Creation’, is it essential to understand what is ‘value’ itself for customers as well; in the scholarly on value creation and value co-cocreation, the term value is often explained in more philosophical point of view, in the more common approach it is deemed as a relationship where one benefits and the other one sacrifices (Sánchez-Fernández & Iniesta-Bonilla, 2007). In general, practical level value for customers can be defined as after getting assistance with the use of resources through an interactive process and the customer feels far better than before (Grönroos, 2011).

According to Grönroos (2011), in business to business context, we can see that it means support of the supplier will have effects on the economic performance of the customer’s business; probability of a customer or business is dependent upon how well the customer manages its different aspects of business practices, for example, producing, making payments, order making, etc. and not only reflecting on operational efficiency but also the effectiveness of these approaches. These tasks also represent how well these are contributing to the customer's profitability and growth or also in the cost level in a positive manner and how well an organization’s suppliers support these. Which means that, the root of the customer or firm’s success can be traced back to the support provided by the suppliers; as a result value for the customer is represented by the monetary gain or performance in relation with the suppliers active role Also, this value has perceptional elements into it as well e.g. trust, attraction, commitment. Based on this, Grönroos (2011), also identified three dimensions through which a supplier can create value to its customers, which are briefly mentioned below:

1. Effecting customer’s growth and revenue generating scope
   a. creating new business growth opportunities (identifying better customers, access to new markets, new customer segment penetration).
   b. More revenue with the help of premium pricing.

2. Effecting the costs
   c. lowering operational or administrative costs.
   d. higher margin of profits through minimizing operational or administrative costs.

3. Effects on perceptions
   e. increased trust
   f. increased commitment
   g. getting more comfortable in interaction with the supplier
   h. getting more attracted to the supplier.

Here, the first two types of value creation effects are measured in monitory terms where the last one is more directed towards cognitive and perception driven approach.

Matthyssens, Bocconcelli, Pagano & Quintens (2016), in their research found that there are presently two types of trend can be detected with the correlation of value creation. Firstly, it is observed that there is a growing practice of to shift from traditional manufacturing only logic to more service logic, which means that the value is created through a networked approach but not relying on a standalone process. Also, the manufacturing logic is defined by its economies of scale, profit, and efficiency maximization with the assumption that value is embedded in its price. Here the service-dominant practice implies that value can only be represented by the consumption of offering, experience, and perception. Secondly, there is an increasing number of organizations who are focusing on value creation through interaction between customer and supplier.
2.5 Value Co-creation

Extension of value creation leads to value co-creation, which will be our discussion point in this section. Koning, Curl & Weyer (2016), explained that the literal meaning of co-creation is: making something new together to exists. Co-creation has its roots in co-production where the consumer participation was introduced in the supply chain; it was deemed as a cost minimization point of view however in the 1990s this was introduced an approach which can lead to higher customer satisfaction. Then Prahalad, Ramaswamy (2000), found that the consumers are taking a more active role in building relationship with the firms and the consumer-supplier relationship is changing, also in the paper Prahalad, Ramaswamy (2004), by them they introduced the term value co-creation; according to them it is about the customer taking actions when they are dissatisfied.

Value co-creation is an approach which enables organizations to build up an understanding of the evolution of the market and deeper collaboration with the (Grönroos & Ravald, 2011). Value Co-creation enables organizations to shift their focus from the simple exchange of goods to or short-term interaction to more to holistic process towards building long-term relations (Payne, Storbacka & Frow, 2007). In order to define value creation in service giving context, scholars have pointed out that, value co-creation is extended from far from only giving the present experience of the service but is extended towards both the journey towards the prior delivering the products and also the experience that can be given afterward and mitigating expectations. To have an effective process to ensure this process the service providers here need to understand how to involve actors who can enhance these experiences in them and not end up having only episodic interaction with the customers (Marcos-Cuevas, Nätti, Palo & Baumann, 2016).

In line with these arguments, Anderson, Narus & Narayandas (2009), also found that value-co-creation process involves both supplier and customer who are actively engaged in the process which includes products, services or knowledge sharing in a mutual understanding manner. This way of interaction does not only involve supplier influenced factor but also the what can customers do in the context is also essential (Vargo & Lusch, 2011). Corsaro (2019), further defined value co-creation as an establishment of the process which involves an interactive platform which ensures interactions between agencies and facilitating to have such structure in the organizations. Furthermore, with the emergence of the digital era, it enables the tools and technologies such as cloud computing, artificial intelligence, machine learning, etc. can help to build up effective value-co-creation platforms which can help all the parties involved, in other words having common digital platforms which where they can contribute concurrently and interactively. Anderson, Narus & Narayandas (2009), from market expansion point of view, scholars have suggested that, as the world is getting more connected with the rapid expansion of IoT and connected devices where many the regular products are having embedded technologies to interact through internet, co-creation is beneficial to capture new market to develop new products which include effective collaboration.

Goda & Kijima (2015), proposes three stages of value co-creation for businesses which are intertwined throughout the process. These stages are networking, integration of resources and exchange of services. Here, in networking stage different actors participate in integrating different resources ranging from private resources, market-facing resources, and public resources in order to create value; after that, they move to the stage of exchanging services with each other. According to Vargo, Wieland & Akaka (2015), the role of the participants in the network changes in the processing time, while some of the participants in the network can prevail as the coordinator as well; with the continuation of resource and service exchange, they will parodically re-form and re-structure.
Figure 5. Value Co-Creation Cycle (source: Goda & Kijima, 2015)
3. Methodology

In this chapter the research approach and design has been explained.

3.1 Research Approach and Design

The study is of a qualitative nature. Tracy (2012), mentions that qualitative research aims to explore the driving force and the purpose of a phenomenon. According to Wacker (1998), qualitative researches creates valuable opportunity and information and data about the topics which other researchers want to investigate also; moreover, qualitative research can build a strong base for further research of an area (Wacker, 1998). The basis of qualitative research is based on gathered primary data; which includes interviews, getting feedback from the target respondents, surveys; researches which are of qualitative and primary serve as the theoretical base for other researchers. (Sofaer, 2002). According to Wacker (1998), the main goals of the research are to find facts and explanations; research enables to determine specific facts which give a better understanding of the research topic. Thus, the research conducted by us is a qualitative study, because it creates the opportunity to understand and collect further data related to business model change in the context of emerging technological shift such as Industry 4.0 and data monetization and add value to this area of research field also for HMS.

![Figure 6. Research Design based on Sekaran & Bougie, (2010).](image)

According to Sekaran & Bougie (2010), it is crucial to have a research design which helps the researchers throughout the intended study and guides to gather data and conduct accurate analysis to achieve the intended result.

Purpose of this study is descriptive, as we aim to determine and describe the behind the shift of business models and way(s) to capture value in IoT domain. Sekaran & Bougie (2010), explains that the goal...
of a descriptive study is to provide the researcher a framework or help to describe related elements of the interesting phenomenon from the perspective of an organization, industry, individual or can be of any other perspective. Also, a study of such kind is cast light on currently prevailing issues or problems with the help of data collection which in turn helps to explain the situation in a comprehensive manner which would not have been possible without this method (Fox & Bayat, 2007). According to Kothari (2004), the main characteristic of this method happens to be that the researchers have no control over the data or variables and can only report the situation which is happening presently or what has happened before. This is also relevant to the non-contrived nature of this paper in terms of study setting with minimal researcher interference.

In order to collect primary data for this study, semi-structured interviews are used; out of the 04 sessions we had, 03 were in interview setup and 01 was in formal meeting environment with the participants. Semi-structured interviews are in-depth interviews where the participants have the flexibility to answer the open-ended questions (Jamsheed, 2014); which was relevant to our data collection efforts. Also, in semi-structured interviews, it is allowed to add questions by the interviewer which may be deemed as necessary during the interview which can further help to identify aspects of the research efforts (Saunders, Lewis & Thornhill, 2012). Interviews for the study are conducted in a cross-sectional time horizon between February to May 2019, each of the participants participated in one interview. Characteristics of cross-sectional study are that it takes place in a single point of time (e.g., weeks, month or days), variables of collected data cannot be manipulated; also, it provides information about the current setting (Cherry, 2019).

3.2 Research Strategy

In this section, we are clarifying the process which is undertaken to solve our research question. According to Saunders, Lewis & Thornhill, (2012), in order to conduct research there are multiple strategies which can be undertaken, such as surveys, template analysis, case study, and narrative inquiry; researcher can adopt one or multiple strategies to conduct academic research depending on the undertaken research design and research question. For this paper, a case study strategy is used. Kumar (2011), in a qualitative study approach, a case can be a group, subgroup, an event, an individual, a community, an organization, etc.; also, case studies are very useful when the researcher wants to understand, answer, explore an area which is little known and also to have a holistic understanding of the phenomenon, group, industry or a particular situation, as a result this research strategy has high relevance when the purpose of the study is to focus on in-depth exploration and understanding but not on achieving confirmation or to quantify. Also, a case study is a type study which examines the studies done in other organizations in a similar environment and uses to solve a problem or to understand phenomenon and efforts to generate further knowledge (Sakeran, 2011).

Taking into consideration the aim of the paper, we find it appropriate to use the case study as our research strategy and to answer the research question. We have used HMS as our single case and industrial IoT setting then explored the settings in the industry subsequently to reach a conclusion.

3.3 Data Collection

We have previously mentioned this thesis is a qualitative study to understand a specific phenomenon which is influenced by the emergence of IoT or industrial IoT. A quantitative approach to find a solution is not suitable in this context as we are not aiming to answer any find or answer any numerical data set which can have an impact on HMS’s business models. Thus, the whole data collection method ranging from an interview, secondary data are mostly qualitative, which can assist the researchers to find answers. Through the process of data collection, we try to understand if the case of HMS can be
connected with the industry practice and what other actors are doing or what can be done to add value, also the interconnection of these silo actors.

### 3.3.1 Primary Data

According to Kumar (2011), the data captured by researchers for a specific study is considered as primary data and sources to gather primary data are interviews, questionnaire, and observations. Here, the source of our primary data is from the conducted semi-structured interviews of the employees of HMS. All the participants are on the mid or higher management positions of the company. A common questionnaire is constructed (see appendix) in relation to our research topic, and however, due to the semi-constructed nature of the interviews and meeting, new viewpoints are also recorded and used for the analysis purpose. Each interview took place between 30-45 minutes. We decided to select these participants as they have relevance in the immediate value creation process and if needed, can play a vital role in the execution of the recommendations made in this thesis. However, as we have not received consent from the participants to disclose their names and designations, the identity details are not disclosed here.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Location</th>
<th>Department</th>
<th>Communication Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>HMS Head Office, Halmstad</td>
<td>Product Management</td>
<td>In-Person Interview</td>
</tr>
<tr>
<td>B</td>
<td>HMS Head Office, Halmstad</td>
<td>Marketing</td>
<td>In-Person Interview</td>
</tr>
<tr>
<td>C</td>
<td>HMS Head Office, Halmstad</td>
<td>Research &amp; Development</td>
<td>In-Person Interview</td>
</tr>
<tr>
<td>D</td>
<td>HMS Head Office, Halmstad</td>
<td>Project Management</td>
<td>Meeting &amp; Discussion</td>
</tr>
</tbody>
</table>

Table 4: Interview Participants from HMS

### 3.3.2 Secondary Data

Different kind of information such company or the case e.g. details, background, etc. can be collected from the published reports, websites, various archives, or some other sources, these type of data also can be policies, procedures; data gathered through such sources which are already existing are known as secondary data, most of the time it is beneficial to collect both primary and secondary data at the same time to gain more knowledge of the field of research (Sekaran & Bougie, 2010). For this research we have collected secondary data in relation to industry practice, use-cases from different journals, company websites, consultancy firm’s report, etc. to help us to answer the research question.

### 3.4 Data Analysis

After the completion of the data collection from primary and secondary sources we have conducted our analysis in relevance with theoretical viewpoints. As a part of the analysis, we have fully transcribed the collected data from the interview to written format and used where it is deemed relevant by researchers in the analysis segment. Data triangulation approach is undertaken in this study to
identify any conscious or unconscious biases which make occur during the interview. Purpose of data triangulation is to use multiple sources of data to achieve more comprehensive understanding of the study which is being conducted (Sargeant, 2012).

3.5 Reliability

The measurement of reliability in an academic research is dependent on the extent of which it is without bias which results into the consistency of the measurement across different time period and different research instrument (Sekaran & Bougie, 2010). However, in qualitative research it is impossible to have a research tool which is fully reliable over different setting as it is influenced by the variables such as physical setting, interviewers/respondent’s mood, regression of the instrument used in the interview, use of words in the questionnaire etc. (Kumar, 2011). However, in order to increase the reliability of this paper, in effort to reduce the cognitive bias of the respondents, we have briefed about the

3.6 Validity

Validity of a qualitative research represents the aptness of the data, process and tools used in the study; also whether the methodology is suitable to get the answer for research question or if the desired outcome is valid for the placed research question and finally the conclusion achieved is valid or relevant with the context and sample (Leung, 2015). According to Kumar (2011), inaccuracies can occur at any stage of the study or research; it is important for researchers to adopt validity measurement to ensure correctness of the outcome or result. And to achieve higher validity data triangulation is highly suitable (Yin, 2011); which we have aimed to do throughout our study.

3.7 Research Ethics

According to Postow (1975), Ethics encompasses grounds of morality, such as how one should behave, what is right and what wrong and rules of conduct. Ethical behaviour should not only be confined in everyday life but also need to apply while conducting research. Before starting the interview process with respective HMS personnel, a non-disclosure agreement was signed with HMS Industrial Networks AB. Interviewees were asked before the interview sessions were recorded via mobile phone and before using the data in the report interviewees were asked if the statements are misrepresenting their views.

4. Empirical Data

This chapter describes the empirical data collected from primary and secondary data sources. First part of this chapter, describes different aspects of HMS, primarily focusing on their business models and IIoT solutions. Second part of this chapter focuses on different market implications of IIoT. Empirical data which are relevant to answer the research question and aligned with the theoretical data are used in this chapter.
4.1 HMS (Hardware Meets Software) Industrial Networks

HMS industrial networks started their journey in 1988, founded by Nicolas Hassbjer and Staffan Dahlström based on a thesis paper written at Halmstad University. HMS is operating in the industrial communication sector, and the core objective of HMS products is to connect industrial machines with control systems and the internet. Even though HMS is at the forefront of industrial communication now, but the company started with a humble beginning. In early days, the business of HMS was focused around consultant services and hardware manufacturing, which helped them to enter the industrial communication sector. Industrial communication products of HMS started to gain popularity, and companies like Atlas Copco and Hitachi collaborated with HMS to design industrial communication products (HMS, 2019a).

HMS continuously explored ways to improve the connection process between industrial devices and various fieldbuses, which resulted in the product called, Anybus. Anybus was launched in 1995; the product facilitated automation devices to become network-neutral; this value proposition was the reason behind the success of Anybus. Anybus helped HMS to capture new customers such as General Motors. To effectively take advantage of the success of Anybus, HMS realized they need to expand technologically and geographically. To facilitate expansion, new investors joined HMS as shareholders. The new investment helped HMS to start the expansion process internationally. Opening subsidiaries initiated the expansion strategy in the USA, Japan, and acquisition of German company Vcom GmbH (HMS, 2019a).

“The evolution of communication products in this industry, mainly driven from central Europe and North America. Since the technology itself originated in other parts of the world, which meant that from the very beginning of the HMS, we have an intention to go global. Going international has been natural for us because of this reason.” (Interviewee A, 2019).

Subsidiaries in countries such as Japan inspired them to improve the manufacturing process and overall quality of the products. The geographical expansion started to get momentum, and HMS opened offices in France, Italy, and China. At the same time, new products in the Anybus line was introduced in 2005 and HMS started to grow their patents as well. Subsidiaries such as IntelliCom helped HMS to innovate new products and solutions. The geographical expansion in all major automation markets around the world established HMS as a major automation company (HMS, 2019a).

The investment in technology (R&D) and manufacturing started to pay off, and HMS experienced rapid growth during the period 2007-2012. New gateway products were included in the HMS portfolio, and HMS expanded into markets such as India, UK, and Denmark. Along with opening offices in different parts of the world, HMS continued their acquisition process, which enriched the product offering. The sound financial capability provided HMS the opportunity to acquire German company IXXAT Automation GmbH in 2013. HMS continued their organic growth strategy in 2016 as well by acquiring Belgian company Ewon, which assisted HMS to capture a dominant place in the Industrial Internet of Things (IIoT) market. In the same year, HMS acquired Spanish company Intesis and entered the building automation and communication industry (HMS, 2019a).

4.1.1 HMS products and IIoT Solutions

Products and solutions offered by HMS help to establish communication between devices and machines and applications related to industrial IoT. By using HMS products, companies can access and analyze industrial data through which monitoring, controlling and optimization of industrial equipment is possible. HMS has a wide range of products and solutions; for this research paper, we
are focusing on the products and solutions that enable the customers of HMS to capture data from their factory machines. Majority of revenue of HMS generated from conventional product sales but gradually HMS is increasing their focus on services as well (HMS, 2019b).

HMS has three major product brands such as Anybus, Ixxat, and Ewon, these products are widely used by the various customer in the industrial sector. Anybus products connect different industrial devices to industrial networks. Ixxat products are widely used in medical automation and energy production. EWON products provide solutions that establish a connection between machines and the internet (HMS, 2019c).

“Our vast majority of sales is hardware sales and it has been like this for a long period of time. We have been focusing on the hardware for a long time so one of our challenge is to increase focus on the software and service side as well. This is an area we need to develop a lot.” (Interviewee A, 2019).

4.1.2 HMS IIoT solutions

HMS IIoT solutions assist companies by capturing data available in an industrial system. The available data help companies to identify product failures, increase productivity and minimize costs. The building blocks of IIOT are Edge Gateways, Wireless Solutions, Protocol Stacks, Security and HMS Solution partners. Through Anybus Edge Gateways customers can access data which are in industrial machines and devices. Users can define which data will go from the gateway to cloud via HMS Hub at the same ensuring secure connections. Value of Anybus Edge Gateway is a customer can monitor their machines and perform predictive maintenance which increases productivity and efficiency (HMS, 2019e). Another important building block is HMS solution partners that can help customers by providing IIoT software solutions which go along with industrial hardware (HMS, 2019d). HMS is increasingly investing on the software side of the IIoT business, and the main reason behind this action is stated by one of the interviewees.

“I think in the past the industrial production was dominated by very much the traditional OT companies. Companies who are making the machines, companies who are making the PLC, companies who are making the communication system. But increasingly we can see that IT companies are coming in because we start to integrate production and IT system. So, the IT systems started to play a bigger role and there is more and more wireless communication. Big infrastructure suppliers like Ericsson, Nokia, Huawei, Cisco and the movers in the IT system side " (Interviewee C, 2019).

Four essential part of Anybus Edge solution is industrial communication, edge intelligence, edge connectivity, and security management. Through industrial communication, various time of machines on the factory floor can be connected, which starts the data journey process. Edge intelligence converts the factory floor data into smart data. Edge connectivity creates the value of the data captured from the factory floor. Finally, security/device management ensures the safety of the data since for manufacturing companies' data can be a sensitive issue (HMS, 2019e).

“I would say that, IIoT has been discussed for quite a many year, but it hasn’t really reached its full potential. For the coming years I think, we will see a lot of big growth in this sector. The technology is available so now my interpretation is, industry is trying to figure out how shall they can use it and for what purpose. I think the industry has started to realize that it can give enormous value in terms of utilization of captured data.” (Interviewee A).

“With industrial IoT the main objective is to make the factories more productive, automated and flexible.” (Interviewee C, 2019).
4.1.3 HMS business models and value creation process

HMS customers can be divided into four different types who are residing at different level of factory automation value chain.

![HMS customer market pyramid](image)

**Figure 7. HMS customer market pyramid (HMS, 2019c)**

End users: Factory owners are considered as the end users of HMS products. In the industrial automation value chain factory owners are at the top. HMS provides value at the end users by supplying products and solution which help the factories to create products for their commercial customers.

System Integrators: System integrators and machine builders are on the second level of the pyramid who are responsible for setting up factories by establishing a connection between different networks.

Machine OEM: On the third layer of the pyramid, there are machine OEM and device manufacturers who are manufacturing all the machines and devices used on a factory floor. Machine OEM is one of the significant customers of HMS. Two serve these customers HMS requires extensive collaboration since the sales cycle length is long.

Suppliers: At the last layer, there are component suppliers who provide components to HMS to create hardware (HMS, 2019c).

“In terms of stakeholders HMS follows a pyramid and provides products at all level of value chain. The factory owners (end users) are at the top of the pyramid. In the second layer of the pyramid there are system integrators and machine builders. The stakeholders in the second layer help to build the factories. The machine builders also provide custom made machines for each factory. Then we have machine OEMs and device manufacturer who produces machines for factories in mass quantities. At the bottom layer we have component suppliers.” (Interviewee C, 2019). “Our major stakeholder is machine OEM companies that provide different type of machines in a large volume.” (Interviewee A, 2019).

“I think HMS traditionally very much focused on factory automation where manufacturing is the prime target. We are moving into other areas as well such as transportation and energy. But you have to say factory automation is where we are standing now.” (Interviewee B, 2019).

HMS has multiple business models which depends on three factors such as customer, market and product line. Three business models which are present at this moment are, direct sales, indirect sales through distributors and solution partners and subscriptions.
Direct sales with framework agreement which is also known as design wins is the original business model of HMS and still plays a vital role. The design win concept focuses on creating long-term collaboration with the machine OEM. For this business model the sales cycles are long but on the other hand it ensures long term revenue generation at HMS end (HMS, 2019c).

“Anybus business unit have a very strong tradition of selling products directly to the customers, over the years. We are also working with the distributors as well, but the focus has always been direct sales and then combined with distributions.” (Interviewee B, 2019).

“I think the nature of the product we started out with are technology intense, so we had to provide a lot of technical support. From day one we need to help the customers how to use it and that’s where the direct sales model plays a vital role.” (Interviewee B, 2019).

Indirect sales business model is based on 300 independent distributors who are residing in more than 50 countries. This business model is targeted towards system integrators and installers where extensive engineering resources are not required (HMS, 2019c).

To market Anybus Gateway products which is targeted towards system integrators and machine builders, HMS needed to create a distribution network. System integrators who specifically plays a vital role in setting factory floors need gateways to establishing a connection between different networks. HMS initiated a program called “System Partner” targeted towards machine builders and system integrators. The main objective of the program is to collaborate with partners by offering them product knowledge, free product course, and exchange of market information (Lysek, 2018).

Solution products such as Anybus Edge solution and EWON Remote solutions are sold through services and subscription model where customers subscribe to a web-based service and they can select specific solutions based on their requirement. HMS has a solution partner program where different companies can collaborate with HMS to provide innovate software that goes with various industrial hardware of HMS (HMS, 2019d).EWON Remote solutions are sold through services and subscription model where customers subscribe to a web-based service and they can select specific solutions based on their requirement. HMS has a solution partner program where different companies can collaborate with HMS to provide innovate software that goes with various industrial hardware of HMS (HMS, 2019c).

“Subscription is kind of following the IIoT trend, a lot of business around IIoT will be based on subscription and we should follow that as well. I think machines in the factories are not necessarily owned by the factories, it is leased per usage. If these models are used in factories, then the suppliers of those factories will also want to have that model from their suppliers and that’s why we need to comply with that business model. In general, we will see more subscription-based models not only from our customers to their customers but also from our customers to their customers.” (Interviewee A, 2019).

Majority of the sales revenue for HMS comes from direct sales of products which is 70% and only 30% of the sales comes from indirect sales such as distribution, services and subscription. Revenue of Anybus product line is 61% which is significant compared to other two brands (HMS, 2019b).

“We are still very much hardware producing company, but the software always goes with the hardware. Then we sell the bundle for a price. It’a very small part of our business where we charge for services and where we charge for software. When you start to sell software it’s more about subscription-based models. Where else in our traditional business we sell the products and the support
The value chain of embedded products of HMS differs from gateway products which also has an impact on the business model characteristics. As mentioned above embedded products are sold through direct sales business model on the other hand gateway products sold through distributors which follows indirect business model. The value proposition for HMS products is offering industrial connectivity and helping customers to generate new revenue streams by capturing data from the industry floor (Lysek, 2018). During the interview, interviewee A shared that the main value of HMS product is to transfer data from industry network to an IT domain and HMS does that efficient and secure way. HMS is also acquiring new companies to provide complete IIoT solutions, recently HMS has acquired Beck IPC GmbH which is a technology company that helps to store data in the factory and in the cloud. Through acquisitions of different type of companies HMS is moving towards complete IIoT solutions and which is also impacting the value proposition of HMS (HMS, 2019c).

“HMS has been acquiring companies continuously you look at the history of the company and these companies are bringing new aspects and strengths to HMS which is also changing the value proposition of the company”. (Interviewee C, 2019).

4.1.4 HMS Value Creation for Different Stakeholders

HMS creates value through products and services for various stakeholders, the table below depicts different types of value created for stakeholders.

<table>
<thead>
<tr>
<th>Customers</th>
<th>Shareholders</th>
<th>Suppliers and partners</th>
<th>Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing current and future communication needs through</td>
<td>Achieving long-term stable dividend for the shareholders</td>
<td>Developing and creating future solutions for customers by collaborating with partners and suppliers.</td>
<td>Providing remote monitoring solutions that lowers energy consumption.</td>
</tr>
</tbody>
</table>
partnership and commitment.

Table 5. Value Created by HMS for Stakeholders (HMS, 2019c)

4.2 IIoT Evolution, Industry Trends, Business Models and Value Creation Process

This section explores different aspect of IIoT market implication. To prepare this section, data has been primarily collected from business consulting firms report such as PwC, Deloitte, BCG and other public report published on IIoT related topic. Main objective of this section is to provide the reader insight about IIoT landscape.

Gartner Hype Curve

![Gartner Hype Curve](image)

Figure 9. Gartner hype curve (Gartner, 2019)

Gartner introduced the hype curve in 1995 which maps the progression of emerging technologies (O'Leary, 2008). From the graph, we can see that there are five stages of the curve, which are innovation trigger, the peak of inflated expectation, trough of disillusionment, the slope of enlightenment, plateau of productivity. This graph is a good starting point to understand the importance of IoT and the value it can create for companies. Within the next 5 to 10 years, the IoT platform will reach a plateau of productivity. Currently, IoT platform is on the peak of inflated expectations that means at the stage only a few companies take actions and many companies do not because of the failure stories compared to the hype (Gartner, 2019). So, the companies operating in the industrial segment are willing to explore alternative ways to create value by IoT adoption will have an enormous competitive advantage in 5 or 10 years. Other than IoT platform, emerging technologies such as Edge AI and 5G will reach a plateau of productivity within a few years, and these technologies will also reshape the value creation process different industries. IoT cannot thrive without adequate and affordable wireless connectivity, interoperability, and common standards. 5G will vastly change the IIoT ecosystem in areas such as security, reliability, latency, individual control, and scalability (Poniewierski, 2019). Deployments of 5G mobile networks are estimated to facilitate an economic output of $3.4 trillion in the global manufacturing sector by 2035 (PwC, 2017).

4.2.1 Main reason Behind Investing on IIoT
In order to better understand the hype behind IIoT, we need to explore why businesses invest in this sector even after many failure stories. PwC (2014) has identified three main reasons: competitive pressure, new revenue streams and customer demand. Companies who are investing on IIoT expecting that connected products and services will provide them distinctive competitive advantage which will open ways to create new revenue streams and customers will recognise value in the products and services.

4.2.2 Different Phases of IIoT Evolution

Implementation of IIoT in marketplace can be challenging because of ambiguity regarding the value creation process and at the same time IIoT is evolving due to rapid change in technology. New actors are entering the ecosystem, and which is also impacting the business models of companies (O’Halloran & Kvochko, 2015).

Currently majority of the companies are in the phase 1 and 2 of IIoT evolution where they are mostly focusing on operational efficiency and new products and services but that also act as a barrier to capture significant value. Eventually the companies will move towards phase 3 phase 4 where the role of ecosystem and platform-enable marketplace will play a vital role in capturing the value of IIoT (O’Halloran & Kvochko, 2015).

4.3 IIoT Business Models

The conventional value chain of companies has a significant focus on the efficiency of the movements of physical goods. This linear outlook on the value chain does not compliment the nature of IIoT industry where companies are increasingly focusing on the outcome rather than just the product itself. To capture the value of IIoT companies need to change their business model from firm-specific to ecosystem (O’Halloran & Kvochko, 2015). Different actors are participating in the IIoT ecosystem. The major actors are Factory, machine OEMs, system integrators, IIoT connectivity provider, IIoT Platform Provider, cloud service provider, data analytics provider, marketplace provider, application, and service provider. These actors can play multiple roles as well by providing more than one solution (Russo & Albert, 2018). To establish a formidable position in the ecosystem, understanding the specific roles and strengths of these various actors is indispensable.
Currently, IIoT platforms are provided by more than 400 companies among this most substantial portion belongs to IIoT start-ups (32%) and enterprise software companies (22%). Around 18% of platforms are offered by industrial technology providers, and telecommunication and internet companies provide the rest of them. These companies are playing a significant role to push the industry towards software-centric business model (Bhatia et al., 2017).

Industrial companies are realizing that they need to collaborate with players in the ecosystem to create revenue-generating offerings and at the same time improving the operational efficiency of their company. To implement an IoT-centric business model, companies need to understand what type of data consumers are willing to pay and which IoT solution to use (PwC, 2017). PwC/MAPI IoT survey (2017), revealed interesting findings regarding IoT industry trends which are, 38% of manufacturers (62% machine OEMs) incorporating IoT-driven product and services in their product portfolio, 14% manufacturers planned a go-to-market IoT strategy and 47% manufacturers are selling bundled offer which includes hardware, data analysis technology, and software.

According to a report published by PwC (2014), IIoT will change existing business models, and the value-added solutions will play a role behind the change in business models. The new business model will enhance interaction between manufacturing equipment, suppliers, and partners. A survey conducted by PwC shows that significant factors that will facilitate new business models regarding Industry 4.0 are networking between customers and partners, solutions and expansion of services. The survey also shows that companies identified new technology advances, customer expectations, and competitive pressure as the main drivers for investing in IoT driven products and services (PwC, 2017). Different IoT business models and monetization opportunities are mentioned below:
PwC survey report also states that closer cooperation with value chain partners will increase and the competitive landscape will be impacted by the ecosystem approach. Among several reasons' companies identified an increase in customer satisfaction and fast time to market are the most important reasons for co-operation (PwC, 2014).

### 4.4 Value Creation Process

According to Russo & Albert (2018), the core value of IIoT is in the captured data and how it can be utilized. IIoT is not only impacting the supply chain and the way companies manufacture products in factories but also the nature of the business model of the companies. IIoT data is basically changing the value proposition of different companies from goods to services. Currently, most of the IIoT solutions are majorly focused on internal applications such as optimization of factories and predictive maintenance but to capitalize on the real value of data companies need to go beyond connectivity aspect. Poniewierski (2019), also agrees with this statement and defines internal applications as “Value Island” and data monetization as “Value ecosystem”.

Companies are exploring different ways to capitalize on data which goes beyond the first-generation IIoT applications (Poniewierski, 2019). Currently, the majority of IIoT solutions are silo application where data from connected devices pass through IIoT platforms. Through data analytics, machine owners can get detail information about the manufacturing process and take actions such as predictive maintenance. IIoT applications are evolving as well, and they are moving from silo application to cross-silo interaction where other partners will participate in the ecosystem, and eventually, it will
move towards marketplace applications. Industrial companies can utilize the IIoT evolution model to test and develop IIoT strategies. Silo approach indicates that IIoT applications are surrounded by organization boundary; the boundary gradually decreases when the approach moves towards cross-silo and marketplace approach (Figueredo, 2019). To take advantage of the full potential of various IIoT application, companies need to integrate an open eco-system approach which increases collaboration between partners. The privacy and security issues are the primary concern while adopting the marketplace approach, which acts as a significant barrier (Figueredo, 2019). A report published by Ericsson (2018), states that data journey of companies flow in three phases, the first phase is utilizing IIoT to enhance operational efficiency which is a company-centric approach, the second phase is sharing data across companies within the same business verticals where companies usually collaborate with, the third and final phase is sharing data across different industries which will create an open marketplace for non-sensitive data but at the same will drastically change the way company do business.

The formation of an ecosystem provides the partners access to valuable data that will help them to create products and services which are primarily data-driven. Data ecosystems allow asset-heavy industries to create revenues and gain a competitive advantage with IoT data. Most of the companies are still in the initial stage of the utilization of IoT and identifying the possibilities of data captured from connected machines. Technology companies went through a similar transition where they moved from direct hardware sales to subscription-based software sales. Currently, there are only a few companies in the industrial sector who are focusing on business models which tries to capture the value of IoT data. To participate in the data ecosystem, companies, need to have a long-term goal since the nature of the industry is conservative compared to technology companies (Russo & Albert, 2018).

In the digital ecosystem, there are actor such as consumers, customers, OEMs, and suppliers who are connected to the data ecosystem through the digital platform. In the data ecosystem their various players such as connectivity providers, cloud providers, system integrators, digital platform providers, data brokers, analytics providers, domain experts and orchestrators who establish communication between different actors (Russo & Albert, 2018). The orchestrator can integrate with different partners and create unique value propositions for stakeholders.

While formulating IIoT strategy companies need to be aware of several factors such as establishing a partnership with hardware and software companies, investing on building new capabilities and changing business models to leverage IIoT data (Hunke et al., 2017). Addressing these factors is fundamental to maximize the success of IIoT implementation across the organization. On the other hand, the primary reason behind IIoT project failures is overprotection by the companies, leading to weak sharing information and ineffective cooperation (Riemer, 2018).

4.5 IIoT ‘Use Cases’

A use case is defined as various ways of using a system to attain specific goal for a certain user. Considering multiple use cases provide useful information regarding how the system can be used effectively and what value it will provide (Jacobson, Spence & Kerr, 2016). Several IIoT use cases are described below to understand how different companies are creating value by capitalizing on IoT.

**Pirelli:** Pirelli, which is a prominent tire manufacturer, had been using the same business model since the 19th century, which focused on efficient production. However, in 2016, Pirelli decided to
incorporate a data-driven business model to gain a competitive advantage by embedding sensor technology in their tires (Russo & Albert, 2018). This initiative helped Pirelli to capture valuable data regarding pressure, temperature, wear statistics that enabled condition monitoring. This data-driven business model not only minimized vehicle downtime but also created new revenue streams (Pirelli, 2019).

**Honeywell**: Honeywell is one of the major players in the industrial automation sector which has established a relationship with various industries such as automotive, manufacturing, oil and gas (Russo & Albert, 2018). Honeywell understood the importance of data-driven IIoT product offering, but the lack of enough capability to develop suitable offering was a significant barrier. To overcome this barrier, Honeywell created an ecosystem called Inspire program which recruits companies that have valuable expertise in required areas such as Dover who specializes in equipment monitoring, air emissions solutions are provided by Aereon, and Flowserv looks after flow control solutions. By entering a partnership with these companies, Honeywell can offer data-driven solutions that increase operational performance, optimizes production, and increase the effectiveness of equipment. In this ecosystem, Honeywell plays the role of orchestrator and effectively manages all the partners to provide competitive solutions. Inspire partner program brings OEMs, process experts, and domain experts under one umbrella to help to solve a customer problem, which was unsolvable before (Honeywell, 2018). Several actors in the Honeywell ecosystem plays a different role in creating the value of the data collected from the factory. Data scientist's analyse the data extracted from the factory floor, that data can be available to knowledge vendors such original equipment manufacturer and process licensors through Honeywell app which is developed by external app developers (Murison, 2019).

**Nokia**: Nokia is implementing data ecosystem business model by providing its customers various IoT data solution and services such as data analytics, installation and management of sensors, processing of data and secure payment method which is blockchain based. These new services are providing the customers of Nokia who are mobile network operators to capture data regarding air quality and light which they are selling to different sectors such as insurance companies and health care providers (Nokia, 2019).

**Preferred Networks**: Preferred Networks is a Japanese company founded in 2014 who specialises in AI, machine learning and deep learning and provides services to manufacturing companies. Preferred Networks has partnership with Toyota and Fanuc which gives them access to huge amounts of data related to factory equipment. Preferred Networks utilized their AI software to analyse these vast amounts of data which can be used in manufacturing environments to make the process more efficient (Russo & Albert, 2018). The data provided by Preferred Networks’ gives Toyota and Fanuc competitive advantage which is difficult to replicate. Preferred Networks’ also started to collaborate with Hitachi in 2017 (Preferred Networks, 2019).

**The Chamberlain Group**: The Chamberlain Group incorporates MyQ technology to garage door openers which provides customers the opportunity to operate their garage doors remotely. Customers can also take advantage of different pattern applications of Google Home for a subscription fee that increases the value proposition of Chamberlain Group products and generates revenue through the data-driven services (Chamberlain Group, 2019).

**Caterpillar**: Caterpillar uses data from various sources such as construction equipment, fluid sampling data to increase productivity, decrease cost, and enhance the safety of their customers. Caterpillar introduced a digital data-driven product called Cat Connect. The primary objective of this solution is to increase the efficiency of job sites by utilizing data collected from industrial machines. Caterpillar gained a significant competitive advantage because of this solution because other brands are not part of this service ecosystem, and it is difficult for customers to switch because the switching cost is high. This solution not only helps Caterpillar to generate revenue but also it has a positive impact on the sales of Caterpillar equipment's and after-sales services. To achieve these Caterpillar played a role of ecosystem orchestrator by partnering with Microsoft Azure, which is a
cloud service provider, Zuora handles the subscription management, AT&T ensures connectivity, and Uptake offers data analytics service. Caterpillar is also making the data available to non-Caterpillar equipment, which is helping them to extend the ecosystem. Caterpillar entered a partnership with Torc Robotics to incorporate new technologies to older mining trucks by Komatsu, which is a competitor of Caterpillar. (Caterpillar, 2019).
5. Analysis

In this chapter, the analysis is initiated by investigating the findings from interviews, secondary data with the literature discussed. To increase the credibility of the study, triangulation analysis has been done where multiple data sources are considered such as interviews and secondary data. The analysis starts with analysing current business model.

The analysis section is divided into several parts, firstly the present business model of HMS is mapped using the business model canvas, which provides insight about nine vital elements of the business model. Secondly, the business model change in the IIoT context is analyzed by answering four key questions, which are why, who, how. Thirdly value co-creation strategy in IIoT environment has been analyzed. Based on the analysis of these three parts, a future model of HMS has been proposed incorporating empirical data and analysis. Finally, the present and future role of HMS in IIoT ecosystem has been mapped.

5.1 HMS Business Model Present and Future

The business model of HMS has evolved over the years based on the product line and the acquisition process. The acquisition process not only diversified the product portfolio of HMS but also impacted the business models (Interviewee B, 2019). Primarily HMS follows three business models, which are direct sales, indirect sales, and subscription (HMS, 2019c). These multiple business models are primarily because of the nature of the product line. For example, the Anybus product line offers the option of extensive customization, which requires close interaction with the customers.

On the other hand, Ewon products are sold through distributors because compared to Anybus, the sales cycle is short (Interviewee B, 2019). Subscription model for HMS is relatively a new concept which is also influenced by the product line and the changing market trend discussed in the empirical part. Even though HMS has multiple business models, but there are core elements in all the models since all the products are creating a similar value proposition which centers around connectivity.

Based on the interviews and secondary data, a consolidated business model of HMS Industrial Networks is presented below. The nine key components of the business model canvas show how companies are creating value and generating revenue (Osterwalder and Pigneur, 2010).
Customer Segments: HMS customer segment resides in one of the three major customer domains (Industrial domain) in IoT (Borgia, 2014). HMS currently serving four customer segments in four different levels of factory automation. At component level HMS is supplying component to device manufacturer, at device level the customers are machine OEMs, at system level the customers are system integrators and at end user level the customers are factory owners. According to the statement of an interviewee, the focus for HMS is the machine OEMs (Interviewee C, 2019).

Value Proposition: The principal value proposition of HMS products is operational efficiency, asset utilization, cost reduction and increase productivity (Ibarra, Ganzarain & Igartua, 2018) through connectivity solution which connects devices to networks that also reflects in their company tagline “Connecting device” (HMS, 2019a). Literature shows that this type of value propositions is the first step towards adapting IIoT without bringing radical changes. In the empirical data, it also states that the first phase of IIoT evolution is operational efficiency (O’Halloran & Kvochko, 2015). Since HMS has customers in different levels of factory automation, the value proposition also varies, but the overall value proposition of the company is to provide a solution that ensures connectivity along with other operational value propositions which are mentioned above. Emerging technologies also have an impact on the value proposition since the definition of connecting devices is changing (HMS, 2019c). Literature shows that this type of value propositions is the first step towards adopting IIoT without bringing radical changes. In the empirical data, it also states that the first phase of IIoT evolution is operational efficiency (O’Halloran & Kvochko, 2015). Since HMS has customers in different levels of factory automation, the value proposition also varies, but the overall value proposition of the company is to provide a solution that ensures connectivity along with other operational value propositions which are mentioned above.

Channels: The primary channel used by HMS is direct sales, which is influenced by the nature of the product and customer segment. Other than direct sales, HMS also use distribution and subscription as a sales channel (Interviewee, 2019). Even though indirect sales and subscriptions account for 30% of...
the sales (HMS, 2019b) but HMS personnel acknowledges that the industry is going towards a subscription-based business model where software is extensively used.

**Customer Relationships**: HMS has long term close relationship with machine OEMs because the sales cycle is long, and the customer requires continuous support throughout the installation process and after sales service is also crucial (Interviewee B, 2019). HMS produces customized products through collaboration with its customers, that also impacts the nature of the customer relationship. This type of close long-term relationship helps HMS to retain customers for an extended, and that also helps to generate recurring revenue (Interviewee B, 2019).

**Revenue Streams**: The main revenue source of HMS product is the Anybus product line, 61% of revenue of HMS comes from this product line (HMS, 2019b). HMS has recurring revenue streams of their long-term customers as mentioned above. Other than this HMS also generate revenue from indirect sales through distributors and subscription (HMS, 2019b).

**Key Resources**: Major key resources of HMS are product development facilities, global supply chain, distribution network, human resources and patents. HMS has initiated solution partner program which can also be considered as a key resource (HMS, 2019d). By utilizing these key resources HMS can create unique value proposition for the company. HMS started their internationalization process early which helped them to build strong global presence which is a major resource for them (Interviewee B, 2019).

**Key Activities**: For HMS major key activities are product development through state-of-the-art research facilities, internationalization and acquisition of companies from different parts of the world which also help them to increase their global presence. The acquisition activity of HMS also played role behind shaping the nature of the company since different acquired companies brought various expertise (Interviewee C, 2019).

**Key Partners**: HMS has several major partners, such as suppliers, investors and providers of solutions. By working with solution providers, HMS offers its customers IIoT solutions. Because of the nature of the IIoT company.

**Cost Structure**: Majority of cost for HMS go purchasing and handling materials, implementation of new technologies and solution partner program.

Traditional business models take a firm-focused approach, which is not adequate to utilize the full potential of IIoT (O’Halloran & Kvochko, 2015). The nature of the IIoT ecosystem requires companies to do business with other partners and even competitors. Technology-intensive industries also require a change in the business model with market changes (Hunke et al., 2017). As a result, companies are gaining competitive advantage through a co-creation approach that modifies their business models. IIoT use cases mentioned before also demonstrate how companies are collaborating across platforms and industries to capture IIoT value. Analysis of the four critical elements of the business model (what, who, why, how) will provide a better understanding of the rapidly changing model in the IIoT context.
What: Value Proposition
Based on empirical data, it can be stated that most of the companies incorporate IIoT in their manufacturing process to increase operational efficiency, asset utilization, cost reduction and increase productivity (Ericsson, 2018). Continuous collection of data on the factory floor not only providing the companies to attain the goals mentioned above but also creating new avenues for different stakeholders to generate values from those data (Russo & Albert, 2018). Due to the unique value proposition of data, new business models such as pay-per-use, pay-per-outcome, data monetization, and subscription are gaining popularity and impacting the revenue generation (O’Halloran & Kvochko, 2015). IIoT use cases discussed in the empirical data section reveals how companies such as Honeywell, Caterpillar, and Nokia are creating a new value proposition for their customers by incorporating business models which are based models where value co-creation is at the core. By providing new value, propositions companies are attaining competitive advantage, which is difficult to replicate (Russo & Albert, 2018). All the cases discussed in the empirical section are heavily dependent on co-creation strategy, which is also aligned with theory (Goda & Kijima, 2015). On the other hand, HMS has implemented multiple business models, but the core value proposition of the benefits of all the major products of HMS has been the same, which is establishing operational efficiency through connectivity.

Who: Collaborations, partnerships and value networks
Due to the complexity of implementing IIoT technology, multiple partners are required who are specialised in that area. In case of HMS, the company is depended on solution providers and suppliers to create IIoT solution products. In the industrial automation sector collaboration and partnering with other companies is common practice, which sometimes blurs the line between competition and customers. This claim is also supported by one of the interviewees, “In this industry one of our biggest customers can be our competitors as well.” (Interviewee C, 2019). Value co-creation is at the core of the successful IIoT business model which enable companies to capture new value and create additional revenue streams. Extensive collaboration between partners in this industry help to create value networks that also impact the position of companies in the ecosystem (Wirtz, 2013). Different partners and collaborators are entering the IIoT ecosystem such as IT platform providers, cloud service provider, analytics provider and marketplace provider.
“IT companies are increasingly showing interest in this sector. Microsoft and SAP, these kinds of companies we have not seen them in industrial automation exhibitions few years ago, but they are attending the events recently. IT platform providers and cloud service providers need companies like HMS to bring this information upwards. So, they can start processing it and that’s why the collaboration between different partners in the ecosystem are increasing”. (Interviewee B, 2019).

Why: Revenue Models
The primary discussion of business model change or adapting new business models have been initiated because of the potential of generating revenue. As mentioned in the empirical part, a lot of interest has been shown in incorporating IIoT, but due to lack of visible value in terms of revenue, the interest did not translate into reality. Companies are continually exploring the possibility of adopting new business models, which creates revenue streams. Companies are investing in IIoT to generate revenues and create additional revenue streams by utilizing the capabilities of IIoT. In the IIoT use cases, The Chamberlain Group created additional revenue streams by incorporating the subscription model. Other revenue models such as pay-per-use, pay-per-outcome, and data monetization are gaining popularity, which is influencing companies to change their business model. HMS has been generating most of the revenue through direct sales, but they also realize the importance of subscription model and pay-per-outcome model, which will be implemented in the future gradually.

“The cloud services will have a major impact on this industry. Cloud services are mostly focused on data driven business models or basically usage-based business model where you only pay for the parts that you use. That will spill over to industry as well.” (Interviewee C, 2019).

This statement is also supported by empirical data where it mentions that IIoT platform providers are extensively working towards software-based model which will gradually change this asset heavy industry and create new revenue streams.

How: Value chain
The empirical data states that the value chain in the IIoT industry is changing from a silo approach to marketplace approach due to the network approach and increasing collaboration. It also mentions that the traditional linear value chain is not suitable for the IIoT industry because the stakeholders are increasingly interested in the outcome rather than just the product. Currently, HMS is applying the traditional value chain and serving customers at a different level of the factory automation approach. Companies such as Honeywell and Caterpillar modified their value chain and taken an ecosystem approach by being an orchestrator to capture the value of IIoT. As discussed in the literature, technologies such as 5G are enabling companies to capitalize on capturing of the massive amount of data that is directly impacting the value chain of IIoT companies (Sultan & Ali, 2017).

5.1.1 Different Approaches Affecting Business Models

Service-oriented approach: Literature suggest industry 4.0 and digitalization is influencing companies to adopt a service-oriented approach (Livari, Ahokangas, Komi, Tihinen & Valtanen, 2016). This statement is also supported by empirical data where IIoT industry is changing because of the rapid expansion of service providers. Several personnel from HMS also confirmed that, the importance of software is gradually increasing and impacting the asset heavy industry.
“Over time we will more focus on data such, so it will be more data-based business models.”
Interviewee A, 2019).

Network-oriented approach: In IIoT setting value generated through ecosystem exceeds the firm-specific value chain which influences the organization to move toward a network-oriented approach (Ibarra, Ganzarain & Igartua 2018) Currently HMS has solution providers and they are collaborating with their customers, but HMS is not collaborating with the prime players in each ecosystem to create a unique value proposition. In the Anybus edge solution, HMS is providing third-party cloud integration, which does not create as much value as partnering with one of the key cloud services provide. In the IIoT use cases of Honeywell, it can be seen how they captured and created a unique value proposition by taking a network-oriented approach.

User driven approach: The user-driven approach is suggested by academics in order to capture value in the IIoT context. By being user-driven companies not only generate additional values but also can obtain vital data from customers, which will help them to make data-driven decisions (Arnold, Kiel & Voigt, 2016). HMS has taken a user-driven approach while selling Anybus products, which can be customizable based on user need, but they have not been successful in transforming it more of an ecosystem.

5.2 Value Co-Creation Strategy

As discussed previously, the business model change in the IIoT context is heavily influenced by value-cocreation between different partners and stakeholders. To implement the new business model HMS to address all three stages of value co-creation process which networking are, integration of resources and exchange of services (Goda & Kijima, 2015). In the networking stage, different partners participate to integrate different resources which can create value and solve unique problems. In case of Caterpillar case, Microsoft (Cloud service provider), Zuora handles (Subscription management), AT&T (Connectivity) and Uptake (Data analytics service) participated in the ecosystem to integrate different resources. In the next stage, the participants exchanged services to create an offering that is valuable for all the stakeholders. Caterpillar created additional revenue streams by playing the role of orchestrator in the network, and all the stakeholders participated in the network benefited by that. The role of the network participants changes depending on who is taking the initiative. HMS can start collaborating with partners such as IT vendors, cloud service providers, data analytics to create a customized offering for customers, which will also help the end customer to create value at the consumer end.

A future business model has been mapped where HMS plays the role of ecosystem orchestrator and creates unique value propositions by collaborating with different key partners (Russo & Albert, 2018). The nine key components of the business model have been modified to enable capturing of new values.
**Customer Segments:** In addition to customers such as machine OEMs, factory, system integrators, and suppliers; HMS can serve the customers who are users of IoT data. This additional customer segment will also open ways for HMS to generate an additional revenue stream.

**Value Proposition:** The value proposition of HMS will be extended radically, and HMS will be able to provide data-driven services and products, flexible and customized service along with data discovery, data security and data monetization. The development of an ecosystem gives its partners access to valuable data that can help them create primarily data-driven products and services. Value proposition generated by this business model will also complement new revenue streams which are mentioned below. The increase in value proposition is related to an increase in key partners and establishing a trustworthy relationship. As discussed in the theory, partners in the ecosystem can participate in value creation in three stages. By following the three stages of networking, integration, and exchange, HMS will be able to propose value specific to customers. As we have seen in the case of Honeywell, by playing the orchestrator role, it created value for all the participating stakeholders.

**Channels:** Along with direct marketing, HMS can use channels such as social media to interact and promote with their key stakeholders. Relationship marketing will be a significant tool in this model because the functionality of this model depends on the nature of the partnership HMS has with the participants of the ecosystem. Using different online and offline channels, HMS can establish a meaningful relationship with their customers and partners.

**Customer Relationships:** HMS can provide consultancy and personalized support through a user-driven approach. Training will also be an essential element in customer relations, as ecosystem unique value propositions could be new to customers. HMS helps to build new customer relationships by working together with key partners from different fields.

**Revenue Streams:** HMS will generate through revenue models such as pay per use, pay per install, pay-per-usage, pay-per-outcome, and subscription. As mentioned in the empirical data, IIoT users are preferring outcome-based model over the linear value chain, and the pay-per-outcome will HMS to generate new customers. This will impact the customization of products and services as well. HMS personnel in the interview also agreed with that, the industry is going towards the pay-per-usage model.
**Key Resources:** In addition to the existing resources, HMS can leverage additional resources, including data centers, to provide a personalized product, services and developers can also play a vital role in creating tailor-made applications. Empirical data show that the value of custom applications in the industry is increasing.

**Key Activities:** HMS will play the role of an orchestrator in this business model by collaborating with various key partners to propose solutions for different segments of customers. It is essential to integrate between different IoT capabilities to provide an IIoT solution that generates value for customers. The same role HMS can play, such as those discussed above by Caterpillar and Honeywell, where they have carefully selected partners to create customer offerings and achieve distinctive competitive advantage.

**Key Partners:** Many new partners will enter in this business model because of the network-oriented approach. Key partners are IT platform providers, cloud providers, analytics providers, data owners, IoT pure-play companies, Telcos, security provider, and marketplace providers. As mentioned in the empirical data, HMS need to decide what kind of partners that want to collaborate with more or if they want to collaborate with both hardware and software partners equally as empirical data suggest that the IT and software companies will dominate this industry through a customized solution. HMS personnel also agree with that statement that IT companies are showing more interest in this industry. Since HMS has always been a hardware product-driven company, to provide complete solution, HMS need to partner with reputable IT and software companies.

**Cost Structure:** The acquisition and integration costs will be the primary costs for HMS, together with the cost of operation, support, and purchase management will be added in the cost structure as well.

5.3 Role of HMS in IIoT Ecosystem

The change of business model will have a profound impact on the role of HMS in the ecosystem. Currently, in the IIoT ecosystem, HMS is positioned as an industrial communication and connectivity solution provider serving customers in factory automation industry. In present scenario interaction between different ecosystem partners are not extensive. From the mapping of the existing business model, it is visible that the primary value proposition of HMS is providing operational efficiency and connectivity, which are not enough to capture the real value of IIoT. In the ecosystem, HMS can take a role of orchestrator which will not only help different stakeholders to capture value but also it will help HMS to capture additional values by taking a consumer-centric approach. The primary role of orchestrator is to integrate between different participants of the ecosystem. To establish this position in the ecosystem, HMS, need to incorporate value co-creation strategies with their key partners. According to Ikävalko, Turkama & Smedlund (2018), there are three types of archetype role in IoT ecosystems such as ideators, designers, and intermediaries. By implementing the new business model, HMS can also take the role of intermediaries who will arrange service innovation by collaborating with different partners in the ecosystem.
5.4 Barriers of Implementing Ecosystem-oriented Business Model

Companies need to be aware about the barriers in the ecosystem business model to establish meaningful collaboration with other ecosystem partners.

Security issues
The primary factors inhibiting decision makers from committing to IIoT development and implementation are safety and security concerns. More and more, companies are acknowledging that the solutions required to secure centralized IT systems are not enough, particularly in applications that require significant levels of reliability, to secure decentralized IIoT systems.

“One of the barriers of IIoT implementation is lack of understanding and fear of connecting due to security concern. Companies who are used to Operational Technology (OT) industry are not comfortable to connect everything to the internet. There is a lack of understanding between the OT side and the IT side which act as barrier when it comes IIoT adoption” (Interview C, 2019).

To combat the security issue PwC (2014), suggested to incorporate cybersecurity risk management in the entire prise. Security concern has always been attached with technological products and services; this is not an IIoT specific issue but a general one.

Data ownership issues
HMS personnel stated that data ownership is a major concern in the IIoT sector, as there is no standard regulation on this. Because of issues such as privacy, the ownership of data remains highly sensitive. Factory owners want the information to themselves and don’t want to share it with anyone else, but it is important to increase data integration with suppliers to increase operational efficiency (Reimar, 2014).
6. Findings and Conclusions

This chapter presents findings, conclusions and practical implications. Limitations and recommendations for future research are also mentioned in this chapter.

In the introductory chapter, we have discussed how emerging technologies, especially IIoT and big data, are reshaping different industries. Fourth industrial revolution defers from other revolution because of extensive automation and the role of data. Even though the technology is expanding at a rapid pace, but the automation and manufacturing industry is conservative in terms of accepting new technology rapidly. One of the primary reasons behind this is that the massive amount of investment is required to adopt new technology. The hype of these emerging technologies is visible in these industries, but in terms of capturing the value and convincing the customer, the value of captured data is not that clear. For us, this was an interesting starting point, and we got the opportunity to work with one of the largest industrial automation company in Sweden. During the first few interviews, HMS has shared the issue the company is facing regarding value creation of IIoT data. Based on our mutual agreement, we decided to answer this research question: “How can companies operating in the industrial automation sector create value for emerging technology ecosystem?”

To answer this research question, three objectives have been formulated, which are:

- Identifying the existing role of the company in the ecosystem
- Identifying the core competencies of the company
- Identifying partnership capability of the company

To answer these objectives, we have triangulated data from three sources which are: in-depth interviews, secondary data available on public domain and literature review.

From the analysis, we have found the answers to the sub-questions. The existing role of HMS in the ecosystem is the connectivity and communication, solution provider. HMS plays a vital role in the ecosystem since they are serving all the customers in the industrial automation value chain. HMS is in this business for a long time, and they have a strong presence in the ecosystem because of the product they are providing. As mentioned by one of the interviewee HMS products are present in all parts of the world where manufacturing is happening, which shows the global reach of HMS. When analysing the existing role of HMS in the ecosystem we need to consider factors such as the nature of the ecosystem itself. As secondary data suggested, even though companies heavily dependent on each other in this industry but cross-company collaboration has not increased that much due to fear of security and other causes which are also mentioned under the barrier of ecosystem model. From HMS perspective we can see that this is a company who wants to evolve by accepting new technology and change their business model to adapt to the market. The intention to change also will impact the future role of HMS in the ecosystem. In the secondary data, we have seen that the importance of software is gradually increasing, and HMS acknowledge that as well which shows that HMS is adaptive in terms of changing their business model which is essential to perform in the ecosystem.

The core competence of the company is their hardware connectivity products, as mentioned above, HMS is operating in this business for a long time, and they have extended the core competence through the acquisition of different companies. Different companies brought various skills and competence to
the company, which also modified the core competence of HMS. From the interview, we can get to know that HMS just acquired a software solution company which shows that HMS is investing in building the software competence along with the hardware competence. The core competence will also play a vital role in defining the position of the company in the ecosystem. To play the role of orchestrator, the company needs to be able to have a wide range of offering to exchange with otherwise integration between different partners will not be possible. In the case of Honeywell, we have seen that since they have extensive expertise in the vast area of industrial automation, it was possible for them to play the role of orchestrator. HMS has also experience in all domain of industrial automation directly or indirectly, which will help them to take the role of orchestrator in the ecosystem. Continuous improvement of core competencies will also them to retain position in the ecosystem because, from the literature, we have seen the role of different players on the ecosystem keep on changing.

The last objective is extremely crucial since the ecosystem is all about collaboration and having high partnership capabilities will help companies to collaborate with different partners. HMS has partnered with several companies to produce their solution products which show that the partnership capability of the company is very high which will also assist them to be the orchestrator in the ecosystem. At the same time, HMS has acquired different companies and while acquiring different companies, it is required to have a high level of partnership capability because different companies are coming from different background. Other factors such as global presence and having a vast number of distributors also shows that HMS has high partnership capability.

Based on this, we have suggested a future business model for HMS where the company will move from a linear value chain to a connected ecosystem. By taking the role of ecosystem orchestrator, HMS will be able to create value for different stakeholders. Value propositions such as data-driven products and services, data monetization, data secured, and mass customization. These value propositions can only be offered by an established partnership with different players in the ecosystem. In the empirical data, we have also provided different values and roles of players in the ecosystem, which will help HMS in case of selecting partners in the ecosystem.

Various literature suggested that to create value in the IoT industry, the importance of value co-creation is immense since all the stakeholders are dependent on each other to create value. The importance of the ecosystem in the industry also shows that without value co-creation, it will be difficult for companies to capture the real value IIoT. There are certainly barriers to achieve the ecosystem model such as data ownership and security issues, but companies need to combat these factors and engage in an ecosystem which will create value for all the stakeholders.

6.1 Practical Implications

This paper suggests several practical implications which will help managers operating in this industry to create value for the stakeholders:

- Understanding the core competence of the company is crucial before deciding which role the company can take in the ecosystem.
- Partnership with ecosystem partners need to be based on what kind of customers the company is serving and their value expectation.
• Companies also need to be aware of data security issues, which can be a critical factor while taking the ecosystem approach.

6.2 Limitations and Future Research

The first limitation of this research is the primary data limited to one company even though extensive interviews were taken which enriched the quality of the primary data but considering multiple companies operating in different roles in the ecosystem would have been enriched the research further. Mapping the business model of each partner would have provided a clearer picture of the different roles performed by participating companies. Further research can be done regarding the value creation process of other industries where emerging technologies are reshaping the business landscape.
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Appendix

Appendix – A Interview Questionnaire

**Interview questions for HMS**

1. How HMS create value and capture value for each stakeholder today?
2. How HMS products complement each other to capture and extract data from different machines?
3. How 5G can help IIOT companies to monetize data?
4. Who are the industry partners for HMS in the IIOT ecosystem?
5. How HMS is monetizing data now and what’s the future potential of data monetization in relation to emergence of 5G?
6. How IIOT data can be shared across platform and which actors can play a major role?
7. In the value chain of manufacturing industry where data is mostly used? Are companies only focusing on Intra-company data recycling or they are considering cross-company data sharing and cross-industry data sharing to leverage the value of data?
8. What are your customer segments?
9. Which customers are HMS major priority?
10. Can you please describe how is IoT is evolving/ changing nowadays? With regards to value creation, delivery and capture?
11. Has HMS changed their product/service mix because of Industry 4.0? (A service-oriented approach)
12. Have new actors entered HMS ecosystem because of Industry 4.0? (A network-oriented approach)
13. Is the factory automation market most lucrative or is this HMS core competence that’s why HMS mostly focus on this segment?
14. In this ecosystem, have you seen any players taking charge?
15. How do you involve the customer in your value creation process?
16. Are the value chain activities between all the three business units are same or different?
17. What encouraged you to opt for multiple business models instead of a single business model?
18. Are current business models built around predominately based on hardware sales or around software and services?
19. How often do you change business models and it depends on what factors?
20. Do you think IIOT data is influencing companies to adopt new business model? If yes, why and how?
21. What data do you collect today and how is it collected?
22. What is the current data monetization process for HMS?
23. What data driven products or services do you offer to your customer?
24. In what applications do you use the collected data? What advantages does it provide?
25. The value of data in B2B is more difficult to extract than in B2C. Do you agree with this statement? Why?
26. Do you mainly focus on the core product or do you also talk about the additional benefits that can be received from those products?
27. Do you have different strategies for different products sales and product development process?
28. Is HMS planning to invest on new data-driven products and services due to the rise of Industry 4.0?
29. How and through which channels do you communicate the value that is offered through your products/services to your customers?
30. Does country matter in case of conveying the value of products to the customers since HMS is present more than 50 countries?
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